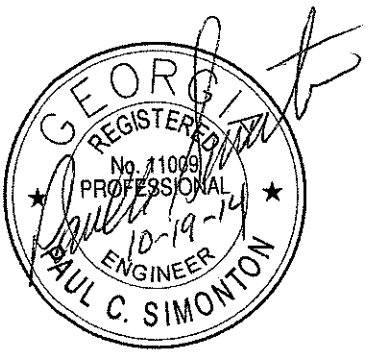
BID DOCUMENTS

HINESVILLE/FT. STEWART WASTEWATER TREATMENT PLANT MODIFICATIONS FOR THE CITY OF HINESVILLE

October 14, 2014



P.C. SIMONTON & ASSOCIATES, INC.
CONSULTING ENGINEERS

309 NORTH MAIN STREET, P.O. BOX 649
HINESVILLE, GEORGIA 31310
(912) 368-5212

1050 PARKSIDE COMMONS, SUITE 101
GREENSBORO, GA 30642
(706) 454-0870

PCS NO. 2009-63

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TECHNICAL SPECIFICATIONS

ADVERTISEMENT FOR BIDS

Sealed proposals will be received by the CITY OF HINESVILLE located at Hinesville City Hall, 115 East M.L. King Jr. Dr., Hinesville, GA. on Wednesday, November 19, 2014 until 2:00 (p.m.) local time for Hinesville/Ft. Stewart Wastewater Treatment Plant Modifications.

The work to be performed consists of furnishing all labor and materials to complete the Hinesville/Ft. Stewart Wastewater Treatment Plant Modifications. More specifically, the project will consist of modifications to the existing plant to include relocating the head works and replacing all equipment to include influent screen, odor control, grit removal system and in plant pump station. The process will be converted from trickling filter/solids contact to SBR System including effluent filters. The existing "UV" system will be relocated and supplemented with additional units, plus associated other work to complete the system.

Plans, Specifications, and Contract documents are open to public inspection at the Hinesville City Hall, 115 East M. L. King Jr. Dr., Dodge Plan Room, and P.C. Simonton and Associates, Inc., Hinesville, Georgia. Copies of the Plans, Specifications, and Contract Documents may be obtained by contacting P.C. Simonton and Associates, Inc., 309 North Main Street, P.O. Box 649, Hinesville, Georgia 31313 (912) 368-5212 and by depositing a non-refundable Five Hundred ($ 500.00) dollars for each set of plans requested.

Each Contractor must prequalify for bid by submitting a completed "Statement of Bidder Qualifications" form supplied by the Engineer. Bids will be accepted from prequalified bidders only.

A Mandatory Pre-Bid Conference will be held at the Wastewater Treatment Plant located on Fort Stewart. Each attendee will be responsible for gaining access into Fort Stewart. Pre-Bid conference will be held on November 5th, 2014 at 2:00 p.m.

Bids must be accompanied by a certified check or bid bond in an amount equal to at least five percent (5%) of total amount bid for the completed work.

No bids may be withdrawn for a period of sixty (90) days after the closing time schedule for receipt of bids.

The Owner reserves the right to accept or reject any or all bids and to waive informalities. Award of the contract, if it is awarded, will be to the lowest responsible bidder.

NOTE: Plans and Specifications must be obtained no later than five (5) working days before the bid date. No exceptions.

INSTRUCTIONS TO BIDDER

1. SUBMISSION OF PROPOSALS:

   A. Sealed proposals will be received by CITY OF HINESVILLE at the Hinesville City Hall, 115 East M.L. King Jr. Dr., Hinesville, GA. until 2:00 (p.m.) local time, on Wednesday, November 19th, 2014 for all labor and materials required to fully complete the work identified in the plans and specifications for Hinesville/Ft. Stewart Wastewater Treatment Plant Modifications.

   B. At the time and place noted above, the proposals will be publicly opened and read aloud.

   C. The proposal (including Statement of Bidder's Qualifications) shall be submitted in triplicate on an exact copy of the proposal form bound herein. All copies of the Proposal Form must be signed. All blank spaces on the forms shall be filled in and all information called for shall be provided. The terms "NO BID" may be used to fill in a blank space on the Proposal Form. All signatures shall be in ink and in longhand, and the completed forms shall be without alterations or corrections; any interlineations must be initialed by the Bidder.

   D. Failure to submit a proposal in the form requested or the inclusion of any alternates, conditions, limitations or provisions not called for, will render the bid irregular and shall be considered sufficient cause for rejection of the bid.

   E. Proposal shall be in opaque, sealed envelope and marked "Hinesville/Ft. Stewart Wastewater Treatment Plant Modifications" and shall bear the name of the Bidder. Proposal is to reach the above address no later than the hour and date named above, or authorized extension thereof. No proposal will be received after that time.

   F. Proposals, together with the full bid bond, may be withdrawn by Bidders prior to the time set for official opening. After time has been called, no proposal may be withdrawn for a period of sixty (90) days after the time and date of the opening.

   G. Included in later section of this section is a list of equipment & materials to be installed by the Contractor. The Contractor along with the Engineer's Representative will inspect the equipment upon delivery; the Contractor will accept responsibility for the equipment. Any concern by the Contractor shall be addressed at delivery.

2. INTERPRETATIONS:

   A. Neither Owner nor Engineer will be responsible for any oral instructions or interpretations of the Drawings and Specifications.

   B. Requests for interpretations of Drawings and Specifications must be made in writing to the Engineer no later than ten (10) days prior to date set for receipt of bids, and failure on the part of the successful bidder to do so shall not relieve him

as Contractor of the obligation to execute such work in accordance with a later interpretation by the Engineer.

C. All interpretations made to bidders will be issued in the form of an addendum to the Plans and Specifications will be sent to all bidders. The requirements of such an addenda are to be included in the bids, and in closing the contract, the addenda will become a part thereof.

3. BASIS OF CONTRACT AWARD:

A. The competency and responsibility of a bidder will be considered in making the award. Owner does not obligate himself to accept the lowest bid or any other bid.

B. The Owner reserves the right to reject any or all proposals and to waive any technicalities.

4. FORMS AND BONDS:

A. The Bidder's attention is directed to the Proposal Form and the Performance and Labor and Materials Payment Bond section.

B. The bond shall be accompanied with the agents and underwriters name, address and telephone number.

5. INSPECTING AND TESTING OF MATERIALS:

A. Whenever, in these Contract Documents, inspecting, testing, or certification of material(s) is called for, the selection of bureaus, laboratories and/or agencies for such inspecting and testing shall be made by an Independent Testing Laboratory and the character of the test shall be stipulated by the Engineer. Documentary evidence satisfactory to the Engineer that the materials have passed the required inspection and test must be furnished in quadruplicate to the Engineer by the bureau, agency, or laboratory selected. Materials satisfactorily meeting the requirements of the inspection or tests shall be approved by the Engineer and the Contractor notified of the results. The cost of such inspecting and testing shall be paid for by the Contractor.

6. CONSTRUCTION SCHEDULE:

A. The Contractor will be required to submit a construction schedule in writing identifying milestones and completion dates at the preconstruction conference. He shall also be required to submit a resume' of the proposed job superintendent for approval by the Engineer along with his bid.

7. INSURANCE:

A. The Contractor's attention is directed to Article 11 of the Supplemental General Conditions, "Insurance." He should review these requirements and be prepared to

submit insurance certificates providing the coverage identified. On the insurance certificates, the "Certificate Holder" should be listed as both the Owner and P.C. Simonton and Associates, Inc.

8. CONSTRUCTION STAKING:

A. The Owner will provide horizontal and vertical control. The Contractor will be responsible for construction staking.

9. UTILITY CONTRACTOR LICENSING LAW:

A. Effective December 31, 1993, a new law took effect which has an indirect effect on engineers. As of that date all utility contractors must be licensed; a utility contractor is anyone who digs 5 feet or deeper on a public or private project and where the cost of work exceeds $100,000.

B. Effective July 1, 2004 the law was modified where the cost of work has no dollar amount therefore anyone who digs 5 feet or deeper on a public or private project must have a utility license.

C. "It shall be unlawful for any person to contract with any other person for the performance of utility contracting work who is known by such person to not have a current, valid license as a utility contractor pursuant to this chapter." (O.C.G.A. 43-14-8.2(h)) Bids or proposals for utility contracting work will NOT be opened or considered unless the Utility Contractor License number is written on the face of the bid or proposal.

10. SUPPLIED EQUIPMENT:

A. The city has purchased direct from the manufacturer/supplier, the following equipment:

1. Polymer concrete pipe and influent structures plus polymer concrete manholes.

2. Influent Parkson Screen.

3. Enduro Odor Control System.

4. Fluidyne Grit Removal System.

5. Gorman Rupp Influent Pumps.

6. Aqua Aerobics SBR System, Effluent Filter, and Digester Aeration Equipment plus blowers for all systems supplied.

7. Cummins Generator

8. Trojan “UV” System to supplement the existing relocated unit.

B. Sales agreements have been issued to each supplier and delivery is expected after the installation contract is awarded. The successful Bidder will be required to take delivery of equipment, inspect, the shipment along with the engineer to determine correctness of content, inspect for damage and if satisfied with the shipment, assume responsibility for the equipment, coordinate start up with the supplier, conduct successful startup and be responsible for any warranty claims until the plant is fully operational.

C. Sales information for each unit is attached. If the Contractor needs additional information regarding the equipment, a written request for additional information should be submitted by the contractor. The Contractor should not expect copies of the full shop drawings prior to bid.

D. Each specification includes the specification of the product to be installed. It is the contractor’s responsibility to understand which equipment he is furnishing and which equipment is furnished by the city.

11. CITY OF HINESVILLE MWBE POLICY

A. Contractors attention is directed to the MWBE Policy attached.

12. Each General Contractor shall provide a complete list of all subcontractors. The General Contractors shall pursue utilization of subcontractors within 100 miles of the project site.

AQUA AEROBICS SBR, FILTER &
DIGESTER EQUIPMENT

= Aqua-Aerobic Supply

GRAPHIC SCALE

SECTION B-B
SCALE 1" = 5'

SECTION A-A
SCALE 1" = 5'

DRAWING COMPLETED BY:

SBR Plan View	Hinesville/Ft Stewart WWTP Upgrade for The City of Hinesville Ft Stewart Liberty County, Georgia
DATE: November 29, 2012	
FILE NO: 2009-53PRJ	
SHEET: M-3	

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REVISIONS

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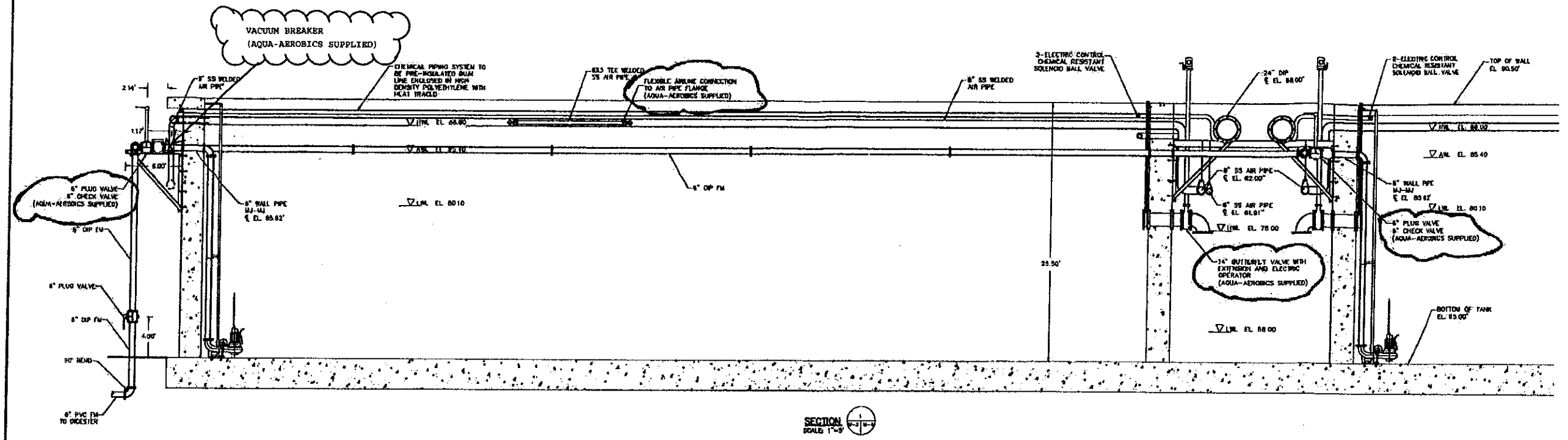
Exhibit "A"



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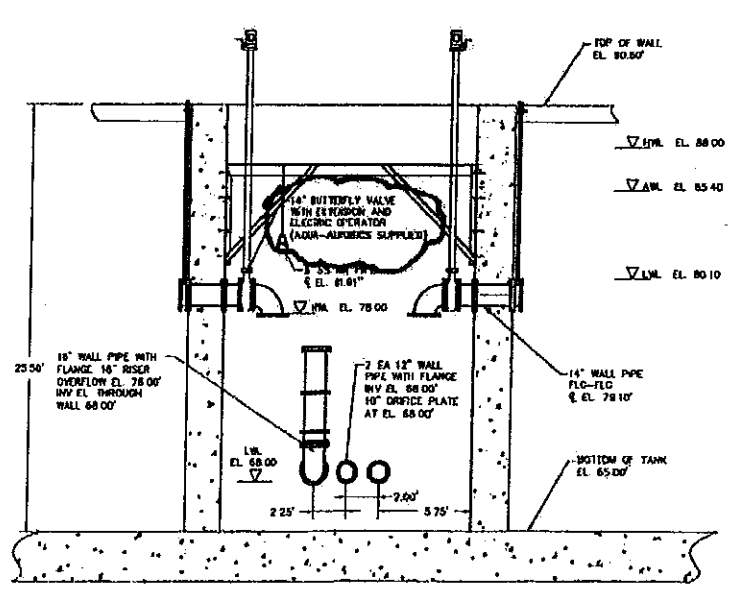

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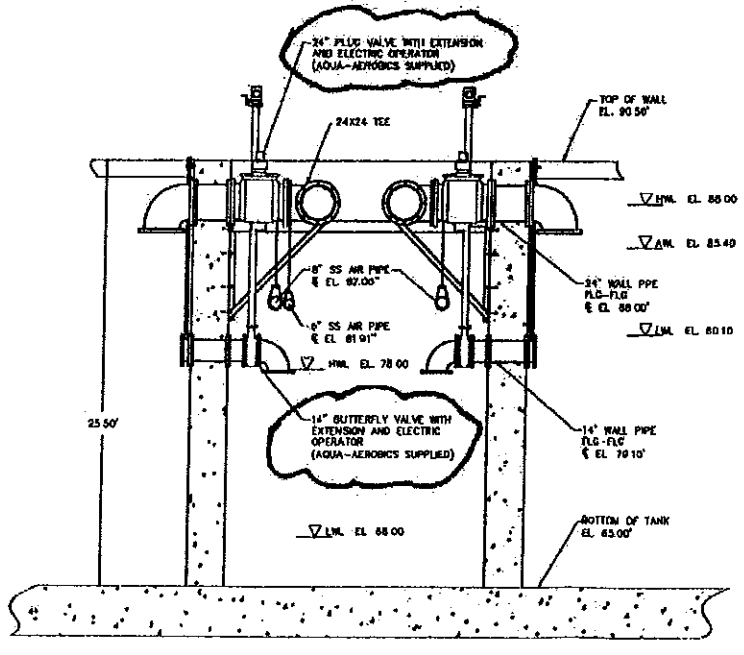

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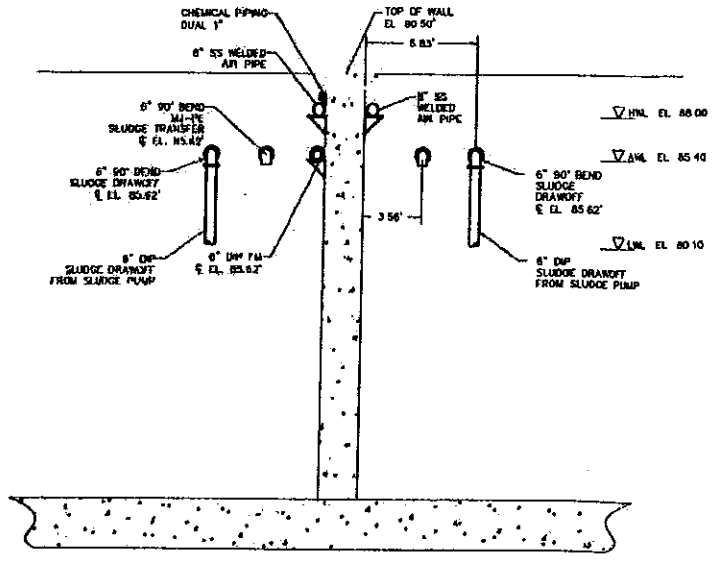

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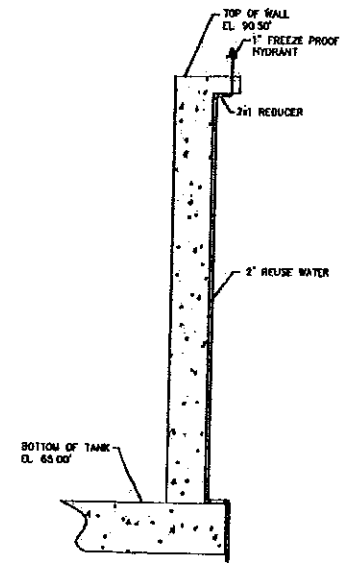

SECTION
SCALE: 1"=5'

= Aqua-Aerobic Supply

DRAWING COMPLETED BY:

REVISIONS:

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GEORGIA REGISTERED No. 14808 PROFESSIONAL ENGINEER PAUL C. SIMONTON

DATE: _____

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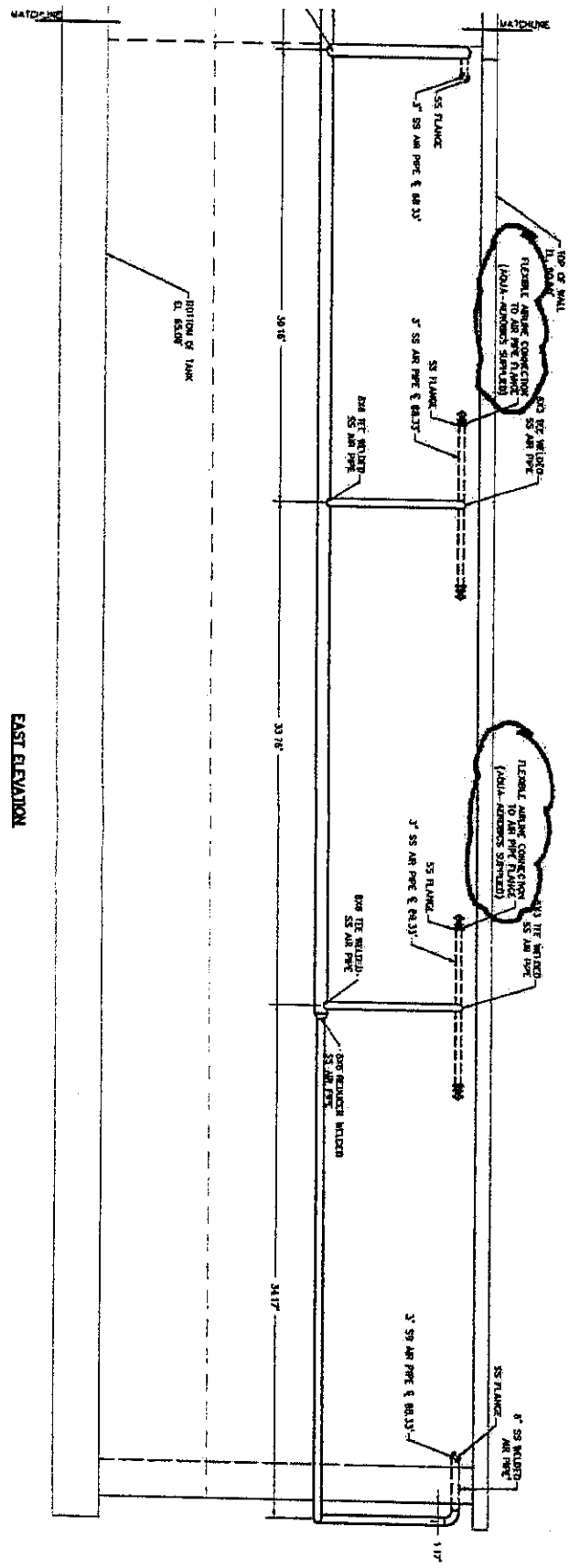
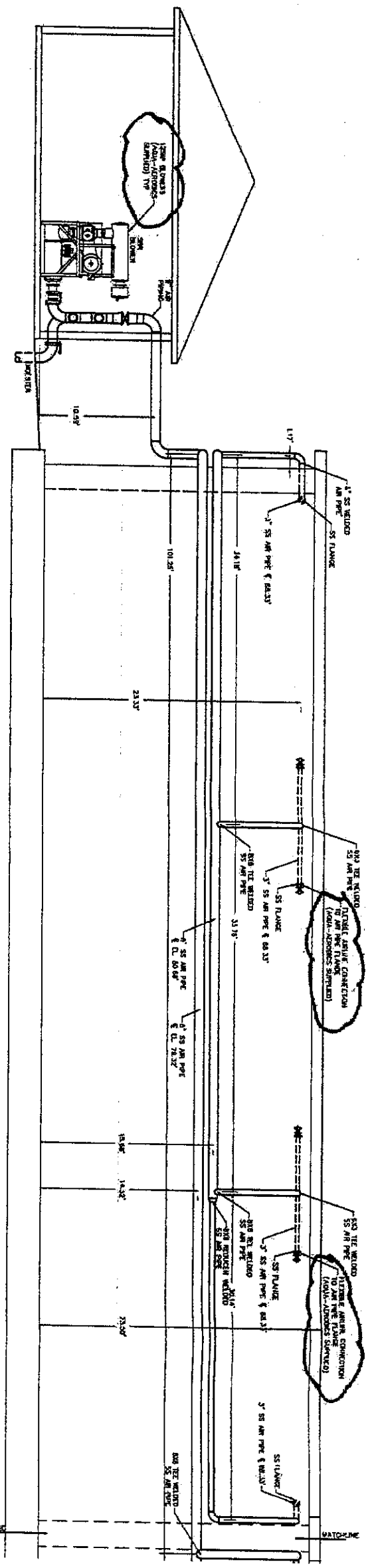
Hinesville/Ft Stewart
WWTP Upgrade
for
The City of Hinesville
Ft Stewart
Liberty County, Georgia

SBR
Sections

DATE: November 29, 2012
FILE NO: 2009-63PW
SHEET: M-4



EAST ELEVATION



EAST ELEVATION

= Aqua-Aerobic Supply

GRAPHIC SCALE

SBR Air Piping East Elevation	Hinesville/Ft Stewart WWTP Upgrade for The City of Hinesville Ft Stewart Liberty County, Georgia
DATE: November 29, 20121 FILE NO: 2009-63PRJ SHEET: M-19	

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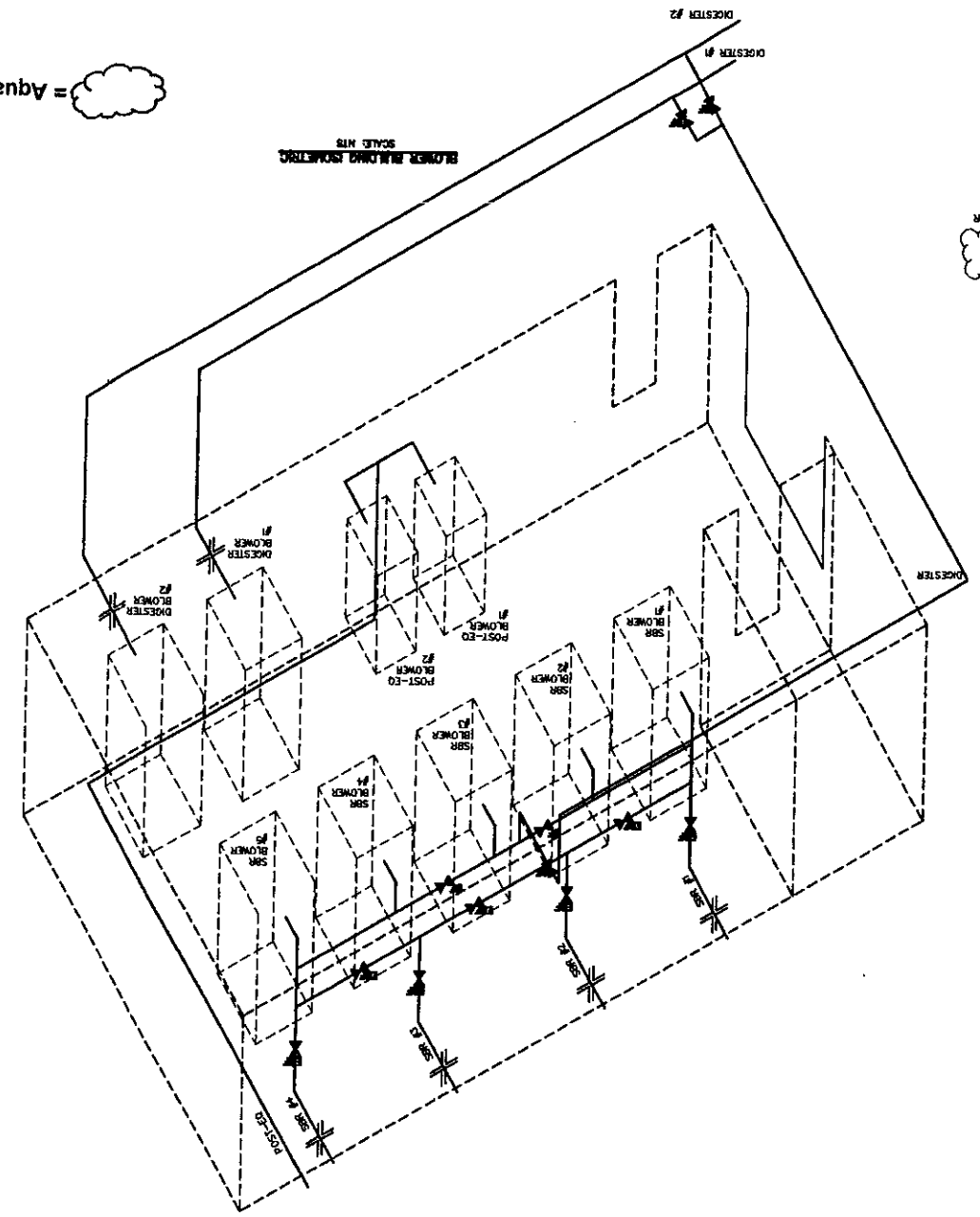
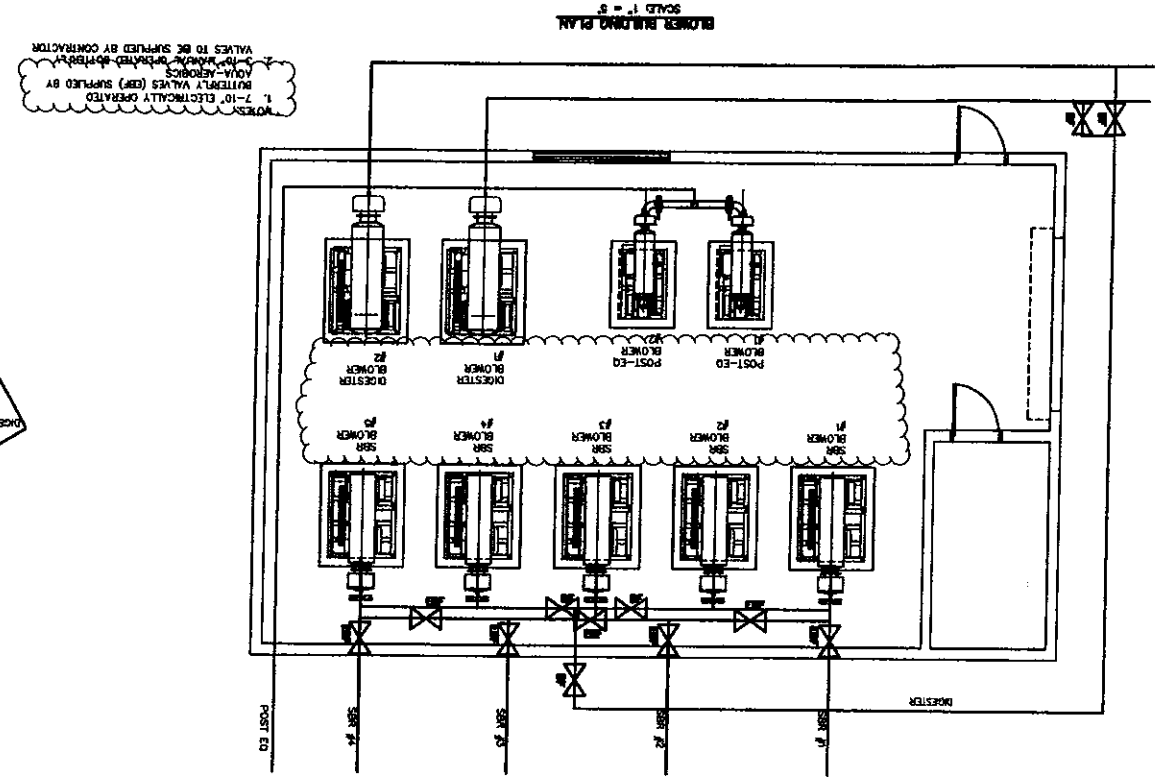
TEL: (706) 454-0870

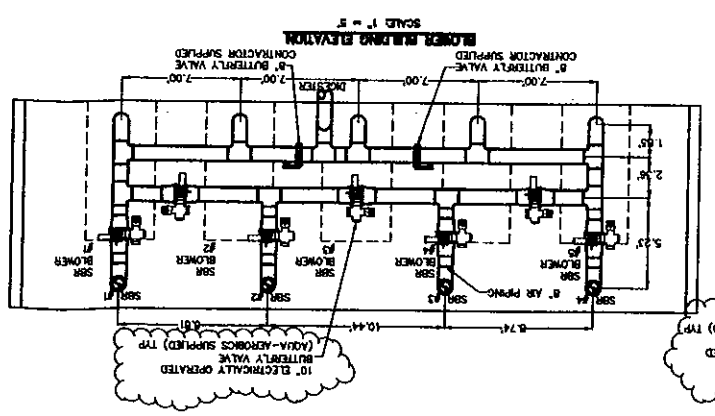
DRAWING COMPLETED BY:

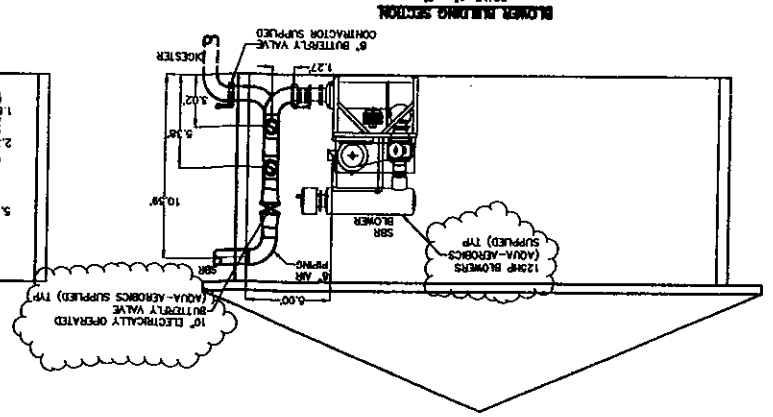
DATE:

REVISED:









NOTES
1. AIR PIPING - SCHEDULE 10S STAINLESS STEEL
2. FLANGES - 304 STAINLESS STEEL 150# CLASS WITH NEOPRENE GASKET
3. ALL AIR PIPING BELOW 8' ELEVATION FROM FINISHED FLOOR WILL BE INSULATED WITH 1" INSULATION
4. INSTALL VALVES WITH STEMS UPRIGHT OR HORIZONTAL, NOT INVERTED
5. AIR PIPING TO BE TESTED TO ZERO LEAKAGE AT 50 PSI PNEUMATIC
6. PLACE EXPANSION JOINTS IN EXTENDED POSITION WHEN PIPING IS INSTALLED
7. EXPANSION JOINT EVERY 40 FEET ALONG PIPE LENGTH, FROM BLOWER BUILDING TO TANK ENTRY
8. ALL DIMENSIONS TO BE VERIFIED BY CONTRACTOR PRIOR TO MANUFACTURING OF AIR PIPING

Blower Building
Air Piping
Details

DATE: November 28, 2012
FILE NO. 2009-63PRJ
SHEET: M-16

Hinesville/Ft Stewart WWTP Upgrade
for
The City of Hinesville
Ft Stewart
Liberty County, Georgia

P.C. Simonton & Associates, Inc.
Consulting Engineers

1650 PARKSIDE COMMONS
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TEL: (706) 454-8979

300 NORTH MAIN STREET
P.O. BOX 649
HINESVILLE, GA 31313
TEL: (912) 368-5212

DATE:

GEORGIA REGISTERED
NO. 11008
PROFESSIONAL
ENGINEER
PAUL C. SIMONTON

REVISED:

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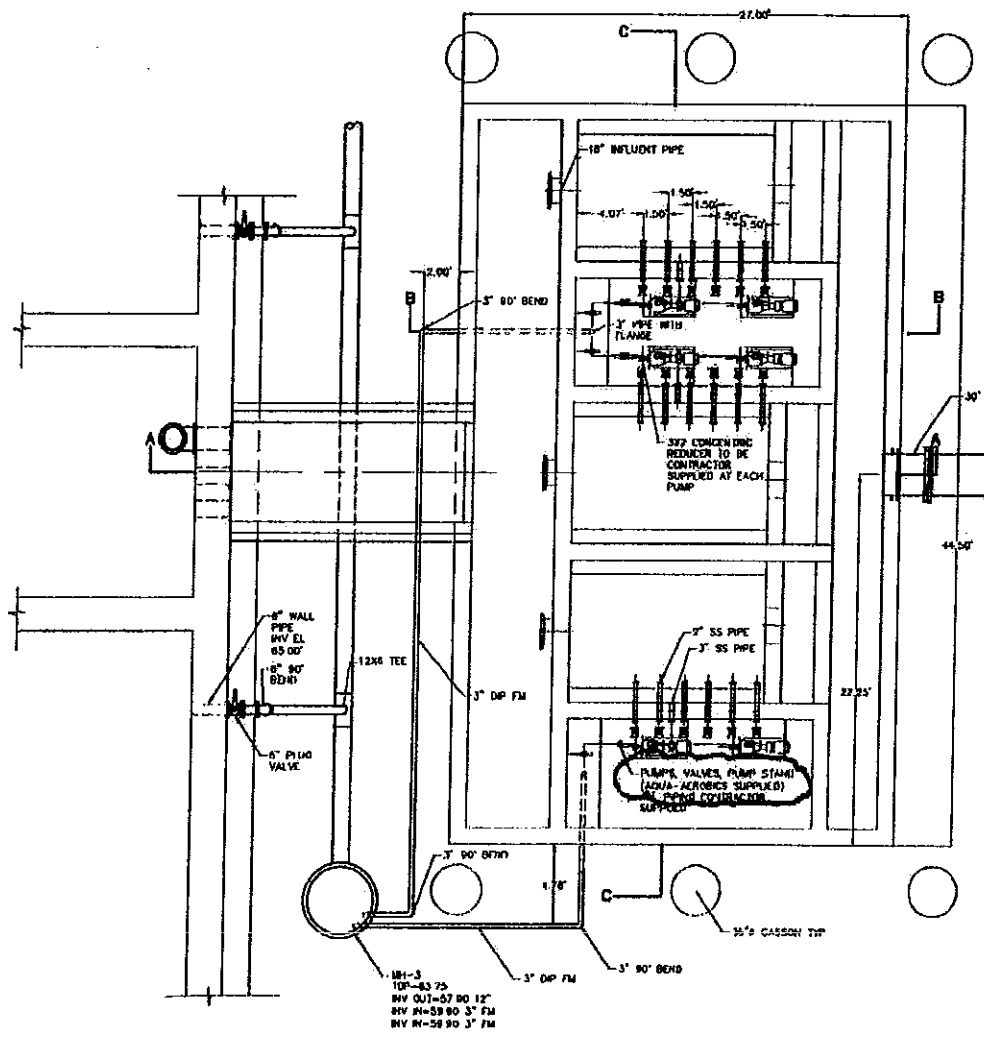
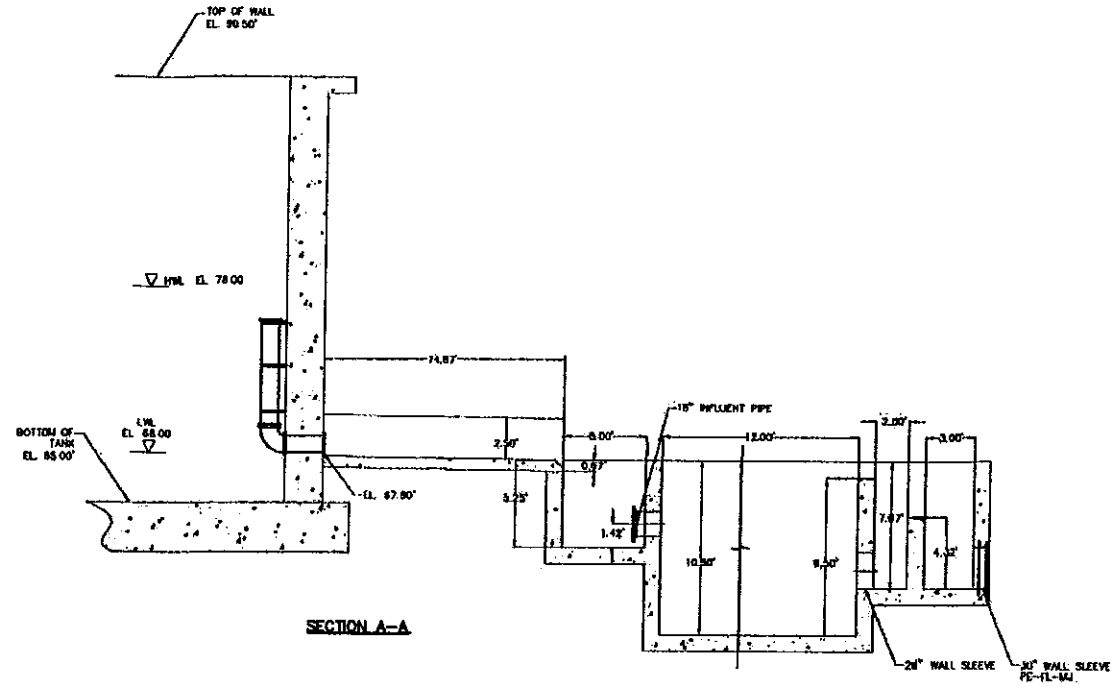
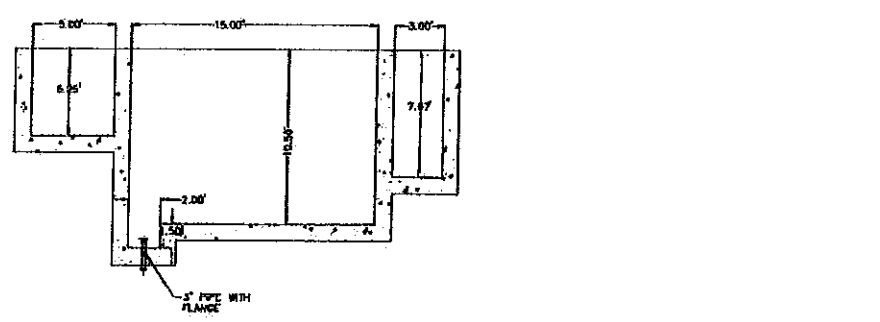




SECTION A–A



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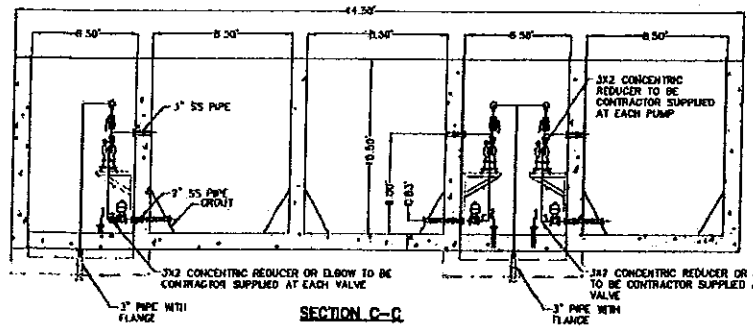

SECTION C–C

= Aqua-Aerobic Supply

GRAPHIC SCALE

(IN FEET)
1 inch = 5 ft.

DRAWING COMPLETED BY:

REVISED:

GEORGIA REGISTERED No. 11609 PROFESSIONAL ENGINEER PAUL C. SIMMONS

DATE:

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Hinesville/Ft Stewart WWTP Upgrade

for

The City of Hinesville

Ft Stewart
Liberty County, Georgia

Disk Filter
Plan & Details

DATE: November 28, 2012
FILE NO: 2009-63PRJ
SHEET: M-5

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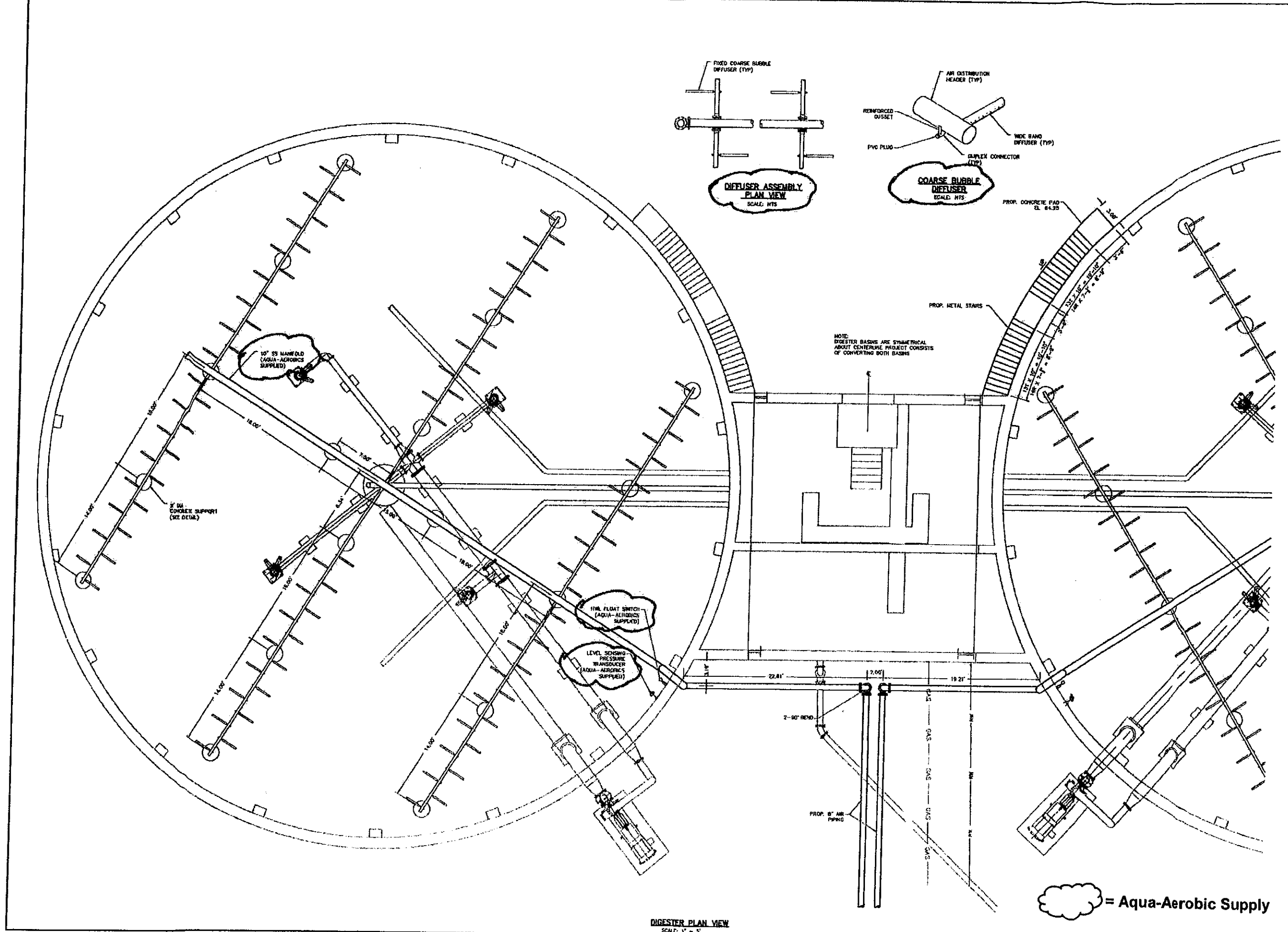

DRAWING COMPLETED BY:

REVISIONS:

GEORGIA REGISTERED No. 11008 PROFESSIONAL ENGINEER PAUL C. SIMONTON

DATE:

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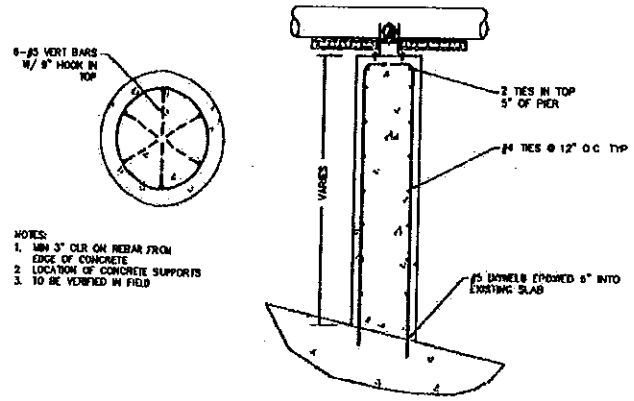
Hinesville/Ft Stewart WWTP Upgrade
for
The City of Hinesville
Ft Stewart
Liberty County, Georgia

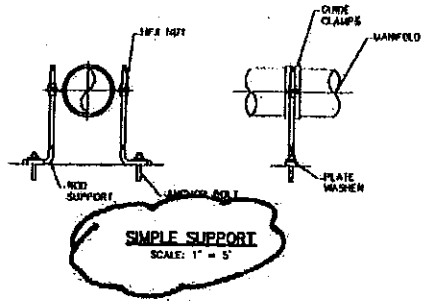
Digester Plan View

DATE: November 29, 2012
FILE NO: 2009-63PRJ
SHEET: M-9



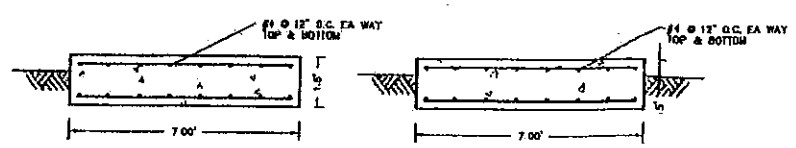
NOTES:
1. MIN 3" CLR ON REBAR FROM EDGE OF CONCRETE
2. LOCATION OF CONCRETE SUPPORTS TO BE VERIFIED IN FIELD

2' DIA CONCRETE SUPPORT DETAIL
SCALE: 1" = 5'

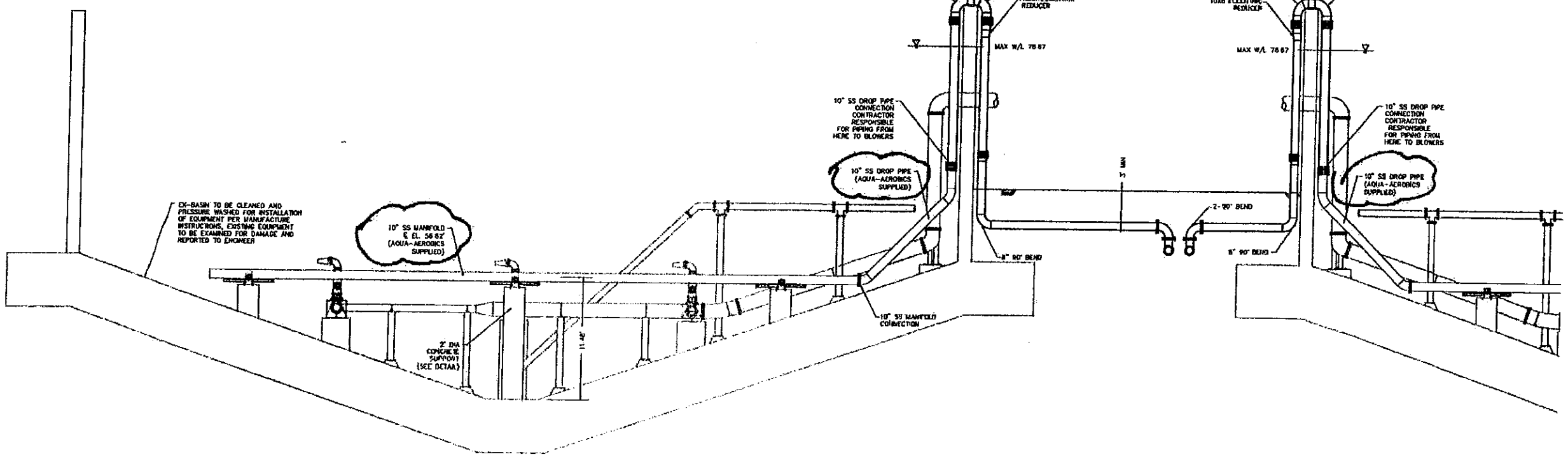


SIMPLE SUPPORT
SCALE: 1" = 5'

NOTES:
1. AIR PIPING - SCHEDULE 10S STAINLESS STEEL
2. FLANGES - 304 STAINLESS STEEL, 150# CLASS WITH NEOPRENE GASKET
3. ALL AIR PIPING BELOW 8' MEASURED FROM FINISHED GRADE WILL BE INSULATED WITH 1" INSULATION AND WRAPPED FOR WEATHER
4. INSTALL VALVES WITH STEMS UPRIGHT OR HORIZONTAL, NOT INVERTED
5. AIR PIPING TO BE TESTED TO ZERO LEAKAGE AT 50 PSI, PNEUMATIC
6. PLACE EXPANSION JOINTS IN EXTENDED POSITION WHEN PIPING IS INSTALLED
7. EXPANSION JOINT EVERY 40 FEET ALONG PIPE LENGTH, FROM BLOWER TO MANIFOLD ALL DIMENSIONS TO BE VERIFIED BY CONTRACTOR PRIOR TO MANUFACTURING OF AIR PIPING
8. ALL AIR PIPING SUPPORTS TO BE STAINLESS STEEL AND SECURED WITH STAINLESS STEEL HARDWARE
9. EXPANSION JOINTS SHOWN IN APPROXIMATE LOCATIONS AND ARE ADJUSTABLE FOR FIELD CONDITIONS AND MANUFACTURING



BLOWER PAD DETAIL
SCALE: 1" = 5'



DIGESTER SECTION VIEW
SCALE: 1" = 5'

= Aqua-Aerobic Supply

DRAWING COMPLETED BY:

REVISED:

GEORGIA REGISTERED No. 11009 PROFESSIONAL ENGINEER PHILIP C. SIMONTON

DATE:

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TEL: (706) 454-8979

Hinesville/Ft Stewart
WWTP Upgrade
for
The City of Hinesville
Ft Stewart
Liberty County, Georgia

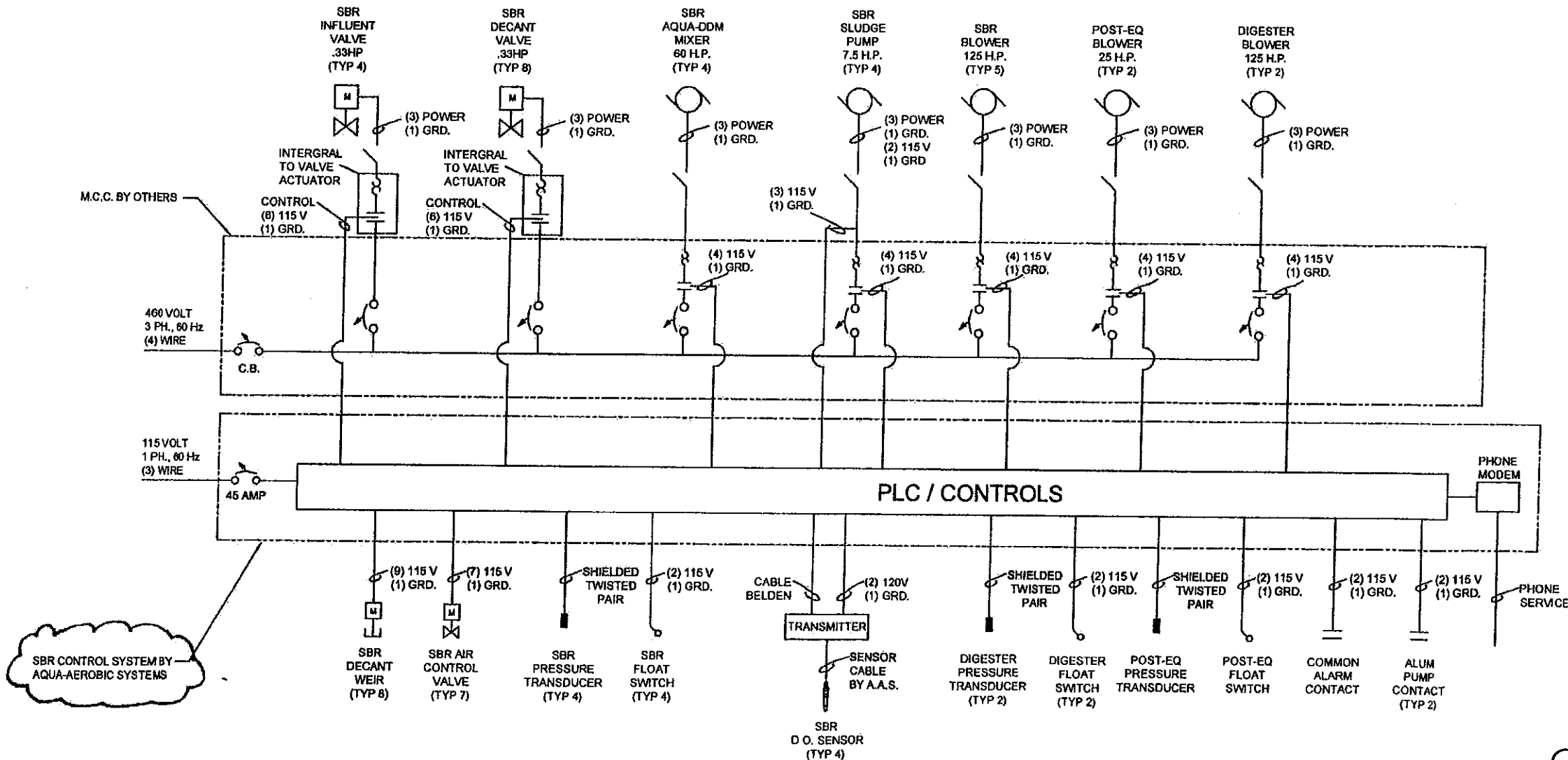
Digester Section View

DATE: November 29, 2012
FILE NO: 2009-63PRJ
SHEET: M-10

SYMBOL KEY

	MOTOR		CIRCUIT BREAKER		ELECTRICAL DISCONNECT	VFD	VARIABLE FREQUENCY DRIVE		PRESSURE TRANSDUCER	M	MOTOR OPERATED WEIR		STARTER CONTACTOR
M	MOTOR OPERATED VALVE		D.O. SENSOR PROBE		MOTOR OVERLOAD	P	PNEUMATIC OPERATED VALVE		FUSE		TRANSFORMER	P	PNEUMATIC OPERATED WEIR

NOTE: SOME SYMBOLS MAY NOT BE APPLICABLE



= Aqua-Aerobic Supply

NOTE: IF PUMPS, MIXERS, AND AERATORS ARE PROVIDED A MULTI-CONDUCTOR S.O. CABLE SHALL BE INCLUDED. THE CABLE SHALL TERMINATE AT A JUNCTION BOX/DISCONNECT PROVIDED BY OTHERS.

NOTE: SUBMERSIBLE PUMPS ARE PROVIDED WITH CONTROL WIRES FOR THE THERMAL SWITCH EMBEDDED IN THE WINDINGS OF THE PUMP. (TWO CONTROL AND ONE GROUND)

NOTE: ANCILLARY EQUIPMENT MONITORING AND/OR CONTROL REQUIREMENTS ARE YET TO BE DETERMINED ELECTRICAL REQUIREMENTS FOR AQUA-AEROBIC SYSTEMS CONTROL PANEL ARE SUBJECT TO CHANGE, PENDING VERIFICATION OF ANCILLARY EQUIPMENT CONTROL FOR MONITORING REQUIREMENTS.

NOTE: IF REQUIRED, SKIMMER LOCAL CONTROL POWER MAY BE PROVIDED VIA ANY SOURCE IN LIEU OF THE SBR CONTROL PANEL

JOB NAME: FORT STEWART ARMY BASE
JOB LOCATION: GA

REV	ENG / ECO	DATE	BY	REVISION DESCRIPTION

DRAWING NAME: 60 HERTZ ONELINE MCC BY OTHERS

AQUA-AEROBIC SYSTEMS INC

DO NOT SCALE DRAWING

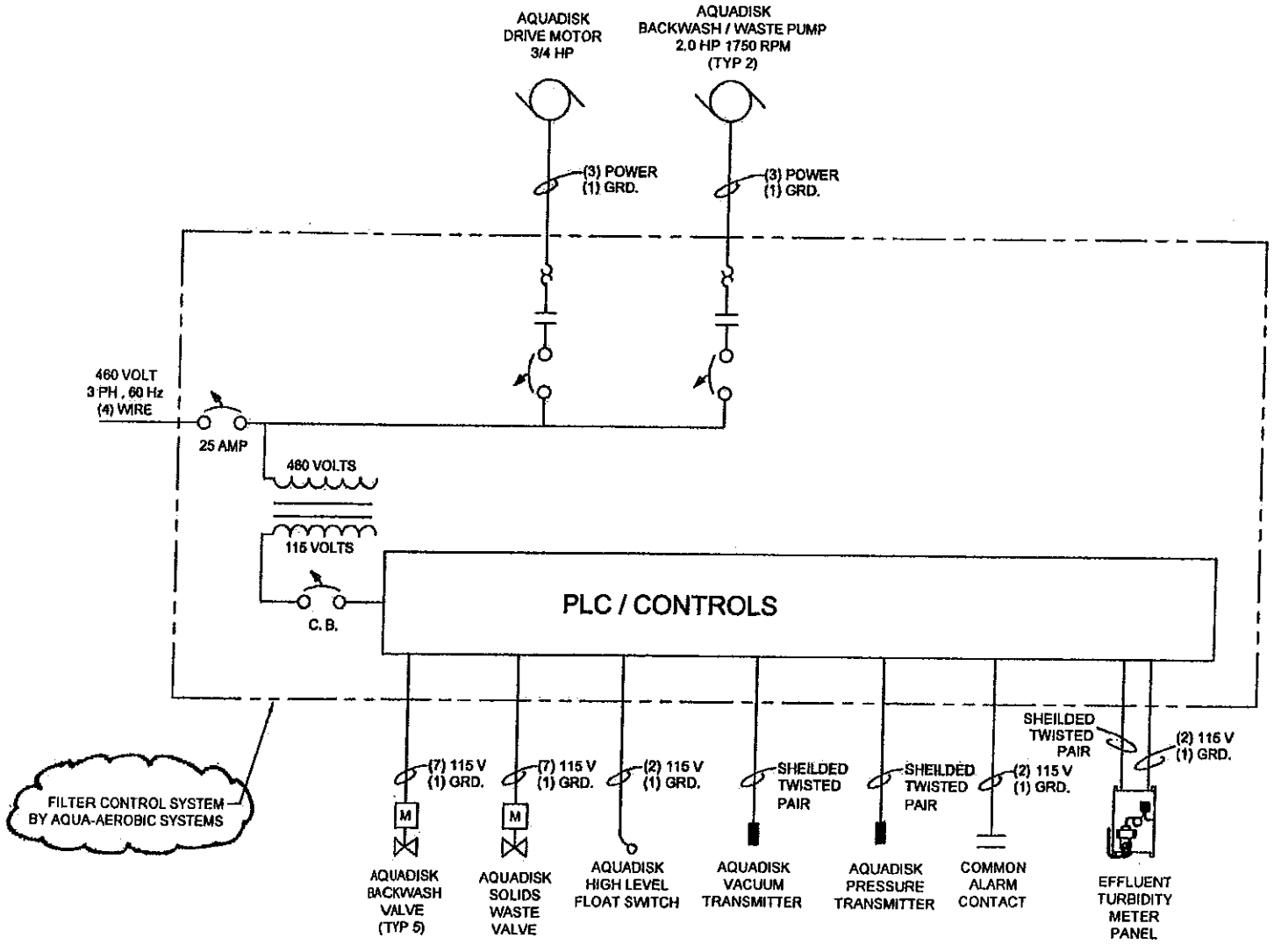
UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS ±1/64
ALL PURCHASE BRACKETS ±1.0 DEG
ALL THREE PLACE DECIMALS ±0.005
ANSI Y14.5 ±1 MC
ANSI

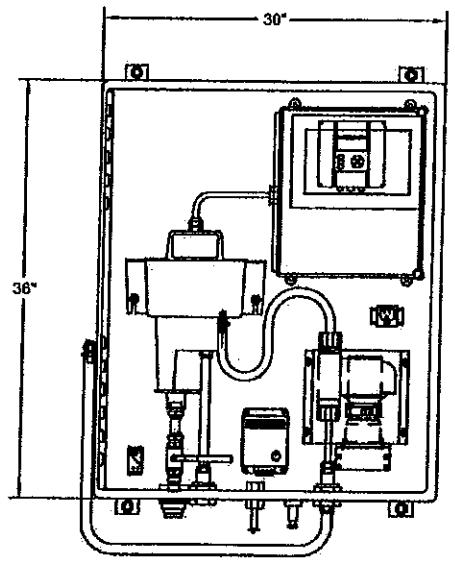
MATERIAL:
TAYLOR ID:
TYPE:
DRAWN BY: SLT — DATE: 5/26/2011
CHECKED BY: — DATE:
WEIGHT: — SHEET: 1 OF
DRAWING NUMBER: 81070863012 — SCALE: — SIZE: D

SYMBOL KEY

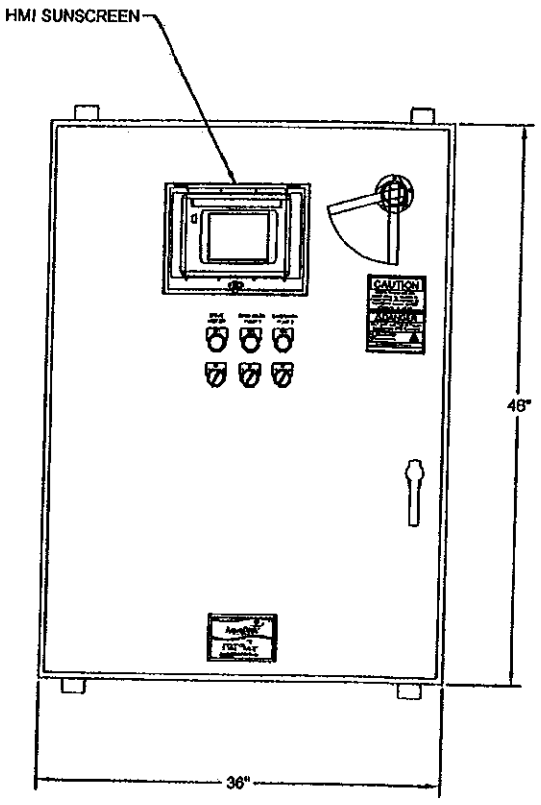
	MOTOR		CIRCUIT BREAKER		ELECTRICAL DISCONNECT	VFD	VARIABLE FREQUENCY DRIVE		TRANSDUCER		STARTER CONTACTOR
M	MOTOR OPERATED VALVE		TRANSFORMER		MOTOR OVERLOAD	P	PNEUMATIC OPERATED VALVE		FUSE		FLOAT SWITCH

NOTE: SOME SYMBOLS MAY NOT BE APPLICABLE





EFFLUENT TURBIDITY METER PANEL



= Aqua-Aerobic Supply

1. CONTROL PANEL
   ENCLOSURE NEMA 4X WALL MOUNTED TYPE STAINLESS STEEL
   FACTORY ASSEMBLED AND SHIPPED LOOSE. INSTALLED BY OTHERS.
   MUST BE LOCATED WITHIN 50 FEET OF THE PRESSURE TRANSMITTER.
   FACING NORTH TO LIMIT THE H.M.I. EXPOSURE TO DIRECT SUNLIGHT.
   FLOOR MOUNTING IS AVAILABLE WITH STEEL OR STAINLESS STEEL ENCLOSURES.
2. STANDARD CONTROL PANEL SIZE
   48" HEIGHT X 36" WIDE X 12" DEEP
3. (1) CONTROL PANEL PER FILTER
   (1) TURBIDITY PANEL PER FILTER

JOB NAME: FORT STEWART ARMY BASE
JOB LOCATION: GA

REV	ENGR / ECO	DATE	BY	REVISION DESCRIPTION

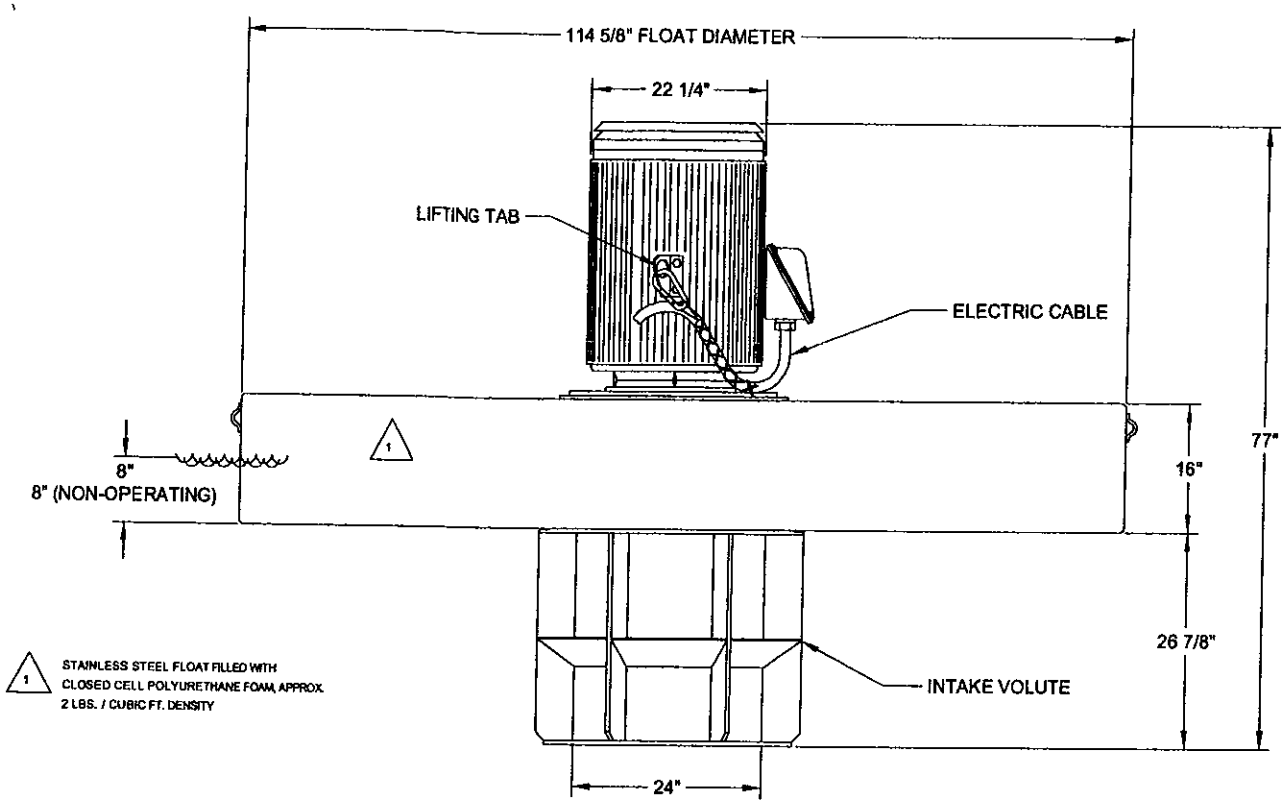
DRAWING NAME: AQUADISK FILTER MODEL ADFSC-54 X 10E-PC

AQUA-AEROBIC SYSTEMS, INC

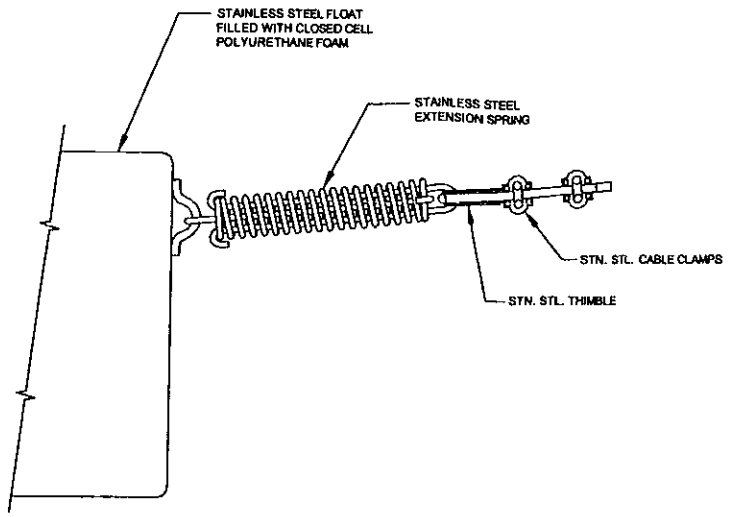
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS ±1/64
ANGLES ±1°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: SLT — DATE: 5/26/2011
CHECKED BY: — DATE:
WEIGHT: — SHEET 1 OF 1
DRAWING NUMBER: 81070866004 — SCALE: — SIZE: D

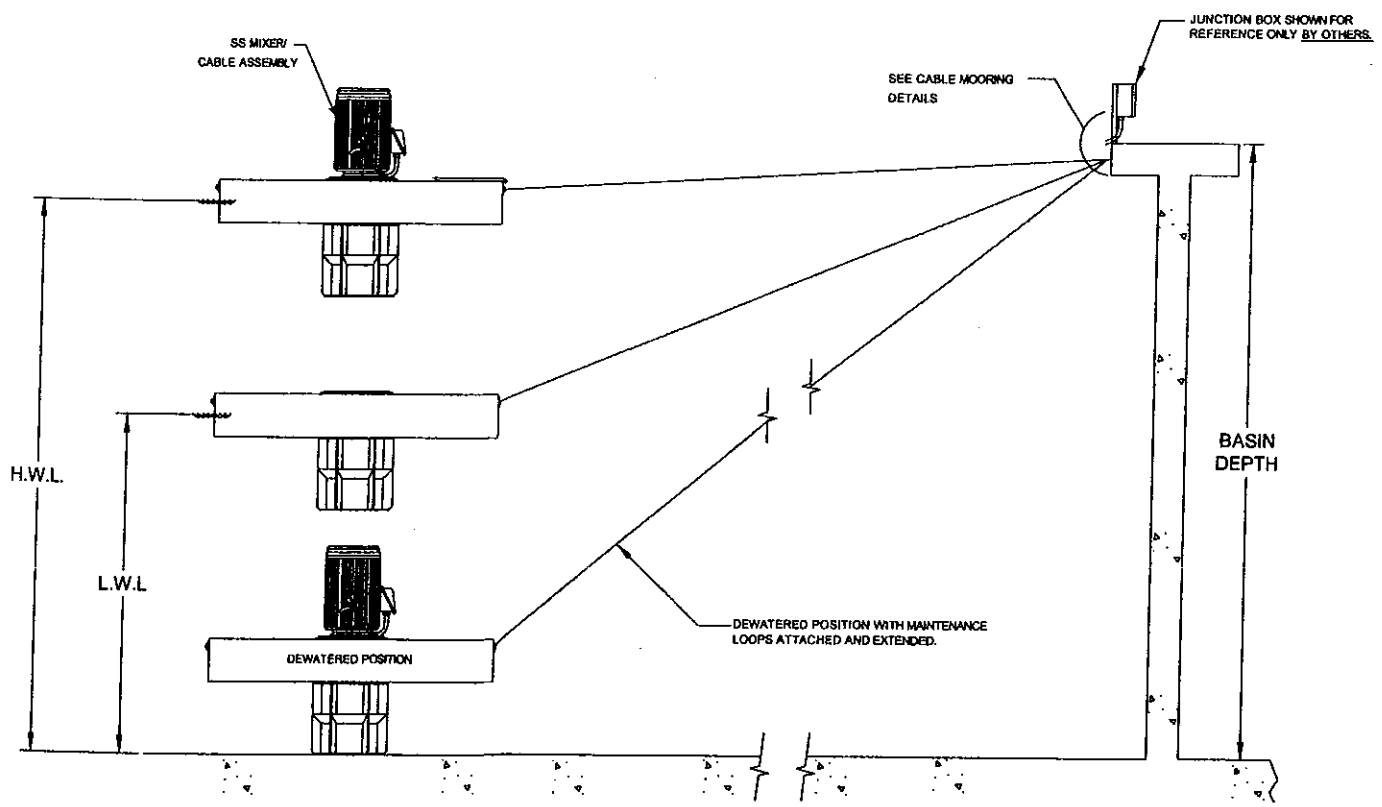


MIXING DETAIL

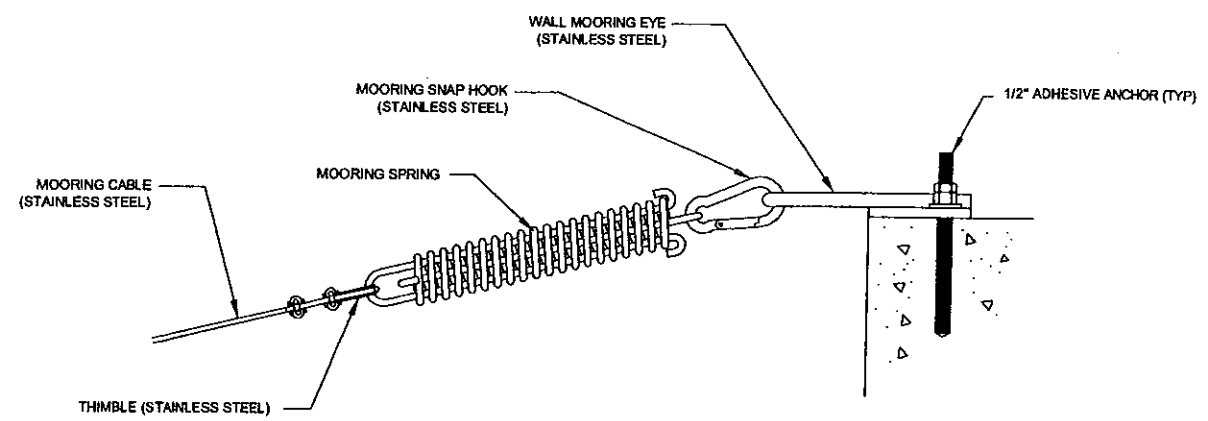


FLOAT MOORING DETAIL

NOTE: MOORING CABLE IS SUPPLIED AS ONE FULL LENGTH AND IS TO BE FIELD CUT INTO EQUAL LENGTHS.



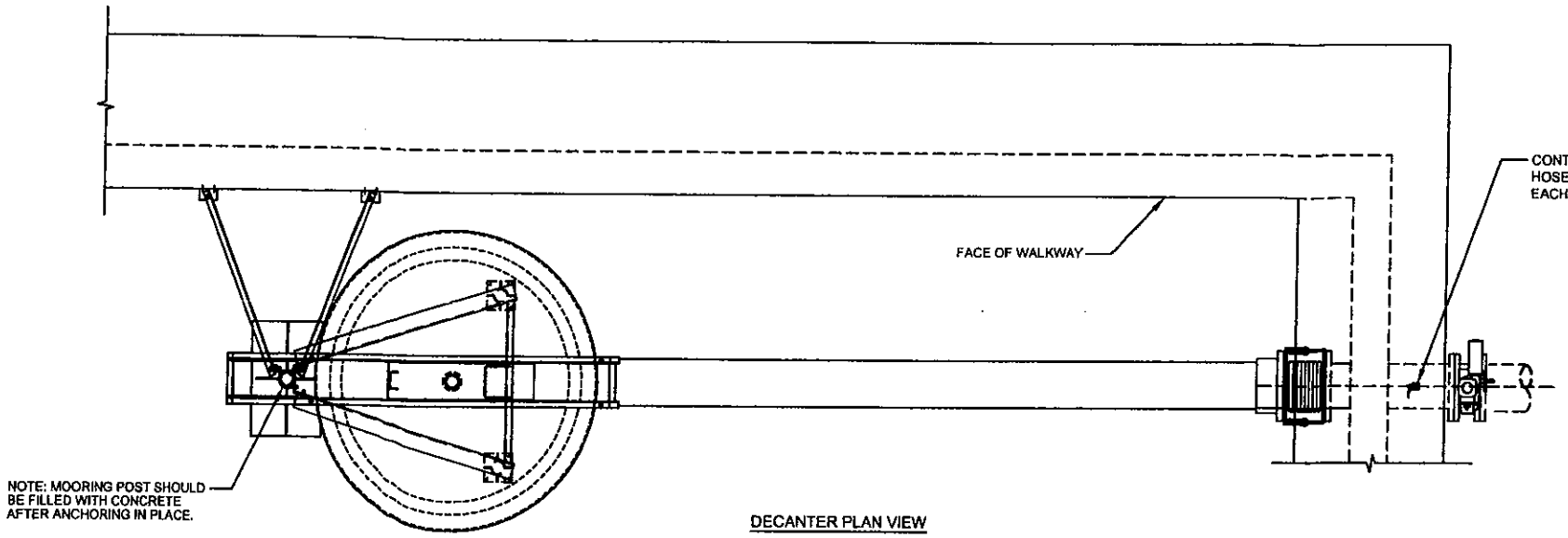
MIXER OPERATIONAL VIEW DETAIL



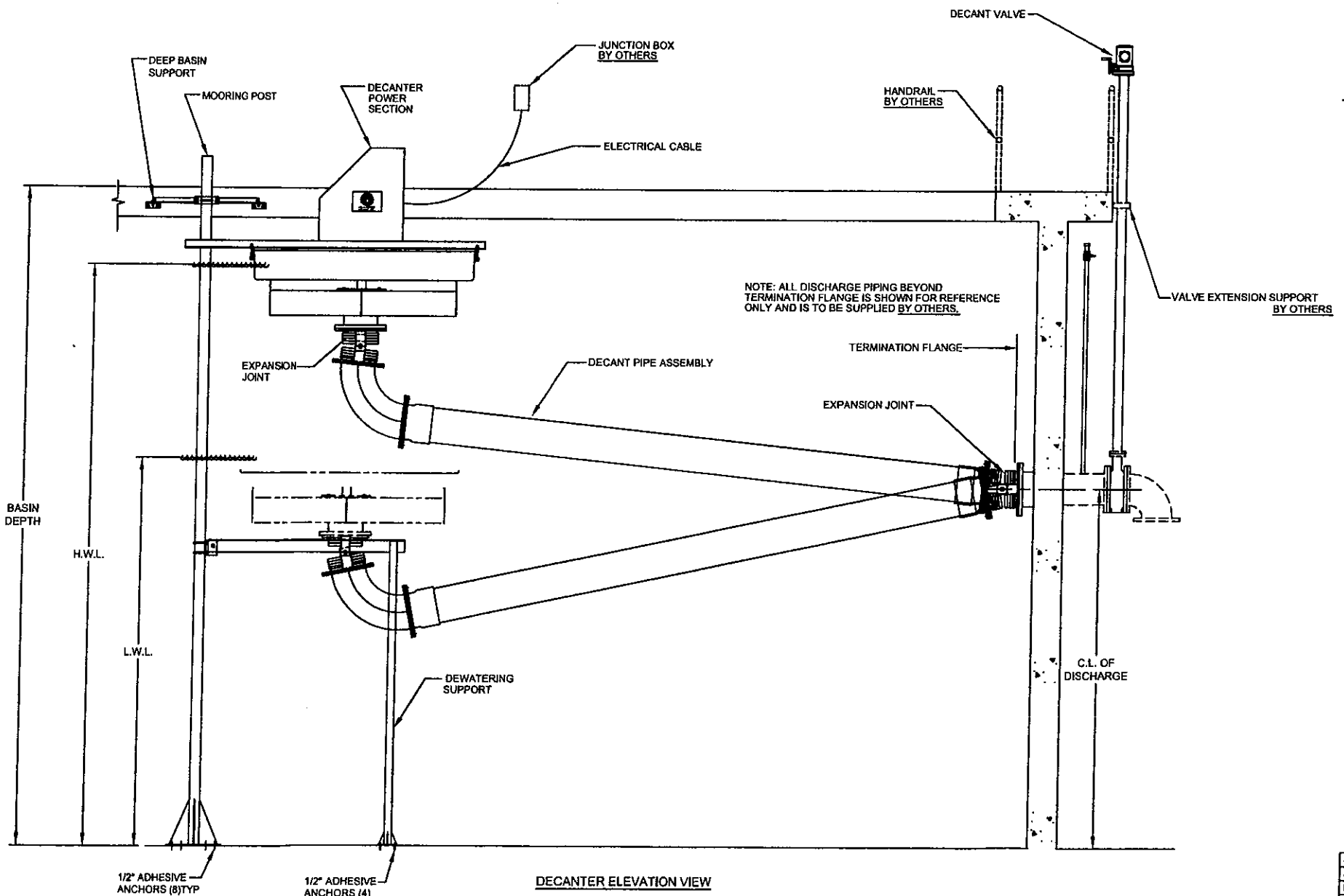
WALL ANCHOR DETAIL

NOTE: POLYPROPYLENE MAINTENANCE LOOP PROVIDED TO ALLOW UNIT TO REST ON BASIN FLOOR IN DEWATERED POSITION OR TO ALLOW UNIT TO BE ACCESSED FROM THE SIDE OF BASIN FOR MAINTENANCE.

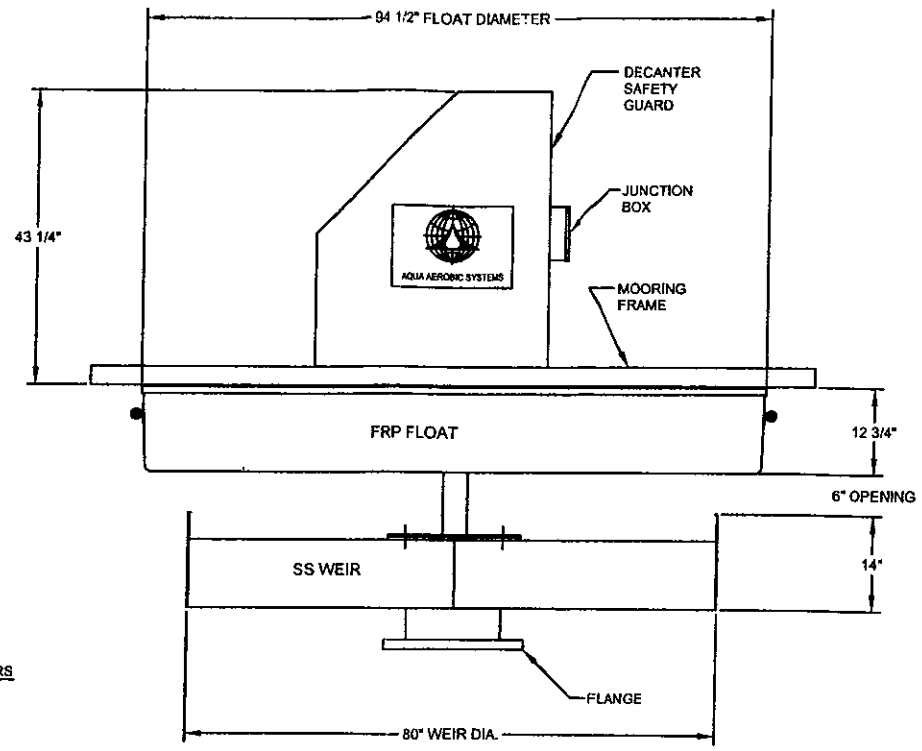
JOB NAME: FORT STEWART ARMY BASE					DO NOT SCALE DRAWING		AQUA-AEROBIC SYSTEMS, INC
JOB LOCATION: GA					DRN BY: SLT	DATE: 5/26/2011	
ENGINEERS:					CKD BY:	ACT WT:	
					SCALE:		NAME: MIXER DETAILS
					SIMILAR:		
					REF:		
REF	ECO	DATE	BY	REVISION	HP/SIZE:		SHEET 1 OF
					TYPE: SS		DWG. NO.: 81070863002



DECANTER PLAN VIEW

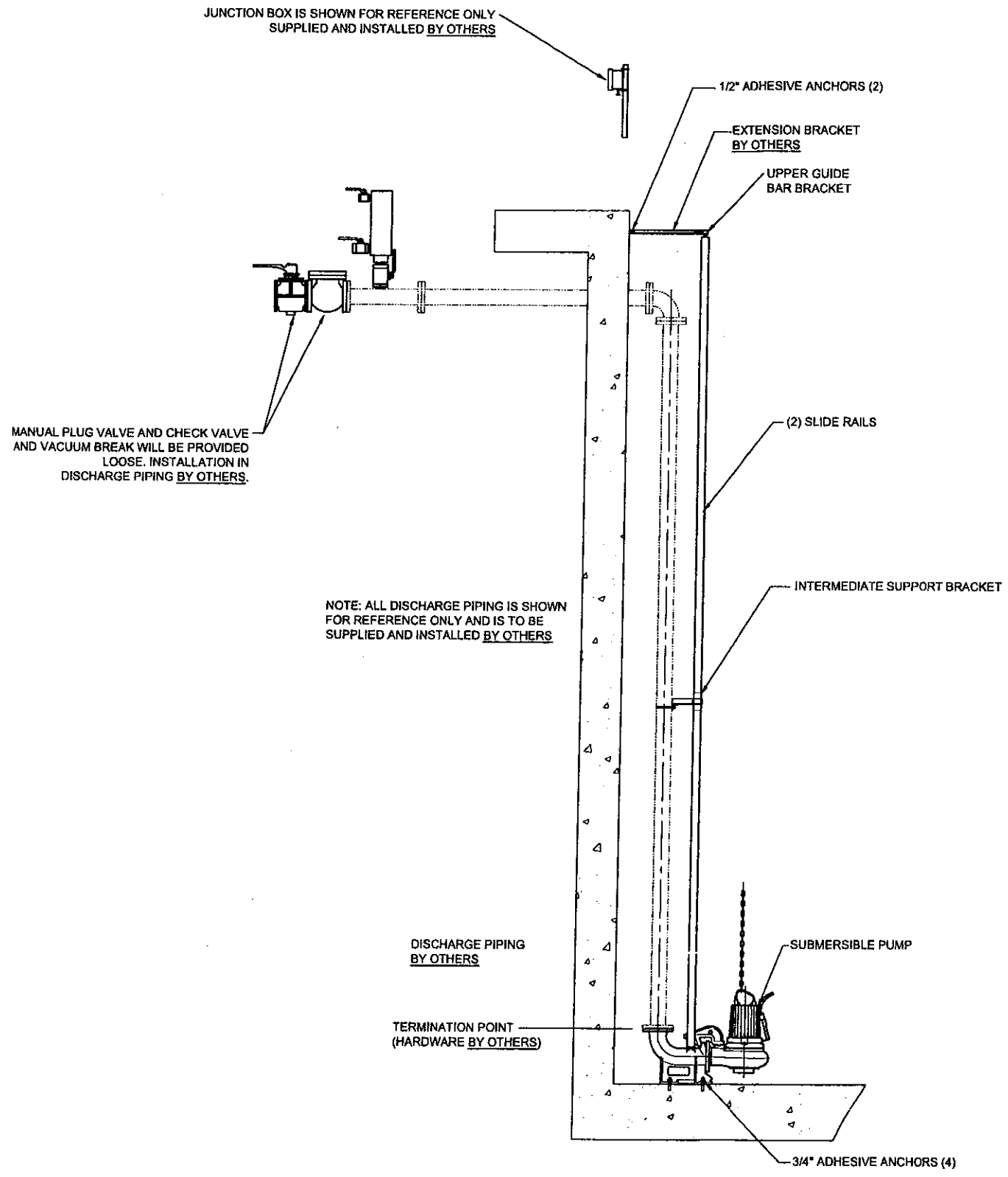


DECANTER ELEVATION VIEW



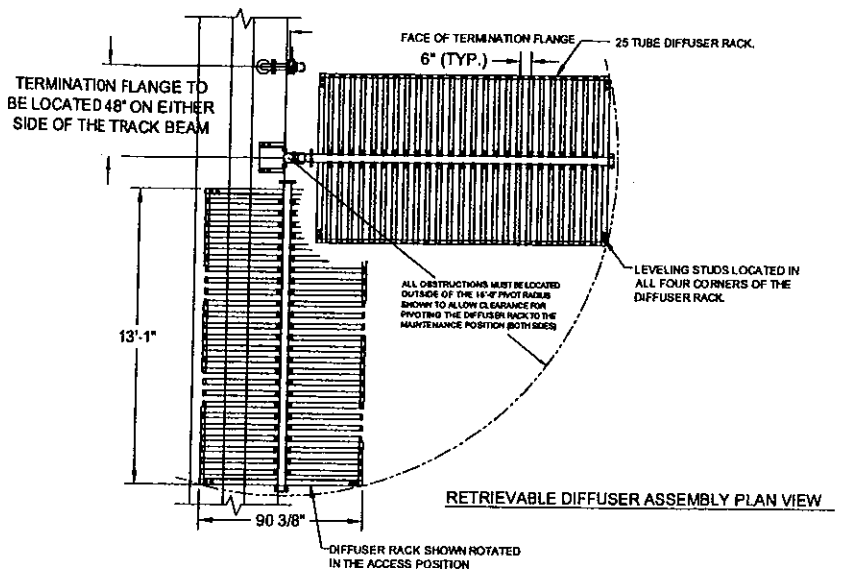
DECANTER DETAIL

JOB NAME: FORT STEWART ARMY BASE	DO NOT SCALE DRAWING	AQUA-AEROBIC SYSTEMS, INC. MANUFACTURERS OF WASTEWATER TREATMENT EQUIPMENT
JOB LOCATION: GA	DRN BY: SLT DATE: 5/26/2011	
ENGINEERS:	CKD BY: ACT WT:	
	SCALE:	PIPE DECANTER DETAILS
	SIMILAR:	
	REF:	
REF ECO DATE BY REVISION	HP/SIZE:	SHEET 1
	TYPE:	DWG. NO.: 81070863003

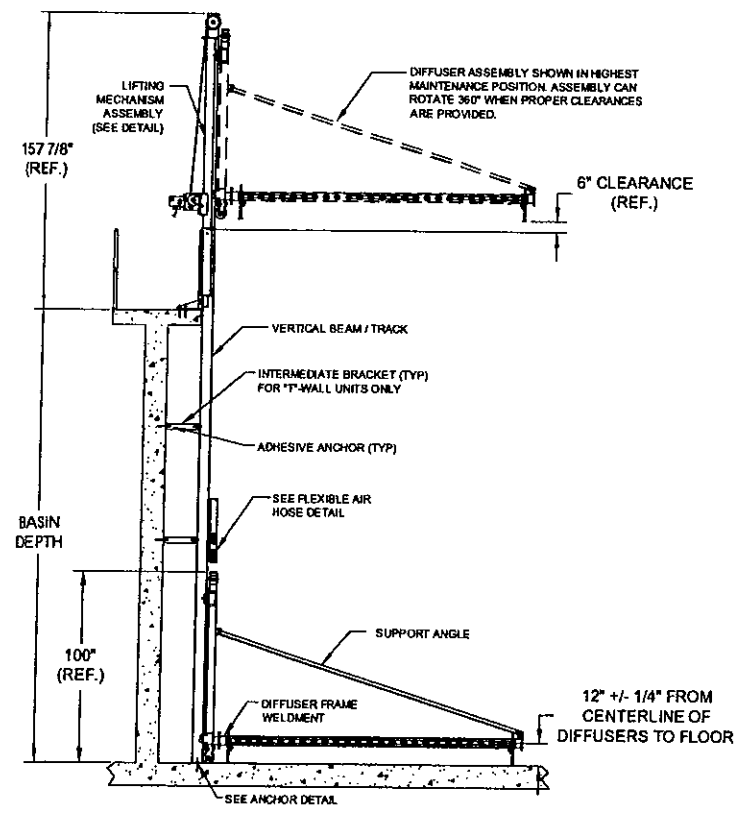


PUMP DETAIL

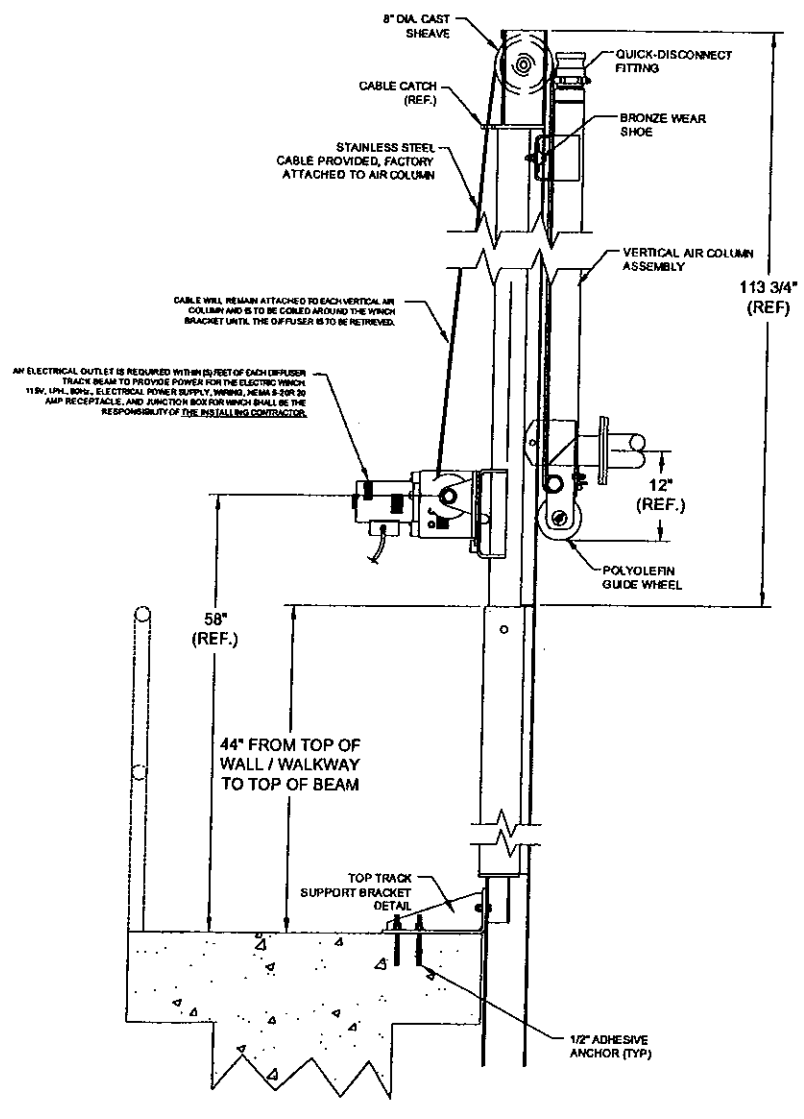
JOB NAME: FORT STEWART ARMY BASE					AQUA-AEROBIC SYSTEMS, INC.
JOB LOCATION: GA					DO NOT SCALE DRAWING — UNLESS OTHERWISE SPECIFIED: FRACTIONAL DIMENSIONS ±1/16; ALL TWO PLACE DECIMALS ±0.005; ALL THREE PLACE DECIMALS ±0.005; ALL ANGLES ±1/2°; ANSI
					MATERIAL:
					SIMILAR TO:
					TYPE:
A	2014-6-12	SLT	ADDED VACUUM BREAK		DRAWN BY: SLT — DATE: 5/26/2011
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	CHECKED BY: — DATE:
DRAWING NAME: TRANSFER PUMP DETAILS					WEIGHT: — SHEET: 1 OF
					DRAWING NUMBER: 81070863004 — SCALE: — SIZE: D



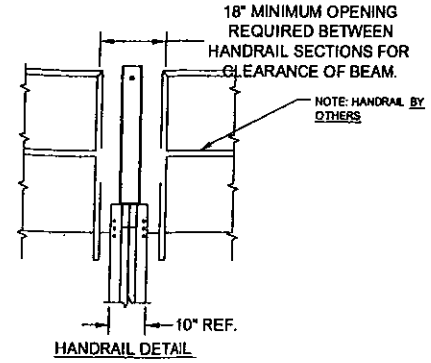
RETRIEVABLE DIFFUSER ASSEMBLY PLAN VIEW



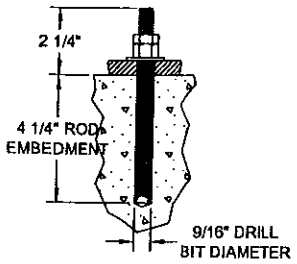
RETRIEVABLE DIFFUSER ELEVATION VIEW



LIFTING MECHANISM ASSEMBLY DETAIL



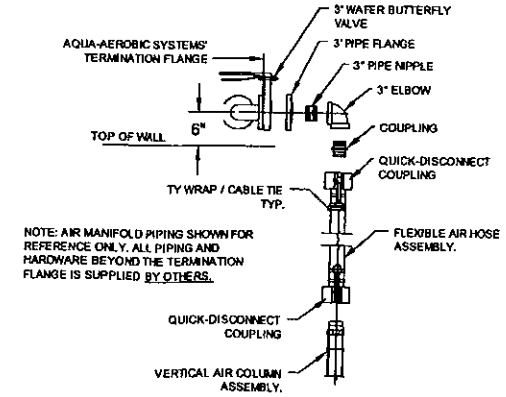
HANDRAIL DETAIL



1/2" ADHESIVE ANCHOR DETAIL

CONNECTING TO PRESTRESSED CONCRETE BASIN:

NOTE: TYPICAL CONNECTION OF AAS FURNISHED EQUIPMENT TO BASIN STRUCTURE IS WITH CONCRETE ADHESIVE ANCHORS. ANY REVISION TO BASIN STRUCTURE TO ACCOMODATE THESE CONNECTIONS SHALL BE BY OTHERS.



FLEXIBLE AIR LINE DETAIL

NOTE: CLOSE CAM-LOCK LEVER ARMS AND TY-WRAP AROUND HOSE, BOTH ENDS. INSPECT THE GASKET INSIDE OF THE CAM-LOCK FITTINGS PRIOR TO ASSEMBLY. GASKET MAY FALL OUT DUE TO HANDLING. EACH FITTING MUST HAVE GASKET TO PREVENT AIR LEAKS.

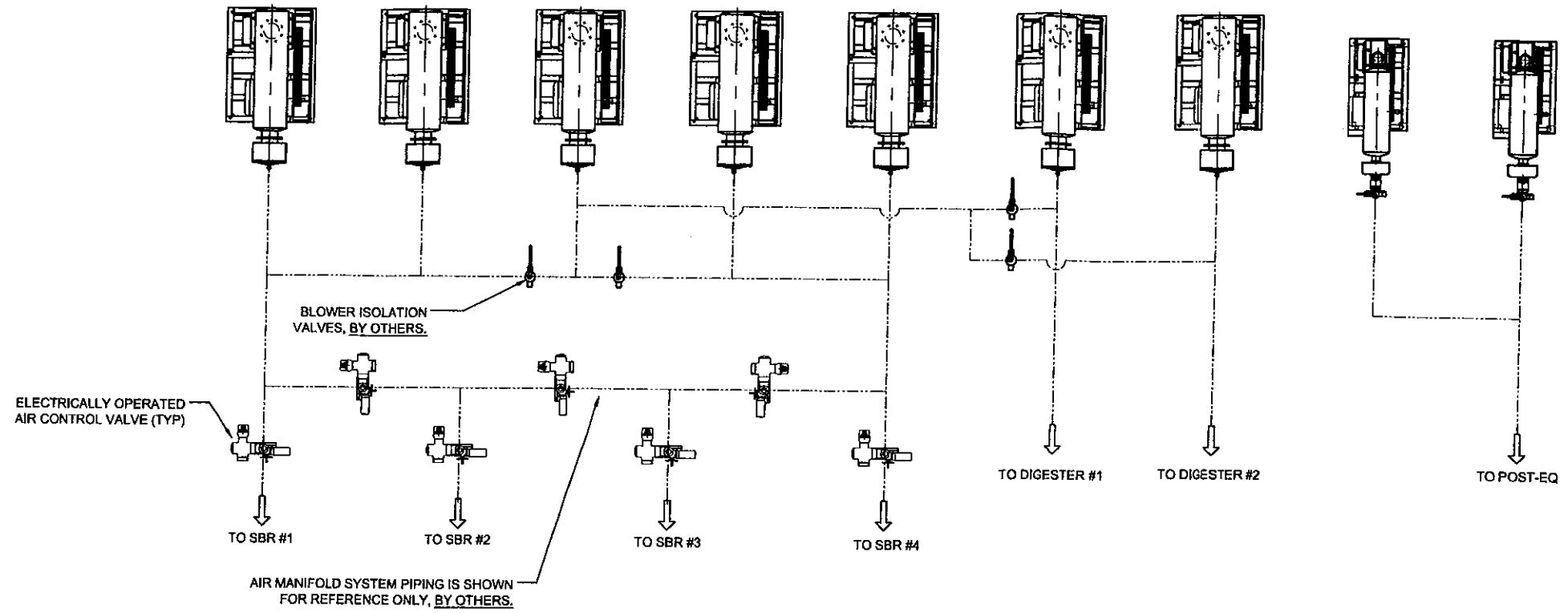
TYPICAL INSTALLATION

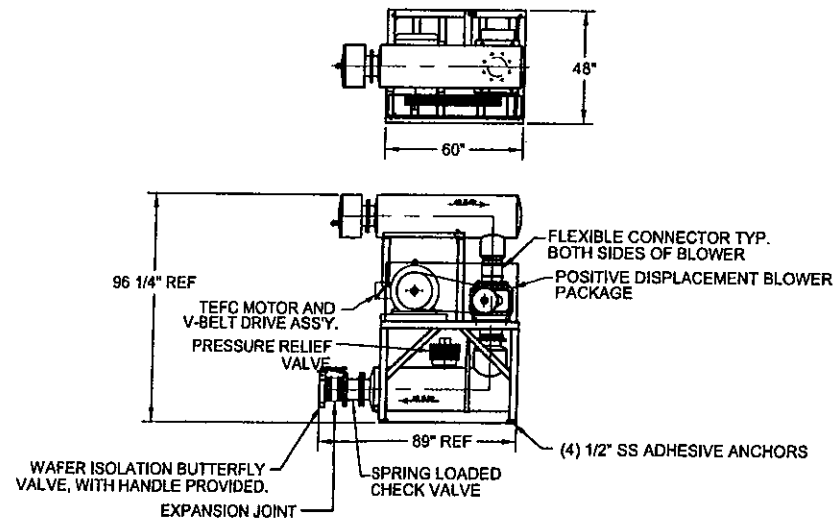
JOB NAME: FORT STEWART ARMY BASE				AQUA-AEROBIC SYSTEMS, INC.	
JOB LOCATION: GA				DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED: TRACTIONAL DIMENSIONS ± 1/64; ALL TWO PLACE DECIMALS ± 0.01; ALL THREE PLACE DECIMALS ± 0.005; ALL ANGLES ± 1/2°; ANSI
				MATERIAL:	
				SIMILAR TO:	
				TYPE:	
				DRAWN BY: SLT	DATE: 5/26/3005
				CHECKED BY:	DATE:
				WEIGHT:	SHEET: 1 OF
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	
DRAWING NAME: 25 TUBE RETRIEVABLE FINE BUBBLE DIFFUSER DETAILS				DRAWING NUMBER: 81070863005	SCALE: SIZE: D

NOTE: THESE ILLUSTRATIONS ARE FOR REFERENCE ONLY. THE EQUIPMENT SHOWN MAY BE ARRANGED DIFFERENTLY. THE EXPANSION JOINT AND ISOLATION VALVE MAY BE ARRANGED ON THE END OF THE "PACKAGE" IN EITHER ORDER. ALL DIMENSIONS ARE APPROXIMATE, AND SUBJECT TO CHANGE. CERTIFIED DIMENSIONS WILL BE PROVIDED WITH SUBMITTALS.

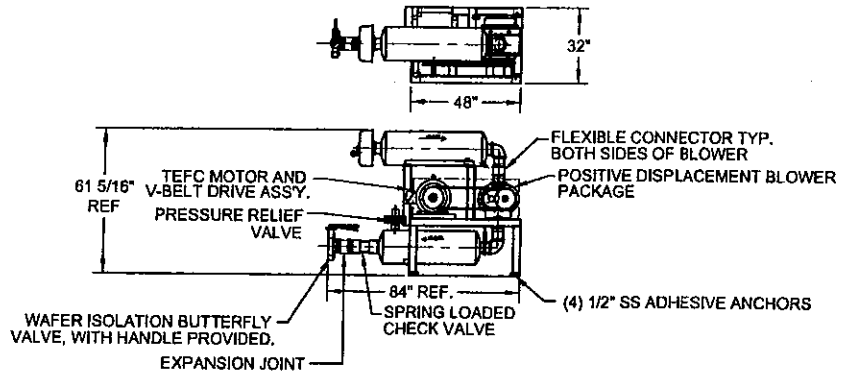
NOTE: ALL PIPING BEYOND THE TERMINATION FLANGE OF THE BLOWER PACKAGES MUST BE SUPPORTED BY THE INSTALLING CONTRACTOR.

MIN. RECOMMENDED DISTANCE BETWEEN BLOWERS IS 3'-0" FOR SERVICING AND MAINTAINING UNITS.





SBR AND DIGESTER BLOWER DETAILS



POST-EQ BLOWER DETAILS

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
A		2014-6-12	SLT	REVISED QTYS

JOB NAME: FORT STEWART ARMY BASE
JOB LOCATION: GA

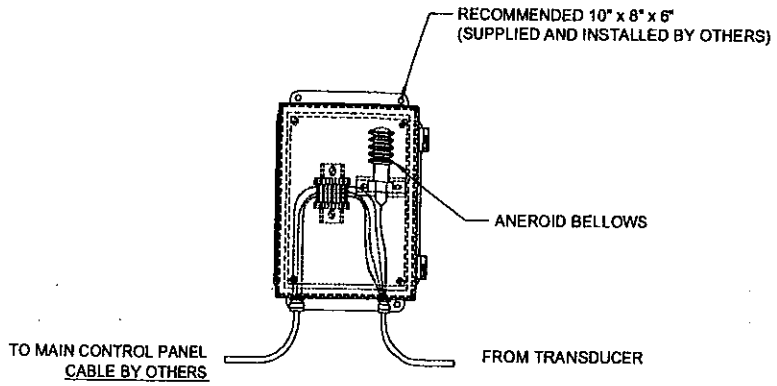
AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

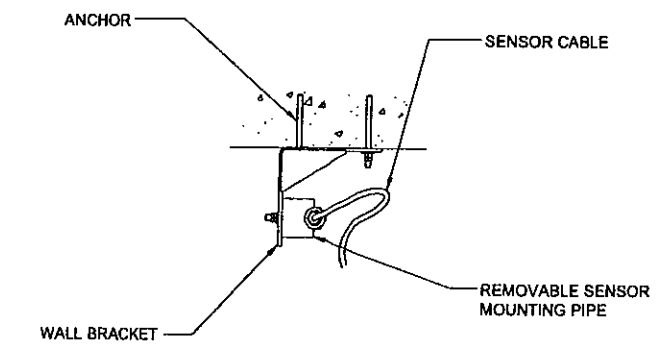
UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS ±
ALL TWO PLACE DECIMALS ±
ALL THREE PLACE DECIMALS ±
ALL ANGLES ±
ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: SLT — DATE: 5/26/2011
CHECKED BY: — DATE:
WEIGHT: — SHEET: 1 OF

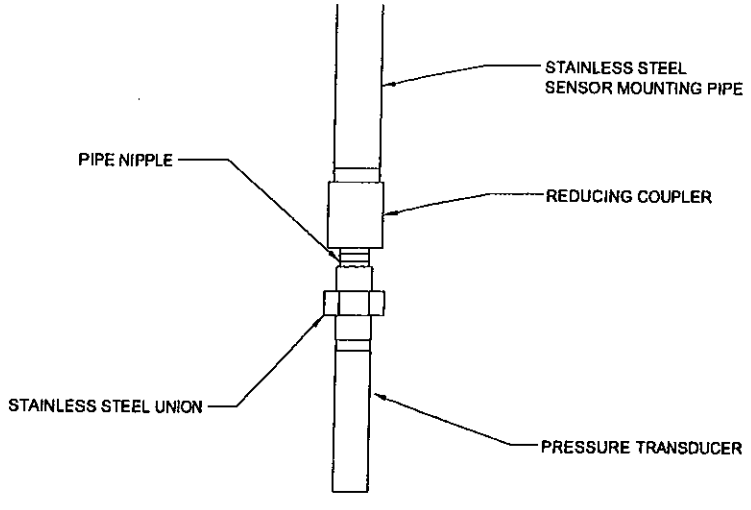
DRAWING NAME: BLOWER DETAILS
DRAWING NUMBER: 81070863006
SCALE: — SIZE: D



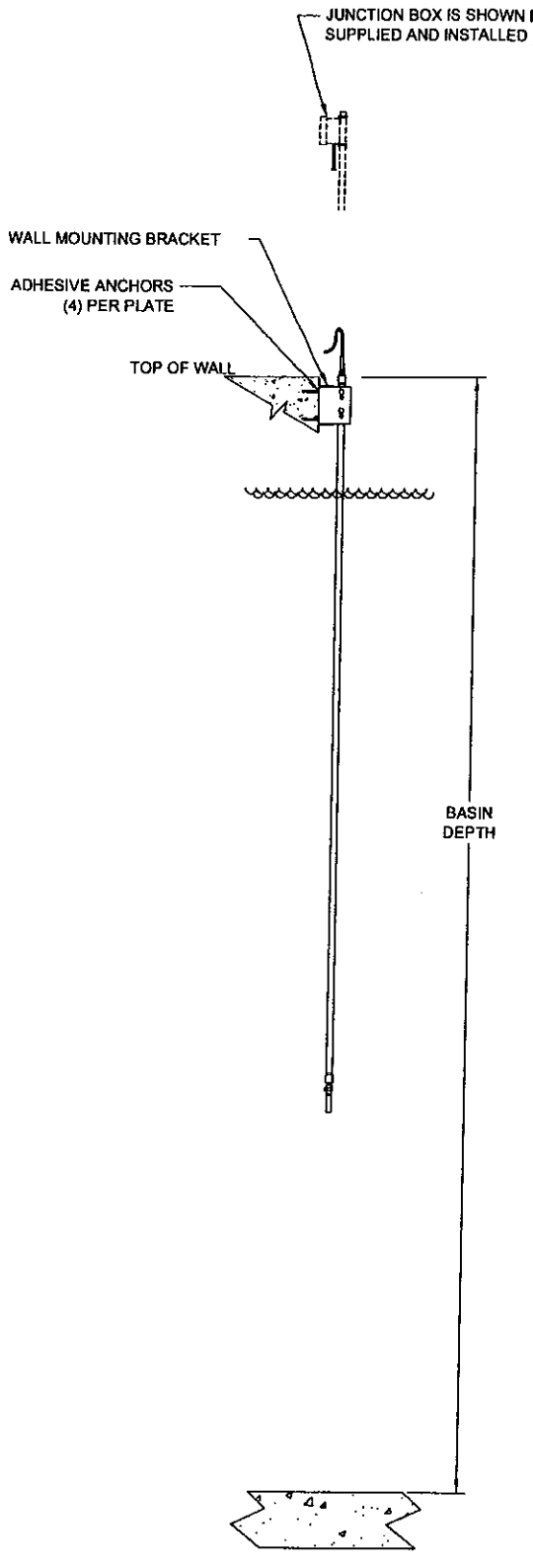
JUNCTION BOX DETAIL

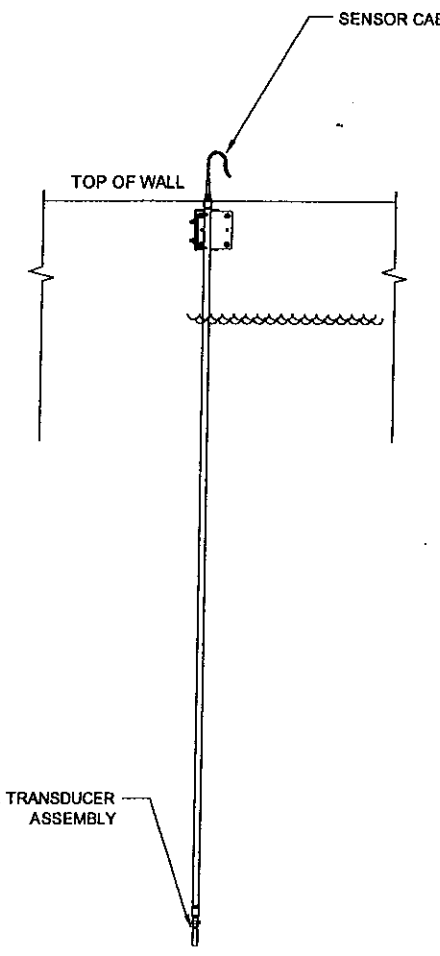


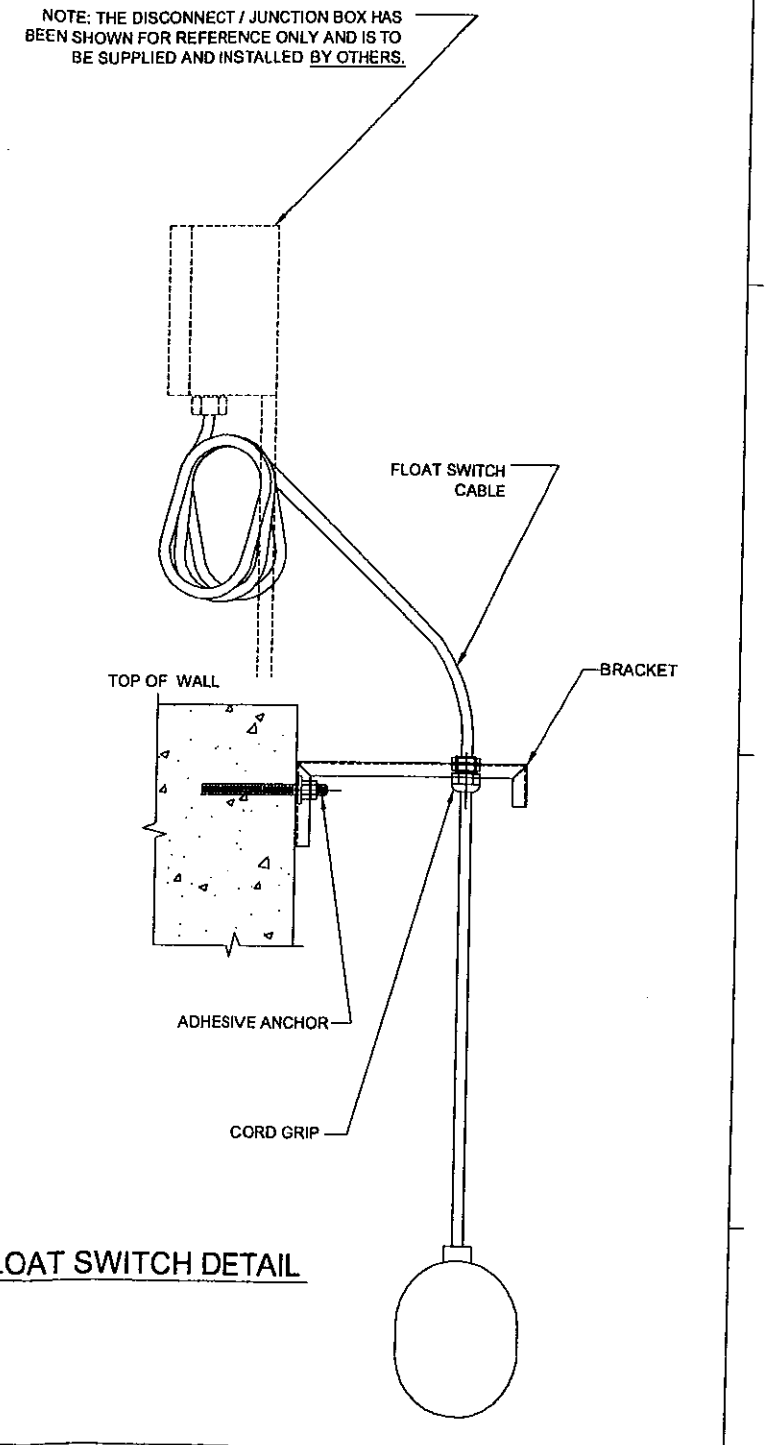
ENLARGED TOP VIEW



ENLARGED SENSOR ASSEMBLY





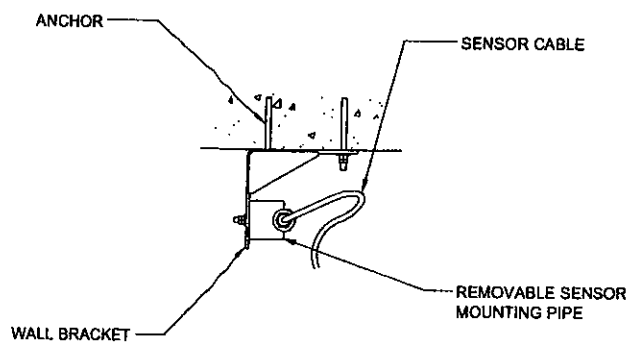


FLOAT SWITCH DETAIL

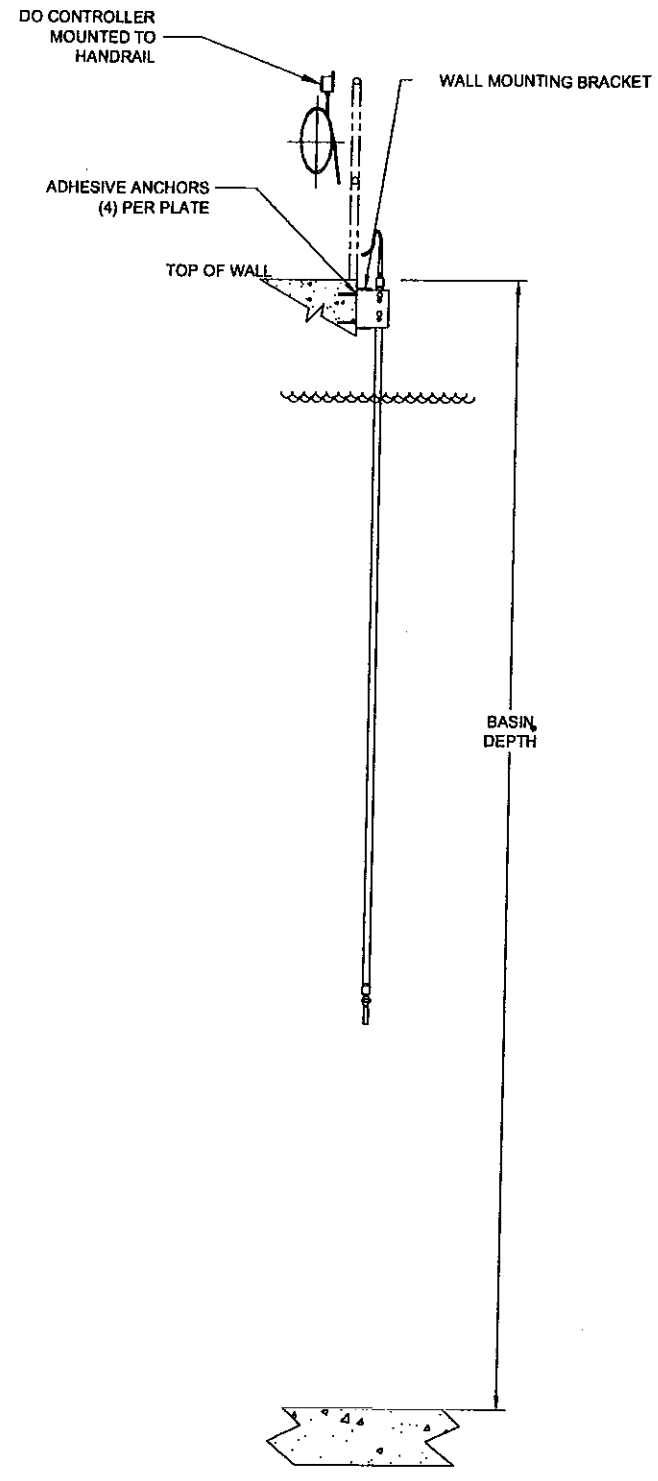
PRESSURE TRANSDUCER DETAILS

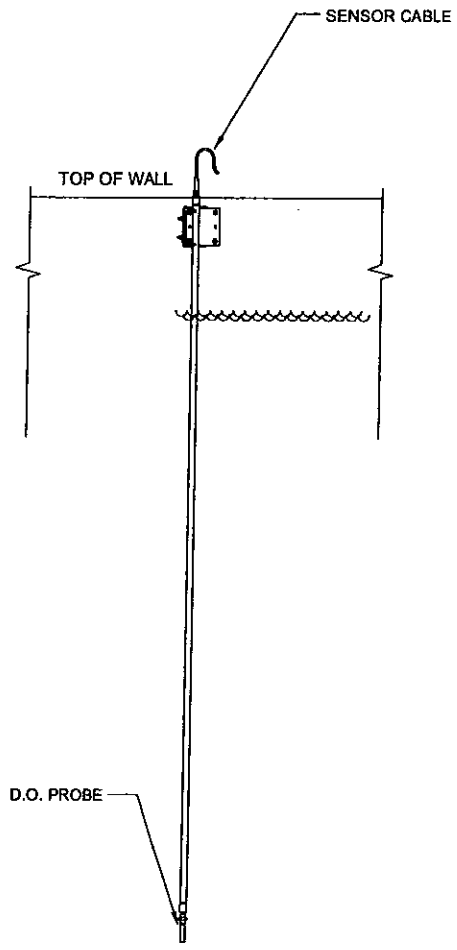
FOR SBR BASINS

JOB NAME: FORT STEWART ARMY BASE					AQUA-AEROBIC SYSTEMS, INC.
JOB LOCATION: GA					
					DO NOT SCALE DRAWING
					UNLESS OTHERWISE SPECIFIED: FRACTIONAL DIMENSIONS ± 1/16; ALL TWO PLACE DECIMALS ± 0.010; ALL THREE PLACE DECIMALS ± 0.005; ALL ANGLES ± 1/2°; ANSI
					MATERIAL:
					SIMILAR TO:
					TYPE:
					DRAWN BY: SLT — DATE: 5/26/2011
					CHECKED BY: — DATE:
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	WEIGHT: — SHEET: 1 OF
DRAWING NAME: HWL FLOAT SWITCH & FIXED MOUNT PRESSURE TRANSDUCER DETAILS					DRAWING NUMBER: 81070863007 — SCALE — SIZE: D

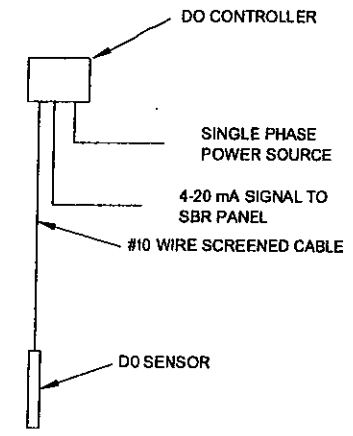


ENLARGED TOP VIEW

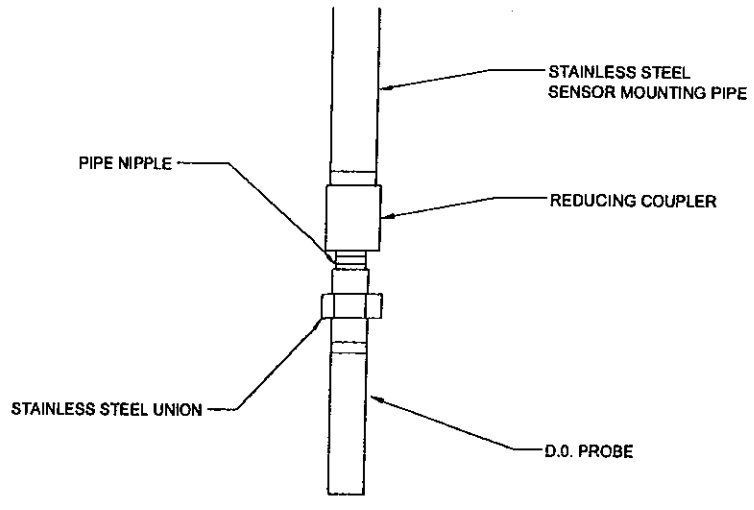




DISSOLVED OXYGEN PROBE DETAILS



DISSOLVED OXYGEN PROBE ELECTRICAL ONELINE



ENLARGED SENSOR ASSEMBLY

JOB NAME: FORT STEWART ARMY BASE
JOB LOCATION: GA

AQUA-AEROBIC SYSTEMS, INC.

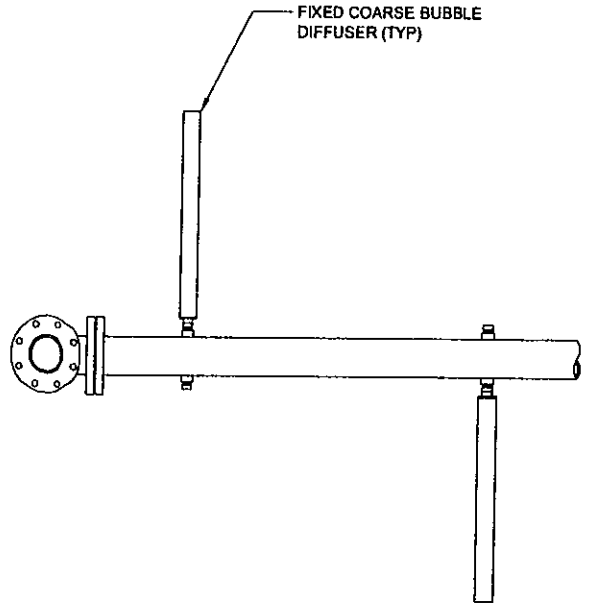
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS ± 1/8
ALL TWO PLACE DECIMALS ± 0.06
ALL THREE PLACE DECIMALS ± 0.03
ALL ANGLES ± 1/2°
ANSI

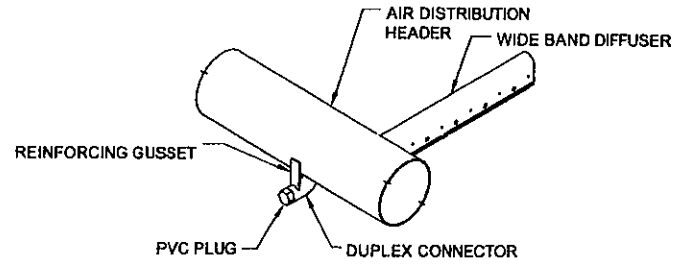
MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: SLT
DATE: 5/26/2011
CHECKED BY:
DATE:
WEIGHT:
SHEET: 1 OF

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION

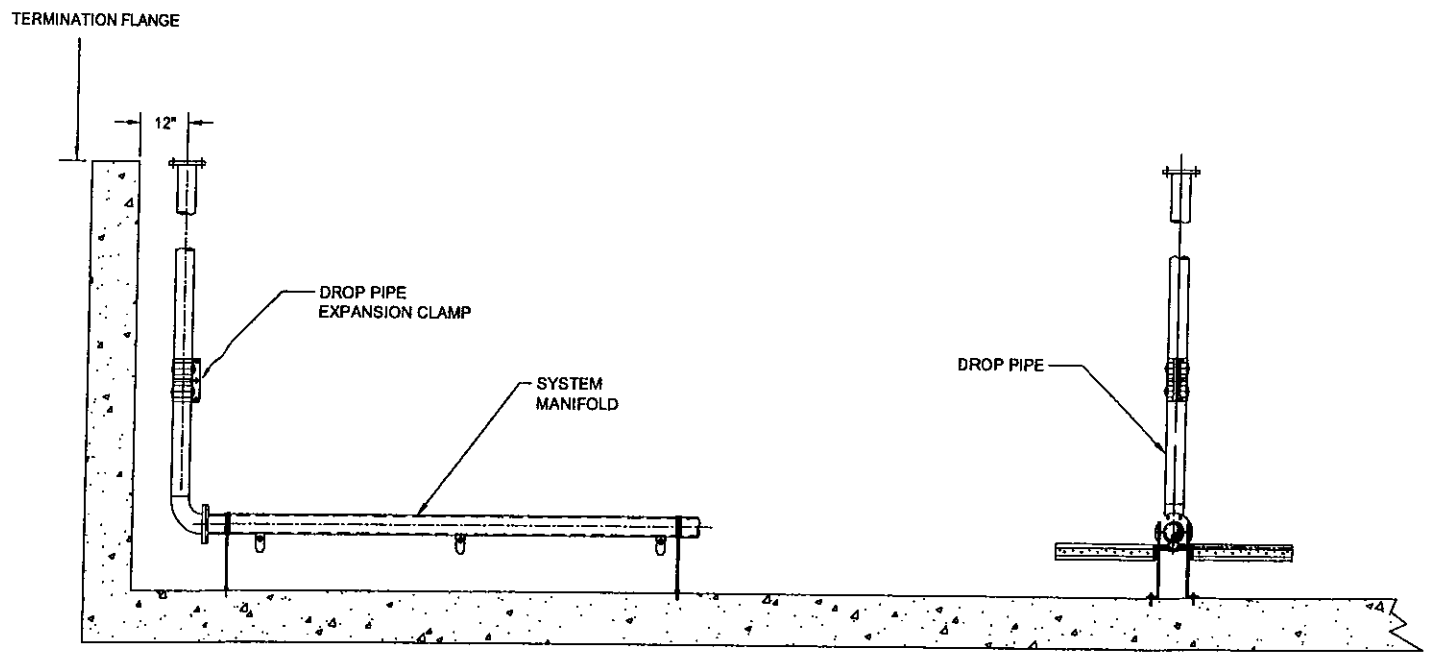
DRAWING NAME: DISSOLVED OXYGEN PROBE
DRAWING NUMBER: 81070863008
SCALE:
SIZE: D



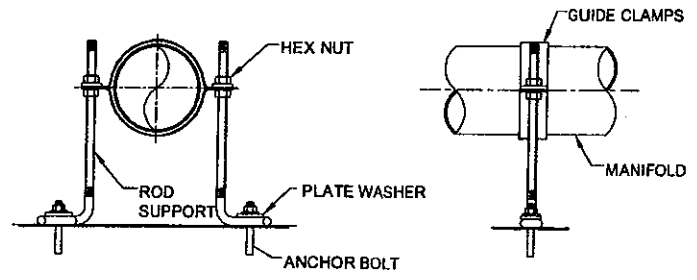
DIFFUSER ASSEMBLY PLAN VIEW



COARSE BUBBLE DIFFUSER



DIFFUSER DROP PIPE ELEVATION VIEWS

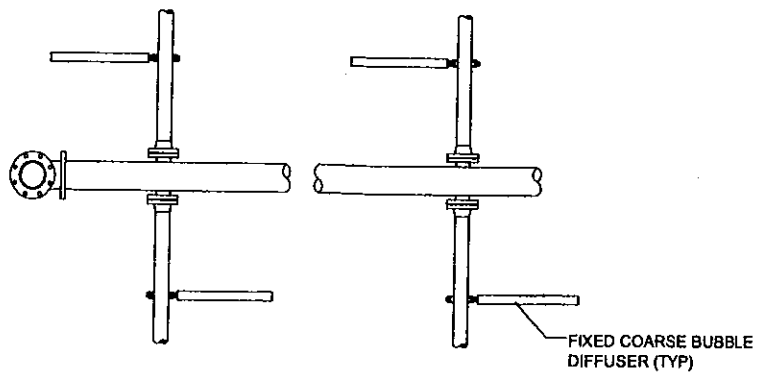


SIMPLE SUPPORT

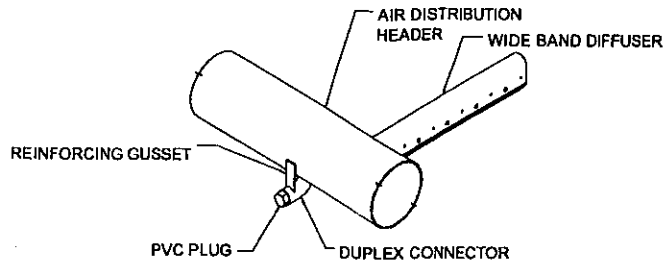
JOB NAME: FORT STEWART ARMY BASE					DO NOT SCALE DRAWING
JOB LOCATION: GA					DRN BY: SLT DATE: 5/26/2011
ENGINEERS:					CKD BY: ACT WT:
					SCALE:
					SIMILAR:
					REF:
					HPSIZE:
REF	ECO	DATE	BY	REVISION	TYPE:

AQUA-AEROBIC SYSTEMS, INC.
BUILT BY SUPPLIERS OF WASTE WATER TREATMENT EQUIPMENT

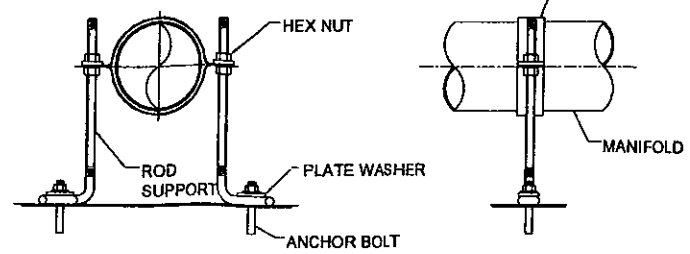
NAME: POST-EQ FIXED COARSE BUBBLE DIFFUSER DETAILS
SHEET 1 OF
DWG. NO.: 81070863009



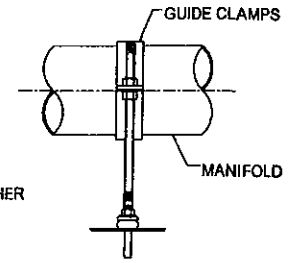
DIFFUSER ASSEMBLY PLAN VIEW

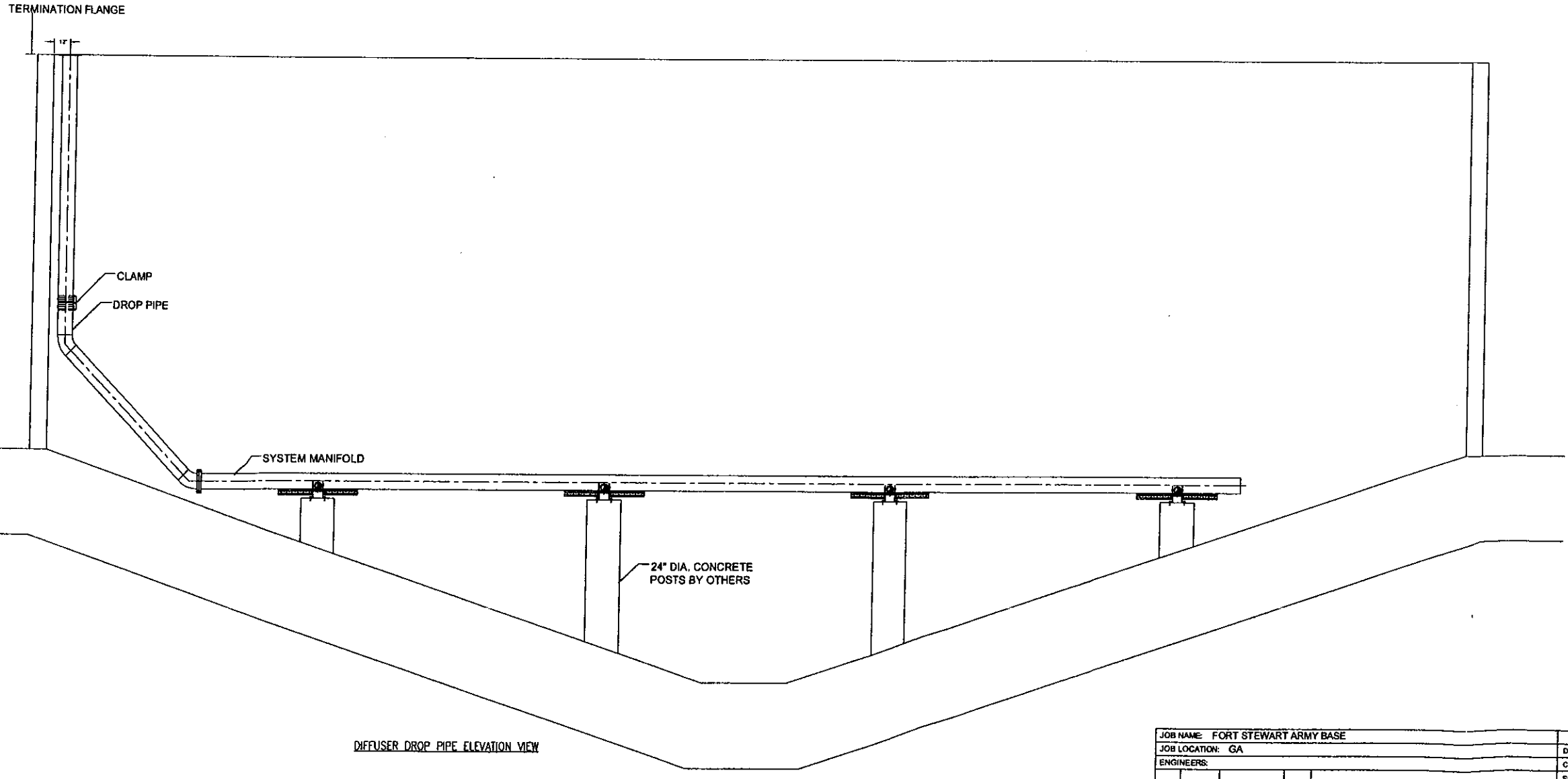


COARSE BUBBLE DIFFUSER

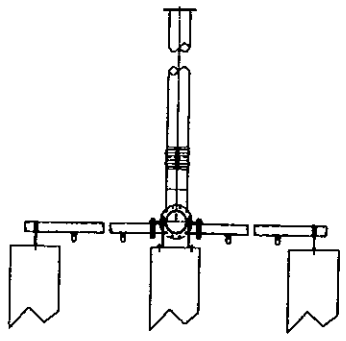


SIMPLE SUPPORT





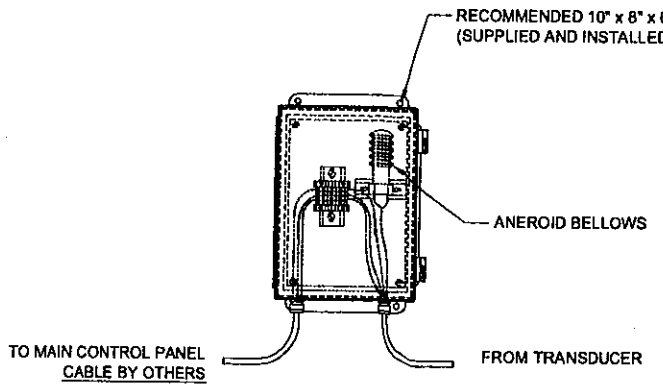
DIFFUSER DROP PIPE ELEVATION VIEW



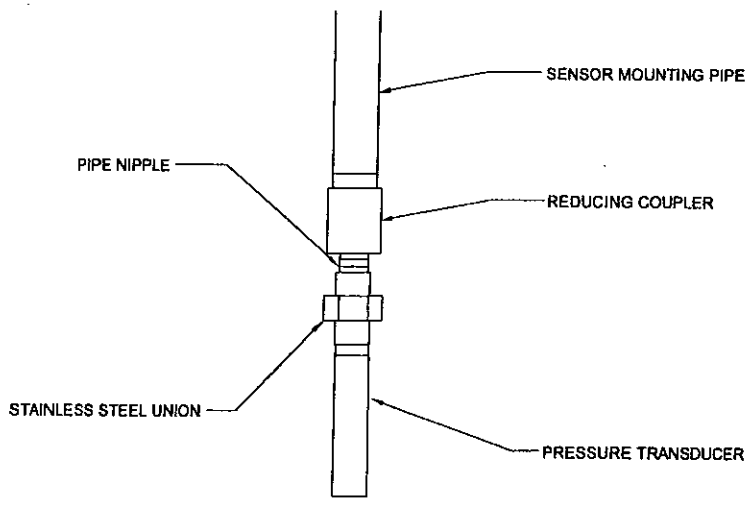
JOB NAME: FORT STEWART ARMY BASE					DO NOT SCALE DRAWING
JOB LOCATION: GA					DRN BY: SLT DATE: 5/26/2011
ENGINEERS:					CKD BY: ACT WT:
					SCALE:
					SIMILAR:
					REF:
					H/P/SIZE:
REF	ECO	DATE	BY	REVISION	TYPE:

AQUA-AEROBIC SYSTEMS, INC.
MANUFACTURERS OF WASTEWATER TREATMENT EQUIPMENT

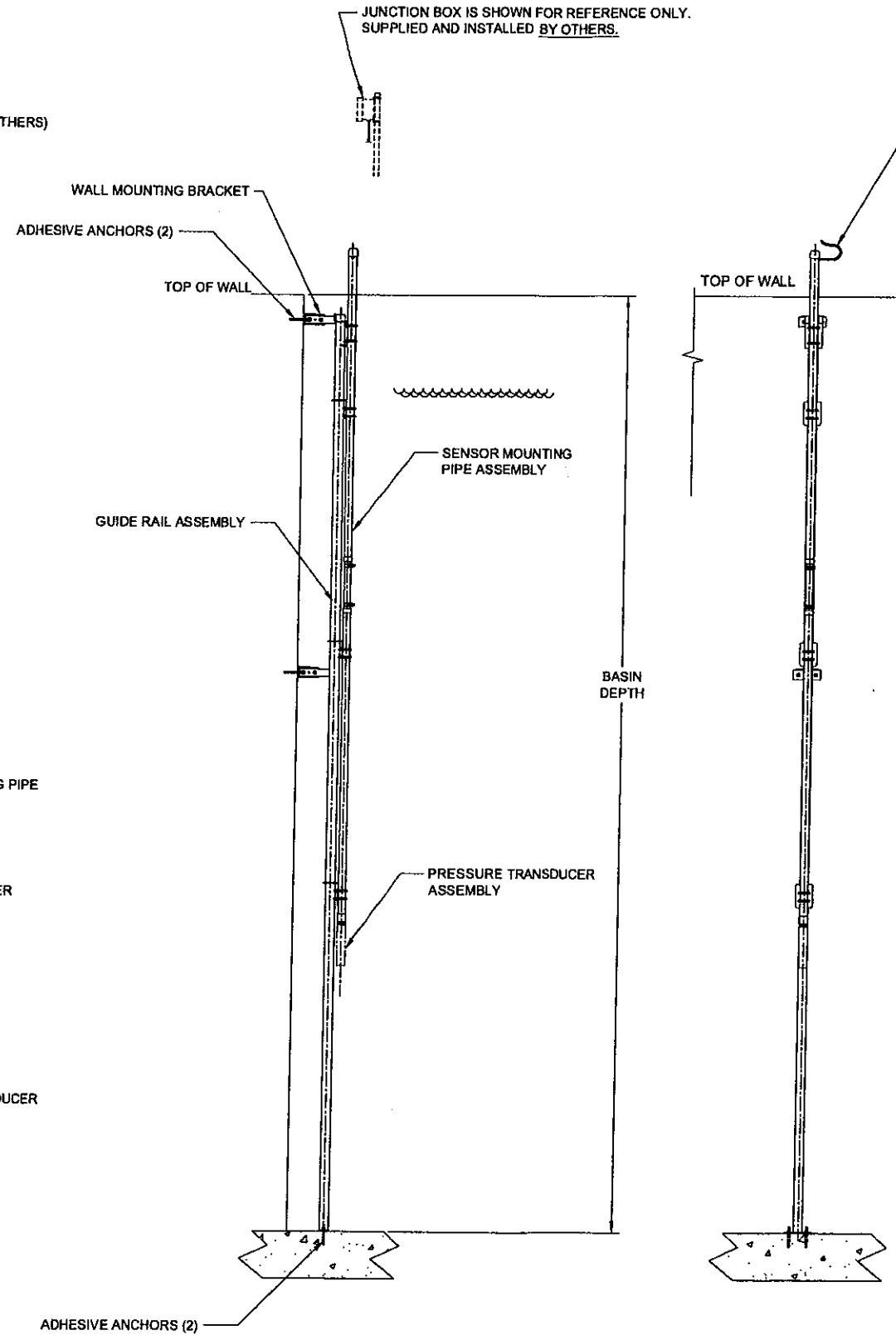
NAME: DIGESTER FIXED COARSE BUBBLE DIFFUSER DETAILS
SHEET 1 OF
DWG. NO.: 81070863010

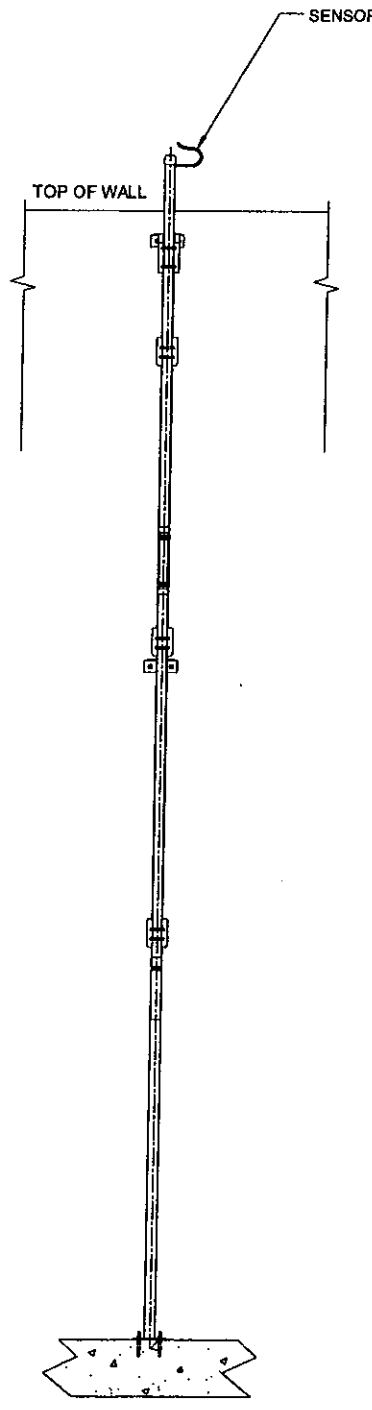


JUNCTION BOX DETAIL



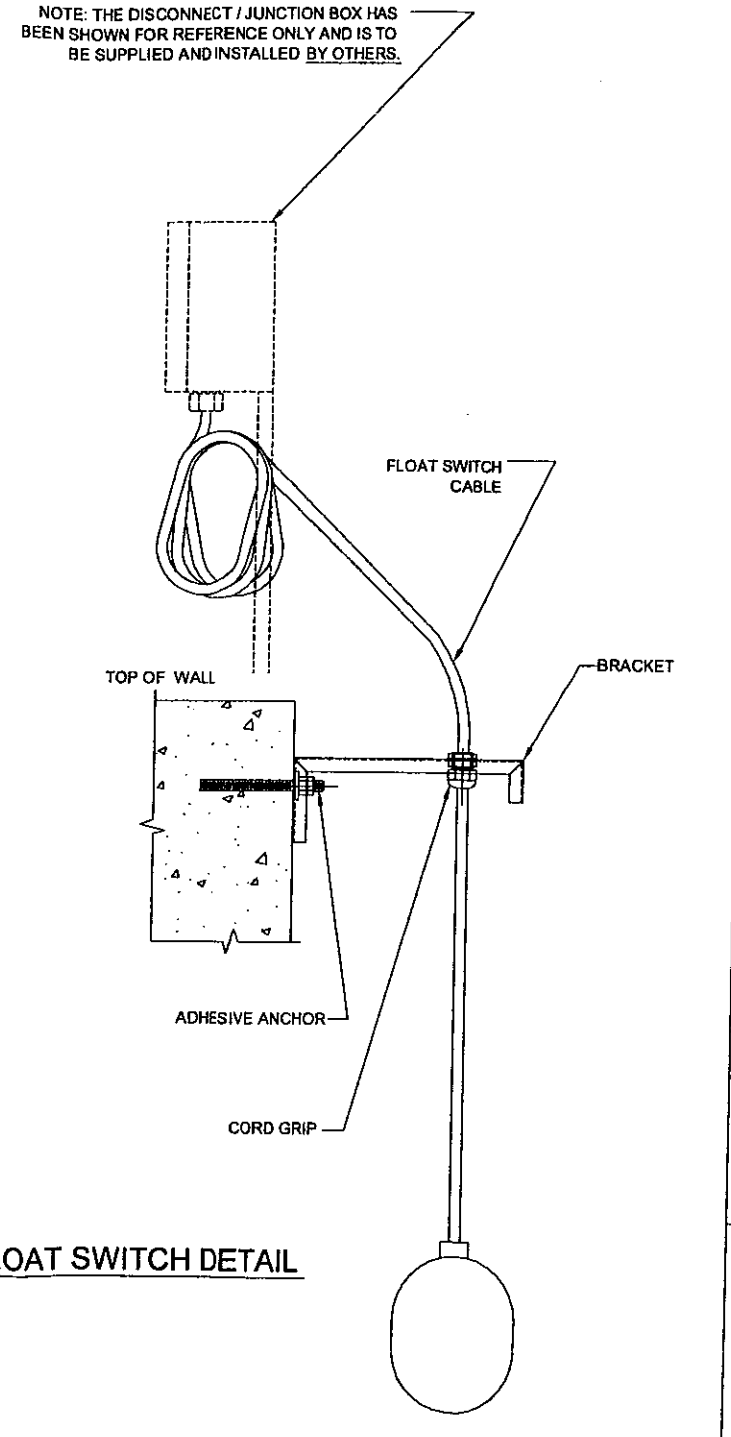
ENLARGED SENSOR ASSEMBLY





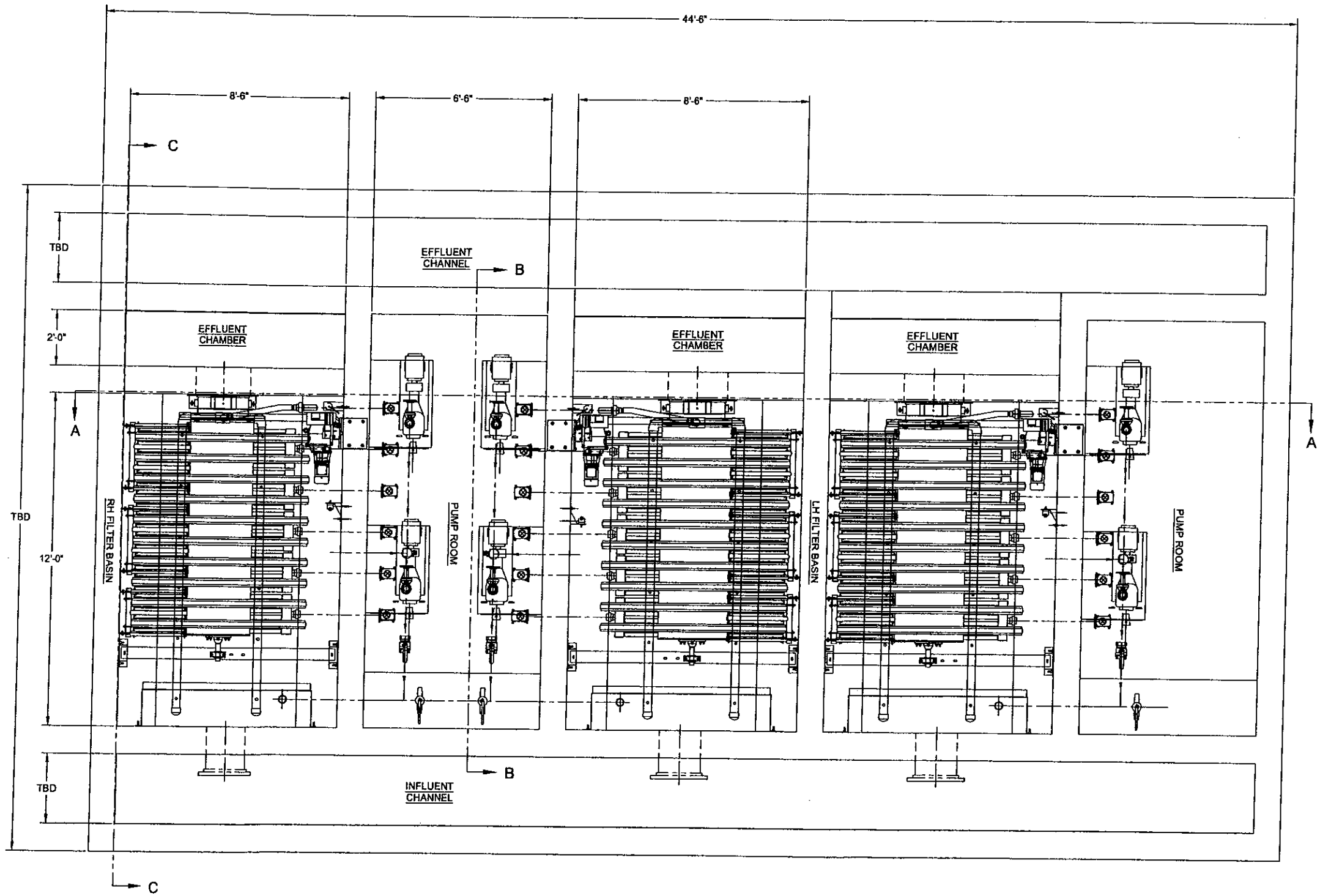
PRESSURE TRANSDUCER DETAILS

DIGESTER AND POST-EQ BASINS



FLOAT SWITCH DETAIL

JOB NAME: FORT STEWART ARMY BASE					AQUA-AEROBIC SYSTEMS, INC.
JOB LOCATION: GA					
					DO NOT SCALE DRAWING
					UNLESS OTHERWISE SPECIFIED: ONE PLACE DECIMALS ±0.1 in; TWO PLACE DECIMALS ±0.01 in; THREE PLACE DECIMALS ±0.005 in; ALL ANGLES ±1°; ANSI
					MATERIAL:
					SIMILAR TO:
					TYPE:
					DRAWN BY: SLT — DATE: 5/26/2011
					CHECKED BY: — DATE:
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	WEIGHT: — SHEET: 1 OF
DRAWING NAME: HWL FLOAT SWITCH & RETRIEVAL MOUNT PRESSURE TRANSDUCER DETAILS					DRAWING NUMBER: 81070863011 — SCALE: — SIZE: D



ITEM WEIGHTS
EFFLUENT SEAL PLATE = 217 LBS.
CENTERTUBE = 990 LBS.
INFLUENT WEIR WELDMENT = 367 LBS.
DRIVE MOTOR ASSEMBLY = 310 LBS.
DISK SEGMENT ASSEMBLY = 24 LBS.
PUMP WITH MOTOR MOUNTED ON BASE = 200 LBS.
WALL MOUNT PUMP BASE = 234 LBS.

1. DRAWING FOR REFERENCE ONLY.
   ALL WALLS ARE SHOWN AT 1'.
   ALL DIMENSIONS TO BE VERIFIED BY CUSTOMER.

2. AQUA-AEROBIC SYSTEMS PROVIDES PUMPS AND VALVES LOOSE FOR INSTALLATION BY THE INSTALLING CONTRACTOR. ALL INTERCONNECTING PIPING, WIRING, AND WALL SPOOL PIPES ARE PROVIDED BY THE INSTALLING CONTRACTOR.

3. IF FREEZING IS A CONCERN, AQUA-AEROBIC SYSTEMS RECOMMENDS THE FILTERS BE PLACED IN A HEATED BUILDING. IF A BUILDING IS NOT PROVIDED, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO, HEAT TRACING AND INSULATION OF PUMPS AND PIPING, AS WELL AS PROTECTION AGAINST INTERNAL TANK FREEZING, SHALL BE PROVIDED BY THE INSTALLING CONTRACTOR.

4. THE GRAPHIC ELEMENTS OF THIS COMPUTER GENERATED DRAWING ARE DRAWN FULL SIZE. THE DIMENSIONS ARE ASSOCIATIVE. IF THE SIZE OF THE GRAPHIC ELEMENTS IS CHANGED THE DIMENSIONS WILL NOT BE CORRECT.

5. TBD THE INFLUENT AND EFFLUENT CHANNELS TO BE SIZED BY THE INSTALLING CONTRACTOR BASED ON THE PLANT FLOW.

6. AN INFLUENT VALVE IS REQUIRED FOR ISOLATION / MAINTENCE OF EACH FILTER UNIT. INFLUENT VALVES SHALL BE PROVIDED BY OTHERS AND INSTALLED BY OTHERS.

7. WALL SPOOL PIPING SHALL BE STAINLESS STEEL. PROVIDED BY OTHERS AND INSTALLED BY OTHERS.

JOB NAME: FORT STEWART ARMY BASE
JOB LOCATION: GA

REV	ERR / ECO	DATE	BY	REVISION DESCRIPTION

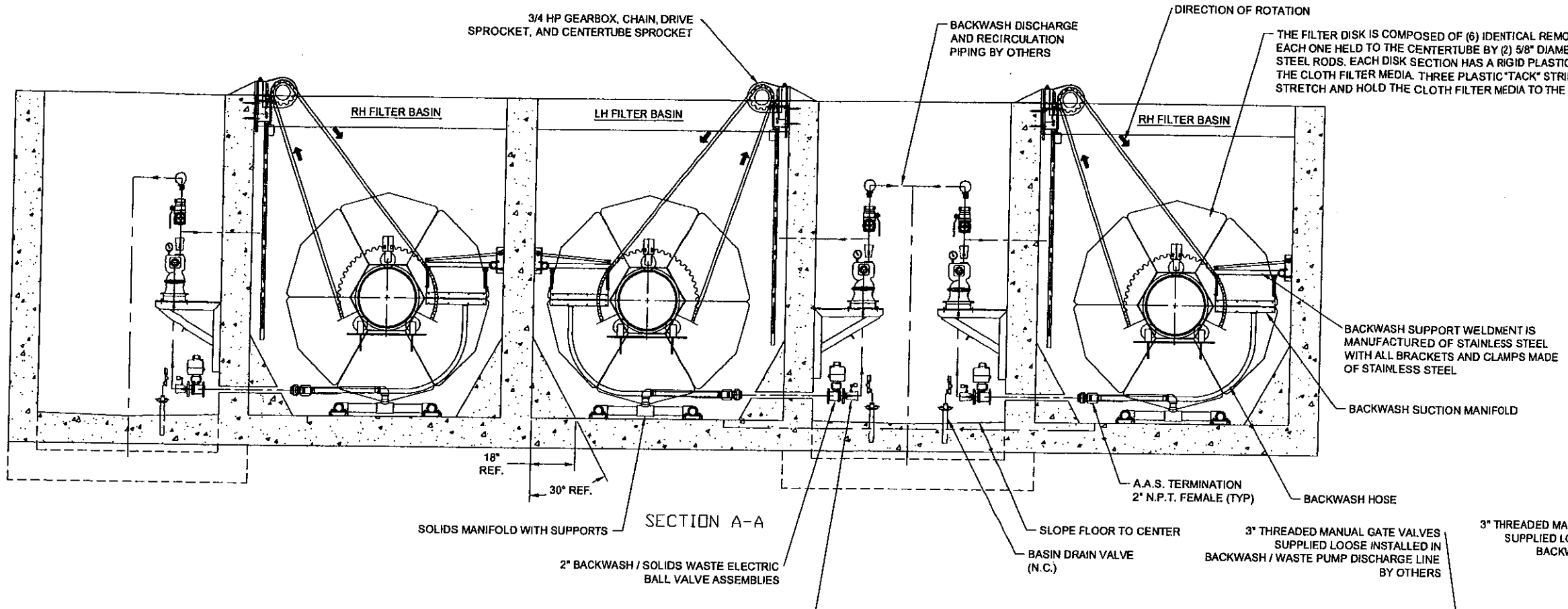
AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
ONE PLACE DECIMALS ± .1
TWO PLACE DECIMALS ± .01
THREE PLACE DECIMALS ± .005
ANGLES ± 1/2°
ANSI

MATERIAL:
SIMILAR TO:
TYPE:
DRAWN BY: SLT — DATE: 5/26/2011
CHECKED BY: — DATE:
WEIGHT: — SHEET: 1 OF

DRAWING NAME: AQUADISK FILTER MODEL ADFSC-54 X 10E-PC
DRAWING NUMBER: 81070866001
SCALE: — SIZE: D



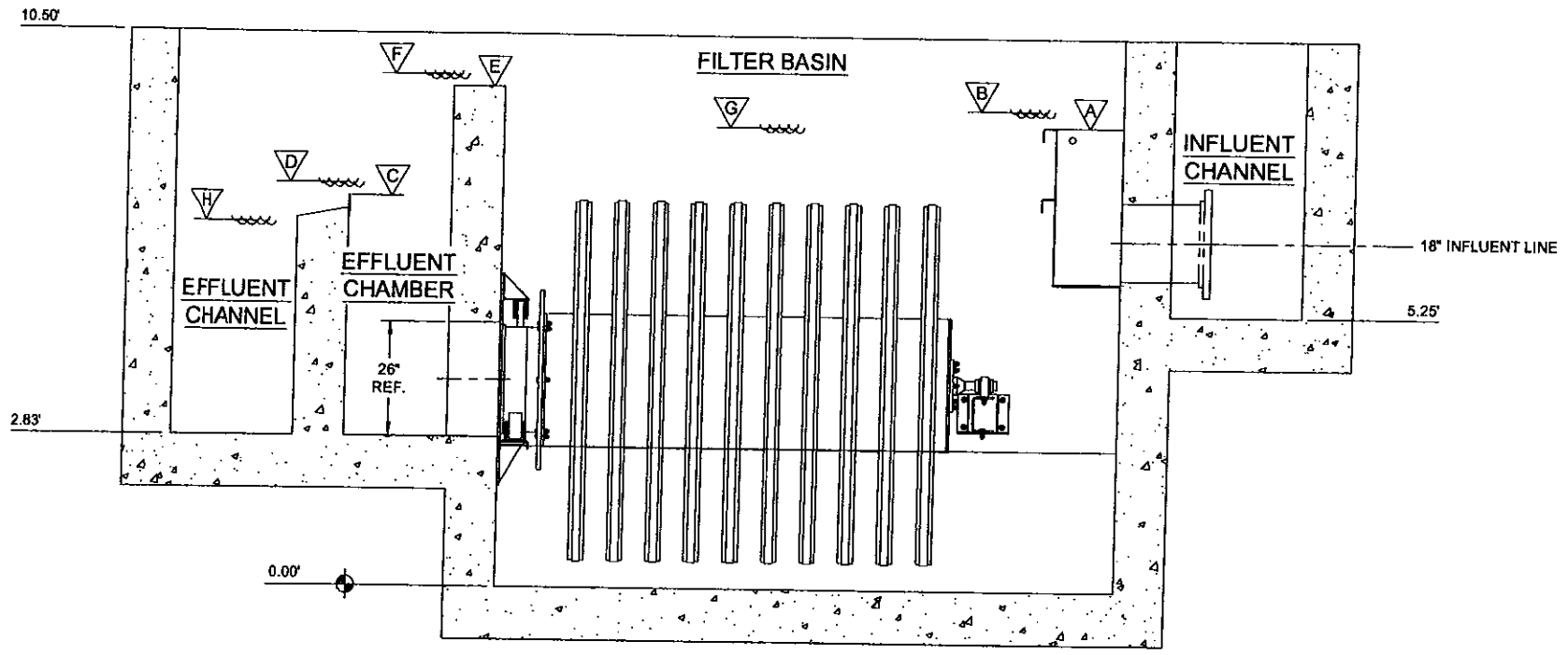
1. ALL PIPING AND FITTINGS SHALL BE PROVIDED BY OTHERS ACTUAL PIPING LAYOUT AND PUMP LOCATION TO BE DETERMINED BY OTHERS WHEN THREADED OR WELDED PIPE IS USED IN LIEU OF FLANGED PIPE, UNIONS SHALL BE USED AT EACH PUMP AND VALVE CONNECTION TO FACILITATE SERVICE.

2. 2 H.P. BACKWASH / WASTE PUMP CONNECTIONS ARE 2" N.P.T. BACKWASH / WASTE PIPING IS 3" DIAMETER. 3" TO 2" CONCENTRIC REDUCER FITTINGS SHALL BE PROVIDED AND INSTALLED BY OTHERS AT EACH PUMP PORT.

3. THE STANDARD BACKWASH / WASTE PUMP PROVIDES 23.2 FEET OF TOTAL HEAD AT A FLOW RATE OF 130 GPM. THE SUCTION SIDE PIPING REQUIRES APPROXIMATELY 11 FEET OF THIS HEAD. THIS LEAVES APPROXIMATELY 12 FEET (5 PSIG) FOR THE DISCHARGE SIDE. THE DISCHARGE DIAMETER, EQUIVALENT LENGTH, AND VERTICAL LIFT MUST RESULT IN A HEAD LOSS LESS THAN 12 FEET. INSTALLATIONS WITH MORE THAN ONE BACKWASH / WASTE PUMP MUST ACCOMODATE ALL BACKWASH / WASTE PUMPS RUNNING SIMULTANEOUSLY WITHOUT EXCEEDING 12 FEET OF DISCHARGE HEAD.

FOR INSTALLATIONS THAT REQUIRE MORE DISCHARGE HEAD, ALTERNATIVE PUMPS ARE AVAILABLE. PLEASE CONSULT AASI ENGINEERING TO VERIFY THE SUITABILITY OF THE DISCHARGE PIPING OR FOR SPECIAL PUMP REQUIREMENTS.

JOB NAME: FORT STEWART ARMY BASE					AQUA-AEROBIC SYSTEMS, INC.
JOB LOCATION: GA					
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	DO NOT SCALE DRAWING — UNLESS OTHERWISE SPECIFIED
					MATERIAL:
					SIMILAR TO:
					TYPE:
					DRAWN BY: SLT — DATE: 5/26/2011
					CHECKED BY: — DATE:
					WEIGHT: — SHEET 1 OF
DRAWING NAME: AQUADISK FILTER MODEL ADFSC-54 X 10E-PC					DRAWING NUMBER: 81070866002 — SCALE — SIZE: D



HYDRAULIC PROFILE
BASED UPON AVERAGE FLOW RATE OF 3.25 GPM PER SQUARE FOOT (2.5 MGD)
BASED UPON MAXIMUM FLOW RATE OF 6.5 GPM PER SQUARE FOOT (5.0 MGD)

WEIR LENGTHS
INFLUENT = 6.58'
EFFLUENT = 8.50'
OVERFLOW = 8.50'

ELEVATION

A	8.82'	INFLUENT WEIR ELEVATION
B	9.14'	NAPPE OVER INFLUENT WEIR AVERAGE FLOW
	9.32'	NAPPE OVER INFLUENT WEIR MAXIMUM FLOW
C	7.41'	EFFLUENT WEIR ELEVATION
D	7.67'	NAPPE OVER EFFLUENT WEIR AVERAGE FLOW
	7.83'	NAPPE OVER EFFLUENT WEIR MAXIMUM FLOW
E	9.50'	OVERFLOW WEIR ELEVATION
F	9.76'	NAPPE OVER OVERFLOW WEIR AVERAGE FLOW
	9.92'	NAPPE OVER OVERFLOW WEIR MAXIMUM FLOW
G	8.78'	BACKWASH START LEVEL
H	6.91'	MAXIMUM AVAILABLE LIQUID LEVEL FOR EFFLUENT CONVEYANCE

JOB NAME: FORT STEWART ARMY BASE
JOB LOCATION: GA

AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED
FRACT DIMS. DECIMAL DIMS. ANGLES
ALL TWO PLACE DECIMALS ±.01 ±.005 ±.5°
ALL THREE PLACE DECIMALS ±.005 ±.003 ±.5°
ALL ANGLES ±.5° ±.25° ±.5°
ANSI

MATERIAL:
SIMILAR TO
TYPE:
DRAWN BY: SLT DATE: 5/26/2011
CHECKED BY: DATE:
WEIGHT: SHEET: 1 OF

REV	ECR / ECO	DATE	BY	REVISION DESCRIPTION

DRAWING NAME: AQUADISK FILTER MODEL ADFSC-54 X 10E-PC
DRAWING NUMBER: 81070866003
SCALE: SIZE: D

CUMMINS STANDBY GENERATOR

Our energy working for you.™

Power Generation

Quotation

CUMMINS POWER SOUTH LLC
Cummins Power South
5534 Augusta Road
Savannah GA 31408 United States
Direct: 912-721-3028

September 4, 2014

Project Name: Hinesville WWTP #2

Quotation: 1667000000478937

Thank you for your inquiry. We are pleased to quote as follows:

USD

Item	Description	Qty
	Diesel Genset: 60Hz-1500/1350kW	
Install-US-Stat	U.S. EPA, Stationary Emergency Application	1
1500DQGAB	Genset-Diesel,60Hz,1500kW	1
A331-2	Duty Rating-Standby Power	1
L090-2	Listing-UL 2200	1
L225-2	OSHPD Seismic Certification	1
L224-2	IBC Seismic Certification	1
L170-2	EmissionCert,EPA,Tier 2,NSPS CI Stationary Emergency	1
R002-2	Voltage-277/480,3 Phase,Wye,4 Wire	1
B601-2	Alternator-60Hz,3Ph,480V,80C-S	1
H611-2	SetCntl-PCC,Basic,NoAlpha/AnalgDisp	1
H613-2	Paralleling-IsolatedBus,Automatic	1
H536-2	Display Language-English	1
H605-2	Display-Control,Graphical	1
KP60-2	Interface-CommunicationsNtwk,FTT-10	1
KA08-2	Alarm-Audible, Engine Shutdown	1
H606-2	Meters-AC Output,Analog	1
K911-2	Shutdown Alarm Relay-3PDT	1
H608-2	Control Mounting-Right Facing	1
A292-2	Heater-Alternator, 120 Volt AC	1
KP80-2	Circuit Breaker Or Entrance Box-Right Side Only	1
KP82-2	CB-2500A,3P,600/690V,UL/IEC,ServEnt,100%UL,Right	1
H668-2	Indication-Ground Fault, 4-Pole XfrSw&Ckt Brkr, RS	1
KR02-2	Circuit Breaker Lugs-Mechanical, Right Side	1

Grand Total **$312,135.64**

Note
No fuel or tax include in price
Shipped to site included, no off load
Lead time is 13 weeks, lead times change from day to day
Generator Enclosure to look as close as possible to existing unit
Price is good for 90 days

Submitted by

John Carper , Power Generation Sales
john.carper@cummins.com
Mobile: 912-210-3383
Fax: 912-232-5145

ENDURO ODOR CONTROL SYSTEM

enduro

WATER & WASTEWATER PRODUCTS

Exhibit "A"

PROPOSAL #14-107-0

PROJECT:	Hinesville/Fort Stewart WWTP -H2S Odor Control Equipment
LOCATION:	Hinesville, GA
BID DATE:	June 17th, 2014
SPEC SECTION:	15281 Hydrogen sulfide odor control

Enduro is a leading company in the supply of odor control equipment. We supply a full line of adsorbers, wet scrubbers, and biofilters along with accessories such as fans, complete FRP ductwork packages, controls and enclosures.
We are happy to offer the following:

1. **Scope of Supply:**
    a. One (1) 550CFM Packaged, skid-mounted multi-stage system, including
        i. Pultruded FRP multi-chamber vessel
            1. ¼" thick wall
            2. FRP internal support structure
            3. 316SS hardware
            4. Internal media supports
            5. Two (2) 20" x 22" access hatches
            6. 6" round inlet connection
        ii. Pultruded FRP unifying skid
            1. Designed to support the entire weight of the system
            2. Includes four (4) SS hold-down bars for installation on-site by others.
        iii. First Stage Biological media
            1. BioScrub-XL by Enduro Composites
            2. Inert, inorganic long-life media
            3. Factory installed
        iv. Second Stage Activated Carbon Media
            1. OdorSorb-Max media by Enduro Composites
            2. 4MM pellet, coal based
            3. 0.2 H2S capacity
            4. Factory installed
        v. One (1) Direct-Drive Cast-Aluminum Fan
            1. 550CFM @ 5" wc
            2. Flanged inlet/flanged outlet
            3. Mounted directly to vessel outlet connection
            4. 1.0HP TEFC motor 115/1/60VAC, 3600RPM
            5. Exhaust silencer included
            6. Factory installed

P 281.921.9002 | F 281.921.9100 | T 888.550.4784 | E wwpsales@endurocomposites.com
8130 McHard Rd. | Houston, TX 77053

www.endurocomposites.com

vi. One (1) Electrical Control panel
    1. NEMA4X cabinet
    2. 115/1/60VAC design
    3. Includes fan motor and pump motor starters
    4. 115V Duplex plug
    5. All required water irrigation controls/timers
    6. Door mounted on/off motor controls
    7. Factory mounted and wired
vii. One (1) Water Control Panel
    1. NEMA4X cabinet
    2. All required water controls, valves, and instrumentation.
    3. Factory plumbed and mounted
    4. ¾" garden hose connection included for customer water source
viii. One (1) Nutrient Addition System
ix. One (1) Water Irrigation, Recirculation system, including:
    1. SCH80 PVC spray piping, spray nozzles
    2. Recirculation pump, with 1/3HP 115/1/60VAC TEFC motor
    3. Factory installed & leak tested
x. EPDM gaskets
xi. 316SS SS hardware
xii. One (1) Lot Instrumentation:
    1. One (1) media temperature indicator (1st stage only)
    2. Two (2) 0-6" DP gauges
    3. All local read
    4. Factory installed

2. **Manufacturers' Services:**
    a. Start-up, Commissioning & Training Services
        i. One (1) trip, Two (2) eight-hour days on-site
    b. Performance Testing:
        i. Shall be performed ONLY after sufficienttime for acclimation of the biomass to form/colonize in the 1st (biological) stage – typically after 4-6 weeks of operating.

3. **Clarifications/Exceptions:**
    a. Certificate of Insurance will be provided upon receipt of PO.
    b. Original copy of Bid Bond is being sent directly to Hinesville Authority as well. (Tracking information included with bid package)

4. **Manufacturer Warranty:**
    a. Equipment warranted for 12 months after start-up, or 18 months after delivery (whichever comes first)

b. Biological filter media shall be warranted against structural defects for a period of ten (10) years from substantial completion.

5. **Design Parameters:**
   a. 550CFM (max)
   b. Process air temp – 50-100F
   c. >99% removal of 30ppm average inlet H2S
   d. >95% total odor removal, or 150 D/T (whichever is greater)

6. **Not Included in this proposal:**
   a. Taxes, Permits, Duties, or Performance/Payment Bonds
   b. Off-loading, storage, or placement of equipment
   c. Supports, anchors, saddles, or hangers
   d. Concrete slab
   e. Utilities to/from the system
   f. Ductwork to/from the system
   g. HVAC testing or balancing
   h. Class 1, Div 1 wiring or classification
   i. TEXP fan motor & pump motor
   j. Winterization

7. **Terms:**
   a. FOB Jobsite. Freight is included.
   b. Pricing valid for 90 days.
   c. Payment terms:
      i. 10% @ delivery of submittals
      ii. 80% @ shipment of equipment
      iii. 10% @ 30 days after delivery
      iv. All payments Net 30 days.
   d. Proposal per Enduro Composites' standard terms & conditions

8. **Schedule:**
   a. Submittals – 2-3 weeks after execution of contract
   b. Equipment delivery – 7-9 weeks after receipt of approved submittals

9. **Price (USD): $43,975.00**

We look forward to working with you and hope this proposal meets with your satisfaction.

Joe Getz
Regional Sales Manager – Water & Wastewater Products
Phone: 610-792-4744
Email: jgetz@endurocomposites.com

FLUIDYNE CORP.
GRIT REMOVAL SYSTEM

FLUIDYNE
CORPORATION
5436 Nordic Drive, Suite D Cedar Falls, IA 50613
Phone: (319) 266-9967 Fax: (319) 277-6034
http://www.fluidynecorp.com

Exhibit "A"

PROPOSAL

FLUIDYNE CORPORATION (HEREINAFTER CALLED THE COMPANY) AGREES TO SELL TO THE PURCHASER AND THE PURCHASER AGREES TO BUY AND ACCEPT FROM THE COMPANY, THE ITEM (S) DESCRIBED HEREIN.

PROJECT:	**Hinesville/Ft. Stewart WWTP Upgrade** **City of Hinesville, Georgia** **Fluidyne Grit Removal Equipment**
PROPOSAL NO.:	SWT 061614
DATE WRITTEN:	June 16, 2014
BID DATE:	June 17, 2014
SECTION:	15520 – Grit Separation
FOR:	The City of Hinesvile, Georgia & P.C Simonton & Associates, Inc. Mr. Paul Simonton, PE
WRITTEN BY:	Erick Mandt Fluidyne Corporation Cedar Falls, Iowa

Representation and Coordination by
Southern Water Technologies
4343 Shallowford Rd.
Building H, Ste 2
Marietta, GA 30062
770-993-4392

FLUIDYNE CORPORATION
5436 Nordic Drive, Suite D
Cedar Falls, IA 50613

Proposal No.: SWT 061614
Project: Hinesville, GA
Date: June 16, 2014

Fluidyne Corporation is pleased to provide our proposal for the supply of our Hydro-Grit ™ - grit removal system for the Hinesville, Georgia WWTP. We have based our proposal on the following design data:

Design Flow:	7.15 MGD
Peak Flow:	14 MGD

Fluidyne is providing two units each designed for the above design and peak flow rate. Fluidyne proposes our standard efficiency Hydro-Grit ™ with concrete chamber supplied by others. With this option we supply the internal components to be placed inside the concrete tank on a stainless steel support bridge.

Fluidyne Corporation is pleased to offer the following equipment for your consideration on the above referenced project:

Two (2) Fluidyne FHG-14 Hydro-Grit ™ including AirCirc™ -circulating jet nozzle assembly, air/liquid separator, air vent, grit airlift piping and internal stainless steel bridgework. The concrete tank is to be done by others.

Two (2) 3 HP Regeneration Blower to provide air for the AirCirc™ operation. Blower package includes in inlet filter/silencer, check valve, pressure gauage and pressure relief valve. Blower discharge piping to be 2" diameter. All blower piping and supports from the discharge to the 2" air connection point at the Fluidyne FHG-14 Hydro-grit is by others.

Two (2) 3 HP Positive Displacement Blower Package with inlet filter, silencer, v-belt drive, discharge silencer, check valve, pressure relief valve, pressure gauge and isolation valve to provide air for the grit airlift function. Blower discharge piping to be 2" diameter. All blower piping and supports from the discharge to the 2" air connection point at the Fluidyne FHG-14 Hydro-grit is by others.

Two (2) 1" diameter Solenoid Valve for fluidizing grit.

Four (4) 1" diameter manual ball valve for fluidizing line isolation.

One (1) Lot 4" diameter grit slurring piping and supports from the grit separator to the spiral sand separation unit.

Two (2) Grit Screw Classifier, stainless steel construction. 1 HP TEFC motor, 12" diameter screw, storage hopper, overflow weir, drain and support legs

FLUIDYNE CORPORATION
5436 Nordic Drive, Suite D
Cedar Falls, IA 50613

Proposal No.: SWT 061614
Project: Hinesville, GA
Date: June 16, 2014

Two (2) Fluidyne Control Panel, Nema 4X, including selector switches, indicating lights, timers and starter for the grit screw classifier, grit airlift and regenerative blower functions. Each control panel to control one Hydro-grit and one grit screw classifier. **Each of the panels requires 460/3/60 – 25 amp incoming power.**

CLARIFICATIONS:

We have included all internal Hydro-grit vortex chamber components to be fabricated out of 304 stainless steel in lieu of FRP. This include the AirCirc assembly, supporting bridgework, airlift assembly and grit piping between the grit vortex chamber and the grit classifier.

We are providing a grit dewatering classifier to the same general specifications and materials as the last two projects we have completed with P.C. Simonton. The grit classifier as specified is outdated. The proposed grit classifier has a 12" diameter shafted grit screw that is nominally 16' long. The motor will be 1 HP.

We have included two (2) NEMA 4X control panels. Each control panel will control one grit vortex separator and one (1) grit dewatering classifier. We have included an emergency stop in each of the control panels

Components of the above proposed equipment will be individually factory assembled and shop inspected to insure the equipment is properly manufactured. It is not possible or feasible to test the entire system for proper operation.

The regenerative blower has a 3.5 HP motor and the positive displacement blower has a 3 HP motor.

Fluidyne has included a 1" grit fluidizing control solenoid valve with manual isolation valves to control grit fluidizing to the bottom of the grit chamber. The contractor will need to provide a 1" fluidizing line to the base of the grit chamber and install these valves. The fluidizing line shluld provide approximately 8 to 10 gpm at 25 psi. Any pressure regulators would also need to be provided by the installing contractor

Fluidyne has included installation inspection in the amount of two (2) days provided in one trip. Additional installation supervision would need to be billed at our service rates. See the details below in the service section of our proposal.

FLUIDYNE CORPORATION
5436 Nordic Drive, Suite D
Cedar Falls, IA 50613

Proposal No.: SWT 061614
Project: Hinesville, GA
Date: June 16, 2014

PRICE: Total lot sum price for the above items is **$208,450.00** FOB-Factory with freight allowed to the jobsite.

SERVICE: Service for the purpose of installation inspection, start up and operator training is included in the amount of four (4) mandays at the jobsite to be made two (2) trips. Travel and living expenses are included. This service is based on a work day of eight hours during the normal work week.

EXCLUSIONS: Not furnished by Fluidyne are the following: concrete tanks; Any pipe and supports; fittings or valves except those specifically included above; grit fluidizing water supply line external to the basin, water supply; anchors bolts and interfacing flange hardware and gaskets; concrete work including grit chamber and blower foundation pads; out of basin blower piping and supports between blower and grit chamber; installation labor; off-loading of equipment; jobsite storage; insurance and other items not specifically mentioned in the body of the proposal.

SHIPMENT: The price quoted is based on a target shipment date of 12 to 14 weeks after receipt of approved shop drawings.

TAXES: Any applicable duties or sales, use, excise or similar taxes are not included in the quoted price.

TERMS: Warranties shall apply only when payments are made in full and according to the following schedule:

Net 30 Days from the Date of invoice

DURATION: This proposal shall remain in effect for 60 days after bid date unless changed in the interim upon written notice.

GORMAN RUPP
IN PLANT PUMP STATION
EQUIPMENT

Specification Data	Basic Pedestal	Sec. 50	PAGE 2525 APRIL 2011

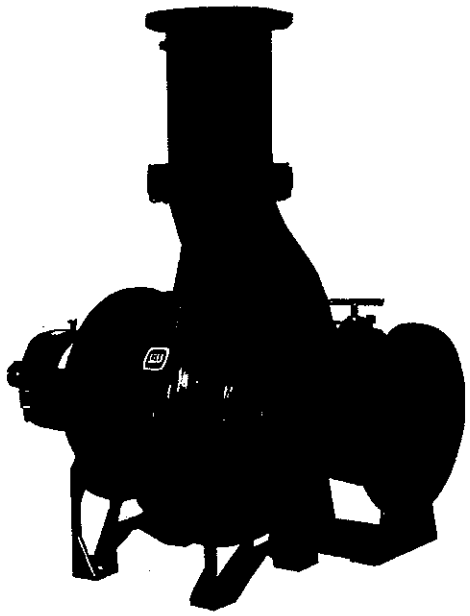
ACE GORMAN-RUPP PUMPS

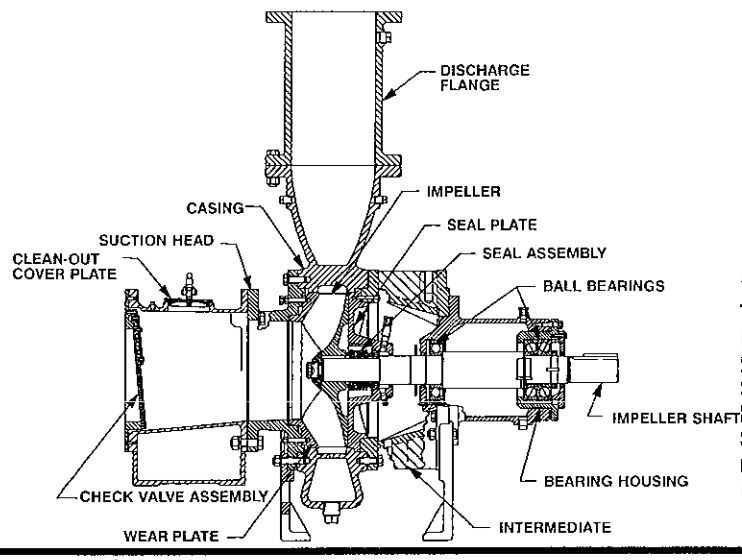
Self Priming Centrifugal Pump

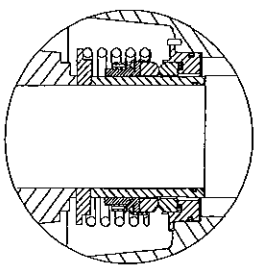
Model 112C60-B

Size 12" x 10"

PUMP SPECIFICATIONS
Size: 12" x 10" (305 mm x 254 mm) Flanged.
Casing: Gray Iron 30.
Maximum Operating Pressure 99 psi (683 kPa).*
Semi-Open Type, Four Vane Impeller: Ductile Iron 80-60-03.
Handles 2-3/4" (69,9 mm) Diameter Spherical Solids.
Impeller Shaft: Alloy Steel 4150.
Replaceable Wear Plate: Ductile Iron 80-60-03.
Removable Clean-Out Cover Plate: Gray Iron 30; 3 lbs. (1,4 kg).
Bearing Housing: Gray Iron 30.
Intermediate Bracket: Gray Iron 30.
Suction Head: Gray Iron 30.
Pedestal Body: Gray Iron 30.
Seal Plate: Gray Iron 30.
Shaft Sleeve: Stainless Steel 304.
Flap Valve: Neoprene w/Steel Reinforcement.
Flap Valve Seat: Gray Iron 30.
Radial Bearing: Open Single Row Ball.
Thrust Bearings: Two, Open Single Row Ball.
Bearing and Seal Cavity Lubrication: SAE 30 Non-Detergent Oil.
Discharge Spool Flange: Gray Iron 30.
Gaskets: Vegetable Fiber, Resistant Synthetic Rubber and Cork.
O-Rings: Buna-N.
Hardware: Standard Plated Steel.
Bearing and Seal Cavity Bottle Oilers.
Strainer.
Optional Equipment: CD4MCu Stainless Steel Impeller and Wear Plate. G-R Hard Iron Impeller and Wear Plate. High Pump Temperature Shutdown Kit.
**Consult Factory for Applications Exceeding Maximum Pressure and/or Temperature Indicated.*







SEAL DETAIL

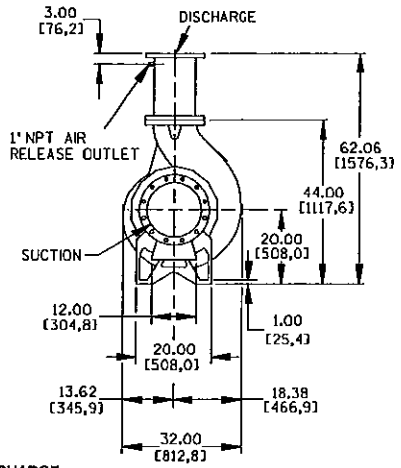
Type 2, Mechanical, Oil-Lubricated, Double Floating, Self-Aligning. Silicon Carbide Rotating and Stationary Faces. Stainless Steel 316 Stationary Seat. Fluorocarbon Elastomers (DuPont Viton® or Equivalent). Stainless Steel 18-8 Cage and Spring. Maximum Temperature Pumped is 160°F (71°C).*

GORMAN-RUPP PUMPS

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA
www.grpumps.com
Specifications Subject to Change Without Notice
Printed in U.S.A.

Specification Data	APPROXIMATE DIMENSIONS and WEIGHTS	NET WEIGHT: 2175 LBS. (987 KG.)
SECTION 50, PAGE 2525		SHIPPING WEIGHT: 2300 LBS. (1043 KG.)
		EXPORT CRATE SIZE: 96 CU. FT. (2,7 CU. M.)

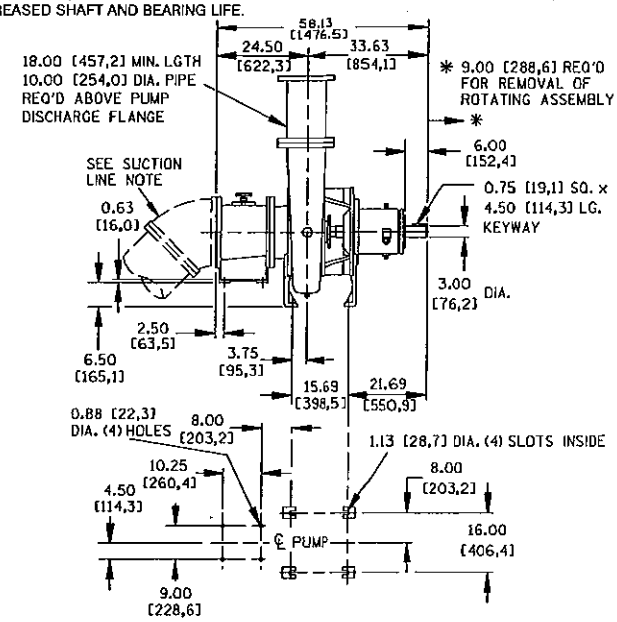
SUCTION:
BOTTOM 1" (25,4mm) DIAMETER SIX HOLES DRILLED THRU. TOP 0.88-9 UNC-3 SIX HOLES TAPPED TO DEPTH AS FOLLOWS: TWO HOLES LOCATED 45° FROM CENTER ARE TAPPED 1.94 (49,2mm) DEEP. REMAINING FOUR HOLES TAPPED THRU. ALL HOLES LOCATED ON 17" (431,8mm) B.C.



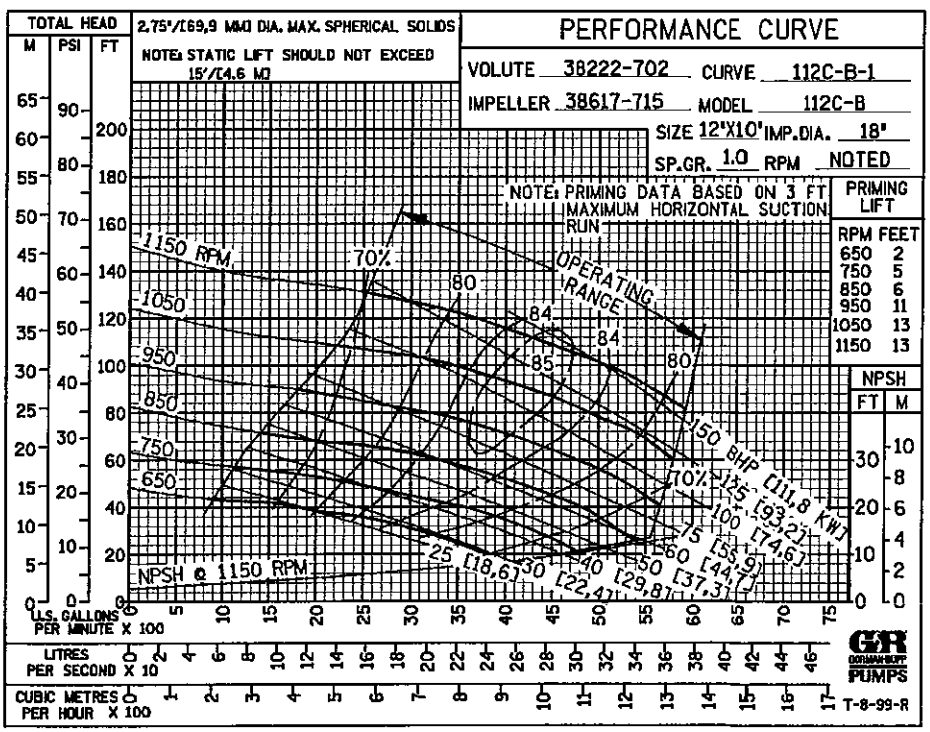
DISCHARGE:
125# ANSI 10" (254mm) FLANGE 16" (406,4mm) O.D. TWELVE HOLES 1" (24,4mm) DIA. ON 14.25" (362mm) B.C.

DIMENSIONS:
INCHES
[MILLIMETERS]

SUCTION LINE NOTE:
FOR SELF PRIMING APPLICATION AVOID HORIZONTAL SUCTION LINES. IF USED, MAXIMUM ACCEPTABLE RUN IS 6' (1,83m). PREFERRED INSTALLATION WOULD ANGLE SUCTION LINE DOWNWARD WITH 45° ELBOW AS SHOWN. LONG HORIZONTAL SUCTION LINES REDUCE EFFICIENCY BY CREATING INCREASED PRIMING TIME, INCREASED OPERATIONAL TIME IN PARTIAL PRIME CONDITION, SURGING, AND DECREASED SHAFT AND BEARING LIFE.



60 HERTZ



GORMAN-RUPP PUMPS

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA

PERFORMANCE CURVE

VOLUTE 38222-702 CURVE 112C-B-1

IMPELLER 38617-715 MODEL 112C-B

SIZE 12"X10" IMP.DIA. 18"

SP.GR. 1.0 RPM NOTED

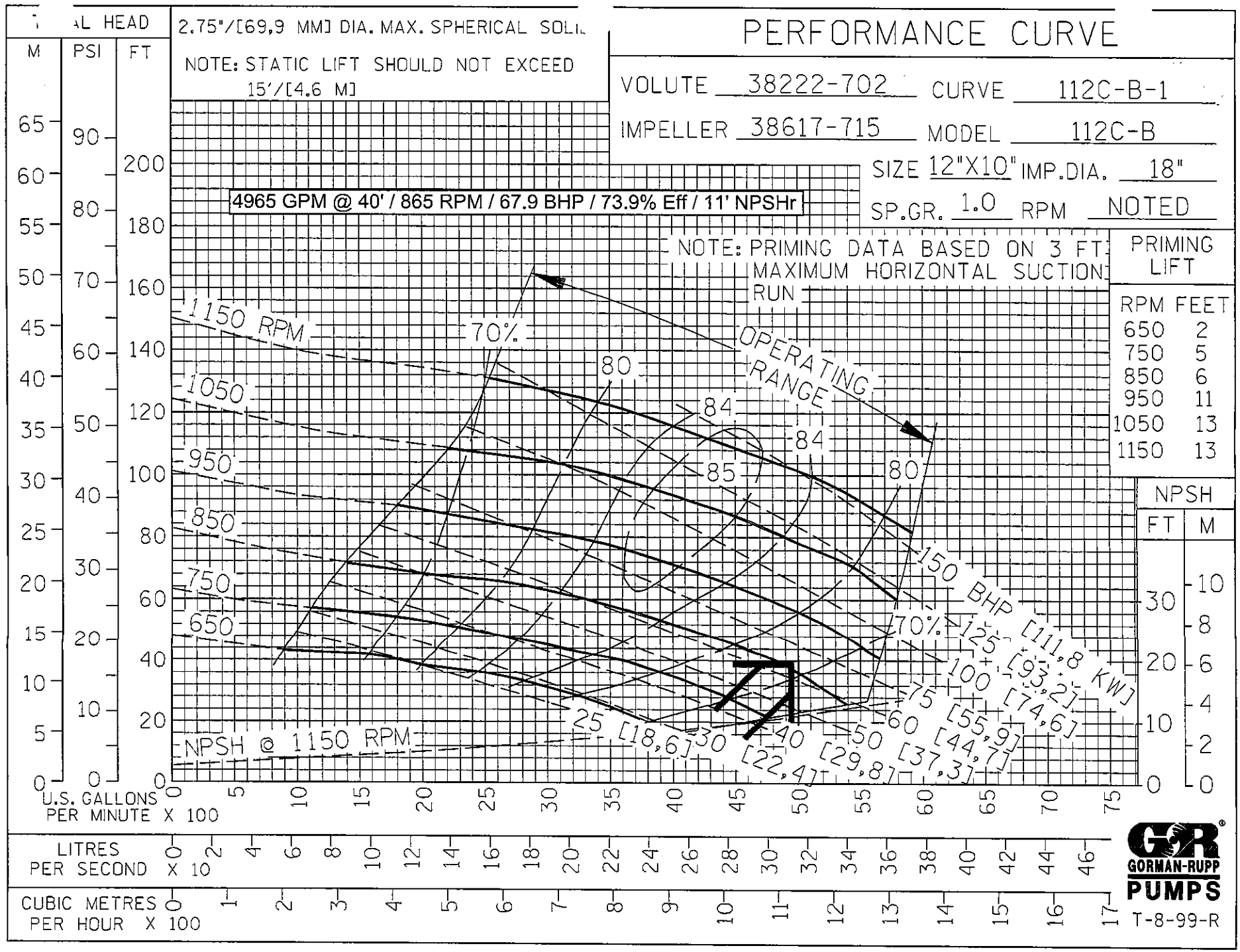
2.75"/[69,9 MM] DIA. MAX. SPHERICAL SOLI

NOTE: STATIC LIFT SHOULD NOT EXCEED 15'/[4.6 M]

4965 GPM @ 40' / 865 RPM / 67.9 BHP / 73.9% Eff / 11' NPSHr

NOTE: PRIMING DATA BASED ON 3 FT MAXIMUM HORIZONTAL SUCTION RUN

PRIMING LIFT	
RPM	FEET
650	2
750	5
850	6
950	11
1050	13
1150	13



GORMAN-RUPP PUMPS

T-8-99-R

FILE NO. 112cb.s01

PARKSON
INFLUENT SCREEN
(ONE INCLUDED, TWO WILL BE SUPPLIED)

Parkson
Treating Water Right

Quotation

NUMBER: B02010629

DATE: June 13, 2014

TO: City of Hinesville
c/o P. C. Simonton & Associates, Inc.
309 North Main Street
Hinesville, GA 31313

Attn: Mr. Paul Simonton, P. E.

REF.: Hinesville/Fort Stewart WWTP Modification
Equipment Purchase
Specification Section 15530-
Auotmatic Self-Cleaning Filter Screen Equipment

Parkson Corporation is pleased to provide this quotation for the following:

ITEM 1 One (1) Aqua Guard® self-cleaning bar/filter screen model AG-MN-A

1.A Equipment Description:

1. Unit shall be 3'-0" wide (W) and designed for installation in a channel 4'-4" deep (H). Solids larger than 6 mm nominal screen opening shall be removed from the flow and conveyed to a discharge point 4'-4" above the top of the channel. When installed, the screen shall be inclined 75° from the horizontal and have a total discharge height (H1) of 9'-0" (as measured from the base of the screen to the discharge point). There will be a 3.5" recess in the bottom of the channel.
2. Unit shall be capable of passing a peak flow of 8 MGD. The head loss across the screen at this flow will be 9" assuming a downstream water level of 2.4'. The head loss calculation is based on assumption of a clean screen, clean water and **steady state flow.**
3. Materials of construction will be as follows:
   Frame: Type 316 stainless steel, 3/16" thick.
   Filter elements: High impact plastic.
   Side plates: High impact plastic.
   Shafts, chain links, guide rails, drive sprocket inserts: Type 316 stainless steel.
   Rollers: 400 series stainless steel (heat treated).
   Chain bushings: 400 series stainless steel (heat treated).
   Side seals: Neoprene rubber, with type 316 stainless steel backing plates.
   Anchor bolts: Type 316 stainless steel.
4. Motor to be 1/2 HP, 230/460V, 3 Ø, 60 Hz.
5. Electrical overload device consisting of an SSAC current monitor.
6. Manifold lubrication system.
7. Covers fabricated of 14 gauge type 316 stainless steel, to enclose the portion of the screen above the channel.
8. Discharge chute fabricated of 14 gauge type 316 stainless steel, to direct screenings into the screenings compactor unit.
9. E-stop pushbutton in a NEMA 4X enclosure.
10. Main control panel furnished in a NEMA 4X type 316 stainless steel enclosure, housing controls for the screen and compactor units. To include programmable relay, motor starter, control transformer, main disconnect, float switch, and all other necessary switches, lights, and pushbuttons.

11. Spare parts consisting of twenty (20) filter elements, ten (10) side plates, twenty (20) 3/4" diameter snap rings, ten (10) 63/64" diameter snap rings, and one (1) rotating brush core replacement assembly.
12. The Aqua Guard® screen shall be factory assembled and tested, and shall be shipped to job site fully assembled (motor/reducer assembly may be removed and crated separately for shipment).

One (1) Rotopress screenings compactor model RP-200

1.B Equipment Description:

1. Unit shall have overall dimensions of approximately 1.75' H by 3.5' L by 2.5' W. Approximate weight is 550 pounds.
2. Unit shall be capable of handling 35 cu. ft/hour of screenings.
3. Unit shall have the following connection sizes:
   Feed: 16" x 9" (approx.) (flanged)
   Filtrate outlet: 3" diameter (approx.)
   Trash outlet: 10" diameter (approx.)
4. Materials of construction shall be as follows:
   Press housing: Type 316 stainless steel.
   Shaft/screw: Type 316 stainless steel.
   Splash guard: Type 316 stainless steel.
   Spray bar: Type 316 stainless steel.
   Front and rear drip pan: 316 stainless steel.
5. Drive unit shall be a helical - worm gear reducer 78.91:1 ratio, hollow shaft with a shrink disc. The unit shall be driven by a 2 HP motor, 230/460V, 3 Ø, 60 Hz.
6. Brass body solenoid valve for water spray connection. Solenoid valve will be rated NEMA 4X and will have a 3/4" NPT connection.
7. Inlet chute of 12 gauge type 316 stainless steel, to receive screenings from the mechanical screen.
8. Discharge piping fabricated of Schedule 10 type 316 stainless steel to discharge the compacted screenings to the required location, including pipe support.
9. The Rotopress unit shall be factory assembled and tested, and shall be shipped to job site fully assembled. No field assembly shall be required (except for chutes and piping).

ITEM 2 SERVICES

2.A Drawings and Installation, Operation and Maintenance (IO&M) Manuals:

1.	Approval drawings:	6 prints included
2.	Certified drawings:	6 prints included
3.	IO&M manuals:	6 included

2.B Start-Up Assistance:

Parkson will furnish one factory representative for a total of six (6) days during two (2) separate trips to the jobsite to assist in installation inspection, start-up supervision, and operator training. Dates of service to be scheduled upon Purchaser's written request. To include all of the equipment listed above.

2.C Mechanical Warranty:

Per Section XVI on the attached Standard Conditions of Sale.

PURCHASE PRICE:

All of the above for ..... $SEE BID FORM.
F.O.B. shipping point, freight allowed to jobsite, taxes excluded.

NOTE:
As an option to the above proposal, Parkson offers a larger screen to be able to handle a peak flow of 12.32 MGD. The unit shall be 4'-0" wide (W) and designed for installation in a channel 5'-0" deep (H). Solids larger than 6 mm nominal screen opening shall be removed from the flow and conveyed to a discharge point 4'-8" above the top of the channel. When installed, the screen shall be inclined 75° from the horizontal and have a total discharge height (H1) of 10'-0" (as measured from the base of the screen to the discharge point). There will be a 3.5" recess in the bottom of the channel. See Bid Form for price.

VALIDITY:

Purchase Price is valid for thirty (30) days from quotation date, for shipment of equipment within the timetable stated below.

PAYMENT TERMS:

90% net 30 days, 10% retainage not to exceed 120 days after shipment.

TIMETABLE GUIDELINE:

Within ten (10) business days of receiving a written Purchase Order in Parkson's office, if necessary, Parkson will submit a written Request for Additional Information requesting items including, but not limited to, full-scale drawings, specification sections, amendments and other documents necessary for Parkson to begin work on this Project. No work can be done on this Project until all Additional Information is received by Parkson, thus beginning the Submittal Phase. If you do not receive such a Request for Additional Information within the stated ten (10) business days, then the Submittal Phase will begin on the eleventh (11th) business day following receipt of the written Purchase Order in Parkson's office. The Shipment Phase is thereafter contingent upon your final approval of all submitted Approval Drawings. Once said final approval is received in Parkson's offices, the Shipment Phase will begin.

Submittal Phase: Approval drawings will be submitted six (6) weeks from receipt of all requested Additional Information if necessary, or if not necessary, from the eleventh (11th) business day following receipt of a written Purchase Order in Parkson's office.

Shipment Phase: Twelve (12) weeks following receipt of final approval of all submitted Approval Drawings in Parkson's office.

If the Submittal Phase is waived, the Shipment Phase will begin on receipt of all requested Additional Information if necessary, or if not necessary, on the eleventh (11th) business day following receipt of a written Purchase Order in Parkson's offices.

Dates are subject to confirmation upon receipt of written Purchase Order.

TERMS AND CONDITIONS:

Parkson's Standard Conditions of Sale, as stated on the attached, shall apply.

BUYER/OWNER RESPONSIBILITY:

- Removal of existing equipment.
- Local disconnects or junction boxes.
- Surge suppressor.
- Level sensor mounting pipe.
- Control panel supports or mounting.
- Spray wash water connection and piping.
- Drain piping.
- Gate valves, check valves, butterfly valves, Y-strainers.
- Screenings dumpster.
- Lubricants.
- Concrete or channel modifications.
- Shop or field painting.
- Unloading, uncrating, installation and installation supervision. Installation will, at minimum, require a forklift and possibly a crane/hoist.
- Readiness of the equipment before requesting start-up service. Non-readiness may incur additional charges.
- Compatibility of equipment materials of construction with process environment.
- Electrical connection and interconnecting wiring (including any of the following: E-Stop button, solenoid valve, level sensor, motors, controls); wiring and conduit from each unit-mounted electrical device to a terminal box or control panel.
- Interconnecting piping.
- Piping connections, platforms, ladders, gratings and railings unless stated otherwise.
- Any other auxiliary equipment or service not detailed above.

Please return one signed copy of this Quotation, or your Purchase Order, to Parkson Corporation at the address below. Refer to this Quotation, date, and related correspondence.

Issued By:

PARKSON CORPORATION
562 Bunker Court
Vernon Hills, IL 60061

Joseph G. Nagel

Name: Joseph G. Nagel
Title: Municipal Sales
Date: June 13, 2014

Accepted By: (Herein called the Buyer)

Name
Title:
Date:

Enclosures: Standard Conditions of Sale, Quotation Addendum

POLYMERCRETE INTERPIPE

P.C. Simonton & Associates, Inc.
Consulting Engineers
Hinesville and Greensboro, GA

Polymer Pipe

PolymerCrete Interpipe

Item No.	Estimated Quantity	Units	Description	Unit Price	Total Price
1	8.89	EA	Manhole-1	$738.02	$6,561.00
2	6.72	EA	Manhole-2	$771.43	$5,184.00
3	6	EA	Manhole-3	$749.25	$4,495.50
4	5.79	EA	Manhole-4	$776.42	$4,495.50
5	9.26	EA	Manhole-5	$745.71	$6,905.25
6	7.47	EA	Manhole-6	$740.09	$5,528.50
7	6.64	EA	Manhole-7	$728.88	$4,839.75
10	4.58	EA	JB B-1	$1,381.83	$6,328.80
11	4.56	EA	JB B-2	$1,290.79	$5,886.00
12	5.77	EA	JB A-1	$1,244.71	$7,182.00
13	5.1	EA	JB A-2	$1,240.94	$6,328.80
14	200	EA	DB Pipe 24" ID with 3" wall	$216.45	$43,290.00
			Est Freight		$20,900.00
			Total		**$127,925.10**

TROJAN UV SYSTEM

TROJAN UV
WATER CONFIDENCE™

SCOPE OF SUPPLY FOR HINESVILLE - FORT STEWART (3RD BANK) WASTEWATER TREATMENT PLANT

ULTRAVIOLET DISINFECTION EQUIPMENT – TROJAN SYSTEM UV3000Plus™

Project Name:	Hinesville - Fort Stewart (3rd bank)	
Consulting Engineer:	P.C. Simonton & Associates, Inc.	
Submitted by:	Ben Zwart, Municipal Applications	
Trojan Quote:	LBZ1309	
Design Criteria:	Current Peak Design Flow:	14.3 MGD
	Future Peak Design Flow:	14.3 MGD
	UV Transmission:	65 %, minimum
	Total Suspended Solids:	5 mg/l, maximum
	Discharge Limit:	23 fecal coliform/100ml, 30 day geometric mean
		100 fecal coliform/100 ml, 1 day maximum

We are pleased to submit the following scope of equipment based on the above criteria.

The purchaser is responsible for reading all information contained in this Supply Contract. Trojan will not be held accountable for the supply of equipment not specifically detailed in this document. Supplemental Terms and Conditions are attached to this document. Detailed installation instructions are provided with the shop drawings and are available earlier upon request. Changes to this Scope of Supply that affect selling price will be handled through a change order.

Please refer all inquiries to Trojan Manufacturer's Representative:

Jon Baker
Templeton & Associates
Phone: 770-614-8550

This proposal has been respectfully submitted by,
Trojan Technologies

Ben Zwart
Municipal Applications
Trojan Technologies

Unless otherwise indicated in this proposal all conduit, conductors, local disconnects and transformers (if required) are the responsibility of the CONTRACTOR and are not included in this Scope of Supply.

ULTRAVIOLET MODULES

Trojan's Responsibility:
Each module supplied shall be completely assembled containing lamps, quartz sleeves and be electrically wired to each electronic ballast. Modules are shipped in a support rack and crated.

Model and Make:	Standard System UV3000Plus™
Quantity:	9 UV modules will be supplied each containing 8 lamps
Material of Construction:	316 stainless steel frame
Approximate Weight:	112 pounds per module

POWER DISTRIBUTION CENTERS

Trojan's Responsibility:
The Power Distribution Center (PDC) distributes power to the UV Modules and shall consist of the following:

Quantity Supplied:	Total of 1 PDC will be supplied
Material of Construction:	304 stainless steel
Enclosure Rating:	Type 4X
Approximate Weight:	220 pounds

Installation Contractor's Responsibility:
The Installation Contractor to be responsible for setting in place and bolting the Power Distribution Centers to the top of channel. The Installation Contractor to be responsible for the supply, installation and connection of the following at the Power Distribution Center:

1. One (1) 480Y, 3 phase, 4 wire (plus ground), 20.9 kVA power feed with local disconnect to the PDC
2. One (1) Ground Link, 14 gauge minimum, TWH stranded single wire from the HSC.
3. One (1) communication link consisting of one (1) shielded twisted pair from the SCC and daisy chained to other PDC's.
4. One (1) pair of 12Volt DC, 18 gauge minimum discrete signal to the Water Level Sensor from PDC closest to the sensor.
5. One (1) pair of 24Volt DC, 18 gauge remote I/O to the HSC.
6. Connection of communication, power cables and hydraulic lines from the UV Modules

SUPPORT RACKS

Trojan's Responsibility:
Support racks are provided to support UV modules in the effluent channel.

Quantity Supplied:	1 rack will be supplied
Material of Construction:	304 stainless steel
Approximate Weight:	< 100 pounds each

Installation Contractor's Responsibility:
The Installation Contractor to be responsible for setting in place and bolting the support racks to the channel walls. The Contractor will be required to supply eight (8) 1/2" Diameter x 5 1/2"Long expansion anchor bolts per rack.

DOCUMENTATION (SHOP DRAWINGS AND O & M MANUALS)

Trojan's Responsibility:
The following documentation will be supplied to the contractor by Trojan per the following schedule:
6 copies of submittal shop drawings 4-6 weeks after receipt of written purchase order.
6 copies of Trojan Standard O&M manuals 2 weeks before equipment delivery.

DELIVERY, START-UP AND TRAINING

Equipment shipped 8-10 weeks after approval of Shop Drawings.
The following start-up services will be provided by Trojan-certified technicians:
Installation assistance as required by phone or fax.
Inspection and certification of the final installation.
3 days for functional testing the UV equipment.
1 day for pre-startup classroom or jobsite training of Owner's personnel.

WARRANTY

Trojan's Responsibility:
Trojan Technologies will warrant the equipment and parts for 12 months after start-up or 18 months after shipment, whichever comes first. Refer to attached Terms and Conditions for additional details.

SELLING PRICE

$149,000 US

PAYMENT TERMS

10% after approved submittal
85% upon delivery of equipment to site
5% upon equipment acceptance or 60 days after delivery (whichever occurs first)
Net 30 Days
If UV System Start-up is required within 30 days of shipment, Trojan requires 95% payment unless agreed upon in writing before authorizing system Start-up.
Freight included for all North American projects. Incoterms 2002
Selling price does not include any applicable duties or taxes.

TERMS AND CONDITIONS

Attached

City of Hinesville
Minority and Women Business Enterprise Program
(M/WBE) Policy

I. M/WBE Implementation of the Policy

The city manager of the City of Hinesville (hereinafter referred to as "the City") or his designee shall implement and administer the City's M/WBE Policy through the City's M/WBE Program.

II. Policy Statement

It is the City's policy to provide minority and women owned and operated business enterprises (M/WBEs) with equal opportunity in the procurement initiative and processes for the purchase of goods and services required for the operation and administrative needs of the City. More specifically, it is also policy to:

A. Ensure the M/WBE Program is narrowly tailored in accordance with applicable law;
B. Ensure that only firms which fully meet the eligibility standards specified in 49 CFR Part 3 are permitted to participate as M/WBEs;
C. Ensure there are no barriers to the participation of M/WBEs in opportunities for contracts with the City.

The M/WBE Program will be administered by the city manager or his designee with support of all other departments of the City that are engaged in the procurement of goods and services. Further, the provisions of the M/WBE Policy shall apply to all contracts and services awarded by the City, subject to the requirements of controlling federal, state, and local laws, except as specifically exempted herein. Special emphasis shall be placed on construction contracts to promote the inclusion of M/WBEs.

III. Purposes and Objectives of the M/WBE Program

The purposes of the City's M/WBE Program are to:

A. Advocate and promote equal opportunity and access to contracting and procurement opportunities within in the City;
B. Develop programs that will increase the participation of M/WBEs in City contract and procurement activities in order to assure equal opportunity;
C. Monitor and assess the utilization of M/WBEs in all City construction contract and procurement activities;
D. Monitor and assess the compliance by contractors with the M/WBE policy on all City construction contracts;
E. Identify M/WBEs and promote their awareness of City contracting opportunities;
F. Support programs that provide assistance and training to less experienced small businesses as well as established small businesses working to expand their present capacity; and
G. Recommend revisions and changes to policies and procedures that are an impediment or barrier to equal opportunity of participation for M/WBEs in City contracting and procurement activities.

The objectives of the City's M/WBE Program are to:

A. Continue a practice of nondiscrimination in the award and administration of City contracts;
B. Remove barriers to the participation of M/WBEs in City contracts;
C. Assist the development of M/WBEs and their capacities so that they can successfully compete in the market outside of the M/WBE program; and

D. Increase the number of M/WBEs and the volume of their business with the City, so as to approximate their population and market share in a given construction trade business sector.

IV. Definitions

Bid – A written quotation, proposal or offer by a bidder or contractor to perform or provide labor, materials, equipment, supplies or services to the City for a certain price, submitted in response to competitive bidding solicitation by the City.

Bidder – Any person, firm, corporation, partnership or business enterprise that submits a bid or proposal to provide labor, goods or services to the City where funds are expended.

Business Enterprise – A legal entity existing for the purpose of engaging in business for profit, including, but not limited to, a corporation, partnership, individual, sole proprietorship, joint stock company, joint venture or any other private, legally recognized entity.

Certification – The process by which M/WBEs verify their status to the City in order to be considered an M/WBE. Certification is a requirement of all M/WBEs who register as such with the City and is a prerequisite to participation in the M/WBE program.

City and City Limits – The incorporated city limits of the City of Hinesville, Georgia and its annexed boundaries, as the same may be amended from time to time.

Classification – The designation which best describes the ownership (MBE or WBE) of a business enterprise.

Commercially Useful Function - Real and actual service in the discharge of any contractual endeavor, including the execution of a distinct element of work by actually performing, managing and/or supervising the work, in accordance with normal business practices, when the firm receives due compensation for the work performed. A supplier is considered to have performed a commercially useful function when it is a manufacturer or a regular dealer.

Compliance – The condition or status of a general contractor whose bid demonstrates that it complies with the M/WBE contract goals.

Construction – The process of building, altering, repairing, improving or demolishing any public infrastructure or building, or other public improvements of any kind to any public real property. Construction does not include the routine operation, routine repair or routine maintenance of existing structures, buildings or real property.

Contract – Any and all agreements, regardless of what they may be titled, for the procurement of supplies, services, or construction.

Contractor – Any business enterprise that has entered into a contract with the City or an agency thereof.

Control or Controlled – As used in this policy, this term refers to an individual's relationship with an M/WBE and shall mean to actually possess and exercise the legal authority and power to manage business assets and/or daily operations of the business and to actively and continuously exercise such managerial authority and power in determining the policies and directing the operations of the

business, as opposed to a nominal relationship existing only to create the appearance of minority or woman ownership.

Exclusive General Contractor/Subcontractor Relations – Agreements made between or among a general contractor and an M/WBE in which the M/WBE promises not to provide subcontracting quotations to other bidders or potential bidders in exchange for preferential treatment from the contractor. Such practice is prohibited by the City; contractors and M/WBEs engaging in such practice risk suspension or debarment from performing or bidding on future City contracts.

Goal – The percentage of M/WBE participation on a given project. Goals are established on a per-project basis based on trade type involved and the trade's history of discriminatory under-participation relative to its market share.

Joint Venture – An association between an M/WBE and one or more other firms to carry out a single, for profit business enterprise, for which the venture will be recognized as partially M/WBE, based on the proportion of M/WBE ownership and participation in the joint venture.

Minority – A citizen of the United States or a lawfully admitted resident alien who is a member of any of the following groups:

A. *African American* – All persons having origins in any black racial groups of African descent as well as those identified as Jamaican, Trinidadian, and West Indian;
B. *Asian or Pacific Islander* – All persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands. This area includes, for example, China, Japan, Korea, India, the Philippine Islands and Samoa;
C. *Hispanic* – All persons of Mexican, Puerto Rican, Cuban, Central American, South American, Spanish or Portuguese culture or origin, regardless of race;
D. *American Indian and Alaskan Native* – All persons having origins in any of the original peoples of North America and who maintain cultural identification through tribal affiliation or community. This includes Aleuts and Eskimo; and
E. *Other* – All persons belonging to an ethnic or minority group identified by the State of Georgia or the U.S. Supreme Court as a "discrete and insular" minority afforded special protection under the Equal Protection Clause of the U.S. Constitution because of inherent cultural or personal characteristics.

Minority Business Enterprise or MBE – An entity or institution that is certified by an entity specified in subsection (IX)(J) as at least 51% owned and controlled by one or more minority individuals, or, in the case of a publically owned business, at least 51% of the stock is owned by one or more minority individuals. The ownership interest must be real and continuous, and not created solely to meet the minority-owned business or contractor provisions of this policy. This definition shall include educational and other non-profit entities, designated as such under section 501(c) of the U.S. Tax Code, that have a recognized historical association with a minority group.

M/WBE Compliance Plan – The document submitted by the general contractor during the prequalification process which demonstrates how the contractor will meet the M/WBE goals of the contract on which it is bidding.

Non-Compliance – The status of a bid or bidder who fails to comply with the M/WBE contract goals upon submission of a bid or proposal.

Non-Discrimination Statement – The statement made by a bidder relating to its conduct prior to submission of a bid, as well as after the award of a contract, in which the bidder agrees to:

A. Follow the policies of the City of Hinesville relating to the participation of M/WBEs.
B. Undertake measures to ensure the maximum practicable participation by M/WBE; and
C. Not engage in discriminatory conduct against M/WBEs.

Non-Local Business Enterprise – Any business that does not meet the definition of a "Local Business Enterprise" recited above.

Non-Responsive Bidder – A bidder who has submitted a bid which does not conform in all material respects to the requirements set forth in the invitation for bids.

Prequalification – The process whereby potential bidders submit their qualifications to the City for evaluation to determine if they are capable of performing the work that is being solicited and therefore, eligible to bid on the project or submit a proposal. Prequalification is a prerequisite to submitting bids or proposals, but is not a guarantee of being awarded a contract.

Procurement – The process of buying, renting, leasing or otherwise obtaining or acquiring any real or personal property, supplies, materials, equipment or services.

Professional Services – Services which require licensure as a prerequisite to participation for a profit and which involve predominately mental or intellectual labor and skills, including, but not limited to, architects, engineers, surveyors, doctors, attorneys, and accountants.

Proposed Schedule of Minority Participation – A formal bid document which expresses how a contractor will meet the M/WBE goals of a contract by listing the proposed M/WBE subcontractors and/or suppliers it will use on the City project on which it is bidding.

Purchasing – The buying, renting, leasing or otherwise obtaining or acquiring of any real or personal property, supplies, materials, equipment or services.

Responsible Bidder– A bidder who has the capacity, in all respects, to fully perform the contract and all of its requirements and the demonstrated experience, reliability, facilities, equipment and credit to reasonably assure performance.

Responsive Bidder– A bidder who has submitted a bid which conforms in all material respects to the requirements set forth in the invitation for bids.

Small Business Enterprise Development Program –A program that assists and supports the development of local small and new businesses.

Subcontract – An agreement between the general contractor and another business entity (the subcontractor) for the performance of work that is part of the general contractor's contract with the City.

Women's Business Enterprise or WBE – An entity or institution that is certified by an entity specified in subsection (IX)(J) as at least 51% owned and controlled by one or more women, or, in the case of a publically owned business, at least 51% of the stock is owned by one or more women. The ownership interest must be real and continuous, and not created solely to meet the woman-owned business or contractor provisions of this policy.

V. Functions Undertaken by the City's M/WBE Program

The City will provide the following services to ensure the recognition and utilization of M/WBEs located in the City and Coastal Georgia:

A. Review the M/WBE certifications of firms seeking to be approved by the City as M/WBEs.
B. Maintain a current database of certified M/WBEs and the services they offer. The database of M/WBEs will be made available to the public via the City's website.
C. Provide support and assistance identifying and contacting certified M/WBEs.
D. Help plan and participate in outreach programs and provide assistance in informing M/WBEs of procurement opportunities with the City and other public sector and private sector entities.
E. Review the City's bid/proposals, specifications, and plans to ensure they do not limit M/WBE participation. After review, advise the City Council of the availability of M/WBE contract opportunities and assist in setting goals on City projects, contracts, and procurements.
F. Encourage M/WBEs to participate in training programs offered by the City and/or third-party education and training providers.
G. Refer M/WBEs to third party technical assistance providers when appropriate for bonding, financial, and technical assistance.
H. Disseminate, through scheduled meetings and other means, information regarding the City's contracting opportunities to M/WBE contractors, subcontractors, service providers, and suppliers.
I. Conduct debriefing sessions for M/WBEs in coordination with City staff on the quality of M/WBE participation.
J. Maintain listing of M/WBE, minority and women –focused media.
K. Place notices of City projects with M/WBE, minority- and women-focused media.

VI. Implementation of the M/WBE Policy

The city manager or his designee shall implement and administer the City's M/WBE Policy through the City's M/WBE Program.

Several methods may be used to increase the opportunity for M/WBE participation in City contracts. These methods include but are not limited to:

A. Conducting pre-bid conferences
B. Creating and distributing pamphlets/literature on doing business with the City
C. Attending community workshops and meetings
D. Conducting workshops and/or seminars for vendors, general contractors and subcontractors
E. Advertising bids in M/WBE-, minority- and women-focused media
F. Allowing vendors to register on a vendor bid list
G. Establish flexible M/WBE prequalification for vendors and contractors.
H. Establishing participation (utilization) goals on a project by project basis
I. Providing information on access to small business assistance programs
J. Establishing separate goals for minority and gender participation (MBE% and WBE %) based on their availability.
K. Categorizing M/WBE firms by business sector, sub-sector and specialty firms and assessing their relative participation levels to most efficiently achieve the goals of this program by the most narrowly tailored means
L. Providing project management on a project by project basis

VII. Minority Participation Encouragement Policies

The M/WBE Participation Policy for the City includes, but is not limited, to the following areas:

A. Procurement of Construction Services

The following procedures and contract requirements will be used to ensure that M/WBEs are encouraged to participate on City construction contracts:

1. For all construction projects in excess of $100,000 the project manager will identify M/WBEs which are qualified to submit bids. Based on information gathered, the project manager will send invitations to bid directly to these firms and, on behalf of the City, will make available plans and specifications to the M/WBEs.
2. The City will establish project-specific goals for M/WBE participation based on availability of minority/women subcontractors and minority/women general contractors.
3. The City shall provide trade-specific lists of certified M/WBEs to potential general contractors.
4. The City shall require bidders to submit with their bids the Bidder's Requirements as detailed in Subsection C, in a separate sealed envelope.

Submission of the above-mentioned documentation will require contractors to fulfill any M/WBE utilization commitments made. Failure to submit the above documentation shall result in the bid being considered non-responsive, and thereby disregarded.

B. Bidder's Requirements

1. For all City bids, bidders shall be required to submit with the bid a Non-Discrimination Statement that shall affirm the bidder's agreement to:
   a. Adhere to City policies relating to the participation of M/WBEs;
   b. Undertake certain measures as provided in this Policy to ensure maximum practicable participation of M/WBEs; and
   c. Not engage in discriminatory conduct of any type against M/WBEs.
2. All construction bidders shall be required to submit, in a separate sealed envelope, a Proposed Schedule of M/WBE Participation, which shall include:
   a. The names and addresses of known M/WBEs that have agreed to perform on the contract;
   b. A description of the work that each M/WBE will perform;
   c. The dollar amount of the participation of each M/WBE; and
   d. A signed commitment to use the M/WBE subcontractor whose participation it submits to meet a contractual goal.

The obligation of the bidder is to make good faith efforts to meet or exceed the M/WBE participation goal for each City contract. If the bidder is unable to meet that goal, it must submit documentation of its good faith efforts to do so. Examples of good faith efforts may be found in 49 C.F.R. 26(c). The Project Manager is responsible for determining whether a bidder who has not met the designated contract goal has documented sufficient good faith efforts to be regarded as responsive. The Project Manager will review all good faith efforts documentation for relevance, legitimacy, and accuracy.

In the event a bid is declared non-responsive as a result of insufficient M/WBE participation and/or insufficient good faith efforts, notice of the bidder's non-responsive status will be delivered in writing. The bidder may then submit an Appeal for Reconsideration to the office of the city manager within ten (10) business days of receipt of the notification. The Appeal for Reconsideration may consist of additional written documentation or the bidder's argument for reconsideration. The office of the city manager shall review the Appeal and within ten (10) business days, render a written decision as to the responsiveness or non-responsiveness of the bid.

Submission of the above-mentioned documentation will require contractors to fulfill any M/WBE utilization commitments made. Failure to submit the above documentation shall result in the bid being considered to be non-responsive, and thereby disregarded.

C. Joint Ventures/Subcontracting Participation

Joint ventures and subcontracting may be utilized to create and increase opportunities for participation of M/WBE firms and to improve managerial and technical expertise.

Joint Ventures: Where bidders engage in a joint venture for the purpose of satisfying the M/WBE participation goal, the bidder shall demonstrate that the M/WBE joint venture's participation is real and legitimate. The City shall review and approve all contractual agreements and other supporting documentation to determine the percentage of M/WBE participation. The City shall determine the level of applicable participation resulting from the joint venture based on the above criteria.

Subcontracting: A general contractor may use subcontractors to satisfy the project's M/WBE participation goal provided the subcontractor performs a commercially useful function. In determining whether an M/WBE has performed a commercially useful function, the following will be considered:

1. The nature and amount of work subcontracted;
2. Whether the M/WBE has the skill and expertise to perform the work; and
3. Whether the M/WBE actually performs, manages and supervises the work.

D. Annual Compliance Report

City staff designated by the city manager shall submit an annual report to the city manager for distribution to the Mayor and City Council, detailing M/WBE participation in City contracts for the preceding fiscal year.

The reported information will include, but will not be limited to, the following data:

1. List of all construction services contracts during the reporting period;
2. Total contract costs;
3. MBE Goal: dollar amount and percentage of total contract costs;
4. MBE Actual: dollar amount and percentage of total contract costs;
5. WBE Goal: dollar amount and percentage of total contract costs;
6. WBE Actual: dollar amount and percentage of total contract costs;

E. Compliance

1. It will be the responsibility of the Project Manager to ensure that bids and/or proposals issued by the City adhere to the provisions set forth in this Policy.
2. The city manager or his designee will assume primary responsibility for evaluating compliance with the M/WBE Program on a continuing basis, including all aspects of the Program's operations, to ensure that the mission and objective are being appropriately addressed and realized.
3. Each City contract will contain a provision requiring compliance with this Policy, including maintenance of records and delivery of all information necessary to document compliance.
4. The Project Manager shall be responsible for the evaluation of good faith effort, required subcontractor information, and all related documentation as required.

5. The Project Manager shall require documentation of all M/WBE pay requests and payments made to M/WBEs.
6. City staff designated by the city manager will monitor and evaluate program performance and compliance. Failure to comply with the M/WBE requirements may result in a recommendation for suspension or debarment of the firms and/or individuals involved.

F. Competitive Bids

Nothing in this policy is to be construed to require the City to award a bid contract to any bidder other than the lowest responsible bidder, to require contractors to award to subcontractors, or to make significant material purchases from M/WBEs who do not submit the best overall pricing to the City.

Notwithstanding the foregoing, projects utilizing state or federal funds will be awarded in accordance with all state and federal rules and regulations.

VIII. Required Contract Clauses

A. Contract Assurance

The City shall require that the following clause be included in every City general contract and subcontract: **The general contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The general contractor or subcontractor shall carry out applicable requirements in the award and administration of contracts. Failure by the general contractor or subcontractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the City deems appropriate.**

B. Prompt Payment

The City shall require that the following clause be included in every City general contract: **The general contractor agrees to pay each subcontractor under this general contract for satisfactory performance of its contract no later than 10 days from the receipt of each payment the general contractor receives from the City. Any delay or postponement of payment from the above-referenced time frame may occur only for good cause following written approval of the City. This clause applies to both M/WBE and non-M/WBE subcontractors.**

IX. Monitoring and Enforcement Mechanisms

The Project Managers will monitor and track M/WBE participation through the general contractor, including City and subcontractor reports of payments in accordance with the following:

A. Post-Contract Award

After the contract award, the City will review the award documents for the scope of work each M/WBE and first-tier subcontractor is scheduled to perform, and the dollar value of that work.

B. Preconstruction Conference

The Project Manager and the general contractor, or their representatives, will schedule a preconstruction conference to discuss the work each M/WBE subcontractor is scheduled to perform.

C. Construction Contract Monitoring

The general contractor will provide the Project Manager with the work each M/WBE is responsible for performing. The Project Manager will notify the city manager of suspected violations.

In the event that it is determined that an approved M/WBE firm is scheduled and contracted to perform a designated scope of work that has been subcontracted to an unapproved firm, the Project Manager will notify the general contractor of the apparent discrepancy and potential loss of payment. The Project Manager will investigate and deliver an opinion and recommendation to the general contractor, both subcontractors, and the city manager.

D. Substitution

In the event that a general contractor is compelled to request a substitution of a certified M/WBE with the approval of the M/WBE, a written request must be signed by both parties to the request and delivered to the Project Manager. The Project Manager shall review, investigate, and render a recommendation to the city manager for approval or denial.

In the event that a general contractor is compelled to request a substitution of a certified M/WBE without the approval of the M/WBE, the written request must be signed by the general contractor and delivered to the Project Manager and the M/WBE. The M/WBE shall submit a written statement concerning the request. The Project Manager shall review, investigate, and render a recommendation to both parties and the city manager for approval or denial.

Where substitution of a certified M/WBE is approved by the city manager, the general contractor shall be required, to the extent necessary to meet the contract's M/WBE goal, to identify another certified M/WBE as a replacement or document its good faith effort to do so within ten (10) business days. Should the general contractor fail to comply, the Project Manager shall issue an order stopping part or all of the general contractor's work and/or payment until a certified M/WBE is identified or a good faith effort is made. The general contractor's continued failure to do so will result in breach of contract.

E. Record Keeping and Final Utilization of M/WBEs

The general contractor shall be responsible for the creation and maintenance of the following:

1. The name and business address, regardless of tier, of every M/WBE subcontractor, professional service provider, and vendor of materials and supplies;
2. The date of payment and the total dollar figure paid to each of the firms; and
3. The date work was performed by the M/WBE firm's own employees along with the corresponding dollar value of the work claimed toward M/WBE goals.

F. Final Report - M/WBE Utilization

Upon the successful completion of the project, contract, or transaction, the general contractor shall submit for approval a summary of the utilization and participation of any and all relevant M/WBEs. This information shall be submitted on the "Project Closeout M/WBE Utilization Report" as provided by the City. This report must be submitted to the city manager and approved prior to the official "closeout" of the project, contract, or transaction. All discrepancies, exceptions, reconciliations, balances, etc. must be satisfied prior to the official closing of the project, contract, or transaction.

G. Overall Goals

Overall goals for M/WBE participation in City contracts have been established. The minimum participation goal for W/MBE firms with City contracts is 10% when there is subcontracting.

H. Contract Goals

Contract goals are established in a manner designed to meet or exceed the overall goal for the fiscal period. Contract goals will be expressed as a percentage of the total amount of a contract.

I. Counting M/WBE Participation

The City will count M/WBE participation in City contracts toward overall and contract goals as provided in the contract specifications for the general contractor, joint venture partner with the general or subcontractor, or vendor of material or supplies.

J. Certification

The City requires that by the date and time of the bid closing all M/WBEs identified for participation in City contracts be certified as such by one of the following agencies or organizations:

City Recognized M/WBE Certification Agencies

1. Chatham County
2. City of Atlanta
3. DeKalb County
4. Fulton County
5. Georgia Department of Transportation
6. Georgia Minority Supplier Development Council
7. Savannah-Hilton Head International Airport
8. U.S. Small Business Administration 89(a) Program

The City reserves the right to, from time to time, add or delete an agency or organization from the list. Additionally, an M/WBE may request that the City consider recognition from an agency or organization unfamiliar to the City.

K. Information Collection and Reporting

1. *Monitoring of Payments to M/WBEs*

   General contractors are required to maintain records and documentation of payments to M/WBEs or certified M/WBE subcontractors for three years following the performance of a contract with the City. Any authorized representative of the City can request these records be made available for inspection during that time. In particular, payments to M/WBE subcontractors may be reviewed by the City to ensure that the actual amount paid to M/WBE subcontractors equals or exceeds the dollar amounts stated in the schedule of M/WBE participation.

2. *Confidentiality*

   The City will safeguard from disclosure to third parties any information that may reasonably be regarded as confidential business information, except to the extent that disclosure is required by federal, state or local law.

Approved this 2nd day of August, 2012.

James Thomas, Jr., Mayor

David Anderson, Sr. Council Member

Charles Frasier, Mayor Pro Tem

Keith Jenkins, ~~Council~~ Member

Jason Floyd, Council Member

Kenneth Shaw, Council Member

ATTEST:

Sarah R. Lumpkin, City Clerk

Test Boring and Sub-Surface Investigation

PROJECT: Hinesville / Ft. Stewart WWTP

Ft. Stewart, GA

CLIENT: P.C. Simonton & Associates, Inc.

REPORT No. : 3-31-11-1

Whitaker Laboratory, Inc.

2500 Tremont Road
Savannah, Georgia 31405
Phone (912) 234-0696
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WHITAKER LABORATORY, INC.

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(912) 234-0696 Fax (912) 233-5061 Email: info@whitakerlab.net

March 31, 2011

P.C. Simonton & Associates, Inc.
P.O. Box 649
Hinesville, Georgia 31310

Attention: Mr. Paul Simonton, PE

Referencing: Report of Geotechnical Investigation
Hinesville/Ft. Stewart WWTP
Ft. Stewart, Georgia
Report No.: 3-31-11-1

Dear Mr. Simonton:

As requested, WHITAKER LABORATORY, INC. has conducted a geotechnical investigation at the above referenced site. Authorization to perform this investigation was provided by your acceptance of our proposal dated March 11, 2011. Our findings and recommendations for design and construction are attached and it is important that you read the report in its entirety.

It is a pleasure to continue service to you and we look forward to further opportunities to assist you on this and other projects.

Respectfully submitted,
WHITAKER LABORATORY, INC.

Carroll L. Crowther, PE
GA Registered Engineer
15017

Jason H. Follo, P.E.
GA Registered Engineer
#31031

Joseph M. Whitaker
President

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APPENDICES

REPORT OF GEOTECHNICAL INVESTIGATION

Hinesville/Ft. Stewart WWTP
Ft. Stewart, Georgia

INTRODUCTION

At any time, we will be glad to discuss the contents of this report. This includes insuring that you fully consider potential problems for design and construction procedures in respect to interpretations of the data.

WHITAKER LABORATORY, INC. has completed this field investigation of the surface and subsurface conditions at this site. The preliminary conditions found, and how those conditions could affect the design and construction of foundations for the structures planned, form the basis for this report. Regardless of the thoroughness of any geotechnical investigation, there are limitations, and deviations from the conditions found in this investigation could be subsequently disclosed. We recommend that this report be provided to all parties involved in the planned development to include but not necessarily limited to the Owner, Architect, Design Engineers, General Contractor and sub-contractors. Unanticipated circumstances often arise during sitework, earthwork and foundation construction. Accordingly, we recommend that our firm be retained to provide the construction surveillance, inspection, and testing on the project, thereby being readily available to assist in the evaluation of any conditions encountered that differ from those anticipated.

We understand a Waste Water Treatment Plant (WWTP) facility is planned for construction on the subject site. Our understanding of the planned construction and assumed loading conditions are as follows:

Sequential Batch Reactors (SBR's):

We understand that the site will be elevated one to two feet above existing grades to achieve finished subgrade elevations for foundation construction. We further understand that the SBR tank will be entirely above grade, constructed of reinforced concrete and hold 23 feet of water. Maximum water elevation is anticipated to be 27 feet above the original ground surface elevation (23 feet of water in the tank).

Based upon the above information, Whitaker Laboratory, Inc. has roughly calculated a net pressure increase applied at the original ground surface elevation of approximately 2,100 pounds per square foot across the entire footprint area of the structure.

Disk Filter Tank:

We understand the tank will be buried 8 feet below the existing ground surface elevation. We further understand the top of the tank resides approximately 5 feet above existing grades. Based upon this information the structure should yield a slight net reduction in pressure at foundation bearing elevations (current stress, from weight of in-situ soil, at bottom of foundation elevation is slightly higher than it will be after structure is constructed).

Blower Building:

For the purpose of this report we will assume that maximum column and strip foundation loads will not exceed 40 kips and 3 kips per linear foot respectively. We understand that site grading requirements will require 5 to 6 feet of fill be placed above existing grades to achieve finished subgrade elevations for floor slab construction of the blower building.

If our understanding of the project and/or assumptions are incorrect, we should be contacted immediately, provided the correct information, and allowed an opportunity to change and/or modify the recommendations contained within this report.

This investigation included the drilling of six standard penetration test borings and a visual reconnaissance.

Please note that this evaluation only applies to the foundations planned for the above referenced construction. This evaluation does not apply to any other current or future improvements, which may be made to the site. In particular, if at any time should additional structures be constructed elsewhere on this site and/or additional fill be placed, adjacent to or nearby the structures referenced in this report, additional geotechnical borings and a follow up geotechnical analysis will be required. Standard billing rates will apply for this work.

AREA GEOLOGY

This project is located on Ft. Stewart, Georgia. This overall project area lies near the eastern edge of the South Atlantic Coastal Plain. In South Carolina and Georgia, this broad, gently sloping region extends southeastward from the Fall Line (Chesterfield - Columbia - Augusta - Macon - Columbus) to the Atlantic Ocean. The soils encountered are sedimentary in origin, and consist of layered marine deposits of sands, silts, and clays. These deposits have since been subjected to successive erosion and re-deposition, by fluctuations of sea levels, storm tides, and winds. Many of the surface sands are the result of depositional forces along ancient beaches, which formed during the changing shoreline and river conditions. Intermittent deposits of shells occur within the strata at irregular intervals. The surface soils in a majority of this Coastal Plain area were deposited during the Pleistocene Era, however surface soils near the coast are likely of the Holocene Era.

TEST BORINGS AND SUBSURFACE CONDITIONS

The field exploration to determine the characteristics of the subsurface materials included a reconnaissance of the project site, and the drilling of exploratory borings. Standard penetration test borings were performed using rotary head drilling equipment and advancing hollow stem augers. Sampling and Standard Penetration Testing, (SPT), was performed in accordance with ASTM-D-1586. SPT samples were taken at 2.5 foot intervals of depth for the first 10 feet, and at 5.0 foot intervals thereafter.

Standard Penetration testing is done with a 140-pound hammer falling 30 inches and a two inch diameter sampling spoon. Results of the Standard Penetration Testing (SPT N values) provide an indication of the relative consistency, density and in-situ strengths of the tested soils.

Soil samples from SPT testing and from the auger cuttings have been used for identification and visual classification. The subsurface stratification and the profile as presented in the boring logs, represent approximate boundary lines between the strata and materials encountered. These boundary lines are usually gradual and not clearly defined, and it is sometimes difficult to record changes in stratification precisely. It should be noted that underlying soil conditions, can, and do, vary considerably within short lateral distances. It is possible that conditions may be revealed between boring locations that are different from those found by our borings and used for our analysis.

The approximate locations of the borings are shown on the attached BORING LOCATION PLAN. Our drilling crews based on landmarks and features available at the time of drilling have estimated the locations of the borings in the field. If the precise location of the boreholes is critical, this can be determined by employing a land surveying firm to plot the true locations. Such survey should be completed promptly and before any disturbance to the area has occurred. If desired, WHITAKER LABORATORY, INC. will be glad to coordinate surveying arrangements for an additional fee.

At the time of our site visit, the site was wooded containing small to large sized trees with underbrush. Ground surface topography was generally flat. The site was accessible after pathways were cleared by others and the near surface soils were stable to our truck-mounted drilling equipment within the pathways. Soil test borings were advanced within the planned construction area to depths ranging from 20 to 55 feet below the ground surface.

Below approximately 6 to 12 inches of topsoil, the near surface soils consist of very loose to very firm fine sands and silty sands (SP, SP-SM and SM) extending to depths reaching 1 ½ to 8 feet below the ground surface. Below the surface sands, inter bedded stratifications of very soft to firm clays and sand clays (SC, SC-CL, CL and CH) and very loose to loose sands and silty sands (SP, SP-SM, SM and SM-SC) were encountered extending to depths reaching depths reaching 30 feet below the ground surface. Below 30 feet, firm to dense sands and silty sands (SP, SP-SM and SM) were predominately encountered extending to the termination depth of the deepest soil test boring at 55 feet below the ground surface.

The above description of the subsurface profile should be considered a general description intended to highlight the major strata encountered. More detailed profiles can be observed within the attached boring logs. Please note that boring logs are only representative of their location. Stratification transitions should be expected to occur outside and between boring locations. Taking into account that sampling was not performed on a continuous basis, lines drawn representing elevations of stratification changes shown on the boring logs were estimated.

GROUND WATER TABLE

The apparent ground water table was measured for each boring location at the time of boring. Ground water levels were measured to range from 3 to 8 ½ feet below the ground surface. The ground water elevation can be expected to fluctuate with the season of the year, surrounding ground surface conditions, and with recent rainfall amounts. Thus, ground water elevations shown on the boring logs should be considered valid only for the date of observation.

WHITAKER LABORATORY, INC. recommends that the contractor determine a groundwater level just prior to site work begins. If groundwater remains at the observed levels it will impact construction. We have addressed groundwater concerns within the EARTHWORK AND FOUNDATION DESIGN CONSIDERATIONS section of this report.

SEISMIC SITE CLASSIFICATION AND RECOMMENDED DESIGN COEFFICIENTS

Liquefaction Potential:

Based upon the design earthquake and characteristics of subsurface soils encountered during this evaluation, liquefaction is not likely to occur on this site.

Seismic Parameters:

In accordance with International Building Code 2006 (IBC 2006), this site would be defined as a Site Class "E". This classification was determined by average soil properties in the top 100 feet of the soil profile utilizing standard penetration test N values.

Site Class "E" (utilizing SPT data):

$S_{DS} = 0.463$
$S_{D1} = 0.233$

Please note that if shear wave velocity values are obtained on this site, a more favorable site class may be achievable. **We recommend performing shear wave velocity testing on this site in an attempt to yield a more favorable site class.** Our firm has the ability to provide our clients such testing and evaluation, and we will be available to discuss the cost of such if you desire.

EARTHWORK AND FOUNDATION DESIGN CONSIDERATIONS

All site work should be performed in accordance with the SITE WORK RECOMMENDATIONS section of this report.

Sequential Batch Reactors (SBR's):

Please note that due to the anticipated loads of the SBR structure applied to the ground surface combined with the very soft and loose subsurface profile extending to depths reaching 28 feet below the ground surface potentially damaging settlements are expected to occur to the structure. Therefore, it is our recommendation for this structure to be supported on a pile supported mat foundation system.

Pile Type	Length	Axial Capacity:	Lateral Capacity:
14" Pre-Stressed Concrete	40 to 45 feet (below existing grades)	60 tons	5 kips (applied at the ground surface)

Lateral loads can be resisted by passive earth pressure due to compacted structural fill placed against the sides of the Mat footing. The upper 1-foot of resistance should be neglected unless the fill is confined by a pavement or slab. A soil unit weight of 110 pcf and passive earth pressure coefficient of 3.0 can be utilized in the analysis. Additionally, a friction coefficient of 0.35 between the bottom of Mat and underlying soil can be used in combination with passive earth pressures to resist lateral loads. The coefficient of friction should be applied to dead normal loads only.

Piling General Notes:

- 14" Pre-Stressed Concrete piles should be precast, a minimum of 14 inches square, and adequately reinforced to withstand all handling and driving stresses. Concrete should have a minimum 28-day compressive strength of 5000 psi.

- We recommend that a minimum of one full-scale load test be performed. The load test location should be selected after the initial indicator piles are driven. The Load test should be in accordance with the "quick" procedures of ASTM D-1143. As an alternate, PDA Testing can be performed during indicator pile driving. A minimum of 5 piles should be tested if the PDA is utilized instead of a full scale load test. The load test or PDA test program should ultimately provide recommendations for driving criteria of production piles.

- Piles should be installed utilizing properly sized power hammers. Compatibility of the pile hammer, cushioning material, and pile should be evaluated by wave equation analyses and submitted to the engineer for approval prior to initiating pile driving operations on site.

- Piling contractors should be responsible for ordering piles of proper length, as well as, (1) cutting off piles not driven to grade and (2) extending piles driven below cut-off elevation.

- Unanticipated circumstances often arise during pile installation. We recommend that our engineers be retained to provide on-site installation surveillance, inspection, and testing, thereby being readily available to assist in the evaluation of any events or conditions encountered, that differ from those anticipated. Installation records, to include all probe or indicator pile data, load test results, and production pile installation or driving records, should be maintained by Whitaker Laboratory, Inc personnel.

All site work should be performed in accordance with the SITE WORK RECOMMENDATIONS section of this report.

Disk Filter Tank (Below Grade Structure):

Settlements of below grade structures are anticipated to be minimal since the pressure exerted by the structures were roughly calculated to be slightly less than the overburden pressure, which existed prior to excavation. Please note however, loosening and softening of subgrade soils during construction could lead to settlement. Careful groundwater control and subgrade preparation will be required. Past experience indicates that insufficient groundwater control combined with insufficient excavation support, could cause the subgrade soils to yield during excavation resulting in heave and disturbance of the bearing soils. If heaving/disturbance of the bearing soils goes undetected, potentially damaging settlements could occur to below grade structures.

Please note that soft and/or loose soils were consistently encountered 8 to 12 feet below existing grades on this site. Due to bearing elevations of the Disk Filter Tank residing 8 to 10 feet below existing grades, Whitaker recommends provisions be made for stabilizing the bottom of the excavation to achieve a stable working surface for foundation construction. Stabilization will require temporary dewatering the area prior to excavation. Dewatering measures should maintain groundwater levels a minimum of 5 feet below the bottom of foundation elevations. In addition to dewatering, the bottom of the excavation should be over excavated a minimum of 18 inches below bottom of mat foundation elevations. Backfill should consist of compacted #57 stone wrapped in filter fabric.

Below grade walls must be capable of resisting the lateral earth pressures that will be imposed on them during and after construction. Based on standard penetration testing of soils encountered on this site, the following earth pressure coefficients given in Table I are recommended. The coefficients given below are based on use of granular on-site sand backfill within a 1:1 (horizontal to vertical) wedge behind the walls. On-site clay soils (SC) are not recommended for use as wall backfill. The "at-rest" coefficient should be used for design based on the assumption of an unyielding or rigid wall.

For temporary retaining structures such as sheet pile walls, the coefficients should be selected by the designer based on the type of wall, whether the wall is braced or unbraced and other conditions. For "worst case" design conditions where positive drainage is not provided or is temporarily interrupted, the hydrostatic pressure will have to be added to the earth pressure on the wall. For this design, groundwater should be assumed to extend within 1 foot of the ground surface.

Table I: Recommended Soil Parameters for Disk Filter Tank

Depth (ft, below ground surface)	SPT "N" Range	Soil Classification	Approximate Soil Unit Weight (pcf)		Internal Friction Angle (degrees)	Cohesion (psf)	Lateral Earth Coefficient		
			Sat	Submerged			Active, K_a	Passive, K_p	At Rest, K_o
0-6	6 - 11	SP-SM, SM	112	49.6	27	0	0.375	2.66	0.45
6-8	10	CL	118	55.6	0	1000	1.0	1.0	1.0
8 - 38	3 - 5	SC	112	49.6	27	0	0.375	2.66	0.45
38-50	30+	SM	120	57.6	32	0	0.28	3.5	0.45

Blower Building:

All site work should be performed in accordance with the SITE WORK RECOMMENDATIONS section of this report.

After completion of site work, the permanent fill shall be monitored for settlement prior to foundation construction. Settlement monitoring plates shall be installed within the mass of the permanent fill and extended above the surface of the fill. Settlement readings shall be made and recorded at one-week intervals after completion of fill.

Foundation construction should not start until approved by the geotechnical engineer. It is estimated that a 30 to 40 day delay will be required to achieve full consolidation of the site due to the weight of the fill.

If our site grading and foundation loading assumptions are accurate and the above settlement monitoring is performed, shallow foundation elements can be utilized for support of the Blower Building structure. Soil bearing pressures of 2000 psf may be used. All footings should have minimum plan dimensions of 24 inches. Bearing elevations of foundations should be at least 12 inches below grade. Overall and differential settlements on the order of 1 inch and 1 ½ inch respectively or less should be expected.

SITE WORK RECOMMENDATIONS

We will be pleased to discuss these recommendations with the owner and the site work contractor selected to do the work. We believe it will be beneficial to the project, for the owner and the contractor to have a clear understanding of our recommendations.

1. Prior to construction, all building areas, plus at least 10 feet on each side and all areas to be paved, should be stripped of all vegetation, topsoil and root systems. Site drainage during construction should be considered prior to this clearing and stripping. Preventing the ponding of storm water is of particular importance.

2. Topsoil, organics, root-mat and other surface materials will likely vary across the site. Individual test borings may not accurately reflect the presence of, or the thickness of such materials due to site variability and/or surfacing clearing to facilitate access for drilling equipment. Site clearing and grubbing, when unsupervised, and particularly in areas of wet soils and times of wet weather, may push organic debris into otherwise stable soils. Undercutting and clearing with a track hoe in lieu of bulldozers can minimize this.

    a. Developers, designers and contractors must be aware that the sand clay strata found at and just below the ground surface, will loose strength and degrade rapidly under construction traffic and repetitive construction operations **when worked during wet periods. It is imperative that a positive site drainage plan be conceived and implemented prior to site clearing, utility construction, and earthwork operations beginning.** This near surface sand clay strata has a strong affinity for free water, and when disturbed under wet conditions are difficult, if not impossible, to adequately dry-out for reuse in construction and/or stabilize to start placing fill. We recommend grading all subgrades to promote positive drainage away from structural areas.

3. Any stump holes or other depressions should be cleared of loose material and debris, and should then be back-filled with approved fill. The backfill should be placed in 6-inch thick lifts and compacted to 95% density in accordance with ASTM D-1557.

4. Any existing utilities that underlie the site should be relocated and their trenches back-filled with approved soil. The backfill should be placed in 6-inch lifts and compacted to 95% density according to ASTM D-1557.

5. Prior to fill placement, the subgrade should be proof rolled with a loaded dump truck to locate unstable or soft areas. Any unstable areas should then be investigated to determine the cause of the instability. If due to unsuitable soils, such as highly organic soils or soft clays, the areas should be undercut to firm soil and replaced with approved fill compacted in 6-inch lifts to minimum density of 95% in accordance with ASTM D-1557. If the instability is due to excess moisture in otherwise stable soil, the area should be drained and compacted to 95% density.

6. Any fill or backfill required to level or raise the site should be placed in 8 to 10 inch thick, loose lifts and compacted by appropriate compaction equipment to 95% density in accordance with ASTM D-1557.

7. All of the fill and backfill (including utility line backfill) for this project should consist of clean, free draining granular soils. The fill should be free of objectionable roots, clay lumps, organics and other debris. The fill should be readily compactable during placement. Soils classified as SW, SP, SP-SM or SM with a maximum of 15% passing a #200 sieve may be acceptable. Soils with the minus #200 fraction classified as MH, CH, OH, ML, CL or SC may be rejected. Soils with a maximum plasticity index of 25 and a maximum liquid limit 40 may be acceptable for use only beneath building pads which are situated well above the groundwater table with approval from the geotechnical engineer. Soils classified as SC or CL, exhibiting moisture sensitivity, soils with excessive clay content, or excessive moisture should not be used without approval from the geotechnical engineer. Approved sands will also need to be moisture conditioned as necessary to facilitate proper compaction throughout its entire depth. If utility trenches cannot be sufficiently dewatered to readily allow compaction of the specified pipe bedding material, then a class I (ASTM-D-2321) gravel or gravel mixture will be required.

8. To assist in reducing moisture beneath the structure, and to reduce the potential for mold growth, the site shall be graded and filled as necessary to direct drainage away from the structure. If sub drains are installed, these alone may not prevent moisture vapor beneath the structure that can cause mold growth. (Also refer to paragraph 10 below). Care must be taken to not place concrete on top of wet soils. For example, if fill or natural soils experience heavy rain, the soils should be properly drained and dried, prior to placement of concrete. Otherwise moisture migration through the slab will occur.

9. Compact all footing excavations and slab subgrades to a minimum density of 95% in accordance with ASTM-D-1557, prior to placement on concrete. The footing excavations, and all prepared slab subgrade, should be maintained in a dry and compacted condition until the concrete is placed. Areas that are softened by water or that are disturbed by construction activity should be re-worked, re-compacted, or appropriately repaired to the required bearing and density. If necessary, stone backfill or other corrective measures may be implemented to stabilize footings.

10. All slabs-on-grade should be supported on a minimum of 4-inches of granular, free-draining gravel or coarse sand to reduce moisture migration by capillarity. A vapor retarding membrane, overlying this granular base, is recommended to further reduce moisture migration into finished areas of the structure. Note that the use of these measures will not totally prevent moisture under or on top of slabs or beneath structures. (Also refer to paragraph 8 above).

11. Any footing excavations that are directly adjacent to the existing foundations should be done in small increments to avoid undermining them and causing a loss of support to the existing structure. If necessary, the excavations should be sheeted and braced or grouting should stabilize the soil in the immediate area.

QUALITY CONTROL AND TESTING

Documented inspections and/or testing performed by Whitaker Laboratory personnel, at the following critical milestones during construction, will be required for the recommendations contained within this report to be validated:

Site Work:

1. After stripping and prior to placement of fill: Verify the site was adequately stripped, perform proofrolling and density testing on exposed subgrade soil and determine if subgrade is acceptable to begin receiving backfill and/or fill.

2. During backfill or fill placement: Perform density testing on each lift of backfill or fill soil.

SBR's:

1. Perform load test on selected pile after indicator pile driving or perform PDA analysis on a minimum of 5 indicator piles during indicator pile driving.

2. Provide driving criteria for production piles and indicate recommended length for production piles.

3. Document and observe production pile driving.

Disk Filter Tank (Below Grade Structure):

1. Verify subgrade soil 18-inches below bottom of mat foundation is acceptable to begin receiving #57 stone backfill wrapped in filter fabric.

Blower Building:

1. Install settlement-monitoring plates to monitor settlement of permanent fill. Provide recommendation when foundation construction can begin.

2. After footings are excavated and prior to steel or concrete placement; perform footing inspections. Provide recommendations for remedial action if required.

At the appropriate time, please contact Whitaker Laboratory, Inc. for budgetary and scheduling purposes for the performance of the above required inspection and testing services.

We further offer concrete, asphalt, masonry, and structural steel inspections and testing. Whitaker Laboratory, Inc. also performs observational services for mold mitigation, including observation of installation of vapor retarding membranes, subdrains, overall site drainage, and regularly scheduled observations after construction of site and landscape drainage, and monitoring of humidity and moisture in slabs and basement walls.

QUALIFICATIONS OF REPORT

Any recommendations or opinions offered in this report are based on our interpretation of the data obtained from this investigation. It should be noted that underlying subsurface and soil conditions can, and do, vary considerably within short lateral distances. Regardless of the thoroughness of any subsurface investigation, it is possible that conditions may be revealed between boring locations that are different from those found by our borings and used for our analysis. For this reason, we recommend that the site preparation and foundation construction for this project be monitored closely. If deviations of the soil conditions from those presented in this report appear, we will be glad to furnish any additional analyses and recommendations that may be required.

This report was made to investigate subsurface properties of the site and is not intended to serve as a wetlands survey, toxic mold assessment, or environmental site assessment. No effort has been made to define, delineate, or designate any area as wetlands or an area of environmental concern or contamination. Any references to low areas, poorly drained areas, etc. are related to geotechnical applications. Any recommendations regarding drainage and earthwork are made on the basis that such work can be permitted and performed in accordance with the current laws pertaining to wetlands, storm water runoff, and environmental contamination.

This report does not attempt to define or represent any FEMA, or otherwise designated, flood, erosion, scour, or other hazardous zones; nor does it presume to reflect that governmental or other authorities will grant approval of the project and issue appropriate permits.

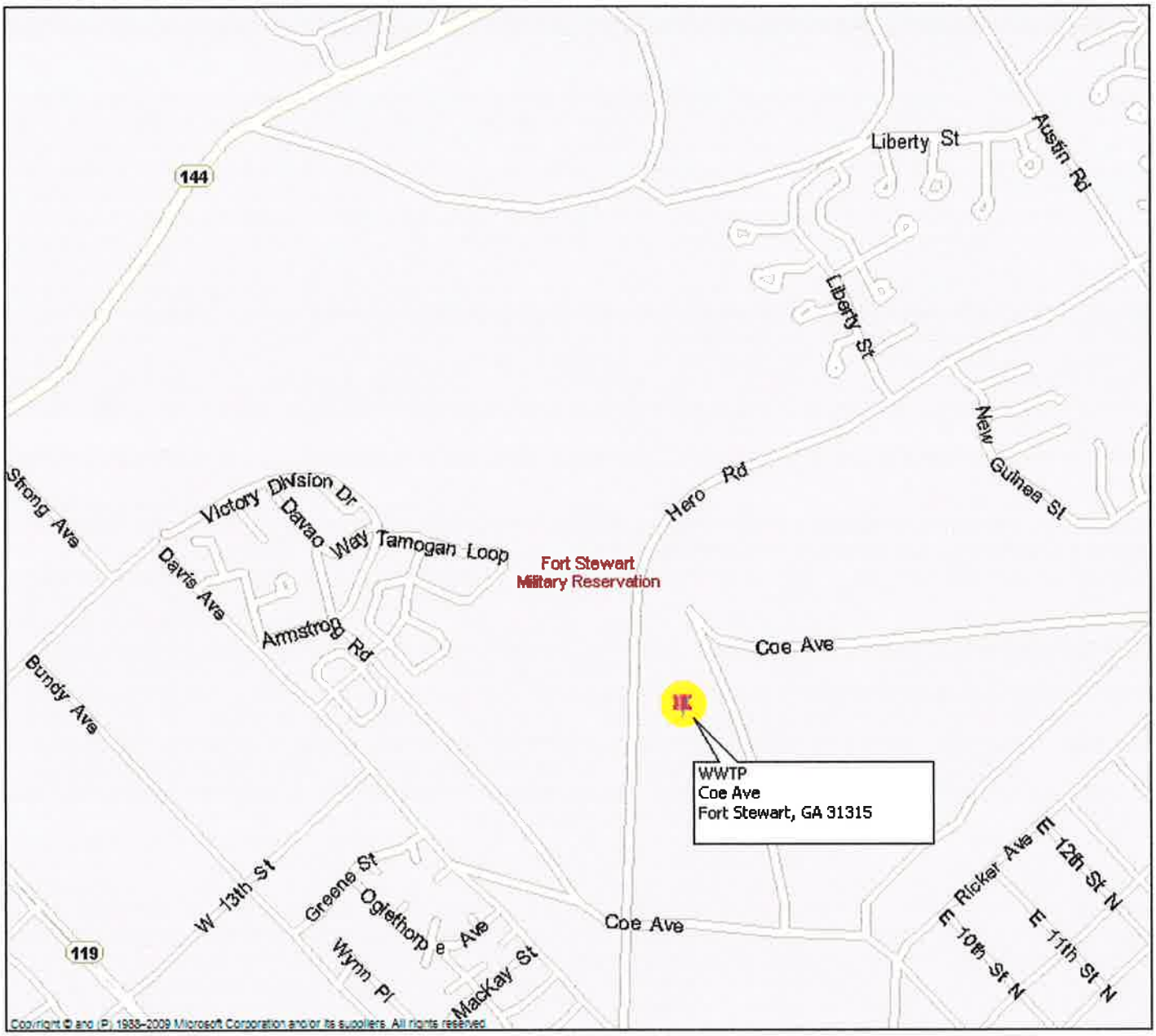
WARRANT: WHITAKER LABORATORY, INC. and its professional engineers strive to perform all services in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering profession practicing in the same locality and under similar conditions. No other warranty or representation, expressed or implied, is included or intended in this agreement, in any report, opinion, document, or otherwise. We carry commercial general liability insurance, including completed operations, and professional liability insurance in aggregate amounts deemed adequate, and we comply with the statutory requirements for workmen's compensation insurance. Accordingly, the liability of WHITAKER LABORATORY, INC. and its professional engineers, to the client, owner, or any other party, for any loss or damage, resulting from any cause, including professional acts, errors, omissions, negligence,

toxic mold and other environmental claims, breach of warranty or breach of contract, shall not exceed the total compensation received by us for services related to this project; and client will defend, settle, and discharge any claims or allegations of liability for same against us by others. If client desires higher monetary limits of our liability, we will be pleased to discuss such higher limits and the impact on liability and fees. In the event the client makes a claim against us, at law or otherwise, for any alleged act, error, omission, negligence, breach of warranty or breach of contract, arising from the performance of our services, and client fails to prove such claim, then client shall pay all costs accrued by us in defending ourselves.

TITLE: The ownership of opinions, technical ideas, methods and means, drawings, calculations, and other data developed by us during the course of preparing proposals or rendering engineering services remains exclusively with us. It is a condition of this report or proposal that the client agrees not to use the opinions, technical ideas, methods and means, drawings, calculations or any other data for projects or locations, other than those specifically addressed in the report, and that no one other than the client may use this report, without the written permission of WHITAKER LABORATORY, INC.

APPENDIX I

SITE VICINITY & BORING LOCATION PLANS



Site Vicinity Map

Waste Water Treatment Plant
Hinesville
Fort Stewart, Georgia

N

Boring Location Plan

Waste Water Treatment Plant
Hinesville
Fort Stewart, Georgia

N

ALL BORING LOCATIONS ARE APPROXIMATE, & ARE BASED ONLY ON FIELD ESTIMATES.

APPENDIX II

BORING RECORDS

Client: P. C. Simonton and Associates

Boring No. B-1

Project: Hinesville/Ft. Stewart WWTP Improvement

Date: 3/24/11

Location: Hinesville, GA

Engineer: Follo

SUBSURFACE PROFILE			Sample		Standard Penetration Test		
Depth	Description	Depth	Number	Blows/ft	blows/ft 10 20 30 40 50 60	Water Table	Remarks
0	Ground Surface	0					
	SM-PT Brown, sandy topsoil		1	6			
			2	8			
5	***SM*** Loose, brown fine silty sand	5	3	7			
	SM-SC Loose, tan fine clayey sand		4	4			
10	***CH*** Soft, gray clay	10	5	6			
	SC Firm, gray fine sand clay						
15	***SC*** Very soft gray fine sand clay	15	6	2			
20	***CH*** Very soft gray clay	20	7	2			
25	***SP-SM*** Loose to firm, gray medium to fine sand	25	8	8			
30		30	9	14			
35	***SP*** Firm, gray coarse to fine sand	35	10	13			
40	***SC-CL*** Hard, gray medium to fine sand clay	40	11	31			
45	***SP*** Dense, gray coarse to fine sand	45	12	39			
50	***SP*** Dense, gray medium to fine sand	50	13	37			
55	***SM*** Very firm, gray medium to fine sand	55	14	30			
	End of Borehole						
60		60					

Drilled By: Wilkerson

Drill Method: H. S. Auger

Drill Date: 3/24/11

WHITAKER LABORATORY INC.
2500 Tremont Road
Savannah, GA 31405

Hole Size: 6.5"

Datum:

Sheet: 1 of 1

Client: P. C. SImonton and Associates

Boring No. B-2

Project: Hinesville/Ft. Stewart WWTP Improvement

Date: 3/24/11

Location: Hinesville, GA

Engineer: Follo

SUBSURFACE PROFILE		Sample		Standard Penetration Test	Water Table	Remarks
Depth	Description	Number	Blows/ft	blows/ft (10 20 30 40 50 60)		
0	Ground Surface					
	SP-SM Loose, tan fine sand	1	6			6" topsoil
	CL Firm, brown gray silty clay	2	6		▼	
5	***SM-SC*** Loose, tan fine clayey sand	3	8			
	CH Firm, gray clay	4	5			
10		5	5			
	SC-CL Firm to stiff, gray fine sand clay					
15		6	4			
	SC Soft, gray fine sand clay					
20	End of Borehole	7	3			
25						

Drilled By: Wilkerson

Drill Method: H. S. Auger

Drill Date: 3/24/11

WHITAKER LABORATORY INC.
2500 Tremont Road
Savannah, GA 31405

Hole Size: 6.5"

Datum:

Sheet: 1 of 1

Client: P. C. Simonton and Associates

Boring No. B-3

Project: Hinesville/Ft. Stewart WWTP Improvement

Date: 3/25/11

Location: Hinesville, GA

Engineer: Follo

SUBSURFACE PROFILE			Sample		Standard Penetration Test		
Depth	Description	Depth	Number	Blows/ft	blows/ft (10 20 30 40 50 60)	Water Table	Remarks
0	Ground Surface	0					
	SP-SM Very loose to loose, brown fine sand		1	3			6" topsoil
			2	5			
5	***SP-SM*** Loose tan fine sand	5	3	6			
	SM Very loose, tan fine silty sand		4	4		▼	
10	***SC*** Soft gray fine sand clay	10	5	4			
15	***SM*** Very loose, gray medium to fine sand	15	6	3			
20	***SC*** Soft gray fine sand clay	20	7	3			
25	***SM*** Very loose, gray medium to fine silty sand	25	8	3			
30	***SP-SM*** Firm, gray medium to fine sand	30	9	11			
35		35	10	19			
	SP Very firm, gray coarse to fine sand						
40	End of Borehole	40	11	26			
45		45					

Drilled By: Wilkerson

Drill Method: H. S. Auger

Drill Date: 3/25/11

WHITAKER LABORATORY INC.
2500 Tremont Road
Savannah, GA 31405

Hole Size: 6.5"

Datum:

Sheet: 1 of 1

Client: P. C. Simonton and Associates

Boring No. B-4

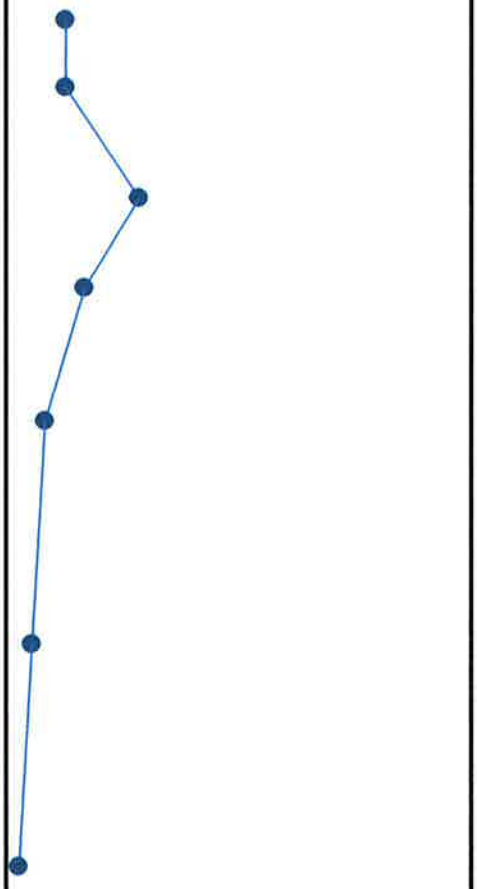
Project: Hinesville/Ft. Stewart WWTP Improvement

Date: 3/25/11

Location: Hinesville, GA

Engineer: Follo

SUBSURFACE PROFILE			Sample		Standard Penetration Test blows/ft 10 20 30 40 50 60	Water Table	Remarks
Depth	Description	Depth	Number	Blows/ft			
0	Ground Surface	0					
	SP-SM Loose, tan fine sand		1	9			6" topsoil
	SC Firm, brown fine sand clay		2	9			
5	***SP-SM*** Very firm, brown fine sand	5	3	20			
	SC Stiff, tan fine sand clay		4	12			
10	***SC*** Firm, tan-gray medium to fine sand	10	5	6			
15	***SM*** Very loose, gray medium to fine silty sand	15	6	4			
	SC Very soft, gray fine sand clay						
20	End of Borehole	20	7	2			
25		25					



Drilled By: Wilkerson

Drill Method: H. S. Auger

Drill Date: 3/25/11

WHITAKER LABORATORY INC.
2500 Tremont Road
Savannah, GA 31405

Hole Size: 6.5"

Datum:

Sheet: 1 of 1

Client: P. C. Simonton and Associates

Boring No. B-5

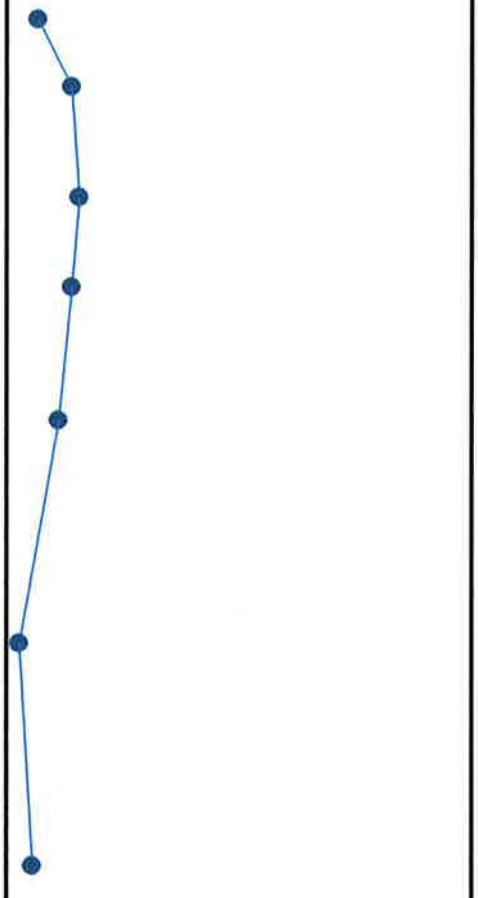
Project: Hinesville/Ft. Stewart WWTP Improvement

Date: 3/25/11

Location: Hinesville, GA

Engineer: Follo

SUBSURFACE PROFILE		Sample		Standard Penetration Test	Water Table	Remarks
Depth	Description	Number	Blows/ft	blows/ft (10 20 30 40 50 60)		
0	Ground Surface					
	SP-SM Loose, tan fine sand	1	5			6" topsoil
	SC Stiff, brown-gray fine sand clay	2	10			
5	***SM*** Firm, tan fine silty sand	3	11			
	SC Stiff, tan fine sand clay	4	10			
10	***SM-SC*** Loose, gray medium to fine clayey sand	5	8			
15	***SM-SC*** Very soft to soft, gray fine silty sand clay	6	2			
20	End of Borehole	7	4			
25						



Drilled By: Wilkerson

Drill Method: H. S. Auger

Drill Date: 3/25/11

WHITAKER LABORATORY INC.
2500 Tremont Road
Savannah, GA 31405

Hole Size: 6.5"

Datum:

Sheet: 1 of 1

Client: P. C. Simonton and Associates

Boring No. B-6

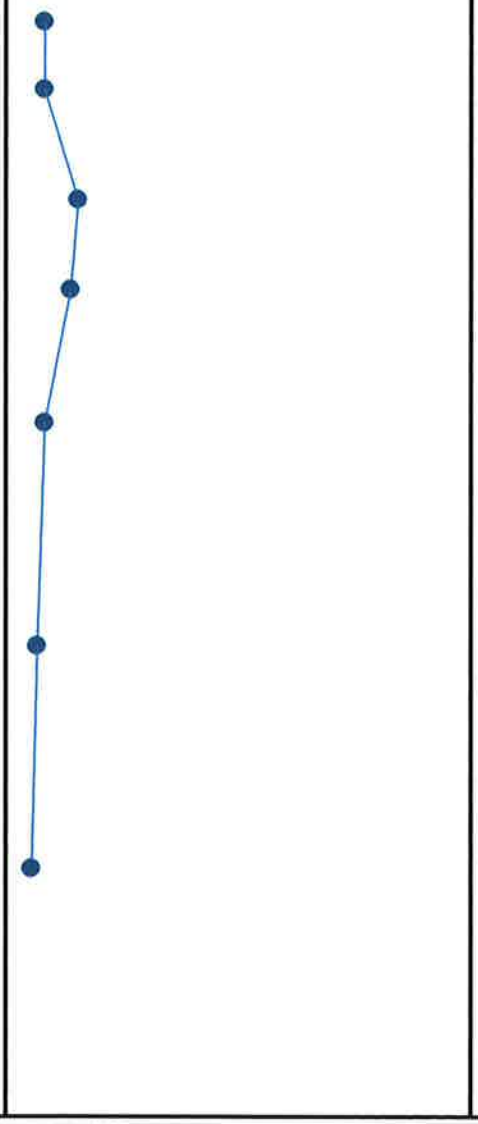
Project: Hinesville/Ft. Stewart WWTP Improvement

Date: 3/25/11

Location: Hinesville, GA

Engineer: Follo

SUBSURFACE PROFILE			Sample		Standard Penetration Test blows/ft 10 20 30 40 50 60	Water Table	Remarks
Depth	Description	Depth	Number	Blows/ft			
0	Ground Surface	0					
	SP-SM Loose, tan-brown fine sand		1	6			
	SM-SC Firm, brown fine silty sand clay		2	6			
5	**SM** Firm, tan fine silty sand	5	3	11			
	CL Stiff, gray-orange silty clay		4	10			
10	**SM** Loose to very loose, gray fine silty sand	10	5	6			
15		15	6	5			
20	End of Borehole	20	7	4			
25		25					



Drilled By: Wilkerson

Drill Method: H. S. Auger

Drill Date: 3/25/11

WHITAKER LABORATORY INC.
2500 Tremont Road
Savannah, GA 31405

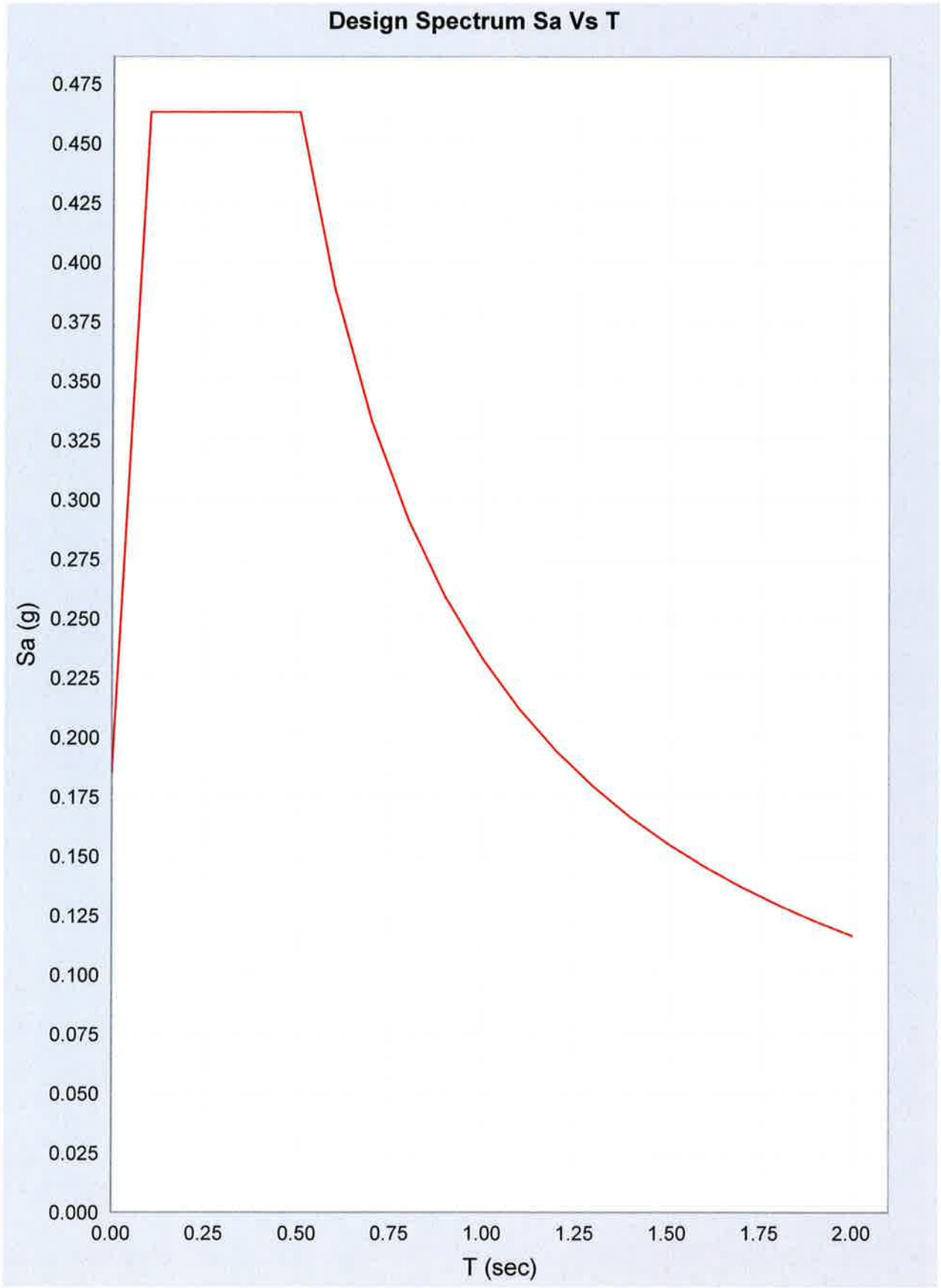
Hole Size: 6.5"

Datum:

Sheet: 1 of 1

APPENDIX III

SEISMIC SPECTRAL PARAMETERS


Design Spectrum Sa Vs T
Sa (g)
0.475
0.450
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
T (sec)

Conterminous 48 States
2006 International Building Code
Latitude = 31.880000000000003
Longitude = -81.6
Spectral Response Accelerations Ss and S1
Ss and S1 = Mapped Spectral Acceleration Values
Site Class B - Fa = 1.0 ,Fv = 1.0
Data are based on a 0.05 deg grid spacing

Period (sec)	Sa (g)
0.2	0.295 (Ss, Site Class B)
1.0	0.100 (S1, Site Class B)

Conterminous 48 States
2006 International Building Code
Latitude = 31.880000000000003
Longitude = -81.6
Spectral Response Accelerations SMs and SM1
SMs = Fa x Ss and SM1 = Fv x S1
Site Class E - Fa = 2.357 ,Fv = 3.5

Period (sec)	Sa (g)
0.2	0.695 (SMs, Site Class E)
1.0	0.350 (SM1, Site Class E)

Conterminous 48 States
2006 International Building Code
Latitude = 31.880000000000003
Longitude = -81.6
Design Spectral Response Accelerations SDs and SD1
SDs = 2/3 x SMs and SD1 = 2/3 x SM1
Site Class E - Fa = 2.357 ,Fv = 3.5

Period (sec)	Sa (g)
0.2	0.463 (SDs, Site Class E)

APPENDIX IV

IMPORTANT GENERAL NOTES

GENERAL NOTES

The "standard" penetration resistance is an indication of the density of cohesion less soils and of the strength of cohesive soils. The "standard" penetration test is measured with a 1.4 inch I.D., 2 inch O.D., sampler driven one (1) foot with a 140 pound hammer falling 30 inches.

RELATIVE DENSITY OF SOIL THAT IS PRIMARILY SAND

Number of Blows	Relative Density
0 - 4	Very loose
5 - 10	Loose
11 - 20	Firm
21 - 30	Very firm
31 - 50	Dense
Over 51	Very dense

CONSISTENCY OF SOIL THAT IS PRIMARILY SILT OR CLAY

Number of Blows	Consistency
0 - 2	Very soft
3 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
16 - 30	Very stiff
Over 31	Hard

While individual test boring records are considered to be representative of subsurface conditions at the respective boring locations on the dates shown, it is not warranted that they are representative of subsurface conditions at other locations and times.

The subsoil stratification shown on these profiles is not warranted but is estimated based on accepted soil engineering principles and practices and reasonable engineering judgment.

Unless notified, samples will be disposed of after 60 days.

MAJOR DIVISIONS	GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS		
More than 50% retained on No. 200 Sieve*		
GRAVELS		
50% or more of coarse fraction retained on No. 4 sieve		
CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silty mixtures
	GC	Clayey gravels, gravel sand clay mixtures
SANDS		
More than 50% of coarse fraction passes No. 4 sieve		
CLEAN SANDS	SW	Well graded sand and gravelly sands, little or no fines
	SP	Poor graded sands and gravelly sands, little or no fines
SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand clay mixtures
FINE GRAINED SOILS		
50% or more passes No. 200 Sieve*		
SILTS AND CLAYS		
Liquid Limit 50% or less		
	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS		
Liquid Limit greater than 50%		
	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS	PT	Peat, muck and other highly organic soils

*Based on the material passing the 3 in. (75 mm) sieve.

PROPOSAL

City of Hinesville
115 East M.L. King Jr. Dr.
Hinesville, GA 31313

Submitted:_____, _____

The undersigned, as Bidder, hereby declares that the only person or persons interested in the Proposal as principal or principals is or are named herein and that no other person that herein mentioned has any interest in this Proposal or in the contract to be entered into; that this Proposal is made without connection with any other person, company or parties making a bid or Proposal; and that it is in full respect fair and in good faith without collusion or fraud.

The Bidder further declares that he has examined the site of the work and informed himself fully in regard to all conditions pertaining to the place where the work is to be done; that he has examined the Plans and Specifications for the work and Contractual Documents relative thereto, and has read all Special Provisions and General Conditions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed.

The Bidder proposes and agrees, if the Proposal is accepted, to contract with the City of Hinesville in the form of contract specified, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary to complete the construction of the work, in full and in complete accordance with the shown, noted, described, and reasonably intended requirements of the Specifications and Contract Documents, to the full and entire satisfaction of the City of Hinesville with a definite understanding that no money will be allowed for extra work except as set forth in the attached General Conditions and Contract Documents, for prices on the following pages.

BID ITEMS

A. Lump sum bid for the necessary additional equipment and installation of the supplied equipment to successfully complete an operational wastewater treatment facility. All cost included except the itemized items below which will be included below.

LUMP SUM BID $_____

In addition to the lump sum bid the following items will be bid at unit prices to provide a unit price for adjustment of quantities if required during the project duration.

	Estimated Quantity	Units	Description	Unit Price	Total Price
1.	_____	SY.	7”-5000PSI Concrete Paving	$_____	$_____
2.	_____	SY.	8”Granite Crusher Run Base	$_____	$_____
3.	_____	SY.	2”-12.5mm Superpave Asphalt Pavement	$_____	$_____
4.	_____	SY.	1 ½”-12.5mm Superpave Asphalt Overlay	$_____	$_____
5.	_____	SY.	4” Sidewalk	$_____	$_____
6.	_____	SY.	Concrete Drainage Channel Removal & Replacement	$_____	$_____

Total Unit Price Items $_____

Total Project Bid $_____

The Bidder further proposes and agrees hereby to commence work under his Contract, with adequate force and equipment, on a date to be specified in written order of the ENGINEER and shall fully complete all work hereunder within Five Hundred Forty (540) consecutive days from and including said date.

The Bidder declares that he understands that the quantities shown for unit price items, are approximate only, are valid only upon written authorization of the ENGINEER, and are subject to either increase or decrease and that should the quantities of any items of work be increased, the Bidder proposes to do the additional at the unit prices stated herein; and should the quantities be decreased, the Bidder also understands that payment will be made on the basis of actual quantities at the unit price bid and will make no claim for anticipated profits for any decrease in quantities, and that actual quantities will be determined upon completion of the work, at which time adjustment will be made to the Contract amount by direct increase or decrease.

The undersigned further agrees that, in case of failure on his part to execute the Construction Contract and the bond within ten (10) consecutive calendar days after written notice being given of the award of the Contract, the check or bond accompanying this bid, and the monies payable thereon, shall be paid into the funds of the _____ as liquidated damages for such failure, otherwise the check or bid bond accompanying this proposal shall be returned to the undersigned.

Attached hereto is a certified check on the_____Bank of _____or a Bid Bond by the_____ in the amount of_____ Dollars ($) made payable to the _____ _____, in accordance with the conditions of the advertisement and provisions herein.

Submitted:

_____

By:

_____

Title:

_____

Bidders Address:_____

City, State, Zip Code:_____

Telephone Number:_____

Bonding Agent:_____

Physical Address:_____

Telephone Number:_____

Underwriters Name:_____

Physical Address:_____

Telephone Number:_____

FAILURE TO COMPLETE THIS SECTION IS GROUNDS FOR REJECTION

BIDDER ACKNOWLEDGE RECEIPT OF THE FOLLOWING ADDENDUM:

No._____ Date_____ No._____ Date_____

No._____ Date_____ No._____ Date_____

EXPERIENCE AND REFERENCES

The Bidder shall state what work he had done (minimum of three) of similar nature to that bid for, and give references that will afford the Owner opportunity to judge as to experience, skill, business standing and financial ability. Failure to complete this section is grounds for rejection.

CONTRACT

THIS AGREEMENT, made this_____day of _____, 20___, by and between_____,herein called "Owner" acting herein through_____and_____ , of _____ . County of _____ , and State of _____, herein called "CONTRACTOR".

WITNESSETH: that for and in consideration of the payments and agreement hereinafter mentioned, to be made and performed by the OWNER, and the CONTRACTOR hereby agrees with the OWNER to commence and complete the construction described as follows:

HINESVILLE/FT. STEWART WASTEWATER TREATMENT
PLANT MODIFICATIONS
FOR
CITY OF HINESVILLE

hereinafter called the project, for the sum of _____ Dollars ($_____) and all extra work in connection therewith, under the terms as stated in the General and Special Conditions of the Contract; and at his (its or their) own proper cost and expense to furnish all the materials, supplies, machinery, equipment, tools, superintendence, labor, insurance, and other accessories and services necessary to complete the said project in accordance with the conditions and prices stated in the Proposal; the General Conditions, Supplemental General Conditions and Special Conditions of the Contract, the plans, which include all maps, plats, blue prints and other drawings and printed or written explanatory matter thereof, the specifications and Contract Documents therefore as prepared by P.C. Simonton and Associates, Inc., herein entitled the ENGINEER, and as enumerated in Paragraph 1 of the Supplementary General Conditions, all of which are made a part hereof and collectively evidence and constitute the Contract.

The Contractor hereby agrees to commence work under this Contract on or before a date to be specified in a written "Notice to Proceed" from the Owner and to fully complete the project within Five Hundred Forty (540) consecutive calendar days thereafter.

The Contractor further agrees to pay, as liquidated damages, the sum of $300 for each consecutive calendar day thereafter as hereinafter provided in Section 01001, Paragraph 1.11.

The owner agrees to pay the contractor in current funds for the past performance of the contract subject to additions and deductions as provided in the General Conditions, Article 14 of the contract. Retainage on progress payments shall be ten (10) percent until the project is substantially complete (80% or more) at which point retainage may be reduced to 5% depending on the contractor's progress related to schedule and workmanship.

IN WITNESS WHEREOF, the parties present have executed this contract in four (4) counterparts, each of which shall be deemed an original, in the year and day first above mentioned.

ATTEST

(Owner)

By

(Secretary)

(Witness)

(Title)

(Contractor)

By

(Secretary)

(Witness)

(Title)

(Address and Zip Code)

PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

1. REFERENCE

By reference, "The Performance Bond and Payment Bond", E.J.C.D.C. Document C-610 and C-615, 2007 Edition, pages 1 through 2 of each inclusive, is a part of this Contract.
.

STATEMENT OF BIDDER'S QUALIFICATIONS

To accompany proposals submitted for construction of_____

Full legal name of Bidder_____

Business Address_____

Business Phone Number_____

Bidder is a (check one) Corporation____ Partnership_____ Individual Proprietorship___ Other (Specify)_____

When Organized? _____When Incorporated?_____

If Bidder is a partnership, list all names of all partners_____

_____

How many years have you been engaged in the contracting business under the present firm name_____

Will you, if requested by the Owner, furnish to them your most recent Financial Statement within 48 hours after bid taking?___ If yes, give date of statement_____

Credit available for this contract $_____

Contracts now in hand, Gross Amount $_____

Have you ever refused to sign a contract at your original bid?_____

Do you have a Georgia Utility Contractor's License?____ If yes, number?_____

Have you ever defaulted on a contract?_____

Remarks_____

_____

(The above statements must be subscribed and sworn to before a Notary Public)

Sworn to and subscribed before me, this _____ day of _____,20__.

Firm Name:_____

_____ (Notary Public)

By:_____ (Title)

REFERENCES:

Provide references for work done, minimum of six, three within the last 12 months of similar size and nature and a listing of all jobs performed in the last 12 months. References will afford the owner opportunity to judge as to capabilities and performance of the contractor.

Provide name, brief description, address, phone number, and contact person for each project listed. Failure to complete this section in its entirety will be grounds for rejection.

LAWFUL PRESENCE AFFIDAVIT

Pursuant to O.C.G.A. § 50-36-1, all persons who - either on behalf of themselves or on behalf of an individual, business, corporation, partnership, or other private entity - apply for certain public benefits must (1) be eighteen years of age or older and (2) submit an affidavit that they are lawfully present in the United States. Public benefits, as defined by O.C.G.A. § 50-36-1(a)(3)(A), include any grant, contract, loan, professional license, or commercial license provided by an agency of State or local government or by appropriated funds of a State or local government.

I, _____, swear or affirm under penalty of perjury under the laws of the State of Georgia that I am 18 years of age or older and (check one):

____ I am a United States citizen, or

____ I am a legal Permanent Resident of the United States, or

____ I am a qualified alien (other than as a permanent resident) or nonimmigrant in the United States pursuant to Federal law.

The secure and verifiable document provided with this affidavit can best be classified as:

_____

I understand that this sworn statement is required by law because I have applied for a public benefit and/or a business license on my behalf as an individual or on behalf of a business, corporation, partnership, or other private entity. I understand that state law required me to provide proof that I am lawfully present in the United States prior to receipt of this public benefit as listed above. I further acknowledge that making a false, fictitious, or fraudulent statement or representation in this sworn affidavit is punishable under the criminal laws of Georgia under O.C.G.A. § 16-10-20 and it shall constitute a separate criminal offense each time a public benefit is fraudulently received.

_____ _____
Signature Date

_____ _____
Title *Alien Registration # for Non-citizens

_____ _____
Business Name TIN or SSN

If this affidavit is not presented in person, applicant must submit a notarized copy of this affidavit.

Notarized this ____ Day of _____, in the State of _____,

County of _____ _____
Notary

_____
Commission Expires

*Note: O.C.G.A § 50-36-1(e) (2) requires that aliens under the Federal Immigration and Nationality Act., Title 8 U.S.C., as amended, provide their alien registration number. Because legal permanent residents are included in the federal definition of "alien", legal permanent residents must also provide their alien registration number. Qualified aliens that do not have an alien registration number may supply another identifying number below:

_____
Another Identifying Number

Contractor Affidavit under O.C.G.A. § 13-10-91(b)(1)

By executing this affidavit, the undersigned contractor verifies its compliance with O.C.G.A. §13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services on behalf of (name of public employer) has registered with, is authorized to use and uses the federal work authorization program commonly known as E-verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned contractor will continue to use the federal work authorization program throughout the contract period and the undersigned contractor will contract for the physical performance of services in satisfaction of such contract only with subcontractors who present and affidavit to the contractor with the information required by O.C.G.A. § 13-10-91(b). Contractor hereby attests that its federal work authorization user identification number and date of authorization are a follows:

_____
Federal Work Authorization User Identification Number/E-verify User Number

_____
Date of Authorization/Date of contract between Contractor and Public Employer

_____
Legal Name of Contractor (please print)

_____
Legal Address of Contractor City, State, & Zip Code

_____
Name of Project

_____
Name of Public Employer

I hereby declare under penalty of perjury that the foregoing is true and correct.
Executed on _____ of _____, 20___ in _____(city), _____(state).

_____
Signature of Authorized Officer or Agent

_____
Printed Name and Title of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME ON THIS _____DAY OF _____, 20___.

_____ _____
Notary Public Commission Expires

Subcontractor Affidavit under O.C.G.A. § 13-10-91(b)(3)

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services under a contract with (name of contractor) on behalf of (name of public employer) has registered with, is authorized to use and uses the federal work authorization program commonly known as E-Verify, or any subsequent replacement program, in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91. Furthermore, the undersigned subcontractor will continue to use the federal work authorization program throughout the contract period and the undersigned subcontractor will contract for the physical performance of services in satisfaction of such contract only with sub-subcontractors who present an affidavit to the subcontractor with the information required by O.C.G.A. § 13-10-91(b). Additionally, the undersigned subcontractor will forward notice of the receipt of an affidavit from a sub-subcontractor to the contractor within five business days of receipt. If the undersigned subcontractor receives notice of receipt of an affidavit from any sub-subcontractor that has contracted with a sub-subcontractor to forward, within five business days of receipt, a copy of such notice to the contractor. Subcontractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

_____
Federal Work Authorization User Identification Number

_____
Date of Authorization

_____
Name of Subcontractor

_____
Name of Project

_____
Name of Public Employer

I hereby declare under penalty of perjury that the foregoing is true and correct.

Executed on _____, ___, 201__ in _____(city), _____(state).

_____
Signature of Authorized Officer or Agent

_____
Printed Name and Title of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME
ON THIS THE _____ DAY OF _____,201__.

_____
NOTARY PUBLIC

My Commission Expires:

_____

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the Controlling Law.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By

ACEC
American Council of Engineering Companies

National Society of Professional Engineers
Professional Engineers in Private Practice

ASCE American Society of Civil Engineers

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
a practice division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

_____

AMERICAN COUNCIL OF ENGINEERING COMPANIES

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AMERICAN SOCIETY OF CIVIL ENGINEERS

This document has been approved and endorsed by

The Associated General Contractors of America

Knowledge for Creating and Sustaining the Built Environment

Construction Specifications Institute

National Society of Professional Engineers
1420 King Street, Alexandria, VA 22314

American Council of Engineering Companies
1015 15th Street, N.W., Washington, DC 20005

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor Nos. C-520 or C-525 (2002 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the EJCDC Construction Documents, General and Instructions (No. C-001) (2002 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (No. C-800) (2002 Edition).

TABLE OF CONTENTS

GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*--Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*--The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*--The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*--Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*--The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*--The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*--The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*--The Advertisement or Invitation to Bid, Instructions to Bidders, bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*--A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*--A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*--The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*-- Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor's submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*--The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*--The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any, (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*--The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*--See Paragraph 11.01.A for definition.

17. *Drawings*--That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*--The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer*--The individual or entity named as such in the Agreement.

20. *Field Order*--A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*--Sections of Division 1 of the Specifications. The General Requirements pertain to all sections of the Specifications.

22. *Hazardous Environmental Condition*--The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto in connection with the Work.

23. *Hazardous Waste*--The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*--Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*--Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*--A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*--The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*--A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*--The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs*--Polychlorinated biphenyls.

31. *Petroleum*--Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*--A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*--The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*--The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*--Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Related Entity* -- An officer, director, partner, employee, agent, consultant, or subcontractor.

37. *Resident Project Representative*--The authorized representative of Engineer who may be assigned to the Site or any part thereof.

38. *Samples*--Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

39. *Schedule of Submittals*--A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

40. *Schedule of Values*--A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

41. *Shop Drawings*--All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

42. *Site*--Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

43. *Specifications*--That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain

administrative requirements and procedural matters applicable thereto.

44. *Subcontractor*--An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

45. *Substantial Completion*--The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

46. *Successful Bidder*--The Bidder submitting a responsive Bid to whom Owner makes an award.

47. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

48. *Supplier*--A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.

49. *Underground Facilities*--All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

50. *Unit Price Work*--Work to be paid for on the basis of unit prices.

51. *Work*--The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

52. *Work Change Directive*--A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following meaning.

B. *Intent of Certain Terms or Adjectives*

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered", "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action or determination will be solely to evaluate, in general, the Work for compliance with the requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day*

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents, or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents, or

c. has been damaged prior to Engineer's - recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 - PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review**:**

1. a preliminary Progress Schedule; indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual or code, or any instruction of a Supplier shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, or Engineer, or any of, their Related Entities, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. Reporting Discrepancies

1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor knew or reasonably should have known thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work

(unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample; (Subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier or other individual or entity performing or furnishing all of the Work under a direct or indirect contract with Contractor, shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or Engineer's consultants, including electronic media editions; or

2. reuse any of such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaption by Engineer.

B. The prohibition of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Copies of data furnished by Owner or Engineer to Contractor or Contractor to Owner or Engineer that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party..

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. Possible Price and Times Adjustments

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

b. with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, Owner and Engineer, and any of their Related Entities shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all such information and data,

b. locating all Underground Facilities shown or indicated in the Contract Documents,

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction, and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the Engineer in the preparation of the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their Related Entities with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered to Contractor written notice: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06. G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 - BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified

in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent must be accompanied by a certified copy of the agent's authority to act.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, include as additional insured (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include completed operations insurance;

4. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

5. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

6. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment.

a. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, (other than caused by flood) and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any

deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insured or additional insured (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order .

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract

Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole,

3) it has a proven record of performance and availability of responsive service; and

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times, and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. Substitute Items

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented in the General Requirements and as Engineer may decide is appropriate under the circumstances.

d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time;

b) whether or not use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

c) whether or not incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

a) all variations of the proposed substitute item from that specified , and

b) available engineering, sales, maintenance, repair, and replacement services;

4) and shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change,

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B Whether or not Engineer approves a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued . No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity, nor

2. shall anything in the Contract Documents create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual

or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, and Engineer,, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of Owner or Engineer its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 *Use of Site and Other Areas*

A. Limitation on Use of Site and Other Areas

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Draw-

ings or Specifications or to the acts or omissions of Owner or Engineer or , or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

D. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the acceptable Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. Shop Drawings

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:* Contractor shall also submit Samples to Engineer for review and approval in accordance with the acceptable schedule of Shop Drawings and Sample submittals.

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals , any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. Submittal Procedures

1. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:

a. all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto; and

d. shall also have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents

with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations, that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample Submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its Related Entities shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or

arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their respective consultants, agents, officers, directors, partners, or employees by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve, maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 - OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or via other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and

properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's actions or inactions.

C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's action or inactions.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

8.06 *Insurance*

A. Owner's responsibilities, if any, in respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility in respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents and will not be changed without written consent of Owner and Engineer.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment , a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to, the Resident Project Representative, if any, and assistants, if any.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall

promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

A.Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.B.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any bond to be given to a surety, the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim, shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Time shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part,

2. approve the Claim, or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to Engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have

resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expresses, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A and 11.01.B.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*

1. Contractor agrees that:

a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

b. Contractor's costs for unloading and handling on the Site, labor, installation , overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. Contingency Allowance

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect any other item of Work; and

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraph 12.01.C.2.a is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted

by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times , or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer and the Related Entities of each of them shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of Engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. All defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in said Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to

be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, it must, if requested by Engineer, be uncovered for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications .

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress

payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. Applications for Payments

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations on the Site of the executed Work as an experienced and qualified design professional and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

b. that there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Work, or

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent

inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

c. there are other items entitling Owner to a set-off against the amount recommended; or

d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor corrects to Owner's satisfaction the reasons for such action.

3. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1.

14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, , Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will within 14 days after submission of the tentative certificate to Owner notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will within said 14 days execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial

Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to complete or correct items on the tentative list.

14.05 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions.

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. Application for Payment

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.7;

b. consent of the surety, if any, to final payment;

c. a list of all Claims against Owner that Contractor believes are unsettled; and

d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. *Engineer's Review of Application and Acceptance*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations

under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Payment Becomes Due

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and , will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion),

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B, and 15.02.C.

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 - DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be

governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions, or

2. agrees with the other party to submit the Claim to another dispute resolution process, or

3. gives written notice to the other party of their intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 - MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

FmHA Supplemental General Conditions

The provisions of the Farmers Home Administration (FmHA) Supplemental General Conditions as described herein change, amend, or supplement the General Conditions and shall supersede any conflicting provisions of this CONTRACT. All provisions of the General Conditions which are not changed, amended, or supplemented, remain in full force.

1. Contract Approval.

1.1 The OWNER and the CONTRACTOR will furnish the OWNER'S Attorney such evidence as required so that the OWNER'S Attorney can complete and execute "Certificate of Owner's Attorney" (Section 14) before the OWNER submits the executed Contract Documents to FmHA for approval.

1.2 Concurrence by the FmHA State Director or designee in the award of the CONTRACT is required before it is effective and the "FmHA Concurrence" (Section 15), shall be attached and made a part of the Agreement.

1.3 When a Performance BOND and Payment BOND are provided, the United States acting through the Farmers Home Administration will be named as co-obligee in these BONDS unless prohibited by State law. Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State where the project is located.

1.4 This CONTRACT is expected to be funded in part with funds from the FmHA. Neither the United States nor any of its departments, agencies, or employees is or will be a party to this CONTRACT or any SUBCONTRACT.

2. Contract Change Orders.

2.1 All changes affecting the project's construction cost or modifications of the terms or conditions of the contract must be authorized by means of a written contract change order which is mutually agreed to by the OWNER and CONTRACTOR and is approved by FmHA. The contract change order will include extra work, work for which quantities have been altered from those shown in the bidding schedule, as well as decreases or increases in the quantities of installed units which are different than those shown in the bidding schedule because of final measurements. All changes must be recorded on a contract change order before they can be included in a partial payment estimate.

2.2 Form FmHA 1924-7, "Contract Change Order" or similar form approved by FmHA shall be used to record CONTRACT changes. (Revised 5-12-87, SPECIAL PN.)

2.3 When the CONTRACT sum is, in whole or in part, based on unit prices, the OWNER reserves the right to increase or decrease a unit price quantity as may be deemed reasonable or necessary in order to complete the work contemplated by this CONTRACT.

3. Partial Payment Estimates.

3.1 Form FmHA 1924-18, "Partial Payment Estimate," or similar form approved by FmHA shall be used when periodic payments due the CONTRACTOR. (Revised 5-12-87, SPECIAL PN.)

3.2 The OWNER may after consultation with the ARCHITECT/ENGINEER withhold or, on account of subsequently discovered evidence, nullify the whole or part of any approved partial payment estimate to such extent as may be necessary to protect the OWNER from loss on account of:

3.2.1 Defective work not remedied.

3.2.2 Claims filed.

3.2.3 Failure of CONTRACTOR to make payments properly to subcontractors or suppliers.

3.2.4 A reasonable doubt that the WORK can be completed for the balance then unpaid.

3.2.5 Damage to another CONTRACTOR.

3.2.6 Performance of WORK in violation of the terms of the CONTRACT DOCUMENTS.

3.3 Where WORK on unit price items is substantially complete but lacks testing, clean-up and/or corrections, amounts shall be deducted from unit prices in partial payment estimates to amply cover such testing, clean-up and/or corrections.

3.4 When the items in 3.2 and 3.3 are cured, payment shall be made for amounts withheld because of them.

3.5 Payments will not be made that would deplete the retainage nor place in escrow any funds that are required for retainage nor invest the retainage for the benefit of the CONTRACTOR.

4. Conflict of Interest.

4.1. Unacceptable bidders. An ENGINEER or ARCHITECT (individual or firm including persons they employ) who has prepared plans and specifications will not be considered an acceptable bidder. Any firm or corporation in which such ENGINEER or ARCHITECT (including persons they employ) is an officer, employee, or holds or controls a substantial interest will not be considered an acceptable bidder. Contracts or purchases by the CONTRACTOR shall not be awarded or made to a supplier or manufacturer if the ENGINEER or ARCHITECT (firm or individual) who prepared the plans and specifications has a corporate or financial affiliation with the supplier or manufacturer. Bids will not be awarded to firms or corporations which are owned or controlled wholly or in part by a member of the governing body of the OWNER or to an individual who is such a member.

4.2. The OWNER'S officers, employees, or agents shall not engage in the award or administration of this CONTRACT if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: (a) the employee, officer or agent; (b) any member of their immediate family; (c) their partner or (d) an organization which employs, or is about to employ, any of the above baa financial or interest in the CONTRACTOR. The OWNER'S officers, employees, or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from the CONTRACTOR or subcontractor.

5. Protection of Lives and Property

5.1 In order to protect the lives and health of its employees under the CONTRACT, the CONTRACTOR shall comply with all pertinent provisions of the Occupational Safety and Health Administration (OSHA) and any State Safety and Health agency requirements.

5.2 The CONTRACTOR alone shall be responsible for the safety, efficiency, and adequacy of its plant, appliances, and methods, and for any damage which may result from their failure or their improper construction, maintenance or operation.

6. Remedies. Unless otherwise provided in this CONTRACT, all claims, counterclaims, disputes, and other matters in question between the OWNER and

the CONTRACTOR arising out of or relating to this CONTRACT or the breach thereof will be decided by arbitration if the parties mutually agree, or in a court of competent jurisdiction within the State in which the OWNER is located.

6.1 The arbitration provisions of this section may be initiated by either party to this CONTRACT by filing with the other party and the ENGINEER/ARCHITECT a WRITTEN REQUEST for arbitration.

6.2 Each party to this CONTRACT will appoint one arbitrator; the two arbitrators will select a third arbitrator.

6.3 The arbitrators will select a hearing location as close to the OWNER'S locale as possible.

6.4 The procedure for conducting the hearings will follow the Construction Industry Arbitration Rules of the American Arbitration Association.

7. Gratuities.

7.1 If the OWNER finds after a notice and hearing that the CONTRACTOR, or any of the CONTRACTOR'S agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of the OWNER, the State, or FmHA officials in an attempt to secure this CONTRACT or favorable treatment in awarding, amending, or making any determinations related to the performance of this CONTRACT, the OWNER may, by written notice to the CONTRACTOR, terminate this CONTRACT. The OWNER may also pursue other rights and remedies that the law or this CONTRACT provides. However, the existence of the facts on which the OWNER bases such findings shall be an issue and may be reviewed in proceedings under the Remedies clause of this CONTRACT.

7.2 In the event this CONTRACT is terminated as provided in paragraph 7.1 the OWNER may pursue the same remedies against the CONTRACTOR as it could pursue in the event of a breach of the CONTRACT by the CONTRACTOR. As a penalty, in addition to any other damages to which it may be entitled by law, the OWNER may pursue exemplary damages in an amount has determined by the OWNER) which shall be not less than three nor more than ten times the costs the CONTRACTOR incurs in providing any such gratuities to any such officer or employee.

8. Audit and Access to Records. For all negotiated contracts (except those of $10,000 or less), the FmHA, the Comptroller General, the OWNER or any of their duly authorized representatives, shall have access to any books, documents, papers, and records of the CONTRACTOR, which are pertinent to the CONTRACT, for the purpose of making audits, examinations, excerpts and transcriptions. The CONTRACTOR shall maintain all required records for three years after final payment is made and all other pending matters are closed.

9. Small, Minority and Women's Businesses. If the CONTRACTOR intends to let any subcontracts for a portion of the work, the CONTRACTOR shall take affirmative steps to assure that small, minority and women's businesses are used when possible as sources of supplies, equipment, construction, and services. Affirmative steps shall consist of (1) including qualified small minority, and women's businesses on solicitation lists; (2) assuring that small, minority and women's businesses are solicited whenever they are potential sources; (3) dividing total requirements when economically feasible, into small tasks or quantities to permit maximum participation of small, minority and women's businesses; (4) establishing delivery schedules, where the requirements of the work permit, which will encourage participation by small, minority and women's businesses; (5) using the services and assistance of the Small Business Administration, and the Minority Business Development Agency of the U.S. Department of Commerce; (6) requiring each party to a subcontract to take the affirmative steps of this section; and (7) CONTRACTORS are encouraged to procure goods and services from labor surplus area firms.

10. Anti-Kickback. The CONTRACTOR shall comply with the Copeland Anti-Kickback Act (18 USC 874) as supplemented in Department of Labor regulations (29 CFR, Part 3). This act provides that each CONTRACTOR shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public facilities, to give up any part of the compensation to which they are otherwise entitled. The OWNER shall report all suspected or reported violations to FmHA.

11. Violating Facilities. Where this CONTRACT exceeds $100,000 the CONTRACTOR shall comply with all applicable standards, orders or requirements issued under section 306 of the Clean Air Act (42 U.S.C. 1857(h)), section 508 of the Clean Water Act (33 U.S.C. 1368), Executive Order 11738, and Environmental Protection Agency regulations 40 CFR Part 15 which prohibit the awarding of non-exempt federal contracts, grants, or loans to facilities included on EPA's list of violating facilities. The CONTRACTOR will report violations to the EPA.

12. State Energy Policy. The CONTRACTOR shall comply with the Energy Policy and Conservation Act (P.L. 94-163). Mandatory standards and policies relating to energy efficiency, contained in the State Energy Conservation Plan, shall be utilized.

13. Equal Opportunity Requirements. For all contracts in excess of $10,000, the CONTRACTOR shall comply with Executive Order 11246, entitled "Equal Employment Opportunity," as amended by Executive Order 11375, and as supplemented in Department of Labor regulations (41 CFR Part 60).

13.1 If the CONTRACT exceeds $10,000, the CONTRACTOR will execute Form FmHA 400-6, "Compliance Statement."

13.2 The CONTRACTOR'S compliance with Executive Order 11246 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the Standard Federal Equal Employment Opportunity Construction Contract Specifications, as set forth in 41 CFR Part 60-4 and its efforts to meet the goals established for the geographical area where the CONTRACT is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the CONTRACT, and in each trade, and the CONTRACTOR shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from contractor to contractor or from project to project for the sole purpose of meeting the CONTRACTOR'S goals shall be a violation of the CONTRACT, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

13.3 The CONTRACTOR shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the CONTRACT resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor; employer identification number; estimated dollar amount of subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the CONTRACT is to be performed.

14. Certificate of Owner's Attorney.

I, the undersigned, _____ , the duly authorized and acting legal representative of_____ _____, do hereby certify as follows

I have examined the attached contract(s) and performance and payment bond(s) and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements are adequate and have has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with terms, conditions, and provisions thereof.

_____

Date:_____

NOTE: Delete phrase "performance and payment bonds" when not applicable.

15. FmHA Concurrence.

As lender or insurer of funds to defray the costs of this contract, and without liability for any payments thereunder, the Farmers Home Administration (FmHA) hereby concurs in the award of this CONTRACT to

_____

U.S. Department of Agriculture
Farmers Home Administration

By_____ Title _____

Date_____

This CONTRACT shall not be effective unless and until concurred in by the State Director of the Farmers Home Administration, U.S. Department of Agriculture or a delegated representative.

SECTION 01001
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 COMMENCEMENTS AND PROSECUTION OF WORK

A. Contract time shall begin at which time the Owner will issue a written Notice to Proceed. The Contractor must commence construction within ten (10) days of issuance of a written Notice to Proceed. The Contractor shall maintain sufficient labor and supervision on the job until all items have been completed and the Engineer's Final Certification has been issued.

1.02 COOPERATION

A. The General Contractor and Sub-Contractors shall cooperate with one another and with other Contractors doing related work, and shall coordinate their work with the work of other trades and other Contractors so as to facilitate the general progress of the work. Each trade shall afford all other trades and all other Contractors every reasonable opportunity for the installation of their work and for storage of their materials.

1.03 SANITARY FACILITIES, TEMPORARY

A. Do not allow any sanitary nuisances to be committed in or about work; enforce sanitary regulations of Local and State Health authorities.

1.04 SITE EXAMINATION OF EXISTING CONDITIONS

A. The Contractor, in undertaking the work under this Contract, is assumed to have visited the premises and to have taken into consideration all conditions which might affect his work. No consideration will be given any claim based on lack of knowledge of existing conditions, except where the Contract Documents make definite provisions for adjustment of cost or extension of time due to existing conditions which cannot be readily ascertained.

1.05 SPECIFICATIONS EXPLANATION

A. Attention is directed to the fact that the detailed specifications and separate sections may be written in short or abridged form. In regard to every section of the specifications and all parts thereof, mentioned therein or indications on the drawings or articles, materials, operations or methods require that the Contractor:

1. Provide each item mentioned and indicated (of quality or subject to qualifications notes).

2. Perform (according to conditions stated) each operation prescribed.

3. Provide therefore all necessary labor, equipment and incidentals.

B. Wherever in these specifications or on the drawings the words "directed", "required", "ordered", or words of like import are used, it shall be understood that the directions, requirements, permission or order of the Engineer is intended; and similar words "approved", "accepted", "satisfactory", or words of like import shall mean approved, acceptable to, or satisfactory to the Engineer.

C. For convenience of reference and to facilitate the letting of Contracts or Sub-Contracts, these specifications are separated into titled sections. Such separation shall not, however, operate to make the Engineer an arbiter to establish limits to the Contracts between the Contractor and Sub-Contractors, nor shall such operation be interpreted as superseding normal union functions.

D. Notwithstanding the appearance of such language in the various divisions of the specifications as "The Electrical Contractor", "The Roofing Contractor", etc., the Contractor is responsible to the Owner for the entire Contract and the execution of all work referred to in the Contract Documents.

1.06 STANDARD

A. Wherever reference is made to the standard specifications of nationally known organizations and specific articles, sections, divisions, or headings are not given, such specifications shall apply in full. Standard specifications where included herein by abbreviation or otherwise shall form a part of this specification the same as if quoted in full.

B. The Engineer may require, and the Contractor shall furnish if required to do so , certificates from manufacturers to the effect that the products or materials furnished by them for use in the work comply with the applicable specified requirements for the materials or products being furnished.

1.07 TELEPHONE, TEMPORARY

A. Contractor shall install and maintain at his expense a job telephone for duration of the Contract.

1.08 TEMPORARY UTILITIES

A. Contractor shall furnish water, electricity, and heating fuel necessary for construction. Contractor shall provide necessary temporary piping, faucets, valves, wiring, switches, outlets, etc., to carry services to the work. The Contractor shall make all temporary utilities connection for his own use and remove temporary services on completion of Contract.

1.09 WORK OUTSIDE OF THE PROPERTY LINE

A. All work outside of the property line called for by the Contract Documents shall be performed by the Contractor and all cost for same shall be included in the Contract.

1.10 AS-BUILT DRAWINGS

A. The Contractor shall, upon completion of the work, furnish a marked set of drawings showing field changes affecting the various mechanical trades, utilities and electrical, as actually installed and as specified under those sections of the specifications, and deliver them to the Engineer. Engineer will furnish prints to Contractor for marking.

1.11 LIQUIDATED DAMAGES

A. Substantial Completion - If the Contractor neglects, fails or refuses to achieve Substantial Completion of the work by not later than 12 P.M. (Midnight), the Contractor shall pay to the Owner, Liquidated Damages in the amount of three hundred dollars ($300.00) per calendar day for each and every day that the Contractor is in default after the date indicated on the Notice to Proceed.

B. Final Completion - If the Contractor neglects, fails, or refuses to complete the work by not later than 12 P.M. (Midnight), the Contractor shall pay to the Owner, Liquidated damages, in the amount of three hundred dollars ($300.00) per calendar day for each and every day that the Contractor is in default after the date indicated on the Notice to Proceed. Liquidated Damages for Substantial Completion and Final Completion are cumulative.

1. The said amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the Owner would in such an event sustain, and said amount is agreed to be the amount of damages which the Owner would sustain and said amount shall be retained from time to time by the Owner from current Progress Payment should the construction progress fall behind schedule.

2. Time is of the essence of each and every portion of this Contract and of the specification wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this Contract.

3. Extensions of time applies to Liquidated Damages only and shall be allowed only for conditions over which the Contractor has no control, such as acts of God, transportation strikes affecting delivery of materials or equipment which are used in the project, manufacturing strikes affecting the production of materials or equipment which are used in the project, and weather above and beyond the normal expected loss of time based on historical climatological conditions over the last 10 years. For any time requested over what should be expected based on historical climatological conditions the amount of rain or temperature must meet the following conditions. To get credit for delays due to temperature the temperature must be at a level that would prevent construction in accordance with the other sections in these specifications. In order to get credit for rain delay the rain event must be persistent for more than four hours during that day and rainfall must be in excess of 0.5” for that 4 hour period or more than 1” during the day.

1.12 MATERIALS PRIOR APPROVAL AND SUBSTITUTIONS

A. Where items of equipment and/or materials are specifically identified herein by a manufacturer's name, model or catalog number, only such specific item may be used in the base bid, except as hereinafter provided.

B. If Contractors wish to use items of equipment and/or materials other than those specifically identified in the Specifications, Contractor shall apply in writing to the Engineer for approval of substitution at least seven (7) days prior to opening of bids,

submitting with his request for approval complete descriptive and technical data on the item(s) he proposes to furnish.

C. Approved substitutions will be listed in an addendum issued to all General Contractors prior to opening of bids.

D. Unless requests for changes in the Specifications are approved prior to the opening of bids, as defined above, the successful Contractor will be held to furnish specified items. After contract is awarded, changes in specifications will be made only as defined under "Substitution of Equipment".

1.13 SUBSTITUTION OF EQUIPMENT AND MATERIALS

A. After execution of contract, substitution of equipment and/or materials other than those specifically named in the Contract Documents will be approved by the Engineer for the following reasons only:

1. That the equipment or material is no longer available.

2. That the equipment or material does not perform the function for which it was intended.

3. That the equipment or material cannot be delivered due to conditions beyond the Contractor's control.

B. To receive consideration, requests for substitutions must be in writing accompanied by documentary proof of equality, and difference in price and delivery, if any.

C. In case of a difference in price, the Owner shall receive all benefit of the difference in cost involved in any substitutions, and the contract altered by change order to credit the Owner with any savings so obtained.

1.14 INSPECTING AND TESTING OF MATERIALS

A. Wherever in these Contract Documents inspecting and testing of material is called for, the selection of bureaus, laboratories and/or agencies for such inspecting and testing shall be made by the Engineer, and the character of the test shall be stipulated by the Engineer. Documentary evidence satisfactory to the Engineer that the materials have passed the required inspection and tests must be furnished in quadruplicate to the Engineer by the bureau, agency or laboratory selected. Materials satisfactorily meeting the requirements of the inspection or tests shall be approved by the Engineer and the Contractor notified of the results. The cost of such inspecting and testing shall be paid for by the Contractor.

1.15 ON SITE TESTING AND INSPECTING

A. Wherever in these Contract Documents testing or inspecting is called for, the selection of bureaus, laboratories and/or agencies for such testing or inspecting shall be made by the Engineer. Documentary evidence satisfactory to the Engineer that the materials have passed the required tests or inspection shall be furnished in quadruplicate to the Engineer. **The cost of such tests and inspection shall be paid for by the Contractor.**

1.16 MEASUREMENTS AND DIMENSIONS

A. Before ordering materials or doing work which is dependent for proper size of installation upon coordination with site conditions, the Contractor shall verify all dimensions by taking measurements at the site and shall be responsible for the correctness of same. No consideration will be given any claim based on differences between the actual dimensions and those indicated on the drawings. Any discrepancies between the drawings and/or specifications and the existing conditions shall be referred to the Engineer for adjustment before any work affected thereby is begun.

1.17 SHOP DRAWINGS

A. Shop drawings shall be dated and contain: Name of project; description and names of equipment, materials, and items; and complete identification of locations at which material or equipment is to be installed, reference to the section of the specifications where it is specified and drawings number, where shown. In addition to the above, the Shop drawings shall: (1) show complete information for checking and for fabrication, installation and erection, without reference to other drawings or note; (2) shall be of drafting line work and lettering that is easily readable under field conditions; (3) have plane oriented the same as plans on the Contract Drawings; (4) list grade, class, or strength of materials; (5) be checked and initialed by the suppliers drafting room checker; (6) be checked and coordinated with other phases of the work, by a person in the Contractor's employ who is experienced and qualified in the checking and coordination of shop drawings.

B. Shop drawings shall not, after having been submitted, be later issued with revised or additional materials, except for items corrected during the checking by the Contractor or reviewed by the Engineer.

C. The following notation will be used by the Engineer in his review.

1. No exceptions taken. (If checked here, fabrication may be undertaken. Approval does not authorize change to contract sums unless stated in a separate letter or by change order.)

2. Note markings. (If checked here, fabrication may be under taken. Contractor is to coordinate markings noted.)

3. Revise and resubmit.

4. Rejected.

5. Engineer review is for conformance with the design concept of the project and compliance with the information given within the Contract Documents only. The Contractor is responsible for dimensions being confirmed and correlated at the site; for information that pertains solely to the fabrication processes or to means, method, techniques, sequence, and procedures of construction; and for coordination of the work of all trades.

6. Failure to note a noncompliance will not prevent later rejection when the noncompliance is disclosed.

D. Submission of Shop drawings shall be accompanied by a transmittal letter in duplicate, containing project name, Owner's project number, Contractor's name, and number of drawings, title and other pertinent data.

E. The Contractor shall promptly submit to the Engineer, five copies for Architectural items and six copies for Engineering items, required by the Contract Documents in accordance with the aforesaid schedule so as to cause no delay in his work or in work of any other Contractor.

F. For standard items not requiring special shop drawings for manufacture, submit six copies of manufacturer's product data showing illustrated cuts of the items to be furnished, scaled details, size dimensions, performance characteristics, capabilities, wiring diagrams, control and all other pertinent information.

G. The Contractor shall: (1) check, coordinate, correct, stamp, date, and sign all copies of each drawing, and deliver them to the Engineer for his review; (2) identify the set of drawings he has checked; this set shall be shown by checked marks or correction that every item has been verified and with the requirements of the Contract Documents.

1.18 MAINTENANCE MANUAL

A. Contractor shall, prior to completion of contract, deliver to the Engineer, three copies of manual, assembled and bound with a hard cover, for the Owner's guidance, full details for care and maintenance of visible surfaces and of equipment included in contract.

B. Contractor shall, for this manual, obtain from subcontractor, literature of manufacturers relating to equipment, including motors; also furnish cuts, wiring diagrams, control diagrams, instruction sheets and other information pertaining to same that will be useful to Owner in overall operation and maintenance.

C. Where the above described manuals and data are called for under separate sections of the specifications, they are to be included in the manual description in this article.

SECTION 02100
CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Clearing shall consist of the felling, trimming, cutting and disposal of trees and other vegetation designated for removal, including down timber, snags, brush and rubbish occurring within the area to be cleared. Grubbing shall consist of the removal and disposal of stumps, roots larger than 1.5 inches in diameter and matted roots.

PART 2 - EXECUTION

2.01 Trees, down timber, stumps, roots, brush and other vegetation in areas to be cleared shall be removed completely, except such trees and vegetation as may be indicated or directed to be left standing. Trees to be left standing within the cleared areas shall be trimmed of dead branches 1.5 inches or more in diameter.

2.02 Limbs and branches to be trimmed shall be neatly cut close to the bore of the tree or main branches. Cuts more than 1.5 inches in diameter shall be painted with commercial tree-wound paint.

2.03 All organic materials, masonry, concrete or metallic debris in the clearing and grubbing areas shall be excavated and removed to a depth of not less than 12 inches below grade where original grade is to remain level and two feet below finish grade, All material shall be removed when under pavement base and bottom of footings.

2.04 Depressions made by grubbing shall be backfilled and compacted with fill material to meet the requirement for trenching and structural backfilling.

2.05 Machine grubbing shall not be done under trees left standing in the area covered by the branches, nor in any manner which might damage the trees or any new work.

2.06 Trees and vegetation to be left standing shall be protected from damage during clearing, grubbing and construction operations, by the erection of barriers.

2.07 Damages caused by the execution of clearing and grubbing shall be paid for by the Contractor.

2.08 Objects above or below grade interfering with construction to be removed as directed by the Engineer.

2.09 Disposal of Materials

A. Cleared and grubbed materials to be disposed of to an approved off-site disposal area.

B. On site burning will not be allowed, without written permission of local authorities.

SECTION 02210
SITE GRADING

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. Reference Standards:

1. Standards of American Society for Testing and Materials:

   ASTM-D-698 Moisture-Density Relations of Soils Using 5.5 lb. (2.5 KG) Hammer and 12 inch (304.8 mm) Drop

2. Methods of Sampling and Testing of American Association of State Highway and Transportation Officials (AASHTO), latest edition.

1.02 TESTING

A. All soil testing shall be performed by an Independent Testing Laboratory selected by the Engineer and paid for by the Contractor.

1.03 EXCESS EXCAVATED MATERIALS

A. Excess excavated materials shall be wasted off site by the Contractor at no expense to Owner, or as directed by the Engineer.

1.04 BORROW MATERIAL

A. Any borrow material required to accomplish all levels, lines and grades indicated shall be furnished by the Contractor at no expense to the Owner.

B. Borrow material shall be obtained from borrow pits off site.

C. The Contractor shall pay for all soil analysis for borrow material.

1.05 EXCAVATED MATERIAL

A. All material to be excavated shall be classified as earth.

1.06 UNSUITABLE BEARING MATERIALS

A. Should unsuitable bearing materials be encountered at levels indicated and found to have insufficient bearing values the Engineer may order the excavation carried to lower depths.

B. Compensation for the removal and/or replacement of unsuitable materials shall be in accordance with the General Conditions, Article 12.1.4.

C. Excavation of unsuitable bearing materials shall not proceed until the conditions have been observed by the Engineer and written approval has been given by the Owner.

PART 2 - EXECUTION

2.01 TOP SOIL

A. Areas to be stripped shall first be scraped clean of all brush, weeds, grass, roots and other material.

B. Remove topsoil from areas to be graded and stockpile in locations where it will not interfere with structures, roads or utility operations.

C. Topsoil shall be free from subsoil, debris and stones larger than 2 inches in diameter. The stored topsoil shall be left in piles to be used for finished grading.

D. Stockpiles shall be protected from contamination by undesirable foreign matter and shall be graded to shed water.

2.02 EXCAVATION

A. Excavations shall be accomplished to bring surface to the levels, lines and grades as indicated.

B. Excavated material to be used for fill or backfill material shall be stockpiled on the site as directed by the Engineer. Stockpiles shall be graded to shed water.

2.03 FILLING

A. All fill material required to bring areas to the levels, lines and grades indicated shall be selected and approved materials from approved borrow areas.

B. Sub-grades on which fill material is to be placed shall be scarified to a depth of not less than 4 inches by plowing or discing. A layer of suitable fill material, approximately 3 inches in depth, shall be spread over the scarified surface and compacted.

C. Fill material shall be spread and compacted in successive uniform layers not exceeding 8 inches in depth (loose measure) until the total thickness of fill is completed.

2.04 COMPACTION

A. Compaction required for material fill shall be 95% of Standard Proctor, maximum dry density as determined by the procedures of ASTM D-698. Fill areas shall be crowned and sloped to drainage ditches or as required to prevent ponding of surface water.

B. Compaction by flooding of any material is not acceptable. In the event that any flooding takes place, the material and all adjacent softened material shall be removed and replaced with compacted fill at no cost to the Owner.

2.05 FINISH GRADE

A. Distribute topsoil evenly to levels, lines and grades shown.

B. Finish grade to be trimmed and raked true to line and grade to avoid surface ponding.

C. Remove stone two inches or greater in diameter and debris from soil.

D. Finish grade tolerance to +/- 0.05 foot for roadways and +/- 0.10 foot for other areas.

SECTION 02221
TRENCH EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.01 SCOPE, STANDARDS & DEFINITIONS

A. Work under this section shall consist of furnishing all materials, equipment and labor for excavation, trenching and backfilling for utility systems. "Utility systems" shall include underground piping and appurtenances for water distribution systems, storm water drains, sewage collection systems, force mains, spray irrigation system and all other pipes and appurtenances shown on the drawings.

B. Applicable Standards and Reference

I. ASTM D2321 Soil Classification and Restrictions

a. Class IA = Manufactured crushed stone, shell, crushed slag or rock, open graded, clean, large voids, contains no fines, can allow sand migration to create excessive settling. Suitable as drainage blanket.
b. Class IB = Manufactured aggregate dense graded, clean, crushed stone with sand and gradation present. Closer void so little migration of sand, little fines. Minimal migration of sand. Suitable as drainage blanket.
c. Class II = Coarse grained soils and sand, graded gravel and sandy mix, minimal migration of silt or sand, Use as drainage blanket and drains limited.
d. Class III = Coarse grain sand with fines, silty gravel, gravel-sand-silt mixture, clayey gravels, silty sand mixture. Not to be used in the presence of water.
e. Class IVA = Fine grain soils, inorganic, Inorganic silts and very fine sand, silty clayey fine sands, inorganic clay with minor plasticity. Lean clay. Use only where no water exists and shallow fills.
f. Class IVB = Fine Grained soils inorganic, micaceous fine sand, silty soil, fat clay, clay with high plasticity. Use requires geotechnical evaluation.
g. Class V = Organic soils, clay and silt with organics. No permitted use other than top 6” outside roadways for soil amendment for grassing.

1.02 EXISTING UTILITIES

A. Before opening trenches, the Contractor shall examine all available records and explore for the location of all sub-surface pipes, valves or other structures and reference such locations on the surface.

B. In opening trenches, every effort shall be made not to interfere with these utilities structures. Expose existing piping by hand before excavating by machine. Excavate existing utilities sufficiently in advance of pipe laying to determine crossing arrangement. Slight deviations may be permitted in order to clear such structures. The Contractor shall be entirely responsible for the preservation of all underground or overhead utility lines and structures, such as gas, water, sewer lines, telephone conduit, power lines, etc., and shall replace, adjust or repair, without additional compensation, any such lines damaged or interfered with as a result of this construction.

C. Schedule work to keep roads and utilities in usable condition; coordinating all operation with the Owner to avoid inconvenience insofar as practicable.

1.03 EXCAVATED MATERIAL

A. All material to be excavated shall be classified as earth.

1.04 BORROW MATERIAL

A. Any borrow material required to accomplish all levels, lines and grades indicated shall be furnished by the Contractor at no expense to the Owner.

B. Borrow material shall be obtained from borrow pits off site.

C. The Contractor shall pay for all soils analysis for borrow material.

1.05 TESTING

A. All soil testing shall be performed by an Independent Testing Laboratory selected by the Engineer and paid for by the Contractor.

1.06 QUALITY ASSURANCE

A. All excavation within the rights of way of city streets and county, State or Federal roadways, shall be backfilled in accordance with the then prevailing requirements of the Georgia Department of Transportation, Highway Division.

B. Reference Standards: Methods of Sampling and Testing of American Association of State Highway and Transportation Officials (AASHTO).

PART 2 - EXECUTION

2.01 GENERAL EXCAVATION

A. The Contractor shall do all excavation of whatever substances encountered to depth shown on plans. Excavated materials not required for fill or backfill shall be removed from site as directed by the Engineer.

B. Contractor is to excavate to provide 3 foot minimum cover over utility.

C. Excavation for manholes and other accessories to have 12 inches minimum and 24 inch maximum clearance on all sides.

D. Excavation shall not be carried below the required level.

E. Where excavation is carried below grades indicated, the Contractor shall refill same to the proper grade with compacted earth or stone, or as directed by the Engineer.

F. Banks of trenches shall be vertical.

G. Width of trench shall be as shown on the plans. The bottom of trench for sewers and culverts shall be rounded so that an arc of the circumference equal to 0.6 of the outside diameter of the pipe rests on undisturbed soil.

H. Bell holes shall be excavated accurately to size by hand.

2.02 UNSUITABLE BEARING MATERIALS

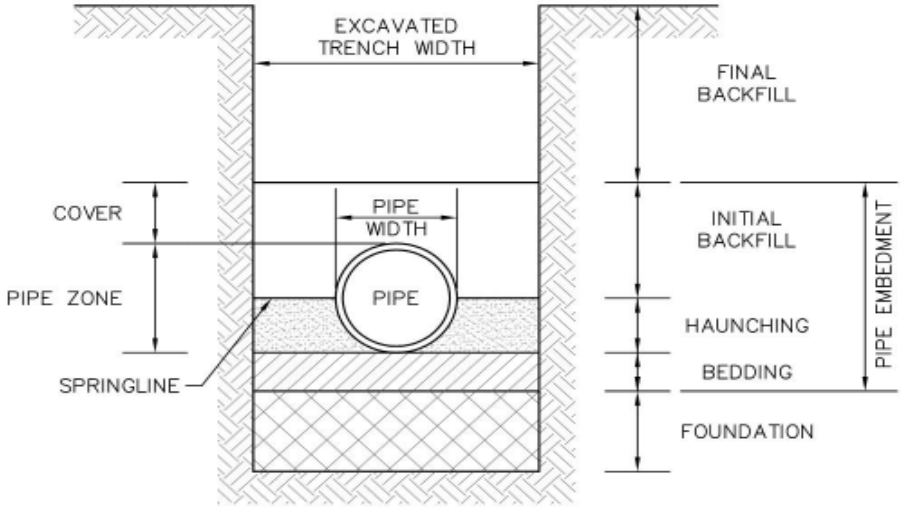
A. Should unsuitable bearing materials be encountered at levels indicated and found to have insufficient bearing values the Engineer may order the excavation carried to lower depth.

B. Compensation for the removal and/or replacement of unsuitable bearing materials shall be in accordance ASTM D2321 requirements.

C. Excavation of unsuitable bearing materials shall not proceed until the conditions have been observed by the Engineer and written approval is given by the Owner.

2.03 PIPE BEDDING

A. The following detail provides trench & pipe zone terminology.



PIPE BEDDING DETAIL
N.T.S.

B. The trench floor should be constructed to provide firm, stable, and uniform support for the full length of the pipe. This can be accomplished by bringing the entire trench floor level grade and then creating bell holes at each joint to permit proper joint assembly, alignment and support. Portions of the trench that are excavated below grade should be returned to grade and compacted as required to provide proper support. If native trench soil is not suitable for pipe bedding, the trench should be over excavated and refilled with suitable foundation material either local sandy

material compacted to 90% Std. Proctor or #57 stone depending on the presence of water and, as approved by the engineer. Bedding material shall be Class IB or II as defined in ASTM D2321. Large rocks or hard material should not be contained in the bedding area (minimum of 4") below the pipe.

C. The most important factor in assuring proper pipe-soil interaction is the haunching material and its density. This material provides the majority of the support that the pipe requires to function properly in regards to deflection and performance. The haunching material shall be placed and compacted under the pipe haunches as shown in the detail above. Proper control should be exercised to avoid deflecting the pipe from proper alignment. The same material that is used for bedding should be used for haunching and compacted to the same standards. Haunching material shall be Class IB or II as defined in ASTM D2321.

D. Initial backfill, as shown in the detail above, shall be accomplished with suitable, compactable material and compacted in 6" layers. Material shall meet the requirements of Class IB II or III as restricted in ASTM D2321.

E. Final Backfill will be accomplished by placing material in 12" lifts and compacting to a level determined by the final use of the area above the pipe. Final backfill in roadways shall require placement of suitable Class IA, IB, II and III backfill material, placed in 12" lifts and compacted to 100% standard proctor (ASTM Test D-698). Final Backfill outside of roadways shall be Class II, III or IVA and lightly compacted to avoid settling in the future. The top 6" of the final backfill, outside of roadways, shall be suitable for establishing a final grassed surface.

F. Material used in the "trench & pipe zone" shall be restricted as per the limitations and restrictions as outlined in ASTM D2321

2.04 BRACING AND SHORING

A. The Contractor shall do all bracing, sheeting and shoring necessary to perform and protect all excavations as required for safety.

B. Sheeting driven alongside the pipe should be cut off and left in place to an elevation 1.5 feet above the top of the pipe.

C. All other sheeting shall be removed as directed by the Engineer.

2.05 DEWATERING FOR EXCAVATION

A. The Contractor shall pump or remove any water accumulated in any excavated area and shall perform all work necessary to keep excavations clear of water while foundations, structures or any masonry are being constructed or while pipe is being laid.

B. No structure or pipe shall be laid in water, and water shall not be allowed to flow over or rise upon any concrete or masonry or piping until same has been inspected and the mortar or joint material has cured.

C. No extra compensation will be allowed for removal of water.

D. All water pumped or bailed from the trenches or other excavation shall be conveyed to a point of discharge where it will neither cause a hazard to the public health, nor damage to the public or private property, or to work completed or in progress.

2.06 BACKFILL

A. The soil at the sides of a pipe and above it is the backfill.

B. Prior to backfilling any excavation, all piping and structures shall be observed by the Engineer.

C. After pipes have been tested and approved, backfilling shall be done with approved material free from large clods or stones.

D. Backfill shall be placed in uniform layers, four inches thick, on both sides of the pipe and thoroughly compacted with pneumatic or hand tampers. The backfill shall be brought up uniformly on both sides of the pipe and compacted to an elevation of one foot above the top of the pipe, after which the fill shall be placed in eight inch lifts. No rock will be allowed in the backfill within a distance of one foot from the pipe, and rock larger than six inches in the greatest dimension will not be permitted in any part of the trench or backfill.

1. Backfill shall be compacted to not less than 95% of the maximum dry weight per cubic foot as determined by AASHTO Method T-99 (Standard Proctor Test).

2. The top 18 inches of backfill under any paved area shall be compacted to 100% Standard Proctor.

3. Water settling will not be permitted in clay soils. It may be required at the option of the Engineer in sandy soils.

2.07 REPLACING PAVEMENTS

A. Subgrades shall be compacted with a mechanical tamper.

B. The minimum width of replaced concrete pavements shall be 4 feet at interiors and 6 feet at joints and constructed as shown on Standard Details. Avoid cutting pavements at joints; if unavoidable, reconstruct same as original joint. Depth shall be equal to the original thickness. Existing pavements edges shall be cut vertical.

C. Use high-early-strength cement if road is to be opened in less than 3 days.

D. The minimum width of replaced bituminous pavements shall be 3 feet with 8 inch concrete patch. The existing pavement shall be cut vertically and horizontally to a straight line. The 8 inch concrete patch shall be minimum 3,000 psi concrete containing black dye and shall be flush with the existing pavement.

SECTION 02520
STORM DRAINAGE AND APPURTENANCES

PART 1 - GENERAL

1.01 APPLICABLE STANDARDS

A. Appurtenances shall be constructed in accordance with the referenced Georgia Department of Transportation Standard Drawings.

B. American Society for Testing and Materials (ASTM):

C- 32 Specification for Sewer and Manhole Brick.

C- 76 Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.

C-139 Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

C-144 Aggregate for Masonry Mortar.

C-270 Mortar for Unit Masonry

C-443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

C-478 Specification for Precast Reinforced Concrete Manhole Section

C-536 Test for Continuity of Coatings in Glassed Steel Equipment by Electrical Testing.

C. Only reinforced concrete pipe will be allowed under roadways or frequently traveled areas.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Roadway Storm Drainage Pipe: Pipe shall be reinforced Concrete Pipe which conforms to ASTM Specification C-76 and shall be of sizes shown. Pipe shall be Class III minimum and as indicated on GA. D.O.T. Standard 1030 D.

B. Non Roadway Storm Drainage Pipe: Pipe shall be one of the following:

1. Corrugated metal pipe shall conform to AASHTO designation M-36, AREA Manual 1-4 requirements for corrugated metal culverts, or Federal Specification QQ-C- 806, with the following applicable requirements:

a. The outside and inside surfaces of the corrugated metal pipe shall be completely coated with bituminous material with a minimum thickness of 0.05 inch at the crest of the corrugations. Immediately prior to the application of the bituminous coating, the corrugated metal pipe shall be cleaned of all dirt, grease, mill scale, or loose rust and shall be dry.

b. The outside and inside surfaces of the corrugated metal pipe shall be completely coated with a pure aluminum coating metallurgically bonded by an alloy layer between the steel and the aluminum. The coating shall be applied at a minimum of 1 oz./sq.ft., 2 mils. each side. The weight of aluminum (total both sides) shall be as follows: Minimum check limit triple-spot test=1.00 oz/sq feet, minimum check limit single-spot test=0.90 oz/sq feet. The aluminized steel pipe shall be Armco Aluminized Steel Type 2 or equal.

c. All rivets shall be placed in the inside valley of the corrugations. The interior coating shall be protected against damage from insertion or removal of struts or tie wires. Lifting lugs, where used, shall be so placed as to facilitate moving the pipe without damage to the exterior or interior coating. All lateral pipe shall be sixteen (16) gauge. All pipe under possible traffic areas will be twelve (12) or fourteen (14) gauge as indicated.

d. To facilitate field jointing, the ends of pipes with helical corrugations shall be rerolled to form circumferential corrugations from the end. The diameter of the reformed ends shall not exceed that of the pipe barrel by more than the depth of the corrugation.

2. Polyvinyl chloride (PVC) pipe shall be manufactured and tested in accordance with specification for "Poly (Vinyl Chloride) PVC Large Diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter." The pipe and fittings shall be made of PVC plastic and shall have a smooth (not ribbed or corrugated) inside surface.

   All pipe shall be bell and spigot. The bell shall consist of an integral wall section or an internal plastic sleeve. The solid cross section rubber ring shall be factory assembled on the spigot. Size and dimensions shall be as shown on the plans. Standard laying length shall be 13 feet ±1 inch.

   All fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations compatible with that of the pipe.

   Pipes shall be designed to pass all tests described herein at 73° F (± 3° F).

   The pipe stiffness shall equal or exceed 10 psi when tested in accordance with ASTM D 2412.

3. High density Polyethylene (HDPE) pipe shall be manufactured for use in nonpressure storm sewer. The pipe shall be manufactured to meet AASHTO M294, Type ‘S’ for 12” through 36” and AASHTO MP6-96, Type ‘S’ OR ‘D’ for 42” and 48” pipe. The pipe and fittings shall be made from HDPE material and shall have a smooth (not ribbed or corrugated) inside surface.

   a. All pipe shall be bell and spigot. The bell shall be an integral part of the pipe. The joint shall use a gasket to form a water tight connection meeting ASTM D3212. Gaskets shall be installed in the bell or in the spigot by the manufacturer. The use of Silt tight fittings may be requested in lieu of water tight connection if approved by the engineer.

   b. All fittings shall conform to AASHTO M294 or MP6-95. Fabricated fittings shall be welded on the interior and exterior at all junctions.

c. Pipe and fittings material shall be high-density polyethylene meeting ASTM D3350.

d. Installation shall be in accordance with ASTM D2321.

e. Pipe may be Advanced Drainage System, Inc., N-12 or N-12 HC or Hancor Sure Lok 10-8 pipe.

C. Pipe Joints:

1. Joints for concrete pipe shall be one of the following types:

a. Bell and spigot with rubber gaskets.

b. Tongue and groove with rubber gaskets.

c. Tongue and groove with preformed plastic gaskets.

2. Rubber Gaskets shall conform to ASTM Specification C443. Only a neutral agent shall be used as a lubricant. Preformed Plastic Gaskets shall conform to Federal Specification SS-S210, Type I-rope form.

3. Field joints of corrugated steel pipe shall maintain pipe alignment during construction and prevent infiltration of side material during the life of the installation. Circumferential and longitudinal strength shall be provided in accordance with the structural joint performance criteria of Division 2, Section 23 of the AASHTO standard specification for Highway Bridges. The bands shall be constructed in such a manner that will effectively engage the pipe ends. Coupling bands shall not be more than 3 nominal sheet thicknesses lighter than the thickness of the pipe to be connected and in no case lighter than 0.052 inches. Bolts and nuts for coupling bands shall conform to the requirements of ASTM Designation: A307.

Bands shall be furnished to lock with the circumferential corrugations, including rerolled end helical pipe. The corrugated bands shall be not less than 7 inches wide for diameter 4 to 36 inches, inclusive, and not less than 10 1/2 inches wide for all other pipe diameters.

NO DIMPLE BANDS WILL BE ALLOWED.

4. Joints for PVC pipe must be an integral bell gasketed joint which forms a silt tight joint.

D. Precast Concrete Manhole Sections:

ASTM C478, except that spacing of manhole steps or ladder rungs shall not exceed 12 inches.

E. Masonry Manholes: Shall be constructed of the following materials:

1. Brick: ASTM C32, Grade MS

2. Concrete Masonry Units: ASTM C139.

3. Mortar of Masonry: ASTM C279, Type M.

4. Aggregate for Masonry Mortar: ASTM C144.

5. Water: Water for Masonry Mortar shall be fresh, clean and potable.

F. METALS

1. Frames, Covers, and Grating: Frames, covers, and grating shall conform to AASHTO M-306-07 and shall be of grey iron castings.

2. Manhole Steps: Manhole steps shall be constructed of a number of 3 reinforcing bar encapsulated in polypropylene plastic with a non-skid tread. Finished dimensions of the steps shall be identical to that of malleable iron manhole steps. Steps to have a minimum tread width of 12 inches.

2.02 DELIVERY AND STORAGE

A. Storm Drainage Pipe: Care shall be exercised in loading and unloading pipe, fittings, specials and castings at all times in order to avoid shock and damage to the materials. Lifting shall be by hoist or by rolling on skids. Dropping will not be permitted. The Contractor shall be responsible for the safe handling of all materials and no damaged materials shall be used in the work. Materials shall be inspected upon arrival at the site, and any damaged or defective materials shall be immediately removed from the site. All materials shall be stored above grade.

B. Cementious Materials: Cementious materials in bags shall be stored in enclosed structures, floors shall be elevated above the ground a distance sufficient to prevent the absorption of moisture.

C. Metal Items: Metal items, including reinforcing steel, shall be stored above grade in a manner which will not cause excessive rusting or coating with grease or other objectionable materials.

D. PVC Pipe: PVC pipe shall be stored protected from sun light by means of covering the pipe or storing inside a building or under a covered shed. Any pipe showing signs of prolonged outside storage (i.e. faded exterior color or signs of drying) shall be rejected.

E. Aggregates: Aggregates shall be stored on areas to prevent the inclusion of foreign material. Aggregates of different sizes shall be stored in separate piles. Stockpiles of coarse aggregate shall be built in horizontal layers not exceeding 4 feet in depth to minimize segregation. Should the coarse aggregate become segregated, it shall be remixed to conform to the grading requirements.

F. Brick, Concrete Masonry Units and Precast Concrete Manholes: Brick, concrete masonry units and precast concrete manholes shall be handled with care to avoid chipping and breakage, and shall be stored to protect them from contact with the earth and exposure to the weather, and shall be kept dry until used. Masonry units or precast concrete containing frost or ice shall not be used.

PART 3 - EXECUTION

3.01 DRAINAGE PIPE

A. Each section of pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used.

B. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Pipe shall be laid true to line and grades indicated and shall rest upon the pipe bed for the full length of each section. Runs of pipe shall be laid with outside bells or grooved ends up-grade beginning at the lower end of the pipe line. Pipe having its grade and/or joint disturbed after laying shall be removed, cleaned, and relayed.

C. When pipes are protected by head walls or connect with drainage structures, the exposed ends of the pipe shall be placed or cut flush with the inside face of the structure. After the pipe is cut the rough edges shall be smoothed up in an approved manner. All pipe shall be laid so that markings are on top and the inner surfaces abut neatly, tightly and smoothly.

D. All pipe in place shall be observed by the Engineer before being covered and concealed unless this requirement is waived by the City Inspector and the Design Engineer. Contractor shall clear all pipe of silt debris prior to final acceptance.

3.02 CORRUGATED METAL PIPE JOINTS

A. Corrugated metal pipe shall be butted to form a smooth joint; the space between the pipe and coupling bands shall be kept free from dirt and grit so that the corrugations fit snugly. The coupling band while being tightened shall be tapped with a soft head mallet of wood, rubber or plastic to take up slack and insure a tight joint. Coupling band bolts and damaged areas of the coupling bands and pipe shall be given a coating of bituminous cement. Pipe on which the asphalt coating has been damaged to such extent that satisfactory field repairs cannot be made will be replaced.

3.03 CONCRETE PIPE JOINT

A. Joint installation shall be in accordance with the recommendations of the manufacturer of the joint material. Surfaces to receive lubricants, cements or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust and other deletious agents at all times. Gaskets and jointing materials shall be inspected before installation of the pipe, and any loose or improperly affixed gaskets and jointing materials shall be removed and replaced.

B. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint, the gasket or jointing material becomes loose and can be seen through the exterior joint recess when the joint is pulled up to within one inch of closure, the pipe shall be removed and the joint remade.

3.04 MASONRY WORK

A. Mortar for Masonry: Mortar for brick masonry, concrete unit masonry, rubble stone masonry, and for bedding cast iron frames in masonry shall be Type M, conforming to ASTM C270.

B. Mortar for pargetting Masonry Walls: Mortar for pargetting masonry walls below grade shall be Type M, conforming to ASTM C270.

C. Brickwork: Brick in circular walls shall be laid in all header courses to form full and close mortar joints, ends and sides in one operation. Vertical joints shall be radial from the center. Brickwork around pipe inlets and outlets shall be built using sufficient mortar to seal the pipe tight in the wall.

D. Concrete Unit Masonry: Walls shall be constructed in horizontal courses, with vertical joints broken. Units shall be laid in mortar, and all joints shall be filled completely with mortar.

E. Masonry Structures: Masonry structure walls shall be constructed of brick, concrete masonry units or precast concrete structural sections.

3.05 PRECAST CONCRETE

A. Walls shall be constructed on a footing of cast-in-place concrete, except that precast concrete base sections may be used for precast concrete structure risers. Precast base sections shall conform to the applicable requirements for precast risers and tops in made ASTM C478. Mortar that has hardened to the extent that it cannot be made workable without the addition of water shall not be used. Thickness of parget shall be not less than 1/2 inch. No pargetting will be permitted on the inside of structures. Pargetting will not be required for precast concrete structures. Joint work inside masonry structures shall be smooth.

3.06 METAL WORK

A. Iron and steel shall be formed to shape and size with sharp lines and angles. Shearing and punching shall produce clean true lines and surfaces. Casting shall be sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Exposed surfaces shall have a smooth finish and sharp well defined lines and arises. The necessary ribbets, lugs, and brackets shall be provided.

3.07 FIELD TEST

A. A light held in a drainage structure shall show a practically full circle of light through the pipe when viewed from the adjoining end of the line.

B. Lines under pavements shall be tested for infiltration by means of a suitable weir or other measurement device as directed by the Owner. When determination of infiltration is not practicable because of dry trench conditions, an exfiltration test shall be applied by filling with water so that the hydraulic head will be at least 6 inches above the crown of the upper end and of the section being tested. The amount of leakage (infiltration or exfiltration) shall not exceed 100 gallons per inch of diameter per day per mile of pipe.

SECTION 02540
EROSION CONTROL

PART 1 - GENERAL

1.01 The work specified in this Section consists of furnishing, installing and maintaining temporary erosion controls and temporary sedimentation controls.

1.02 DEFINITIONS

A. Temporary erosion controls shall include grassing, mulching, watering and reseeding on-site sloped surfaces, providing berms at the top of the slopes and providing interceptor ditches at the ends of berms and at those locations which will ensure that erosion during construction will be either eliminated or minimized.

B. Temporary sedimentation controls shall include silt dams, traps, barriers and appurtenances at the toe slopes.

PART 2 - MATERIALS

2.01 Hay bales shall be clean, seed free cereal hay type, securely bound.

2.02 Netting shall be 1/2 inch, galvanized steel chicken wire mesh.

2.03 Filter stone shall be crushed stone conforming to the Department of Transportation - State of Georgia-Standard Specifications – Construction of Transportation Systems - 2013 - Table 800.01, Size Number 3.

2.04 Rolled Erosion Control Products:

A. Mulch Control Netting. A planar woven natural fiber or extruded geosynthetic mesh used as a temporary degradable rolled erosion product anchor loose fiber mulches
Max. Gradient = 5:1 (H:V) in slope application
C Factor = ≤0.10 @ 5:1 in slope application
Max Shear stress 0.25 lb/sf in channel application
Min. Tensile Strength ultra short (3 mo) and short (12 mo) term = 5 lbs/ft
Min Tensile Strength extended term ((24 mo) = 25 lbs/ft

B. Open Weave textile. A temporary degradable rolled erosion control product composed of processed natural or polymer yarns woven into a matrix, used to provide erosion control and facilitate vegetation establishment.
Max. Gradient = 3:1 (H:V) in slope application
C Factor = ≤0.15 @ 3:1 in slope application
Max Shear stress = 1.5 lb/sf in channel application
Min. Tensile Strength ultra short (3 mo) and short (12 mo) term = 50 lbs/ft
Min Tensile Strength extended term ((24 mo) = 100lbs/ft

C. Erosion Control Blanket. A temporary degradable rolled erosion control product composed of processed natural or polymer fibers mechanically, structurally or chemically bound together to form a continuous matrix to provide erosion control and facilitate vegetation establishment.

Netless Rolled Erosion Control Blankets:
Max. Gradient = 4:1 (H:V) in slope application
C Factor = ≤0.10 @ 4:1 in slope application
Max Shear stress = 0.5 lb/sf in channel application
Min. Tensile Strength ultra short (3 mo) and short (12 mo) term = 5 lbs/ft

Single-net Erosion Control Blankets:
Max. Gradient = 3:1 (H:V) in slope application
C Factor = ≤0.15 @ 3:1 in slope application
Max Shear stress = 1.5 lb/sf in channel application
Min. Tensile Strength ultra short (3 mo) and short (12 mo) term = 50 lbs/ft
Min Tensile Strength extended term ((24 mo) = 100lbs/ft

Double-net Erosion Control Blankets:
Max. Gradient = 2:1 (H:V) in slope application
C Factor = ≤0.2 @ 2:1 in slope application
Max Shear stress = 1.75 lb/sf in channel application
Min. Tensile Strength ultra short (3 mo) and short (12 mo) term = 75 lbs/ft

D. Turf Reinforcement Mat. A rolled erosion control product composed of non-degradable synthetic fibers, filaments, nets, wire mesh,and/or other elements, processed into a permanent, three dimensional matrix of sufficient thickness. TRMs, which may be supplemented with degradable components, are designed to impart immediate erosion protection, enhance vegetation establishment and provide long term functionality by permanently reinforcing vegetation during and after maturation. These products are typically used in hydraulic applications such as high flow ditches, channels, steep slopes, stream banks, and shorelines, where erosive forces may exceed the limits of natural, unreinforced vegetation.
Slope Application max gradient = 0.5:1 (H:V)
Channel Application Max Shear Stress: 5A, B,C as defined in FHWA guidelines
5A = 6.0 lb/sf, 5B = 8.0 lb/sf, 5C = 10.0 lbs/sf
Min. Tensile Strength: 5A, B,C as defined in FHWA guidelines
5A = 125.0 lb/ft, 5B = 150.0 lb/ft, 5C = 175.0 lbs/ft
5A, B,C as defined in FHWA guidelines

PART 3 - EXECUTION

3.01 SEDIMENTATION CONTROL

A. Silt dams, traps, barriers, and appurtenances shall be installed and shall be maintained in-place for duration of construction.

B. Hay bales shall be staked with two (2) 1 x 4 wood stakes per bale driven eighteen (18) inches into the ground and finishing flush with the top of the bale.

1. Install two (2) stakes per bale with the long dimension of the stakes parallel to the long dimension of the bale.

2. Where bales are installed in multiple layers the bales shall be installed with vertical joints staggered and two (2) 1 x 4 wood stakes per bale driven through all layers, full from top of bale to eighteen inches into the ground.

C. Hay bales which have deteriorated shall be replaced with new materials.

D. Erosion and sedimentation controls shall be maintained in a condition which will retain unfiltered water.

E. The Contractor shall construct the sedimentation ponds and control devices prior to clearing and grubbing the site to insure complete silt control. When the silt or the debris level is greater than 1 foot above the bottom of the pond, the Contractor shall remove the silt or debris to restore the proper elevation for the bottom of the pond.

F. The Contractor shall have all erosion and sedimentation control devices in service and operating properly prior to completion and final acceptance of the contract.

G. Two widths of silt fence are available, Type A or C (36" height) and Type B (22" height). In order to determine which to use, the project duration, slope gradient, and slope length must be known (See Table 6-13.1 below). Approved silt fence fabrics are listed in the Georgia Department of Transportation list #36. The manufacturer shall have either an approved color mark yarn in the fabric or label the fabricated silt fence with both the manufacturer and fabric name every 100 feet.

TABLE 6-13.1

Land Slope	**Maximum Slope Length Behind Fence**
Percent	feet
<2	100
2 to 5	75
5 to 10	50
10 to 20	25
>20	15

All silt fence must meet the minimum standards set forth in Section 171- temporary Silt Fence, of the Department of Transportation, State of Georgia, Standard specification, current edition. See Table 6-13.5 for current Georgia DOT silt fence specifications.

3.02 EROSION CONTROL BALNKET INSTALLATION

A. Prepare a stable and firm soil surface free of rocks and debris. Apply soil amendments as necessary to prepare seedbed. Place fertilizer, water, seed in accordance with manufacture and specification recommendations. Unroll parallel to the primary direction of flow. Ensure that the product maintains intimate contact with the soil over the entire installation. Do not stretch or alow material to bridge over the surface. Staple/stake blanket to soil such that each staple/stake is flush with the underlying soil. Install anchor trenches, seams and terminal ends as specified.

B. The Upslope Trench, Seams and Terminal Ends may be secure by anchor trench, checks, slots or staples as outlined in Erosion Control technology Council (ECTC) standards for upslope security.

C. Staple installation shall be at a rate of 1.7 staples per square yard minimum. Sandy or silty soils may require more. Wet installations may require a more density securing.

D. If seaming method is used seams shall overlap at least 4" and staples must be placed at sufficient spacing to avoid separation.

E. Staples must be placed at 4”x 4” spacing on check slots and check seams.
F. Consecutive rolls shall have overlaps of at least 6” and secured with staples every 1foot.

3.03 RESPONSIBILITY

A. The Contractor shall be solely responsible for insuring that no silt or debris leaves the immediate construction site. Any silt or debris that does leave the immediate site shall be cleaned up and the area disturbed shall be returned to its natural state as directed by the Engineer at the Contractor’s expense.

B. The Contractor has the option to submit additional control measures in the form of shop drawings.

SECTION 02555
WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

C500 Gate Valves 3" - 48" for Water and Other Liquids

C502 Dry-Barrel Fire Hydrants

C600 Installation of Cast Iron Water Mains

C601 Disinfecting Water Mains

C800 Threads for Underground Service Line Fittings

B. American National Standards Institute (ANSI):

A-21.10 Gray-Iron and Ductile Iron Fittings, 2"-48" for Water and Other liquids

A-21.11 Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe Fittings

A-21.4 Cement Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water

A-21.51 Ductile Iron Pipe, Centrifugally Cast in Metal or Sand-Lined Molds, for Water or Other Liquids

B-18.2 Square and Hex-Head Bolts and Screws

C. American Society of Testing and Materials (ASTM):

A-47 Malleable Iron Castings

A-48 Gray Iron Casting

A-88 Seamless Copper Water Tube

A-240 Chromium and Chromium-Nickel Stainless Steel Plate Sheet and Strip for Fusion-Welded Uni-fired Pressure Vessels

A-307 Low Carbon Steel Externally and Internally Threaded Standard Fasteners

D-1784 Rigid Poly (Vinyl chloride) Compounds, and Chlorinated Poly (Vinyl Chloride) Compounds

D-2239 Polyethylene (PE) Plastic Pipe (SDR-PR)

D-2241 Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR and Class T)

D-3139 Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals

D. Rule for Safe Drinking Water, Georgia State EPD: Chapter 391-3-5

1.02 DESCRIPTION

A. All valves of the same type shall be from a single manufacturer. Parts for valves of the same type and size shall be interchangeable. Spare parts shall be furnished where required in the payment items. Special tools required for repacking or dissembling valves shall be provided.

B. All valves shall open left (counter-clockwise).

1.03 SUBMITTALS

A. Six copies of manufacturer's drawings and catalog cuts of the following items shall be submitted for approval of the Design Engineer and the LCPC Inspector:

1. Pipe
2. Fittings
3. Joints and Couplings
4. Hydrants
5. Valves

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Materials delivered to site shall be inspected for damage, unloaded and stored with the minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and rubber gaskets under cover and protect from exposure to direct sunlight. Store materials above ground. Interior of pipe and fittings shall be kept free of dirt and debris.

B. Pipe, fittings, valves, hydrants and other accessories shall be handled to insure delivery to the point of installation in sound undamaged condition. If coatings or linings of pipe or fittings are damaged, such pipe or fittings shall be removed from the site and new materials furnished. Pipe shall not be dragged. Rubber gaskets that are not installed immediately shall not be left in the sunlight, but shall be stored under cover and protected from exposure to direct sunlight.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE (PVC)

A. IPS Size PVC Pipe: Class 200 SDR 21 - Polyvinyl chloride water main pipe shall conform to Designation ASTM D2241 and shall consist of Type I, Grade 1 PVC compound conforming to ASTM D1784. All pipe shall be Class 200, SDR 21. The standard laying length shall be 20 ft. ±1 inch.

B. DIP Size PVC Pipe: AWWA C-900-07

1. C-900 polyvinyl chloride water main pipe 4" TO 12" shall conform to Designation ASTM D2241 and shall consist of Type I, Grade 1 PVC compound conforming to ASTM D1784. All pipe larger than 4" to 12" shall meet the requirements of AWWA C900, "Poly Vinyl Chloride (PVC) pressure pipe." All pipe shall be class 200 pipe and shall meet the requirements of DR14. The standard laying length shall be 20 ft. ±1 inch. The FM approved pressure class will be used to determine pressure class.

2. C-905 polyvinyl chloride water main pipe 14" to 30" shall be manufactured from compounds conforming to PVC cell classification of 12454B as defined in ASTM D-1784. The integral bell joint system meets the requirements of ASTM D-3139 and utilizes an elastomeric seal conforming to ASTM F-477. All pipe shall be class 200 pipe and shall meet the requirements of DR18. The standard laying length shall be 20 ft. ±1 inch.

C. When DIP size PVC pipe is used two 2" PVC pipe shall be SDR 21, 200 PSI pressure class, iron pipe

D. Pipe shall have integral bell and spigot joints. Provisions shall be made for contraction and expansion at each joint with an elastomeric ring. Threaded or solvent welded type joints shall not be used. Bell end pipe and couplings with elastomeric gaskets shall meet the requirements of ASTM 3139.

E. The Contractor shall install a continuous run of 14 gauge copper tracer wire with underground coating above the top of the PVC pipe 12 inches above the pipe but no deeper than 48 inches below finished grade. The tracer wire shall be suitable for detection with metal pipe location equipment.

F. All water pipe shall be blue in color and labeled "water" every three feet as a minimum.

G. Pipe shall carry National Sanitation Foundation (NSF) seal and be factory marked with manufacturer's identification, pipe size, material and pressure rating.

2.02 DUCTILE IRON PIPE

A. Ductile iron pipe shall conform to the requirements of ANSI Standard A21.51 and AWWA C151. All pipe shall class 350. Class designations for the various classes of pipe shall be painted on the outside of each joint of pipe. Weights shall be conspicuously painted in white on each joint of pipe after the bituminous coating has hardened.

B. All joints shall have the same pressure rating as the pipe with which it is used. Joints shall be rubber gasketed push on or mechanical joint. Joints shall meet the requirements of ANSI A21.11 and AWWA C111.

C. Pipe shall be coated inside and out with one mil. thick bituminous coating conforming to ANSI A21.4 and AWWA C110, C115OR C151. The interior shall be lined with a cement mortar lining conforming to ANSI/AWWA C104/A21.4.

2.03 GALVANIZED STEEL PIPE

A. This pipe and fittings shall conform to the requirements of ASTM A120. The pipe shall be "standard weight", unless otherwise specified.

2.04 PLASTIC TUBING

A. Plastic pipe shall conform to all the requirements of the "Specifications for Polyethylene (PE) Plastic Pipe (ADR-PR)", as they apply to PE 3306 of ASTM D2239.

B. The hydrostatic design stress shall be 630 psi for water at 23° centigrade (73.4° F) and 500 psi for water at 37.8° C (100° F).

C. The polyethylene extrusion compound from which the pipe is extruded shall meet the requirements of Type III, Grade 3, Class C material as described in "Specification for Polyethylene Molding and Extrusion Materials", ASTM D1248, except that melt index shall be determined under a higher temperature than any of the conditions as listed in Section 6(b) of "Method of Test for Measuring Flow Rates of Thermoplastics by Extrusion Plastometer", ASTM D1238. The test condition shall be the same as for condition J, except that the temperature shall be 310° C (590° F), with a load of 12-5 kilograms. Under these conditions the resin shall extrude at a maximum rate of 0.25 grams per ten (10) minutes. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other defects. The pipe shall be uniform in color, capacity, density, and other physical properties.

D. The size, the type of plastic pipe material, dimension ratio, commercial standards with which the pipe complies, the manufacturer's name and the National Sanitation Foundation (NSF) seal of approval, shall be conspicuously marked on the outside of the pipe at intervals of not more than five (5) feet.

2.05 FITTINGS

A. Ductile iron mechanical joint fittings shall conform to the requirements of ANSI/ AWWA C110 and C153. The fittings shall be of the lightest class conforming to the pressure rating of the pipe lines in which they are installed, in no case shall the fittings be lighter than class 200.

B. Fittings for galvanized steel pipe shall be malleable iron conforming to ANSI B16.3 except the nipples and couplings shall be the same material as the pipe. All fittings shall be hot-dip galvanized in accordance with ASTM A120.

C. The mechanical joint shall meet requirements of ANSI A21.11 and shall have the same pressure rating as the fitting of which it is a part.

D. Fittings shall be coated inside and out with one mil. thick bituminous coating conforming to ASNI A21.4.

2.06 HYDRANTS

A. All fire hydrants shall conform to AWWA C502.

B. All fire hydrants shall have a 6" mechanical joint inlet connection and be equipped with a 5-1/4 inch valve, two 2-1/2 inch hose nozzles and one 4-1/2 inch pumper

connection, all with ANSI (National) standard threads. Operating nuts shall be 1-1/2 inch, pentagon type.

C. All fire hydrants shall be equipped with "O" ring type stem seals.

D. All fire hydrants shall be designed for 150 psi working pressure and 300 psi test pressure.

E. All fire hydrants shall be equipped with a 6" gate valve, complying with other sections of the specifications, installed on the fire hydrant lead between the hydrant and the main.

F. The Contractor shall paint the hydrant with XO-14 Tractor Red (Federal Safety Color) paint.

G. All fire hydrants shall be designed such that clockwise rotation of the stem closes the valve and counterclockwise rotation opens the valve. Hydrant covers shall have the word "Open" and an arrow showing the proper rotation of the operating nut cast in or permanently attached.

H. An independent drain shall be provided, completely draining the hydrant after use. The drain shall be activated to the open position by the closing of the hydrant valve. The drain rod shall be easily cleaned. The drain shall have a protective shield integral with the hydrant base to minimize clogging and prevent undermining.

I. All working parts of the hydrant shall be easily removed for inspection or servicing without digging or the use of hoists or derricks or special tools. The hydrant cover and stand pipe shall be removable without requiring the water to be shut off.

J. Each fire hydrant shall be equipped with a ground line mounted breakaway flange and cast iron safety stem coupling specially designed so that upon sustaining severe impact the hydrant will shear off at the ground line without loss of water in the main.

K. All fire hydrants shall be Mueller standard or equal as approved by the Engineer.

2.07 METERS

A. All meters shall be approved first line product of recognized manufacturer and shall be compatible with the meter reading system currently being used by the water system owner and operator.

B. Meters, meter materials and meter test shall conform to applicable AWWA Specifications and shall meet or exceed current AWWA Specifications.

C. Each meter shall have manufacturer’s serial number on the lid.

D. All body parts as cases, boxes and lids shall be of bronze composition.

E. Meters shall be split case, positive displacement type.

F. The register shall read in U.S. Gallons and shall be hermetically sealed and driven by permanent magnets.

2.08 METER BOXES

A. The meter box shall be the approved standard product used by the water system owner and operator.

B. They shall be rectangular and of adequate dimension to accommodate the specified meters.

C. Boxes shall have cast iron or polyethylene covers labeled "WATER METER".

D. Boxes for 5/8" by 3/4" meters shall have inside width not less than 10 inches, inside length not less than 15 inches and overall height not less than 12 inches.

E. Boxes shall be designed and built to withstand traffic loads typical of yard installations.

2.09 VALVES

A. All valves 2" in diameter and smaller shall be constructed of brass or bronze except that the hand wheel which shall be of malleable iron construction with screwed ends. All valves 2-1/2" in diameter and larger shall have flanged ends for interior service and mechanical joints for buried service unless otherwise approved. They shall be iron body, bronze mounted, except that in the smaller sizes the valves may be all bronze.

B. Gate Valves:

1. Gate valves smaller than three inches shall meet the requirements of Fed. Spec. WW-V-54, Class A, 125 pounds.

2. Gate valves three inches and larger shall have nonrising stems and shall meet the requirements of AWWA Standard C-500. Valves for lighter pressures than the AWWA Standard shall meet the requirements of the above specifications except that the requirements for metal thickness and strengths and structural designs shall be adjusted as required to meet hydrostatic test pressures not less than 150 psi.

3. All gate valves shall have standard stuffing box seals. Bonnet bolts, studs and nuts shall be cadmium plated. Seating devices shall be bronze to iron or bronze to bronze. The glands shall be bronze or bronze bushed. Gland bolts and nuts shall be bronze.

4. All gate valves shall be of the double disc or wedge type. The wedge or disc shall be totally encapsulated in rubber. The sealing rubber shall be permanently bonded to the wedge or disc to meet ASTM tests fro rubber metal bond ASTM D249.

5. Valves to have two inches square operating nut, with the exception that gate valves in altitude valves pits shall have hand wheels.

6. Valves buried in ground or located in vaults or structures shall have suitable extensions for socket operation with top of operating nut located two feet below finished grade maximum.

7. Any valve installed in a vault readily accessible for entry shall be equipped with handle wheels in lieu of operating nuts. No hand wheels are allowed in buried valves.

C. Check Valves:

1. Check valves 2" through 24" shall be iron body, bronze mounted swing check valves meeting the requirements of AWWA Standard C508-76.

2. The check valve shall be metal to metal or composite to metal seat construction with flange ends or screw and coupled ends.

D. Altitude Valves:

1. All altitude valves furnished for use in the syatems shall be equipped for showing at all times the position of the valve. Said altitude valves shall be of the size specified on the drawings and suitable for the use intended.

2. The Contractor shall supply the services of a qualified manufacturer's representative to check and calibrate each altitude valve installation for proper working pressure and sequence.

E. Air Release Valves

1. Air release valve shall have all bronze body and bonnet. They shall be the direct acting type.

2. Valves shall be hydrostatically tested to at least 150 psi.

3. The valve shall have stainless steel floats and an internal coating with rust inhibitors.

2.10 BACKFLOW PREVENTERS

A. The backflow preventers used shall be those specifically designed for use in connections when the danger from backflow presents a health hazard.

B. All backflow preventers shall be of the reduced pressure type.

C. Backflow preventers 3/4" to 2" shall be Hersey, Model FRPII or equal meeting or exceeding the following specifications:

Mainline Case - Bronze
Working Parts - Bronze & Stainless Steel
Springs - Stainless Steel
Diaphragms - Buna N and Mylar
Valve disc - Silicone Rubber
O Ring - Buna N
Check Valve Enclosure - Glass Reinforced Plastic
Maximum Rated Working Pressure - 150 psi

Temp. Range - 33° - 210°F

D. Backflow Preventers 2½" to 10" shall be Model 6CM or equal meeting or exceeding the following specifications:

Body 8"-10"- Hot Dipped Galvanized or Epoxy Coating
Body 2½"-6" - Bronze
Working Parts - Bronze & Stainless Steel
Springs 2½"-6"- Stainless Steel
Springs 8"-10"- Vinyl Coated Carbon Steel
Diaphragms - Reinforced Elastomer
Valve Disc - Silicone Rubber
Maximum Rated Working Pressure - 175 psi
Temp. Range - 33° - 140°F

E. Backflow preventers larger than 10" shall be designed for conditions that do present a health hazard. It shall be the reduced pressure type and depending on the application, may require detection of leaks or unauthorized use. Detectors above 10" shall be submitted for approval. The submittal shall include complete shop drawings. The submittal will be reviewed based on the product's ability to meet the needs of the project and the Owner.

PART 3 - EXECUTION

A. All valves shall be carefully mounted in their respective positions free from distortion and strain. All valves shall be properly packed and left in satisfactory operating condition at the completion of the project.

B. Valve box, cover and concrete pad shall be installed with each valve as shown in miscellaneous details.

3.01 PIPE INSTALLATION

A. PVC pipe shall be installed in accordance with the Uni-Bell Plastic Pipe Association guide for installation of polyvinyl chloride plastic pressure pipe for municipal water main distribution system and the printed recommendations of the manufacturer.

B. Ductile iron pipe shall be installed in accordance with AWWA C600.

C. Pipe line alignment and gradient shall be straight, or shall follow true curves as near as practicable. Curvature in pipe lines, where required, shall be well within the allowable laying radius, horizontal and vertical.

D. Excavation, cleaning, laying, jointing and backfilling shall follow as closely as is possible so as to progress the work. In no case shall pipe be left in the trench overnight without completing the jointing. The completed pipe line shall not be left exposed in the trench unnecessarily, and the Contractor shall backfill and compact the trench as soon as is possible after laying and jointing is completed. Each day at the close of work, and at all times when laying is not in progress, the exposed end of the pipe line in the trench shall be closed with a head or barrier of wood or metal. If at any time it becomes necessary to cover the end of any uncompleted pipe line with backfill, the end of that pipe shall be closed with a mechanical joint plug.

E. The Contractor shall keep exposed ends of pipe properly plugged during laying to prevent dirt and other materials from entering the line, and shall also, before the system is accepted, thoroughly clean all lines.

F. Thrust Blocks (Reaction Blocking) shall be provided as specified AWWA C600. All exposed pipes, valves, hydrants, etc., shall be securely strapped and all ends and bends braced.

G. Other means of pipe restraining in addition to thrust blocking shall include "mega lug" utilization and all threads bolted through fittings in accordance with AWWA C600. Thrust blocking may not be eliminated with the use of joint restraint.

H. Mechanical joints shall be made only by experienced mechanics. Sockets and spigots shall be washed with soapy water before slipping gland and gasket over spigot. The spigot shall be inserted in the socket full depth. The gasket shall be brushed with soapy water, and pushed into position making sure the gasket is evenly seated in the socket. The gland shall then be properly positioned for compressing the gasket. All bolts and nuts shall be tightened with a torque wrench to a uniform, permanent tightness. Bolts shall be tightened alternately 180 degrees apart. Sockets, spigots, glands and bolts shall be kept clean and wet with soapy water until each joint is completed.

I. All water distribution mains shall have a minimum 36" of cover.

3.02 FIRE HYDRANT INSTALLATION

A. All fire hydrants shall have 36" minimum pipe cover provided for the branch supply line.

B. Each fire hydrant shall be set on a stable foundation at least 18 inches square and 6 inches thick and shall be blocked against the end of the trench with concrete and anchored.

C. Hydrant drainage shall be provided by installing around the hydrant at least 7 cubic feet of gravel or crushed stone below the top of the hydrant supply pipe.

D. The barrel of the fire hydrant shall be set plumb (perpendicular to the ground) with the lowest discharge outlet at least fifteen (15) inches high but no higher than 24 inches above finished grade. No fire hydrant shall be installed within 10 feet of any private driveway. Hydrants shall be located no closer than 5 feet of a curbing and no further than 12 feet of the curbing.

E. Immediately before installation of a hydrant, the following operations shall be performed:

1. The hydrant shall be thoroughly inspected.

2. The hydrant interior shall be thoroughly cleaned.

3. The hydrant shall be opened and closed to determine that all parts are in proper working order, with valves seating properly and the drain valve operating freely.

3.03 HYDROSTATIC TEST

A. Upon completion of backfilling operations and not less than seven (7) days after the last concrete blocking anchor has been poured, the pipe system shall be subject to hydrostatic test.

B. The system shall be filled with water and all air expelled.

C. The Contractor shall pressurize the system to 150 pounds per square inch at the highest point in the system.

D. The test pressure shall be maintained for two hours.

E. If the pressure cannot be maintained, the cause shall be determined, corrected and test repeated until successful.

3.04 LEAKAGE TEST

A. Following the pressure test, the system shall be subject to a leakage test.

B. Leakage shall be defined as the quantity of water that must be supplied into the pipe to maintain the design working pressure after all air in the pipe line has been expelled and the pipe has been filled with water.

C. Leakage shall not exceed the quantity determined by the formula given below:

$$L = \frac{ND(\text{Square Root of } P)}{7400}$$

WHERE L = allowable leakage in gallon/hr.
N = number of joints in pipe line
D = nominal diameter of the pipe inches
P = average test pressure during leakage test in psig

D. If leakage exceeds the allowable rate, leaks shall be found and repaired and the test repeated until successful.

3.05 DISINFECTION

A. Water mains and accessories shall be disinfected in accordance with "Rules for Safe Drinking Water" as published by the Georgia Environmental Protection Division.

B. The mains shall be flushed intro the storm drainage system before disinfecting by maintaining a velocity of at least 2.5 feet per second for a period of ten minutes.

C. The continuous feed method may be used for any size main or system where satisfactory quantity and quality water is available. The tablet method shall not be acceptable.

D. Following disinfection of the water system, the system shall be flushed until chlorine concentration is less than 1 milligram per liter. Flushing shall not allow chlorinated

water to be discharged into the storm sewer system without first allowing the chlorine in the system to dissipate. The contractor Shall use a Pollard Water LPD-250 or equal equipment along with LPD-Chlor tablets (Sodium Sulfate or Ascorbic Acid) to de-chlorinate the water using 1 tablet per 2000 gallons of water minimum prior to flushing, then after adequate testing, discharge the de-chlorinated water to the storm sewer system or onto the land surface. During the de-chlorination flushing the flow through the LPD 250 will be maintained at between 200 and 1200 GPM. No flows for de-chlorination or flushing will not be allowed outside this flow specification. The contractor may apply to the owner of the sanitary sewer system to obtain permission to discharge the chlorinated water into the sanitary sewer system for a fee. The contractor shall be charged at the going rate per gallon for treating the water discharged to the sanitary sewer system.

E. Bacteriologic Tests:

1. Tests shall be performed to detect the presence of coliform organisms on samples taken from the end farthest from the point at which chlorine was introduced into the system and at 1000 ft. intervals.

2. The bacteriolical sample shall meet the requirements established by EPD for suitable disinfection for human consumption.

3. If unsatisfactory samples are produced, disinfection shall be repeated until samples are satisfactory.

SECTION 02560
NON-POTABLE REUSE WATER SYSTEM

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

C500 Gate Valves 3" - 48" for Water and Other Liquids

C502 Dry-Barrel Fire Hydrants

C600 Installation of Cast Iron Water Mains

C601 Disinfecting Water Mains

C800 Threads for Underground Service Line Fittings

B. American National Standards Institute (ANSI):

A-21.10 Gray-Iron and Ductile Iron Fittings, 2"-48" for Water and Other liquids

A-21.11 Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe Fittings

A-21.4 Cement Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water

A-21.51 Ductile Iron Pipe, Centrifugally Cast in Metal or Sand-Lined Molds, for Water or Other Liquids

B-18.2 Square and Hex-Head Bolts and Screws

C. American Society of Testing and Materials (ASTM):

A-47 Malleable Iron Castings

A-48 Gray Iron Casting

A-88 Seamless Copper Water Tube

A-240 Chromium and Chromium-Nickel Stainless Steel Plate Sheet and Strip for Fusion-Welded Uni-fired Pressure Vessels

A-307 Low Carbon Steel Externally and Internally Threaded Standard Fasteners

D-1784 Rigid Poly (Vinyl chloride) Compounds, and Chlorinated Poly (Vinyl Chloride) Compounds

D-2239 Polyethylene (PE) Plastic Pipe (SDR-PR)

D-2241 Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR and Class T)

D-3139 Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals

D. Rule for Safe Drinking Water, Georgia State EPD: Chapter 391-3-5

1.02 DESIGN

A. The design of the proposed NPRL system shall include a hydraulic model that insures sufficient capacity and pressure at each point of delivery.

B. The design of the proposed NPRL system shall include horizontal alignment, all creek, wetlands, and bridge crossings, all tie-ins, future stubs, hydrants and valves included in the system.

C. The NPRL shall maintain at least 3' (feet) horizontal separation from existing parallel water mains or sewage collection lines, and 18" (inch) vertical separation from any existing perpendicular crossing of sanitary sewer mains. A minimum of 18" shall be vertical separation provided between the bottom of any potable water lines and the top of any NPRL.

D. If the proposed development does not have an existing NPRL of sufficient capacity at the project entrance, the engineer shall design a NPRL of a size and source specified by the City of Hinesville. Such design will be submitted along with the hydraulic model, for approval by the City.

E. The engineer shall layout the proposed NPRL system on the development utility plan and shall include the NPRL in the roadway typical section. The NPRL mains shall be located on the same side of the road as the potable water mains, between the potable water main and the right of way. The NPRL shall be located 9' from the back of the curb.

F. On existing City streets, the NPRL will be located 5' inside the right of way.

G. All NPRL owned and operated by the City of Hinesville shall have a minimum pipe size of 4". If adequate flow and/or pressure is not available at the point of connection, a larger main and/or additional improvements may be required. Determination of volume or pressure inadequacy will be hydraulically modeled and calculated by the developer's engineer.

H. Standard depth of cover is four (4) feet and shall not exceed five (5) feet in depth unless authorized by the City of Hinesville.

1.03 DESCRIPTION

A. All valves of the same type shall be from a single manufacturer. Parts for valves of the same type and size shall be interchangeable. Spare parts shall be furnished where required in the payment items. Special tools required for repacking or dissembling valves shall be provided.

B. All valves shall open left (counter-clockwise).

C. All pipe and fittings shall be Pantone 522 or 512 or a shade of purple acceptable to the City of Hinesville.

D. No NPRL shall be less than 2".

1.04 SUBMITTALS

A. Six copies of manufacturer's drawings and catalog cuts of the following items shall be submitted for approval of the Design Engineer:

1. Pipe
2. Fittings
3. Joints and Couplings
4. Hydrants
5. Valves

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Materials delivered to site shall be inspected for damage, unloaded and stored with the minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and rubber gaskets under cover and protect from exposure to direct sunlight. Store materials above ground. Interior of pipe and fittings shall be kept free of dirt and debris. Pipe with faded color not meeting acceptable color requirements will not be installed.

B. Pipe, fittings, valves, hydrants and other accessories shall be handled to insure delivery to the point of installation in sound undamaged condition. If coatings or linings of pipe or fittings are damaged, such pipe or fittings shall be removed from the site and new materials furnished. Pipe shall not be dragged. Rubber gaskets that are not installed immediately shall not be left in the sunlight, but shall be stored under cover and protected from exposure to direct sunlight.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE (PVC)

A. Polyvinyl chloride water main pipe shall conform to Designation ASTM D2241 and shall consist of Type I, Grade 1 PVC compound conforming to ASTM D1784. All pipe shall be Class 200-SDR 21. The standard laying length shall be 20 ft. ±1 inch and shall be purple in color throughout the PVC compound.

C. Pipe shall have integral bell and spigot joints. Provisions shall be made for contraction and expansion at each joint with an elastomeric ring. Threaded or solvent welded type joints shall not be used. Bell end pipe and couplings with elastomeric gaskets shall meet the requirements of ASTM 3139.

D. The Contractor shall install a continuous run of 14 gauge copper tracer wire with underground coating above the top of the PVC pipe 12 inches above the pipe but no deeper than 48 inches below finished grade. The tracer wire shall be suitable for detection with metal pipe location equipment.

2.02 DUCTILE IRON PIPE

A. Ductile iron pipe shall conform with the requirements of ANSI Standard A21.51 and shall be class 350 pipe. Class designations for the various classes of pipe shall be painted on the outside of each joint of pipe. Weights shall be conspicuously painted in white on each joint of pipe after the bituminous coating has hardened.

B. All joints shall have the same pressure rating as the pipe with which it is used. Joints shall be rubber gasketed push on or mechanical joint. Joints shall meet the requirements of ANSI A21.11.

C. Pipe shall be coated inside and out with one mil. thick bituminous coating conforming to ANSI A21.4. The interior shall be lined with a cement mortar lining conforming to ANSI/AWWA C104/A21.4.

D. All ductile iron pipe shall be coated with a sealer to prevent bleeding of bituminous coating through the paint then painted to the following specifications.

1. Paint shall be Pantone 522 or 512 or a shade of purple approved by the City.
2. Paint shall be manufactured in Induron, Koppers or Tnemec
3. Dry firm thickness shall be 1-2 mils per coat.
4. Surface shall be clean and dry.
5. Coverage shall be 600 SF/gallon.
6. Apply coating in strict accordance with manufactures requirements.

2.03 PLASTIC TUBING

A. Plastic pipe shall conform to all the requirements of the "Specifications for Polyethylene (PE) Plastic Pipe (ADR-PR)", as they apply to PE 3306 of ASTM D2239 and shall be purple in color.

B. The hydrostatic design stress shall be 630 psi for water at 23° centigrade (73.4° F) and 500 psi for water at 37.8° C (100° F).

C. The polyethylene extrusion compound from which the pipe is extruded shall meet the requirements of Type III, Grade 3, Class C material as described in "Specification for Polyethylene Molding and Extrusion Materials", ASTM D1248, except that melt index shall be determined under a higher temperature than any of the conditions as listed in Section 6(b) of "Method of Test for Measuring Flow Rates of Thermoplastics by Extrusion Plastometer", ASTM D1238. The test condition shall be the same as for condition J, except that the temperature shall be 310° C (590° F), with a load of 12-5 kilograms. Under these conditions the resin shall extrude at a maximum rate of 0.25 grams per ten (10) minutes. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other defects. The pipe shall be uniform in color, capacity, density, and other physical properties.

D. The size, the type of plastic pipe material, dimension ratio, commercial standards with which the pipe complies, the manufacturer's name and the National Sanitation

Foundation (NSF) seal of approval, shall be conspicuously marked on the outside of the pipe at intervals of not more than five (5) feet.

2.05 FITTINGS

A. Mechanical fittings and restrained fittings shall conform to ANSI A21.53/AWWA C153 or A21.10/AWWA C110.

B. Flanged fittings shall conform to ANSI A21.10/AWWA C110. The AWWA C110 fitting flanges shall have facing and drilling which match AWWA C115 thread-on flanges which also match ANSI B16.1 class 125 flanges except where class 250 are specifically noted.

C. Fittings shall be available in 4" through 24" sizes and shall be cast from ductile iron in accordance with ANSI/AWWA C153/A21.53 with mechanical joint bells or push-on joint bells. Fittings shall be listed by an approved certifying agency as conforming to the requirements of ANSI/NSF 61. The working pressure shall be 350 PSI. Fittings shall be made in the USA. No foreign fittings shall be allowed. Ductile iron fittings shall be coated with 6-8 mil. nominal thickness, fusion bonded epoxy conforming to the requirements of ANSI/AWWA C550 and C116/A21.16.

2.06 HYDRANTS

A. All fire hydrants shall conform to AWWA C502.

B. All fire hydrants shall have a 6" mechanical joint inlet connection and be equipped with a 5-1/4 inch valve, two 2-1/2 inch hose nozzles and one 4-1/2 inch pumper connection, all with ANSI (National) standard threads. Operating nuts shall be 1-1/2 inch, pentagon type.

C. All fire hydrants shall be equipped with "O" ring type stem seals.

D. All fire hydrants shall be designed for 150 psi working pressure and 300 psi test pressure.

E. All fire hydrants shall be equipped with a 6" gate valve, complying with other sections of the specifications, installed on the fire hydrant lead between the hydrant and the main.

F. The Contractor shall paint the hydrant with Pantone 522C or 512C paint. Another shade of purple may be used if accepted by the City. In addition, a sign in accordance with the City detail must be attached to the hydrant.

G. All fire hydrants shall be designed such that clockwise rotation of the stem closes the valve and counterclockwise rotation opens the valve. Hydrant covers shall have the word "Open" and an arrow showing the proper rotation of the operating nut cast in or permanently attached.

H. An independent drain shall be provided, completely draining the hydrant after use. The drain shall be activated to the open position by the closing of the hydrant valve. The drain rod shall be easily cleaned. The drain shall have a protective shield integral with the hydrant base to minimize clogging and prevent undermining.

I. All working parts of the hydrant shall be easily removed for inspection or servicing without digging or the use of hoists or derricks or special tools. The hydrant cover and stand pipe shall be removable without requiring the water to be shut off.

J. Each fire hydrant shall be equipped with a ground line mounted breakaway flange and cast iron safety stem coupling specially designed so that upon sustaining severe impact the hydrant will shear off at the ground line without loss of water in the main.

K. All fire hydrants shall be Mueller standard or equal as approved by the Engineer.

2.07 METERS

A. All meters shall be approved first line product of recognized manufacturer and shall be compatible with the meter reading system currently being used by the Owner.

B. Meters, meter materials and meter test shall conform to applicable AWWA Specifications and shall meet or exceed current AWWA Specifications.

C. Each meter shall have manufacturers serial number on the lid.

D. All body parts as cases, boxes and lids shall be of bronze composition.

E. Meters shall be split case, positive displacement type.

F. The register shall read in U.S. Gallons and shall be hermetically sealed and driven by permanent magnets.

2.08 METER BOXES

A. The meter box shall be the approved standard product used by the City of Hinesville. Painted in accordance with NPRL standards and marked as "REUSE WATER, NOT FOR HUMAN CONSUMPTION" on the lid.

B. They shall be rectangular and of adequate dimension to accommodate the specified meters.

C. Boxes shall have cast iron or heavy plastic covers labeled "REUSE WATER, NOT FOR HUMAN CONSUMPTION".

D. Boxes for 5/8" by 3/4" meters shall have inside width not less than 10 inches, inside length not less than 15 inches and overall height not less than 12 inches.

E. Boxes shall be designed and built to withstand traffic loads typical of yard installations.

2.09 VALVES

A. All valves 2" in diameter and smaller shall be constructed of brass or bronze except that the hand wheel which shall be of malleable iron construction with screwed ends. All valves 2-1/2" in diameter and larger shall have flanged ends for interior service and mechanical joints for buried service unless otherwise approved. They shall be iron body, bronze mounted, except that in the smaller sizes the valves may be all bronze.

B. Gate Valves:

1. Gate valves shall conform to AWWA C500-86 for double-disc gate valves or AWWA C509-87 for resilient-seated gate valves, and shall be as manufactured by American Flow Control, U.S. Pipe, Mueller or approved equal. Gate valves shall be hand operated, non-rising stem, with ductile iron bodies, and adapted for joints as indicated in the approved design drawings, or as directed.

2. All gate valves shall open by turning the operating nut to the left (counter clockwise).

3. Gate valves shall only be used in sizes 2" through 10".

C. Butterfly Valves:

1. Butterfly valves shall conform to the requirements of AWWA C504-87, and shall be as manufactured by American Flow Control, Henry Pratt, Allis-Chalmers, or approved equal.

2. Butterfly valves shall be hand operated with ductile iron bodies, and adapted for joints as indicated in the approved design drawings, or as directed.

3. All butterfly valves shall open by turning the operating nut to the left (counter clockwise). Butterfly valves shall only be used in sizes 12" and larger.

D. Tapping Sleeves and Valves:

1. The Contractor shall furnish and install tapping sleeves and valves suitable for connection to the existing NPRLs at locations indicated on the approved plans, or as directed. The Contractor shall also provide the tapping machine and competent supervision for the making of taps. It is the Contractor's responsibility to verify the type, size and O.D. and class of the existing pipe before ordering the tapping sleeve and valve.

2. Prior to making the tap, the Contractor, in the presence of the City Engineer/Inspector, shall hydrostatically pressure test the complete tapping sleeve and valve installation at a test pressure of 150 PSI, or 50 PSI over the existing system static pressure, whichever is greater, **(PNEUMATIC, OR AIR-PRESSURE TESTING IS PROHIBITED)**. The Contractor shall properly support the tapping sleeve and valve using bricks, blocks, wedges, or other substantial supporting materials, which will not permit the tapping valve or tapping machine to transfer any downward rotational force to the tapping sleeve. This support shall be provided before mounting the tapping machine.

3. Tapping sleeves shall be ductile iron with mechanical joint ends as manufactured by American Flow Control, Mueller, or approved equal. Outlets shall be sized to permit a tap to be made using a full-size shell cutter. The existing pipe shall be thoroughly cleaned prior to the installation of the tapping sleeve. **THE USE OF STRAP-TYPE TAPPING SADDLES FOR TAPS LARGER THAN 2" IS NOT PERMITTED.**

4. Tapping valves shall conform to the requirements for gate valves hereinbefore stipulated, except for any modifications necessary to permit the use of full size shell cutters. If of the double-disc variety, tapping valves 16" and larger shall be

installed in a horizontal configuration, and shall be supplied with a by-pass. Resilient seated tapping valves 16" and larger may be supplied without the by-pass. When using resilient seated gate valves for making taps 16" and larger, it is the Contractor's responsibility to determine the finished depth of cover that shall remain over the operating nut of the valve after installation. If finished depth of cover in a standard vertical configuration is less than 2 feet, then the tapping valve shall be supplied in a horizontal configuration with differential operator.

E. Backtaps

BACKTAPS SHALL NOT BE PERMITTED UNLESS SPECIFICALLY AUTHORIZED BY THE CITY OF HINESVILLE. ANY SAID AUTHORIZED BACKTAPS SHALL BE CONSTRUCTED USING M.J. FITTINGS AND "MEGALUG" RETAINER GLANDS, AND SINGLE JOINTS OF PIPE. THREADED ROD SHALL ONLY BE PERMITTED FROM THE STEEL CASING TO THE FIRST FITTING, AND SHALL BE WELDED FOR A MINIMUM OF 8-INCHES ON EACH ROD ALONGSIDE THE CASING. **WELDING OF I-BOLTS DIRECTLY TO THE CASING FOR THE PURPOSE OF INSTALLING THREADED ROD IS NOT PERMITTED.**

F. Accessory Equipment

All valves, which are to be buried in the ground, shall be provided with a valve and box cover. The Contractor shall provide suitable, permanently installed valve stem extensions and guides, which have been approved by the City of Hinesville prior to fabrication and placement.

G. Valve Markers

Valve markers shall be furnished and installed with each valve on the proposed project. The markers shall be white drivable markers #CIB-380 seventy-eight (78") inches long (manufactured by Carsonite International) and extend to the valve. The markers shall be installed as close to the valve as possible, facing the street. The marker is not to protrude the finished surface grade more than three (3') feet and no less than eighteen (18") inches above the finished grade. Each marker must be labeled on both sides in accordance with the attached detail.

H. Future Stubs

All stubs for future use must be marked with a White Drivable Marker #SNFB096-01 eight (8') feet long (manufactured by Carsonite International) and extend to the pipe. The markers shall be installed facing the street. The marker is not to protrude the finished grade less than two (2') feet and not to exceed three (3') feet. Each marker must be labeled on both sides as per the attached detail.

2.10 BACKFLOW PREVENTERS

A. The backflow preventers used shall be those specifically designed for use in connections when the danger from backflow presents a health hazard.

B. All backflow preventers shall be of the reduced pressure type.

C. Backflow preventers 3/4" to 2" shall be Hersey, Model FRPII or equal meeting or exceeding the following specifications:

Mainline Case - Bronze
Working Parts - Bronze & Stainless Steel
Springs - Stainless Steel
Diaphragms - Buna N and Mylar
Valve disc - Silicone Rubber
O Ring - Buna N
Check Valve Enclosure - Glass Reinforced Plastic
Maximum Rated Working Pressure - 150 psi
Temp. Range - 33° - 210°F

D. Backflow Preventers 2½" to 10" shall be Model 6CM or equal meeting or exceeding the following specifications:

Body 8"-10"- Hot Dipped Galvanized or Epoxy Coating
Body 2½"-6" - Bronze
Working Parts - Bronze & Stainless Steel
Springs 2½"-6"- Stainless Steel
Springs 8"-10"- Vinyl Coated Carbon Steel
Diaphragms - Reinforced Elastomer
Valve Disc - Silicone Rubber
Maximum Rated Working Pressure - 175 psi
Temp. Range - 33° - 140°F

E. Backflow preventers larger than 10" shall be designed for conditions that do present a health hazard. It shall be the reduced pressure type and depending on the application, may require detection of leaks or unauthorized use. Detectors above 10" shall be submitted for approval. The submittal shall include complete shop drawings. The submittal will be reviewed based on the product's ability to meet the needs of the project and the Owner.

PART 3 - EXECUTION

A. All valves shall be carefully mounted in their respective positions free from distortion and strain. All valves shall be properly packed and left in satisfactory operating condition at the completion of the project.

B. Valve box and cover shall be installed with each valve as shown in miscellaneous details.

3.01 PIPE INSTALLATION

A. PVC pipe shall be installed in accordance with the Uni-Bell Plastic Pipe Association guide for installation of polyvinyl chloride plastic pressure pipe for municipal water main distribution system and the printed recommendations of the manufacturer.

B. Ductile iron pipe shall be installed in accordance with AWWA C600.

C. Pipe line alignment and gradient shall be straight, or shall follow true curves as near as practicable. Curvature in pipe lines, where required, shall be well within the allowable laying radius, horizontal and vertical.

D. Excavation, cleaning, laying, jointing and backfilling shall follow as closely as is possible so as to progress the work. In no case shall pipe be left in the trench overnight without completing the jointing. The completed pipe line shall not be left exposed in the trench unnecessarily, and the Contractor shall backfill and compact the trench as soon as is possible after laying and jointing is completed. Each day at the close of work, and at all times when laying is not in progress, the exposed end of the pipe line in the trench shall be closed with a head or barrier of wood or metal. If at any time it becomes necessary to cover the end of any uncompleted pipe line with backfill, the end of that pipe shall be closed with a mechanical joint plug.

E. The Contractor shall keep exposed ends of pipe properly plugged during laying to prevent dirt and other materials from entering the line, and shall also, before the system is accepted, thoroughly clean all lines.

F. Thrust Blocks (Reaction Blocking) shall be provided as specified AWWA C600. All exposed pipes, valves, hydrants, etc., shall be securely strapped and all ends and bends braced.

G. Other means of pipe restraining shall include "mega lug" utilization and all threads bolted through fittings in accordance with AWWA C600.

H. Mechanical joints shall be made only by experienced mechanics. Sockets and spigots shall be washed with soapy water before slipping gland and gasket over spigot. The spigot shall be inserted in the socket full depth. The gasket shall be brushed with soapy water, and pushed into position making sure the gasket is evenly seated in the socket. The gland shall then be properly positioned for compressing the gasket. All bolts and nuts shall be tightened with a torque wrench to a uniform, permanent tightness. Bolts shall be tightened alternately 180 degrees apart. Sockets, spigots, glands and bolts shall be kept clean and wet with soapy water until each joint is completed.

I. All water distribution mains shall have a minimum 48" of cover.

3.02 HYDRANT INSTALLATION

A. All fire hydrants shall have 36" minimum pipe cover provided for the branch supply line.

B. Each fire hydrant shall be set on a stable foundation at least 18 inches square and 6 inches thick and shall be blocked against the end of the trench with concrete and anchored.

C. Hydrant drainage shall be provided by installing around the hydrant at least 7 cubic feet of gravel or crushed stone below the top of the hydrant supply pipe.

D. The barrel of the fire hydrant shall be set plumb (perpendicular to the ground) with the lowest discharge outlet at least fifteen (15) inches high but no higher than 24 inches above finished grade. No fire hydrant shall be installed within 10 feet of any private driveway. Hydrants shall be located no closer than 5 feet of a curbing and no further than 12 feet of the curbing.

E. Immediately before installation of a hydrant, the following operations shall be performed:

1. The hydrant shall be thoroughly inspected.

2. The hydrant interior shall be thoroughly cleaned.

3. The hydrant shall be opened and closed to determine that all parts are in proper working order, with valves seating properly and the drain valve operating freely.

3.03 HYDROSTATIC TEST

A. Upon completion of backfilling operations and not less than seven (7) days after the last concrete blocking anchor has been poured, the pipe system shall be subject to hydrostatic test.

B. The system shall be filled with water and all air expelled.

C. The Contractor shall pressurize the system to 150 pounds per square inch at the highest point in the system.

D. The test pressure shall be maintained for two hours.

E. If the pressure cannot be maintained, the cause shall be determined, corrected and test repeated until successful.

3.04 LEAKAGE TEST

A. Following the pressure test, the system shall be subject to a leakage test.

B. Leakage shall be defined as the quantity of water that must be supplied into the pipe to maintain the design working pressure after all air in the pipe line has been expelled and the pipe has been filled with water.

C. Leakage shall not exceed the quantity determined by the formula given below:

$$L = \frac{ND(\text{Square Root of } P)}{7400}$$

WHERE L = allowable leakage in gallon/hr.
N = number of joints in pipe line
D = nominal diameter of the pipe inches
P = average test pressure during leakage test in psig

D. If leakage exceeds the allowable rate, leaks shall be found and repaired and the test repeated until successful.

3.05 DISINFECTION

A. Non-potable reuse water lines (NPRL) and accessories shall be disinfected in accordance with "Rules for Safe Drinking Water" as published by the Georgia Environmental Protection Division.

B. The mains shall be flushed before disinfecting by maintaining a velocity of at least 2.5 feet per second for a period of ten minutes.

C. The continuous feed method may be used for any size main or system where satisfactory quantity and quality water is available. The tablet method shall not be acceptable.

D. Following disinfection, the system shall be flushed until chlorine concentration is less than 1 milligram per liter.

E. Bacteriologic Tests:

1. Tests shall be performed to detect the presence of coliform organisms on samples taken from the end farthest from the point at which chlorine was introduced into the system and at 1000 ft. intervals.

2. If unsatisfactory samples are produced, disinfection shall be repeated until samples are satisfactory.

SECTION 02611
BASE AND PAVING

PART 1 - GENERAL

1.01 APPLICABLE STANDARDS

A. When used in this section, the term "Standard Specifications" shall mean the DEPARTMENT OF TRANSPORTATION, STATE OF GEORGIA STANDARD SPECIFICATIONS FOR CONSTRUCTION OF ROADS AND BRIDGES 2013 or later edition .

B. American Society for Testing and Materials (ASTM):

D-698 Test for, Moisture-Density Relations for soils

D-1557 Test for, Moisture-Density Relations for soils

PART 2 - PRODUCTS

2.01 MATERIALS

A. Base: The base shall conform to Section 310, Graded Aggregate Construction, of the Standard Specifications and must be granite base material.

B. Prime: The prime coat shall be RC-70 and shall conform with Section 412, Bituminous Prime, of the Standard Specifications.

C. Tack Coat: The tack coat shall be RC-70 and shall conform with Section 413, Bituminous Tack Coat of the Standard Specifications.

D. Intermediate Course (Binder): The intermediate course shall be Superpave 19 mm Asphaltic Concrete and shall conform with Section 402, Hot Mix Asphaltic Concrete Construction of the Standard Specifications.

E. Surface Course - Asphalt Plant Mix: The surface course shall be either Superpave 9.5 mm or 12.5 mm Asphaltic Concrete and shall conform with Section 402, Hot Mix Asphaltic Concrete Construction, of the Standard Specifications.

F. Paint: Paint for pavement marking shall be in conformance with MUTCD publication and shall conform with Section 870, Paint, of the Standard Specifications.

B. Concrete Curb and Gutter: Shall conform to Section 441 -Concrete Curb, Gutter, Combination Curb and Gutter, Header, and Median of the Standard Specification.

PART 3 - EXECUTION

3.01 COMPACTION

A. Sub-grade: The upper 24 inches of sub-grade soils in all cut areas and all fill areas that are to receive new pavements shall be scarified and re-compacted until a density equivalent to 95% standard Proctor maximum dry density in accordance with ASTM D698 has been obtained.

B. Base: All base shall have minimum compaction of 100% of the maximum density obtained by the test procedure present in ASTM D1557, Method D (Modified Proctor). The maximum permissible lift thickness shall be 6 inches (compacted). The contractor shall be required to perform all work necessary to meet the minimum compaction requirements.

C. Moisture Content: Compaction shall be performed only when the moisture content of the soil is within 4% of the optimum moisture content at the time of compaction as determined by ASTM D698. Soils are to be dried prior to compaction by discing and aeration. An Independent Testing Laboratory shall determine if soils are within the optimum moisture content. The contractor shall be required to perform all work necessary to meet the minimum compaction requirements.

3.02 CONSTRUCTION

A. Preparation of Sub-grade: Prior to placing of base and pavements, the construction of all utility lines (water, sewer, power, gas, etc.) which are to be placed under the pavements shall have been completed.

B. Base: The base course shall be constructed in accordance with Section 310 of the Georgia Department of Transportation Standard Specifications to the compacted thickness specified.

C. Prime: The prime coat shall be applied at a rate of 0.25 gallons per square yard and in accordance with Section 413 of the Georgia Department of Transportation Standard Specifications.

D. Tack Coat: The tack coat shall be applied at a rate of 0.10 gallons per square yard and in accordance with Section 413 of the Georgia Department of Transportation Standard Specifications.

E. Intermediate and Surface Course - Asphalt Plant Mix: The intermediate and surface courses shall be constructed in accordance with Section 402 of the Georgia Department of Transportation Standard Specifications to the thickness indicated. All thicknesses are compacted.

F. Painting Stripe: Pavement striping is required and shall be in accordance with Georgia Department of Transportation MUTCD publication.

G. Existing pavement which has pavement markings damaged by this construction shall be repainted.

H. Concrete Curb and Gutter: Shall be constructed in accordance with Section 441 of the Georgia Department of Transportation Standard Specification.

3.03 TESTING

A. Compaction testing shall be performed by an approved testing laboratory. Sub-grade and base compaction testing shall be performed at a spacing not to exceed 500’ staggered for the entire length of the street. On streets shorter than 1,000’ the testing spacing shall reduce to 300’ and in no case will be less than three tests per street, equally spaced. The Design Engineer and the construction Inspector shall be

provided copies of the test information prior to placement of base material or final pavement.

B. Prior to the installation of any curb & gutter or base material a test roll must be performed along the entire roadway length, both sides of the road. The test roll shall be performed utilizing an 18 C.Y. tandem axle dump truck loaded with at least 12 C.Y. of soil or gravel. The same test roll will be required on the base material prior to beginning pavement installation. The Design Engineer and construction Inspector shall be present during the test roll.

C. Prior to beginning the installation of any asphalt pavement, the base material shall be tested to determine thickness and graded cross section of the base material. The contractor shall provide labor and equipment to auger through the base material to check to insure the thickness specified in the plans and specifications has been achieved. In addition, the cross slope of the base and the depth below the gutter face shall be checked, utilizing a string line, to insure proper crown and asphalt depth at the edge has been achieved with the base grading. If the depth of base material is insufficient the base present will be removed, the subgrade lowered and adequate base material will be replaced to achieve the required thickness. If the cross slope or edge depth is determined to be less than the specified thickness, the area will be rejected until the area is re-graded to the slope and the thickness specified on the approved plan.

D. The Owner at his option may check the thickness of the asphalt pavement and base material after the installation is complete. If the Owner finds the materials to be less than specified the contractor/developer shall take necessary measures to meet the requirements of the approved plans and specifications.

E. Prior to any striping being performed, the contractor shall prepare a striping plan for approval by the construction inspector.

3.04 EXISTING PAVEMENT RESTORATION

A. Pavement damaged due to construction shall be patched or replaced in accordance Section 400 of the Georgia Department of Transportation Standards and Specifications.

B. Pavement damaged by new utility trenches shall be restored in accordance with the pavement removal and replacement details. Any pavement removed must be disposed of by the contractor at a permitted site.

C. Existing inlets, manholes, or valve boxes shall be adjusted by the Contractor to the new grade lines and elevations. All adjustments to structures in areas proposed for pavement shall be accomplished prior to construction of the surface course.

D. Adjustment to grade of existing frames shall include raising or lowering the upper portion of the structure, including any necessary sleeve extensions, adjustable manhole rings, gaskets, mortar, masonry or other approved material, to bring the frame to the required grade.

3.05 STRIPING OF PAVEMENT MARKINGS

A. Striping shall consist of furnishing and applying traffic markings with paint or thermoplastic in accordance with the contract drawings and specifications, and the requirements of the current Federal and State "Manual of Uniform Traffic Control Devices."

B. Thermoplastic Plastic Stripe shall consist of solid or broken (skip) lines, words and/or symbols of the type, color and the location shown on the plans. It is the intent of these specifications that short lines which are defined to be crosswalks, stop bars, arrow symbols and crosshatching shall be extruded. All other lines, unless otherwise specified, shall be sprayed.

C. Cleaning: All pavement areas to be striped shall be thoroughly cleaned. Cleaning may be accomplished by the use of hand brooms, rotary brooms, air blasts, scrapers or other approved methods which leave the paving surface thoroughly clean and undamaged. Particular care shall be taken to remove all vegetation and road film from the area to be striped.

D. Warranty: The Contractor shall transfer to the Governing Authority the warranty on Thermoplastic materials issued by the Manufacturer.

SECTION 02650
SANITARY SEWERS

PART 1 - GENERAL

1.01 APPLICABLE STANDARDS

A. American National Standards Institute (ANSI):

A21.4	Cement-Mortar Lining for Cast-Iron and Ductile-Iron Pipe and Fittings for Water
A21.6	Cast-Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids
A21.11	Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings
A21.51	Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

B. American Society of Testing and Materials (ASTM):

A48	Gray Iron Castings
C12	Installing Vitrified Clay Sewer Pipe
C425	Compression Joints for Vitrified Clay Bell and Spigot Pipe
C478	Precast Reinforced Concrete Manhole Sections
C594	Compression Couplings for Vitrified Clay Plain-End Pipe
C700	Extra Strength and Standard Strength Clay and Perforated Clay Pipe
D1784	Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds
D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR and Class T)
D2321	Underground Installation of Flexible Thermoplastic Sewer Pipe
D2774	Underground Installation of Thermo-plastic Pressure Piping
D3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3139	Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals
D3212	Sewer Pipe Joints using Elastomeric Seals

C. American Water Works Association (AWWA):

C-600	Installation of Cast-Iron Mains

1.02 SUBMITTALS

A. Materials used in the sanitary sewer system shall be submitted for approval to the Design Engineer. The Design Engineer shall review the drawings, provide a list of materials and certify compliance to the Owner.

B. Six copies of shop drawings or manufacturer's standard drawings or catalog cuts shall be submitted for the following:

1. Precast concrete manholes

2. Manholes and Frames

3. Gaskets - One of each type

4. Pipe - One of each type

5. Valves - One of each type

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall be responsible for handling and storage of all materials and damaged materials shall not be used in the work. Materials delivered to the site shall be promptly inspected for damage upon arrival. Damaged or defective materials to be immediately removed from the site.

B. All materials to be stored at least 12 inches above grade. Inside of pipes and fittings shall be kept free of dirt and debris. Rubber gaskets and plastic pipe not used immediately shall be protected from direct sunlight. Manhole units shall be handled with care to avoid chippage or breakage.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. Polyvinyl chloride pipe and fittings for gravity sewers shall be SDR-35 for less than 12’ bury and SDR – 26 for 12’ bury and over, meeting ASTM D3034 for type PSM Polyvinyl Chloride (PVC) sewer pipe. The joints shall be Push-On "O" ring gasket type with integral bell and spigot meeting ASTM 3212. Threaded or solvent welded type joints shall not be used.

B Polyvinyl chloride pressure pipe shall meet one of the following specifications:

1. IPS Size PVC Pipe: Class 200 SDR 21 - Polyvinyl chloride water main pipe shall conform to Designation ASTM D2241 and shall consist of Type I, Grade 1 PVC compound conforming to ASTM D1784. All pipe shall be Class 200, SDR 21. The standard laying length shall be 20 ft. ±1 inch.

2. DIP Size PVC Pipe: AWWA C-900-07

a. C-900 polyvinyl chloride water main pipe 4” TO 12” shall conform to Designation ASTM D2241 and shall consist of Type I, Grade 1 PVC compound conforming to ASTM D1784. All pipe larger than 4” to 12” shall meet the requirements of AWWA C900,

"Poly Vinyl Chloride (PVC) pressure pipe." All pipe shall be class 200 pipe and shall meet the requirements of DR14. The standard laying length shall be 20 ft. ±1 inch. The FM approved pressure class will be used to determine pressure class.

b. C-905 polyvinyl chloride water main pipe 14" to 30" shall be manufactured from compounds conforming to PVC cell classification of 12454B as defined in ASTM D-1784. The integral bell joint system meets the requirements of ASTM D-3139 and utilizes an elastomeric seal conforming to ASTM F-477. All pipe shall be class 200 pipe and shall meet the requirements of DR18. The standard laying length shall be 20 ft. ±1 inch.

c. When DIP size PVC pipe is used two 2" PVC pipe shall be SDR 21, 200 PSI pressure class, iron pipe

C. Marking: Pipe shall be clearly marked with:

1. Manufacturer's Identification

2. Nominal Pipe Size

3. Material, Type and Grade

4. SDR or Pressure Rating

5. All gravity sewer pipe shall be green. Force main pipe shall be white or brown.

6. All pipe regardless of color shall be clearly marked **"SEWAGE FORCE MAIN"** or **"GRAVITY SEWER"** as appropriate, marked every three feet.

2.02 DUCTILE IRON PIPE AND FITTING

A. Type: Coated Ductile

B. Joints:

1. Push on type in accordance with ANSI A21.11.

2. Mechanical joint in accordance with ANSI A21.11 and fittings may be in accordance with A21.53..

C. Ductile iron pipe shall conform to ANSI A21.51.

D. Pipe shall have a Protecto 401 lining or equal. The lining should have a high resistance to fatty oils, detergents and sewage generated hydrogen sulfide.

E. Pipe shall be coated outside with one mil. thick bituminous coating conforming to ANSI A21.4 and AWWA C110, C115OR C151.

2.03 REINFORCED CONCRETE PIPE AND MANHOLES (WET WELLS OR VALVE PITS)

A. Precast concrete sections to be manufactured in accordance with provisions of ASTM C478. As a minimum, the interior of all sections shall be coated with two coats of bituminous coating. The first coat shall be spray applied and the second coat should be roller applied. In addition, in extremely corrosive environments, to include force main receiving manholes, wetwells, and the first two manhole from the force main connection shall be lined with sealed HDPE sheet liner. The HDPE liner shall have a watertight seal at all joints and penetrations. The liner shall be Agru Sure Grip Liner or equivalent.

B. Precast concrete riser sections to be 48 inches in diameter with minimum wall thickness of 4 inches.

C. Precast concrete base units to have minimum wall thickness of 5 inches.

D. Jointing material shall be rubber gasket type conforming to ASTM C443 or vulcanized butyl rubber base flexible joint sealer in rope form conforming to Federal Specification SS-S-00210, Kent-Seal No. 2 or approved equal. The inside and outside of the joint shall be finished with mortar. Mortar shall be one part Portland cement and two parts sand.

E. Manhole base sections shall provide for a flexible watertight union between pipe and manhole base. Manhole sleeves shall be of high quality synthetic rubber with tensile strength of 1,500 psi, resistant to raw sewage, ozone, acids, and weathering, flexible at temperatures below 0°F and resistant to heat as high as 250°F. A substantial, serrated flange of the sleeve material shall be integrally cast into the wall of the manhole base forming a tight waterseal. The sleeve shall protrude through the wall of the base. A watertight union shall be secured with the end of the pipe with stainless steel strap clamps. Manhole sleeves shall be Interpace Corp. Lock Joint Manhole Sleeves or approved equal.

F. Pick up holes shall not penetrate the interior walls or the riser.

2.04 MANHOLE FRAMES AND COVERS

A. Frames and covers to have machined bearing surfaces.

B. Covers to have checkered top design and marked "Sanitary Sewer" and include the name of the utility owner.

C. Combined weight of frame and cover shall be approximately 450 pounds.

D. Frame shall have a depth of approximately 9 inches and an access opening of not less than 20 inches.

E. Covers shall have two pick holes located at edges.

F. Materials shall conform to ASTM A48 for Class 30 gray iron castings.

2.05 MANHOLE STEPS

A. Manhole steps shall be constructed of a number 3 reinforcing bar encapsulated in polypropylene plastic with a non-skid tread.

B. Finished dimensions of the steps shall be identical to that of malleable iron manhole steps.

C. Steps to have a minimum tread width of 12 inches.

2.06 NUTS AND BOLTS

A. Stainless Steel Flanged: Square head MB/SF, hexagon nuts; ASTM 307B; ANSI B18.2, zinc plated.

2.07 GASKETS

A. Flanged pipe gaskets shall conform to requirements of ASA A21.10 and shall be suitable for the indicated services.

2.08 VALVES

A. All valves two inches in diameter and smaller shall be constructed of brass or bronze except the hand wheel, which shall be of malleable iron construction. Valves two inches in diameter and smaller shall have screwed ends unless approved otherwise. All valves 2½ inches in diameter and larger shall have flanged ends unless otherwise approved. They shall be iron body, bronze mounted, except that in the smaller sizes the valves may be all bronze at the contractors option and expense.

B. The contractor shall prepare and submit for approval complete detailed drawings of all valves in accordance with the requirements of the appropriate section of these specifications. All valves of the same type shall be from a single manufacturer. Parts of valves of the same type and size shall be interchangeable. Spare parts shall be furnished as specified under the proposal items. Special tools required for repacking or disassembling valves shall be provided.

C. All valves shall be carefully mounted in their respective positions free from all distortion and strain. All valves shall be properly packed and left in satisfactory operating condition at the completion of the project. All valves shall open left.

D. Gate Valves

1. Gate valves should not be used in raw sewage applications. Gate valves should only be used where primary and partial secondary treatment has already occurred.

2. Unless otherwise specified or directed, gate valves three inches and larger shall have non- rising stems and shall meet the requirements of AWWA Standard C-500. Valves for lighter pressures than the AWWA Standard shall meet the requirements of the above specifications except that the requirements for metal thicknesses and strengths and structural designs shall be adjusted as required to meet hydrostatic test pressures not less than 125 psi.

3. Unless otherwise specified or directed, gate valves smaller than three inches shall meet the requirements of Federal Specification WW-V-54, Class A, 125 pounds.

4. All gate valves shall have standard stuffing box seals. Bonnet bolts, studs and nuts shall be cadmium plated. Seating devices shall be bronze to iron or bronze to bronze as specified or required. The glands shall be bronze or bronze bushed. Gland bolts and nuts shall be bronze.

5. All gate valves 2½ inches in diameter and larger shall be of the double disk type. All gate valves two inches in diameter and smaller may be of the double disk or the solid wedge type.

E. Plug Valves

1. All plug valves shall be the two-way type.

2. Nonlubricated, eccentric with resilient faced plugs.

3. Port area of 4 to 20 inch valves shall be at least 70 percent of full pipe area.

4. Valves to be designed for 125 psi working pressure.

5. Bodies to be semisteel with raised seats.

6. Seats to have either a welded-in overlay of approximately 90 percent pure nickel on surfaces contacting the plug face or shall be bronze conforming to ASTM B-62 and attached to the body by stainless steel set screws.

7. Upper and lower plug stem bushings to be stainless steel and shall be permanently lubricated.

8. Exposed nuts, bolts and washers to be zinc plated.

9. Flanges to be faced and drilled to ASA 125 pound standard.

F. Check Valves

1. Type: Ball Check

a. Static head must exceed 10 feet to use ball check valves.

b. No ball check valve will be mounted vertically to compensate for low static head.

c. Ball check ends must be flanged.

d. The body shall be cast iron, ASTM A159-72, Class 35.

e. The ball shall be hollow steel with vulcanized nitrile rubber covering.

f. Pressure rating shall be 150 psi.

g. Valve to be Flygt HDL or equal.

2. Lever Actuate Spring Check Valve

   a. Where static head is less than 10 feet lever action swing check valves shall be used.

   b. Lever action swing checks may be spring and lever type or weight on lever type as approved by the design engineer and the Owner.

   c. Valves shall be installed in the horizontal position.

   d. The valve body, disc, cover and lever shall be cast iron, ASTM A159-72, Class 35.

   e. The disc arm shall be cast steel

   f. The seat ring shall be bronze or stainless steel.

   g. All studs, bolts or nuts shall be commercial grade steel.

   h. The gate shall be rubber faced.

   i. The hinge shaft shall be stainless steel.

   j. The chamber shall be bronze.

   k. The valve shall be Clow F5340 (outside spring and lever) or Clow F5345 (outside weight and lever) or an approved equal.

G. Automatic Sewage Air Release Valve

1. The automatic sewage air release valve shall be designed to allow entrapped air to escape from the sewage force main line. After the air escapes out of the air release valve, the valve shall shut-off until more air accumulates in it and the opening cycle will repeat automatically.

2. The sewage release valve must have a compound internal linkage of precision molded delfin or stainless steel. All other internals must be stainless steel to positively prevent galvanic action. The float rod shall be 20" long to provide an air gap between the linkage and waste level inside the valve to retard the waste solids from clogging the linkage. The stainless steel float must withstand a minimum 1000 psi pressure. Each valve shall be complete with hose and blow off valves to permit back flushing without dismantling valve.

Body and cover cast iron	ASTM A48 Class 30
Internal Delfin linkage	ASTMD2133 (or Stainless Steel)
Stainless Float	ASTM A240
Buna-N	ASTM SB800

3. Typical installation will utilize standard body valve. Valve height 28"-with back flushing attachments-33-1/2". If depth of trench is not deep enough, furnish short valve. Valve height 17-1/2" -with back flushing attachments-23-1/2".

4. Automatic sewage air release valve to be as manufactured by Crispin, Val-matic, or APCO equal to APCO Series 400 with accessories.

2.09 ACCESSORIES, PLUG, AND GATE VALVES

A. Valves to have two inch square operating nut unless otherwise indicated.

B. Valves buried in ground or located in vaults or structures to have suitable extensions for socket operation with top of operating nut located two feet below finished grades maximum.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Plastic piping installation shall be in accordance with ASTM D2321 Recommended Practice for non-pressure pipe and ASTM D2774 Recommended Practice for pressure pipe.

B. Ductile iron pressure piping shall be installed in accordance with AWWA Standard C600.

C. Material selection for piping material shall be as indicated. If piping materials are not indicated the Contractor has the option of selecting materials in accordance with this section.

D. Service sewer lines shall be constructed of same material as the mains.

E. Sewer lines shall not be laid closer than 10 feet horizontally to a water main. Pressure sewer lines shall pass beneath water lines, with the top of the sewer being at least 18 inches below the bottom of the water line. Where sanitary sewer lines pass beneath water lines, no joints in the sewer line shall be closer than 10 feet, horizontal the water line. When the vertical or horizontal separation cannot be accomplished, then concrete encasement shall extend a minimum of 10 feet on both sides of crossing.

F. Pipe laying to proceed up-grade with pipe bells or groove on the upper end. Pipe to be laid with joints close and even, butting all around. Sagging joints will not be tolerated.

G. Pipe shall be straight and of uniform grade between manholes, laid to line and grade.

H. All sewer shall be designed and constructed to give velocities of not less than 2.0 FPS. Since the Owner has adopted a low flow plumbing device ordinance, the following slopes will be used.

Sewer Size	Minimum Slope in Feet Per 100 Feet
8"	0.44
10"	0.30
12"	0.24
15"	0.15
18"	0.12
21"	0.10
24"	0.08
30"	0.058
36"	0.046

I. An allowable deviation from the design grades will be allowed up to 5% of the grade shown on the plan. If the grade is steeper than allowed 5% deviation the engineer must verify that the project was installed to all minimum requirements and determine the impact of the additional grade. If the grade is flatter than the 5% deviation, then it exceeds the allowable tolerance and the installation of that line is not acceptable and must be replaced. All sewer mains installed will be field checked for grades during preparation of "Record drawings".

I. Bell holes shall be dug so the pipe barrel will carry the load of the pipe. Pipe shall be bedded in undisturbed earth or, where rock occurs, on a thoroughly compacted layer of #57 stone or sand fill of a minimum thickness of 6 inches under the barrel or bell of the pipe.

J. Where sewers or force mains are to be connected to existing manholes or other structures, and where no stub or opening has been provided for the connection, the Contractor shall make an opening of minimum diameter through the side wall of the structure utilizing a professional coring machine and installing a boot for inserting the sewer pipe. The boot and stainless steel strap shall be sized and installed to create a water tight seal.

K. Lateral connection made to the sewer prior to back-filling shall be laid on a slope not exceeding 2 feet vertical to 1 foot horizontal, and not less than 1/8 inch per foot, so that the lateral shall have a solid bearing on undisturbed earth as stipulated for pipe sewers. The lateral shall make such a horizontal angle with the sewer line that a proper connection with the wye or tee branch or slant is obtained without trimming the pipe and with no danger of jointing material being forced into the sewer. All laterals shall be closed by means of suitable stoppers or end caps.

L. Wye or tee branches shall be field located for service to all subdivided lots or inhabitable structures unless otherwise directed by the Architect/Engineer. Wye branches shall be installed so that the lower lip of the branch is not more than 2 inches below the outside top of the pipe. Tees shall be installed with the branch 45° to vertical. After installation, wye or tee branches shall not be covered with backfill until determination and record has been made of the locations of each with reference to the nearest manhole downstream and the direction in which the wye faces.

M. All laterals shall be properly marked on ground surface at the point where laterals terminate with treated timber markers. Timber markers shall consist of a 2 inch by 4 inch timber extending from the end of the lateral vertically to within 2 inches of the ground surface. All such markers shall be securely anchored and maintained in a

proper vertical position until backfilling has been completed. The top end of such markers shall be marked or left exposed until an "as-built" survey has been made.

N. The top rim of manhole frames and covers shall be set to conform to grades and transverse slopes. Generally along outfall lines, the manhole frames and covers shall extend approximately 6 inches above finished grade or to a designated elevation for flood protection. Generally where lines are located along streets, the manhole frames and covers shall be set flush with the surface.

O. The Contractor shall install a continuous run of plasticized metallic tape above the top of the sewer main at 12 inches to 18 inches below finished grade. Tape shall be suitable for detection with metal pipe location equipment labeled "sewer buried below," and brightly colored to contrast with the soil.

P. A 14 gauge copper tracer wire with underground coating shall be installed along the route of pressure sewers. The wire shall be located 12 inches above the pipe but no deeper than 48 inches.

Q. All PVC pressure pipe shall have a minimum of 36" cover. Areas where the cover is not maintained may require the use of extra strength (D.I.) pipe as directed by the engineer.

R. All sewer mains will be installed at a constant grade and line as shown on the plans. If after video inspection “sags” are found in the line, then the depth of the sag will be determined by the utility owner. If the sag is determined to be deeper than the following chart then the line will be removed and replaced to meet the minimum requirements of these specifications.

Pipe Size	Max. Sag Depth
8”	0.50”
10”	0.50”
12”	0.75”
15”	0.75”
18”	0.75”

3.02 PRESSURE TESTS

A. FORCE MAINS: The Contractor shall test by hydrostatic pressure to 150 pounds per square inch. Each section tested shall be slowly filled with water, care being taken to expel all air from the pipes. The required pressure shall be applied for not less than two hours. No pipe installation will be accepted until the leakage during the pressure test is less than the number of gallons listed below for each 1000 feet of pipe.

6" - 1.5 gallons	12" - 2.75 gallons
8" - 1.75 gallons	14" - 3.00 gallons
10" - 2.75 gallons	16" - 3.5 gallons

B. GRAVITY MAINS: On All sewer mains less than 8’ deep, the Contractor shall pressure test the gravity mains with air. Each section including manholes shall be pressurized to 3.5 psi. The allowable pressure drop of 0.5 psi on any portion of the system shall not be less than the times shown on the following chart.

PIPE SIZE	MINIMUM TIME

4"	3 MIN.
6"	4 MIN.
8"	6 MIN.
10"	7 MIN.
12"	8 MIN.

If the main will not maintain the specified pressure, the Contractor will isolate the weak joint and repair. The test will be repeated until successful. The service lines must be installed at least to the back of the curb prior to testing. These pressure drops represent a maximum infiltration/exfiltration rate of 25 gallons per inch of pipe diameter per mile per 24 hour period.

3.03 ALLOWABLE INFILTRATION/EXFILTRATION

A. If any visible flow is observed in the pipe during installation or final inspection a weir test will be conducted.

B. The leakage inward or outward (infiltration or exfiltration) of the entire system including the sewer mains, service sewers, manholes and wet wells shall not exceed 25 gallons per inch of pipe diameter per mile per day for any section of the system.

C. The weir shall be installed in each manhole. The manhole will then be filled with water to a depth of 3' from the top of the pipe, which should be at the bottom of the weir. The water level will stand for one (1) hour to stabilize then filled (if necessary) to the initial level. During the next hour the water level will be observed and the amount flowing through the weir or the amount of water required to maintain the level will be measured. This measured amount should not exceed the allowable.

3.04 INSPECTION

A. Upon complete installation of the gravity sewer, the Contractor must enter a waiting period of not less than 10 days prior to inspection. In order to initiate the waiting period, the Contractor must notify the Design Engineer and the LCPC inpsector in writing of the status of the sewer.

B. After completion of the waiting period all sewer mains must pass a 5% deflection mandrel pulled by hand. If a 5% deflection mandrel will not pass through any section, that section will be replaced or rerounded at the expense of the Contractor. Mandrel to be supplied by the City of Hinesville inspector.

C. Once the mandrel and physical inspection is complete the contractor will schedule a time when the owner may internally inspect the sewer main utilizing a sewer camera and generating a video inspection of the system. If any defects are found in the system as a result of the internal inspection then, that section of the sewer main and any mains feeding into that system will not be accepted.

C. No sewer main will be accepted if there is any evidence of sagging or bowing in the line which will adversely effect the performance of the pipe. Nor will any sewer mains be accepted if they are laid on a grade substantially less that specified on the Construction Plans. No line will be accepted if laid on less grade than the minimum stated in this specification.

D. All manholes will be inspected for general appearance, cracks, leaks, proper installation of frame and cover, steps and inverts. Any manholes, which do not conform to the specifications, will not be accepted until the deficiency is corrected by the Contractor.

E. All 4" sewer services will be tested for continuity and minimum bends by passing a standard tennis ball. Each sewer service shall be temporarily capped during construction. During the inspection, a tennis ball will be dropped down the open end of the sewer service. If the ball does not appear in the lower manhole the contractor will excavate the service, correct the blockage and repeat the test until successful.

F. All manhole and wetwell liner systems shall be tested using the “Spark Test” to locate incomplete welds or penetrations in the liner not adequately sealed for gas containment.

3.05 CLEANING

A. Contractor to clean the completed system of any debris or obstructions prior to Final Inspection.

SECTION 02711
CHAIN LINK FENCE

PART 1 - GENERAL

1.01 APPLICABLE STANDARDS

A. American Society for Testing and Materials (ASTM):

A 90 Weight of Coating on Zinc-Coated (Galvanized) Iron and Steel Articles

E 8 Tension Testing of Metallic Materials

1.02 DEFINITIONS

A. All fences must meet Ft. Stewart Security requirements as shown on the security fence detail contained in the plans. If any conflicts are found between this specification and the security fence detail shown on the plan, the detail shall govern.

B. Chain Link Fence Fabric: Chain link fence fabric shall be fencing material made from wire helically wound and interwoven in such a manner as to provide a continuous mesh without knot or ties except in the form of knuckling or of twisting and barbing the ends of the wires to form the selvage of the fabric.

C. Knuckling: Knuckling is the term used to describe the type of selvage obtained by interlocking adjacent pairs of wire ends and bending the wire ends back into closed loop.

D. Twisting and Barbing: Twisting and barbing is the term used to describe the type of salvage obtained by twisting adjacent pairs of wire ends together in a close helix of 1½ machine turns which is equivalent to three full twists and cutting the wire ends at an angle to provide sharp points.

PART 2 - MATERIALS AND INSTALLATION

2.01 FABRIC

A. Chain link fabric shall be Commercial Grade No. 9 gauge core galvanized wire, with 2" mesh and zinc-coated by electrolytic or hot dipped process before fabrication.

2.02 FABRIC COATING

A. If specified for on the plans, the chain link fabric coating shall be vinyl and be dipped after material is helically wound. The vinyl coating shall have a 6 gauge finish over a 9 gauge core.

2.03 CORNER AND TERMINAL POSTS

A. Corner posts shall be 3 inch O.D. standard weight galvanized steel with top caps, except when shown differently on plans. Posts shall be set in concrete footings. Fabric shall not be attached to posts until concrete footings are sufficiently cured. Centerline of posts shall be set 12 inches from the facility property line as shown on the plans. Where specified for vinyl coating, the posts shall be powder coated.

B. Line posts shall be 2 inch O.D. standard weight galvanized steel with top caps, except where shown on plans differently. Where specified for vinyl coating, the posts shall be powder coated.

2.04 FABRIC CONNECTIONS

A. Fabric shall be attached to corner and terminal posts with $^{3}/_{16}$ inch x ¾ inch tension bars and ⅞ inch beveled steel. Tension band spaced at a maximum of 14 inches on center. Where specified on the plans for vinyl coating, all hardware shall be powder coated.

2.05 RAILS AND DIAGONAL BRACING

A. If specified, the top, middle, and bottom rail shall be 1⅝ inch O.D. standard weight pipe fastened to corner and terminal post with malleable rail end cup and ⅞ inch beveled steel brace band. Where specified on plans for vinyl coated fence, rails, and bracing shall be powder coated.

B. Install diagonal bracing midway between the top rail and ground level from the terminal post to the corner post and fasten to post with malleable rail end and ⅞ inch beveled brace bands.

C. Barbed-wire shall consist of three (3) strands of 12½ gauge zinc-coated wire with 14 gauge 4 point barbs spaced at five (5) inches apart. Furnish barb-wire and supporting arms. Barb-wire and supporting arms shall be zinc-coated.

2.06 GATE FRAMES

A. Gate frames shall be constructed of tubular members round welded at all corners or assembled with fittings. Steel welds shall be painted with zinc based paint. Where vinyl coating is called for, welded joints shall be sanded, primed, and repainted with vinyl paint. Where corner fittings are used, gates shall have truss rods of ⅜ inch nominal diameter to prevent sag or twist. Gate leaves shall have vertical intermediate bracing as required, spaced so that members are no more than 8 feet apart. Gate leave 10 feet or over shall have a horizontal brace or one ⅜ inch, diagonal truss rod. When barbed wire top is specified at the end members of the gate, frames shall be extended one foot above the top horizontal member to which 3 strands of barbed wire, uniformly spaced, shall be attached by use of bands, clips, or hook bolts. Gate filler shall be of the same fabric as specified for fence and shall be attached to gate frame at intervals of 14 inches.

2.07 HINGES

A. Hinges shall have large bearing surfaces for clamping in position. The hinges shall not twist or turn under the action of the gate. The gate shall be capable of being opened and closed easily by one person. All hardware shall be pressed steel. Where specified on plans for vinyl coated fence, the hinges shall be powder coated.

2.08 LATCHES, STOPS AND KEEPERS

A. Latches, stops, and keepers shall be provided for all gates. Latches shall have a plunger bar arranged to engage the center stop, except that for single gates of openings less than 10 feet wide a fork latch may be provided. Latches shall be arranged for locking. Center stops shall consist of a device arranged to be set in concrete or asphalt and to engage a plunger bar of the latch of double gates. No stop

is required for single gates. Keepers shall consist of a mechanical device securing the free end of the gate when in full open position. All hardware shall be pressed steel. Where specified on the plans for vinyl coated fence, the hardware shall be powder coated.

SECTION 02821
GRASSING

PART 1 - GENERAL

1.01 APPLICABLE STANDARDS

A. Conform to Section 700 and other applicable articles of the "Standard Specifications Construction of Roads and Bridges", of the Department of Transportation, State of Georgia, dated September 15, 1977. Omit all references to measurement and payment.

1.02 SOIL SAMPLES

A. The Contractor shall take soil samples from several areas of the site to be grassed and have them analyzed by the Georgia Extension Service. The results of the analysis shall determine the best fertilizer mixture to use on the site.

PART 2 - MATERIALS

2.01 FERTILIZER

A. Commercial Fertilizer: Fertilizer for lawns shall be a complete fertilizer, the nitrogen content of which shall be derived from either organic or inorganic sources and meeting the following minimum requirements of plant food by weight, unless the soil analysis and report indicates a need for a different fertilizer mixture in which case the recommended mixture shall be furnished and applied. All State and Federal laws relative to fertilizer must be complied with.

10% Nitrogen - 12% Phosphoric Acid - 12% Potash

B. Ground Limestone: Lime shall be ground dolomitic limestone containing not less than 85% of total carbonates and shall be ground to such fineness that 50% will pass through a 20-mesh sieve. Coarser material will be acceptable, provided the specified rates of application are increased proportionately on the basis of quantities passing the 100-mesh sieve.

C. Sodium Nitrate shall be a commercial product in dry powder form and shall be delivered in the original, unopened containers each bearing the manufacturer's guaranteed statement of analysis. It shall contain not less than 16% Nitrogen.

2.02 LAWN MATERIALS

A. Bermuda Grass (Cyanodon Dactylon): Seed shall be 98% minimum purity and 85% germination.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prepare the seed bed by thoroughly cultivating, discing and hand raking as necessary to produce a smooth even grade free from hollows or other inequalities. Before any seeding is attempted the soil must be in a well pulverized, smooth, friable condition of uniformly fine texture.

3.02 FERTILIZING AND LIMING

A. Approximately two (2) days prior to the start of seeding operations, apply ground limestone at the rate of 20 pounds per 1000 sq. ft. of lawn area. Either in conjunction with the above operation or immediately afterwards apply the specified Commercial Fertilizer over all lawn areas at the rate of 30 pounds per 1000 sq. ft. of lawn area. Work limestone into the top 6 inches of ground and the fertilizer into the top 2 inches of ground.

B. When the grass has started to cover well (approximately 4 weeks after sowing seed) apply 1-1/2 pounds of Ammonium Nitrate to all lawn areas and immediately water using a fine spray. At the end of the maintenance period and prior to the final inspection apply 10 pounds of the specified Commercial Fertilizer per 1000 sq. ft. of lawn area and immediately water.

3.03 SEEDING

A. Before any seeding is attempted the soil must be in a well pulverized, smooth, friable condition of uniformly fine texture. Lawn areas shall be seeded evenly with a mechanical spreader at the rate of 2 lbs. of seed per 1000 sq. ft., 50% in one direction and the remainder sown at right angles to first sowing. The seeded areas shall be lightly raked, rolled with a suitable weight roller and watered with a fine spray.

B. Bermuda Grass seeding shall be planted only between May 1 to September 1.

C. When grassing is required between curbs and sidewalks, behind sidewalks in areas adjacent to private property, the Engineer may change the type of seeding to that required to match any type of grass which may be planted and growing on the adjacent lawn. No increase in the Contract Sum will be made for this substitution.

3.04 WATERING

A. Soak soil to a minimum depth of 6 inches immediately after seeding. Do not wash away soil or seed. Keep all surfaces continuously moist thereafter until 30 days after the lawn has been seeded. Use fine spray nozzles only.

3.05 RESPONSIBILITY

A. Maintenance of grass areas shall consist of watering, weeding, cutting, repair of any erosion and reseeding or resodding as necessary to establish a uniform stand of the specified grasses, and shall continue until final acceptance.

B. All grassed areas that do not show satisfactory growth within 15 days after sowing shall be re-sown and re-fertilized as directed until a satisfactory blanket is established. Approximately 3 weeks after sowing the last seed, but not before the seed has taken

hold and the grass is growing well, apply sulfate of ammonia or sodium nitrate at the rate of 300 pounds to the acre and water immediately. The lawns shall be considered established when they are reasonably free from weed, green in appearance and the specified grass is vigorous and growing well on each square foot of lawn area. Full coverage is required in 60 days.

C. All grassed areas shall be protected until accepted. All eroded and damaged areas, regardless of cause, shall be immediately repaired and reseeded. Protect lawn areas against traffic.

D. Grassed areas shall be covered evenly with a loose layer of clean wheat, rye, oats, Serecia Lespedeza or Coastal Bermuda Hay. Two tons of dry mulch shall be applied to each acre seeded. Hay shall be placed during calm weather with no wind.

E. As soon as the grass becomes established, a final inspection of the work will be made, provided a written request for such inspection is given to the Engineer. Satisfactory coverage is defined as coverage of the areas seeded with grass that is alive and growing, leaving no bare spots larger than one (1) square foot with 98% coverage.

F. All temporary valves, cutoffs and piping shall be removed by the Contractor at final acceptance of the grassing.

Part 1 General

1.01 Scope

Furnish and install the concrete formwork as required by the concrete outlines shown and indicated on the Drawings and specified in this Section, complete.

1.02 Form Design

Provide the design of all forms for this work. Formwork shall comply with ANSI A10.9 and OSHA Construction Standards, Part 1926, Subpart Q, Concrete, Concrete Forms, and Shoring. In addition, the form designs shall meet the requirements of ACI 347.

1.03 Submittals

A. Do not provide submittals for the structural design of forms.

B. Form Tie Assemblies: Manufacturer's product data sheets fully describing the form tie assemblies.

C. Form Releasing Agent: Manufacturer's product data sheets fully describing the form coating.

D. Plywood Panels: Certification that the plywood panels for use on this work meet the specified standard.

1.04 Storage and Protection

All form materials and accessories shall be stored above ground on framework or blocking, shall be protected from precipitation and shall have adequate air circulation and ventilation.

Part 2 Products

2.01 Form Material

A. Smooth Form Finish: Forms for this finish shall be applied to surfaces specified in Section 03300 of these Specifications. Some of these surfaces will receive a rubbed stone finish as specified in Section 03300 of these Specifications.

1. Form facing material shall produce a smooth, dense, uniform texture on the concrete. Form facing shall be one of the following:

   a. Plywood, meeting the requirements of U.S. Department of Commerce Product Standard (PS). PS 1 - Construction and Industrial Plywood, B-B Concrete Form Panels. The arrangement of the facing material shall be orderly with the number of seams kept to a practical minimum.
   b. Patented forms may be used, subject to acceptance by the Engineer,

provided they produce a smooth, even surface. This acceptance is for the finish these forms will leave on the contact surfaces and will not relieve the Contractor of the responsibility for the design and structural soundness of the forms. Patented forms shall be lined with the specified plywood. Plywood panels and form liners shall not be used more than three times unless further use is acceptable to the Engineer.

B. Rough Form Finish: Forms for this finish shall be applied to the surfaces specified in Section 03300 of these Specifications. Forms for this finish may be the same as specified for the Smooth Form Finish or may be constructed of used plywood panels, unlined steel forms or straight dressed lumber.

2.02 Accessories

A. Form ties for use in all liquid containment structure walls shall be one of the following:

1. Form clamp assemblies with smooth tie rods with a waterstop at their centers; or "she bolt" tie assemblies with a waterstop at their centers.

2. Both of the assemblies shall permit tightening of the forms and be of such type that leaves no tie metal, or any other tie material, within 1-1/2-inch of the surface after use. The assemblies shall provide cone-shaped depressions at the surface of the concrete at least 1-inch in diameter to allow filling and patching with the specified grout.

B. Form ties for use in all other walls shall be one of the assemblies specified in Article 2.02, paragraph A., except that waterstops are not required.

C. Form releasing agents for liquid containment vessels in water treatment plants shall be equal to Sealtight Duogard by W.R. Meadows.

D. Form releasing agents shall permit coating the concrete surface without additional surface preparation.

E. Form releasing agents shall be a non-staining form coating compound.

Part 3 Execution

3.01 Form Construction

A. Formwork shall be in accordance with ACI 347 and as follows:

1. Forms shall conform to shape, lines and dimensions of members indicated and shall be sufficiently rigid and tight to prevent leakage of mortar. Forms shall be properly braced or tied together so as to maintain position and shape. Construct forms so that they can be removed readily without hammering or prying against the concrete. Forms for exposed concrete shall be carefully made and accurately placed to obtain correct shape and lines.
2. Joints shall be butted tight. Arrangements of panels shall be orderly and

symmetrical, and use of small pieces shall be avoided. Forms shall be chamfered 1-inch for external corners of concrete, including top of walls, which will be exposed to view in the finished work.

3. Provide adequate formwork in its entirety. Forms shall safely support loads they will sustain and shall maintain their dimensional and surface correctness to produce members required by the Drawings. Form ties shall be spaced close enough to avoid bulges and variations in the required cross-sectional dimensions shown on the Drawings for the members being cast.

4. Box out for chases, recesses or other openings required in the completed work.

5. Install all the items (sleeves, inserts, hangers, anchors, etc.) to be supported by the formwork as required by the work.

6. Install pipe sleeves, wall pipes and wall sleeves, as shown or specified, for all piping penetrating walls and slabs. The use of block-outs in walls is prohibited. Pipe sleeves shall be used in slabs for plumbing pipes and wiring conduits.

7. Provide a sufficient number of cleanout doors at the base of walls and columns to facilitate cleaning and the application of grout to the column bases.

8. The use of reinforcing steel, partially embedded in concrete, as toe pins or form spacers is prohibited.

3.02 Tolerances for Formed Surfaces

A. Variation from Plumb

1. In the Lines and Surfaces of Columns, Piers, Walls:

a. In any 10 Feet of Height: 1/4-inch (walls 1/2-inch).

b. Maximum for the Entire Height: 1-inch.

2. For Exposed Corner Columns, Construction and Expansion Joint Grooves and Other Conspicuous Lines:

a. In any 20 Foot Height: 1/4-inch.

b. Maximum for the Entire Height: 1/2-inch.

B. Variation from the Level or from the Grades Shown on the Drawings:

1. In Slab Soffits, Beam Soffits and Tops of Slabs, Measured Before Removal of Supporting Shores:

a. In any 10 Foot Length: 1/4-inch.
b. In any Bay or in any 20 Foot Length: 3/8-inch.

c. Maximum for the Entire Length: 3/4-inch.

2. In Exposed Lintels, Sills, Parapets, Horizontal Grooves and Other Conspicuous Lines:

a. In any Bay or in any 20 Foot Length: 1/4-inch.

b. Maximum for the Entire Length: 1/2-inch.

C. Variation of the Linear Building Lines from Established Position in Plan and Related Position of Columns, Walls and Partitions:

1. In any Bay: 1/2-inch.

2. In any 20 Foot Length: 1/2-inch.

3. Maximum for the Entire Length: 1-inch.

D. Variation in the Sizes and Location of Sleeves for Plumbing Pipes and Electrical Conduits, Floor Openings and Wall Openings: ±1/4-inch.

E. Variation in Cross-Sectional Dimensions of Columns and Beams and in the Thickness of Slabs and Walls: -1/4-inch, +1/2-inch.

F. Variation in Sizes of Pipe Sleeves, Wall Pipes and Wall Sleeves: None.

G. Variation in Location of Pipe Sleeves, Wall Pipes and Wall Sleeves: ±1/8-inch.

H. Footings

1. Variations in Dimensions in Plan: -1/2-inch, +2-inches.

2. Misplacement or Eccentricity: Two percent of the footing width in the direction of misplacement but not more than: 2-inches.

3. Thickness: Decrease in specified thickness - none; increase in specified thickness 25 percent unless otherwise approved by the Engineer.

4. Tolerances above apply to concrete dimensions only, not to positioning of vertical reinforcing steel, dowels or embedded items.

I. Variation in Steps

1. In a Flight of Stairs:

a. Rise: ±1/4-inch.

b. Tread: ±1/4-inch.

2. In Consecutive Steps:

a. Rise: +0-inch, -1/8-inch.

b. Tread: ±1/8-inch.

3.03 Application of Form Coating

Before the placing of reinforcing, faces of all forms to be in contact with the concrete shall receive a thorough coating of the liquid form-releasing agent specified, applied in compliance with the manufacturer's instructions.

3.04 Inspection

Inspect all the work in accordance with Section 03300 of these Specifications.

3.05 Removal of Forms

A. Forms shall be removed in a manner that will insure the complete integrity of the structure. The forms and shoring shall remain in place for the following minimum periods of time after the casting of the concrete is completed:

	Form Removal, Days	Shoring, Days
Beams and Slabs (Soffits)	7	14
Walls	1	0
Columns	1	0

B. Formwork for beam and slab soffits shall be designed so that they can be removed without removal of sufficient original shores to adequately support the work until such time that the concrete strength reaches its specified 28 day strength.

C. Removal of forms shall be coordinated with the selected specified method of curing concrete.

D. Wood forms shall be completely removed from all the work to avoid termite infestation.

END OF SECTION

Part 1 General

1.01 Scope

Furnish and install the concrete reinforcement as shown and indicated on the Drawings and specified in this Section, complete in place.

1.02 Submittals

A. Shop Drawings

1. All shop drawings shall be of the same size. Reproductions of the Drawings for use as shop drawings is not permitted. Shop drawings shall include placing drawings, bending details, and bar lists with bar marks. All details and notes appearing on the Drawings, giving information for the placing of reinforcing steel, shall be shown on the shop drawings. Shop drawings will not be reviewed without such information.

2. Wall reinforcing shall be shown in elevation.

3. Show location and size of all penetrations greater than 6-inches in diameter or across the opening with the corresponding added reinforcing around the penetrations.

4. Submittals shall be complete for each structure. Partial submittals are not permitted and will be returned unmarked. Each submittal shall clearly indicate the structure and Drawing numbers that the work is for. The identifying numbers of the shop drawings for each structure shall be in numerical order.

5. Location and arrangement of accessories shall be clearly indicated.

6. All shop drawings shall be checked by the fabricator and Contractor before being submitted to the Engineer. The shop drawings shall bear clear indication that they have been reviewed and approved by the Contractor.

B. Mill tests of reinforcing steel shall be submitted prior to use for each 15 tons or less shipped to the site. Tests shall be conducted in conformance with ASTM A 615, and methods prescribed therein.

1. Cost of mill tests shall be borne by Contractor.

2. Three copies of each test report stating whether the material meets the requirements of the ASTM specifications shall be submitted to the Engineer.

3. Certified copies of the mill tests may be considered evidence of compliance provided such tests are regularly conducted by the reinforcement supplier by experienced, competent personnel using adequate testing equipment. In case of doubt as to the adequacy or accuracy of the mill tests, the Engineer may require the Contractor to furnish, at no additional cost to the Owner, test results from an

independent testing laboratory acceptable to the Engineer on mill samples or delivered steel reinforcement.

Part 2 Products

2.01 Reinforcing Bars

A. Bar reinforcement shall be deformed-type bars conforming to ASTM A 615. Reinforcement shall be manufactured from new billet steel of American manufacture, Grade 60.

B. Reinforcing steel for welded connections conform to ASTM A706. Welding procedure shall conform to ANSI/AWS D1.4 “Structural Welding Code – Reinforcing Steel”. Do not tack weld.

C. Reinforcing steel shall be shop fabricated to shapes and dimensions indicated on the Drawings and in compliance with applicable provisions of ACI 315 and ACI 318.

D. Bars shall be bent cold. Bars shall be pre-fabricated to detail and delivered on the job plainly tagged and ready to set.

2.02 Welded Wire Fabric

Welded wire fabric shall be in flat sheets conforming to ASTM A 185, with wire conforming to ASTM A 82.

2.03 Accessories

A. All chairs and bolsters shall have plastic-covered or galvanized steel legs at formed slabs and beams. For slabs on grade, bare metal is acceptable.

B. For slabs on grade 10-inches or less, all reinforcing shall be supported on chairs and/or bolsters as required to properly position the bars or welded wire fabric. The chairs and/or bolsters shall be supported on precast concrete pads bearing on the subgrade. The concrete pads shall be at least 6 x 6-inches and be no more than 1-1/2-inches thick. Pads shall be cast from Class "A" concrete or from mortar made up of one part cement and two parts sand, with tie wires embedded.

C. For slabs on grade greater than 10-inches, reinforcing shall be supported directly on concrete brick bearing on the subgrade or the system noted above for slabs 10-inches or less.

Part 3 Execution

3.01 Storage of Materials

Reinforcing steel delivered to the site, not immediately placed in forms, shall be protected from mud and excessive rust-producing conditions by storing in a

well-drained area and supported off the ground. All reinforcing shall be properly tagged with their bar marks and location in the structure clearly noted.

3.02 Tolerances

A. Allowable tolerances for fabricating steel reinforcement shall be as follows:

Item	Maximum Tolerance, Inches	
Sheared Length of Bars	+1	-1
Depth of Truss Bars	+0.0	-1/2
Outside Dimensions of Stirrups, Ties and Spirals	+1/2	-1/2
Location of Bends	+1	-1

B. Allowable tolerances for placing steel reinforcement shall be as follows:

Item	Maximum Tolerance, Inches	
Concrete Cover from Outside of Bar to Finished Surface	+1/4	-0.0
Lateral Spacing of Bars in Plane of Reinforcement in Beams and Joists	+1/4	-0.0
Lateral Spacing of Bars in Plane of Reinforcement in Slabs and Walls	+1	-1
Spacing of Stirrups, Ties and Spirals Along Longitudinal Axis of Member	+1/2	-1/4
Height of Bottom Bars in Slabs, Beams and Joists	+1/4	-1/4
Height of Top Bars in Slabs, Beams and Joists Depth 8" and Less Depth 9" - 24" Depths 25" & Greater	+1/4 +1/2 +1	-1/4 -1/2 -1

3.03 Field Fabrication

Field fabrication of reinforcing steel is not permitted.

3.04 Placement and Anchorage

A. Space metal chairs, bolsters, spacers and hangers in accordance with ACI 315.

B. Reinforcement, at the time concrete is placed, shall be free from rust scale or other coatings that will destroy or reduce bond. Bars with kinks or bends not shown on the plans shall not be used.

C. Reinforcement shall be accurately placed in accordance with the Drawings and shall be adequately secured in position with not less than 16 gauge annealed wire or suitable clips at intersections. Reinforcement shall be held securely at the required distance

from the forms. Nails shall not be driven into outside forms to support reinforcement.

D. Install welded wire fabric reinforcement for concrete slabs on ground and as otherwise indicated. Lap all joints 6-inches and wire securely. Extend mesh to within 2-inches of sides and ends of slabs. Sheets that do not lay flat when in their intended position will be rejected. Tags designating the wire size and spacing shall be left on each sheet until ready for use. Tuck ends of welded mesh well down into edge of beams or walls. Do not leave unreinforced border strips. Welded wire fabric shall not contain loose rust. All welded wire fabric shall be supported and tied in its proper location.

E. Conduits: Where conduits are permitted in slabs, low conduit shall be wired to the upper side of bottom reinforcing and top conduit shall be wired to lower side of top steel. Where parallel conduits occur, they shall be separated by at least 2-inches clear.

3.05 Concrete Cover

Reinforcement shall be protected by concrete cover as shown and noted on the Drawings.

3.06 Splicing

A. Splicing of reinforcement shall be as shown and indicated on the Drawings. Splices not shown on the Drawings shall be Class "B" splice, in accordance with ACI 318. Any changes to the location and type of splices desired by the Contractor must be specifically requested and must meet with the acceptance of the Engineer before they can be used.

B. Splices shall not be made at point of maximum stress and shall provide sufficient lap to transfer stress between bars by bond.

C. Mechanical splices may be used instead of lap splices provided that their location and type meets with the acceptance of the Engineer.

D. No more than 50% of horizontal wall reinforcing shall lap in a single vertical plane.

3.07 Inspection

Inspect all the work in accordance with Section 03300 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

The work under this Section includes, but is not necessarily limited to, furnishing and installing all concrete accessories as indicated on the Drawings, herein specified, and as necessary for the progress and complete performance of this work.

1.02 Submittals

The waterstop manufacturer shall submit documented test results demonstrating that the waterstop will not permit water leakage when subjected to pressure and joint movement.

1.03 Quality Assurance

The waterstop manufacturer shall demonstrate five years (minimum) continuous, successful experience in production of waterstops.

1.04 Storage and Protection

Store waterstops under tarps to protect from oil, dirt, and sunlight.

Part 2 Products

2.01 Acceptable Manufacturers

A. Waterstops for construction joints shall be Greenstreak Waterstop Style 732 or 724 manufactured by Greenstreak, St. Louis, Missouri (or approved equal).

B. Waterstops for expansion joints shall be Greenstreak Waterstop Type 732 as manufactured by Greenstreak, St. Louis, Missouri (or approved equal).

2.02 Materials and Construction

A. Waterstops

1. Waterstops shall be extruded from an elastomeric plastic compound of which the basic resin shall be prime virgin polyvinyl chloride meeting U.S. Army Corps of Engineers Specification CRD-C572. The PVC compound shall not contain any scrapped or reclaimed material or pigment whatsoever.

2. Provide factory installed hog rings, grommets, or embedded wire loop to facilitate tying off waterstop at 12-inches on center along the length of the waterstop.

3. Provide factory made PVC waterstop fabrications for all changes of direction,

intersections and transitions, leaving only straight butt joint splices for the field.

B. Dovetail Slots

1. No. 22 gauge, galvanized steel, 1-inch wide back.

2. Crimped anchors shall be furnished by other trades whose work abuts concrete.

C. Inserts for General Trades

1. Malleable iron, strength as required.

2. Include bolts, nuts, and washers.

D. Expansion Joint Filler

1. Asphalt impregnated fiberboard, ASTM D 1751, for interior work.

2. Self-expanding corkboard, ASTM D 1752, for exterior work.

E. Construction Joint Form for Building Floor Slabs on Grade: 16 gauge, tongue and groove galvanized metal.

F. Control Joint Form for Building Floor Slabs on Grade

1. 20 gauge galvanized steel.
2. Depth shall be 1/4 the slab thickness or more.

G. Flashing Reglet: 26 gauge galvanized steel. Coordinate with waterproofing subcontractor.

2.03 Other Materials

All other materials not specifically described, but required for a complete and proper installation of concrete accessories, shall be as selected by the Contractor subject to the approval of the Engineer.

Part 3 Execution

3.01 Installation

A. General: Install concrete accessories as indicated on the Drawings, specified in various other Sections and as necessary for the proper and complete performance of this work.

B. Waterstops

1. Waterstops shall be installed in all construction joints in walls and slabs which are

to hold water and also where shown on the Drawings. The waterstop shall extend the entire length of the joint and all splices shall be installed and tested in accordance with the manufacturer's recommendations.

2. Waterstops for all joints shall be continuous around all corners and intersections. For PVC waterstops, provide factory formed corners and intersections where angle intersections occur, and only straight splices shall be made in the field. Splices shall be made in accordance with the manufacturer's recommendations and shall be subject to the approval of the Engineer.

3. No holes will be permitted in waterstops.

4. PVC waterstops shall be securely fastened to formwork or reinforcing steel every 12-inches or less on both edges as required to concrete placement.

C. Piping, Mechanical and Electrical Equipment Support

1. Inserts for hangers will be supplied by the trade whose work is supported.
2. Locations of the inserts shall be given to the Contractor by the various trades.

3. Installation of the cast-in-place inserts shall be by the Contractor.

D. Dovetail Slots: Install dovetail slot at 24-inches on center where masonry adjoins concrete or as noted on the Drawings.

END OF SECTION

SECTION 03300
GENERAL CONCRETE

PART 1 - GENERAL

1.01 QUALITY STANDARDS

A. Any procedure and material operation specified by reference to the following publications shall comply with the requirements of the current specification or standard:

1. American Society for Testing Materials (ASTM):

A185 Welded Steel Wire Fabric for Concrete Reinforcement.

A615 Deformed Billet-Steel Bars for Concrete Reinforcement.

C31 Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field.

C33 Specification for Concrete Aggregate.

C39 Compressive Strength of Molded Concrete Cylinders.

C94 Specification for Ready-Mixed Concrete.

C143 Slump of Portland Cement Concrete.

C150 Portland Cement.

C172 Sampling Fresh Concrete.

C192 Making and Curing Concrete Test Specimens in the Laboratory.

D1751 Preformed Expansion Joint Fillers for Concrete Paving.

2. American Concrete Institute:

ACI 301 Specification for Structural Concrete for Buildings.

ACI 305 Recommended Practice for Hot Weather Concreting.

ACI 318 Building Code Requirements for Reinforced Concrete.

1.02 QUALITY CONTROL

A. The Contractor shall submit to the Engineer, for review a design mix for each class of concrete listed under CLASSES OF CONCRETE, prior to placing any concrete.

B. Verification tests of design mixes and aggregates are required by the Engineer. Verification test specimens shall be made in accordance with ASTM C39 by an Independent Test Laboratory. Compressive strength shown by verification tests shall be

at least fifteen percent in excess of the strengths listed under CLASSES OF CONCRETE. The Independent Testing Laboratory shall report the test results to the Engineer, in writing and shall note any failure to meet the specification.

C. Verification tests of design mixes made not more than one year prior to the date of submittal will be acceptable provided they were made from materials identical to those to be used in the project.

D. Mill Test: Conducted in accordance with ASTM A615 recommendations on each 15 tons, or less reinforcing shipped to the job. Two (2) copies of test to be sent to the Engineer.

E. Inspection and Testing of Concrete:

1. The cost of slump tests and sampling, molding, storing, materials, transporting concrete test specimens shall be paid by the Contractor. The laboratory or inspection agency shall be selected by the Owner. Costs of all laboratory testing services required because of failure to meet the requirements of these specifications shall be paid by the Contractor.

2. One set of four (4) acceptance cylinders shall be prepared for each day's placing of each strength of concrete and if more than 50 cubic yards of concrete is placed in any day, there shall be an additional set of cylinders prepared for each 50 cubic yards placed or for any fraction thereof. One cylinder shall be broken at seven days and two at twenty-eight days, with one cylinder held in reserve.

3. Responsibilities in Inspection:

a. Laboratory's Duties

1. The reception and marking of specimens in the laboratory, laboratory curing, preparation for breaking and testing of cylinders shall be the responsibility of the laboratory and shall be performed by qualified laboratory personnel, observing all requirements of applicable ASTM Standards. Compression test specimens shall be tested in accordance with ASTM C39.

2. Prior to the commencement of concrete work, the laboratory shall provide initial instruction in the performance of sampling and testing duties for an employee designated by the Contractor and shall provide him with copies of all ASTM Standards pertinent to his duties.

b. Contractor's Duties:

1. The Contractor shall deliver to the laboratory all materials to be used in required testing. He shall supply wheelbarrows, shovels, mixing boards, shaded work space and similar equipment required for molding test cylinders. He shall provide stable, insulated storage boxes, equipped with thermostatically controlled heat, for storage of cylinders in the first 24 hours after molding.

2. He shall designate an employee, who alone shall perform all operations of sampling concrete, molding test specimens, protecting test specimens for the first 24 hours after molding, and packing and

shipping of test specimens. The employee shall make a record of a slump test in connection with each truckload of concrete. The designated employee shall receive initial instruction in the performance of his sampling and testing duties from a representative of the testing laboratory and shall have available copies of all ASTM Standards pertinent to his duties. Sampling shall conform to ASTM C172. Slump tests shall conform to ASTM C143. Compression test specimens shall be made and cured in accordance with ASTM C31.

3. Each set of test cylinders shipped to the laboratory shall be accompanied by a report giving information as to location in the structure of concrete sampled, time and date of sampling, air temperature, slump, class designated nominal strength, air content if applicable, temperature of concrete, truck number, and time batched. Each report shall be signed by the employee making the test and by the Contractor or his representative, certifying that the test specimens have been made by the one designated, fully instructed employee and have been made in accordance with applicable standard specifications.

4. Should any concrete fail to meet the specified strength, have a slump in excess of that required by the design mix for each class of concrete listed under CLASSES OF CONCRETE, or result in voids, honeycombs or otherwise fail to meet the requirements, the Engineer may order the concrete removed, further tests made, or other remedial measures taken, all at the Contractor's expense.

1.03 SHOP DRAWINGS

A. After making his check the Contractor shall submit to the Engineer one (1) blue line copy of each of placing plans, bending details and bar lists covering all reinforcing steel.

B. Full information for checking and for proper installation without reference to other drawings shall be included. At splices the amount of lap shall be shown. Location and arrangement of accessories shall be clearly shown. Elevations shall be drawn for all reinforced masonry and reinforced concrete walls to a scale no smaller than 1/4 inch = 1 foot.

C. Work shall not proceed before the Contractor has received shop drawings approved by the Engineer. The Contractor shall be responsible for the conformation of all typical and special reinforcing steel details.

D. Engineer's review is for conformance to the design concept and contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

E. Proposed construction joint shall be clearly indicated on shop drawings and subject to approval of the Engineer.

1.04 INSPECTION

A. The Contractor shall give the Engineer 24 hours advance notice before starting to place concrete in any portion of the structure to permit observation. An authorization of the Engineer shall be secured before concrete is placed. Any concrete placed in violation to this provision shall be replaced by new concrete if required by the Engineer.

B. Prior to notification of the Engineer, the Superintendent shall personally inspect the work and verify that it is ready for observation.

C. At the time of observation, all reinforcing in the area where concrete is to be poured shall be in place, tied and ready for the placement of concrete. All anchors, sleeves, inserts, etc., shall be securely held in position.

1.05 STORAGE

A. Reinforcing steel delivered to the job and not immediately placed in forms shall be placed in racks or other supports at least eighteen (18) inches above ground.

PART 2 - MATERIALS

2.01 CEMENT

A. Portland cement shall conform to ASTM C150, Type I.

2.02 AGGREGATES

A. Aggregates for standard weight concrete shall conform to ASTM C33, maximum size: 3/4 inch.

2.03 WATER

A. Mixing water shall be potable.

2.04 REINFORCING STEEL

A. Reinforcing bars shall be American manufactured conforming to the requirements of ASTM A615 "Deformed Billet Steel Bars for Concrete Reinforcement", Grade 60.

B. Welded wire-fabric or cold-drawn wire for concrete reinforcement shall be of American manufacture and shall conform to the requirements of the ASTM A185 "Welded Steel Fabric for Concrete Reinforcement".

C. Accessories shall conform to the requirements of C.R.S.I. Manual.

2.05 READY MIXED STRUCTURAL CONCRETE:

A. Ready mix concrete shall be mixed and delivered in accordance with these specifications and requirements set forth in ASTM C94. In addition, these following conditions must be met:

1. Concrete shall be normal weight with an ultimate compressive strength at 28 days, and slump as follows:

2. Air entrained concrete shall be used for all structural concrete with the air content not less than 3 percent and no more than 5 percent.

B. Classes of Concrete:

Class A f'c = 3000 psi, Slump 4 inches +/- 1 inch
Class AA f'c = 4000 psi, Slump 3 inches +/- 1 inch
Class B f'c = 5000 psi, Slump 5 inches +/- 1 inch

2.06 EXPANSION JOINT MATERIAL

A. Expansion joint material at slabs on grade shall be premolded asphalt saturated cellulose fiber or mineral strips conforming to ASTM D1751.

2.07 WALL TIES

A. Ties shall be made with break back ends or other means of removing the tie end to a depth of at least 1 inch from the concrete surface after the forms are removed.

2.08 LIQUID FORM SEALER

A. Form sealer shall be a standard product compatible with the finish required for exposed concrete and shall contain no paraffin oil or mineral oil.

PART 3 – EXECUTION

3.01 FORMWORK

A. Forms shall conform to the shapes, lines and dimensions of the members as indicated, and shall be substantial and sufficiently tight to prevent leakage of mortar. They shall be braced or tied together so as to maintain position and shape.

B. Formwork shall be observed by the Engineer before pouring concrete. Before placing the reinforcement, surfaces of wood forms in contact with the concrete, unless lined, shall receive a thorough coating of form sealer. The Engineer shall have the right to reject any forms that do not appear to him to be sufficient as to alignment and of producing the required finished surface. Should misalignment of forms or screed, excessive deflection of forms or displacement of reinforcing occur during concrete placing, corrective measures shall be immediately made to the extent, if necessary, that placing operations shall be stopped and concrete removed from within forms. The surfaces to required dimensions and cross section. Exposed lines and surfaces shall not vary from dimensions shown on plans by more than 1/4 inch in twenty feet.

C. Forms may be constructed of wood or metal. Earth forms for footings may be permitted if local conditions are favorable, and approved by the Engineer. Form work for exposed concrete shall be form grade plywood.

D. Studs, waler, and ties shall be so spaced that the load of wet concrete will not stress ties beyond the printed working load recommended by the manufacturer not cause spans of form material to deflect from a true surface.

E. The Contractor shall maintain a continuous check upon formwork during the placing of concrete. An instrument check shall be periodically made or "Tattle Tail" rods or other devices shall be used to detect any settlement in forms.

F. Conduits in Concrete: Conduits shall not displace reinforcing steel from its intended position, nor impair the strength of the structure.

G. The Contractor shall assume all responsibility for removal of formwork. Elevated concrete slabs shall attain 70% of the specified ultimate strength before removing the forms. After removing forms, slabs shall be reshored at mid-span and at all points under shores supporting forms for the work above. No floor shall be loaded in excess of the live load for which designed unless adequate shores are place beneath members supporting the concrete of load.

3.02 PLACING REINFORCING STEEL

A. Reinforcement shall be shop fabricated, accurately positioned and secured with not less than 16 gauge annealed wire or suitable clips.

B. No bars, partially embedded in concrete shall be field bent, unless noted otherwise.

C. Reinforcing bars shall be accurately placed and secured in position by approved chairs, spacers or ties to maintain the position of the reinforcing steel prior to and during placing of concrete.

D. Reinforcing steel support chairs and bolsters for use in concrete to be exposed shall have galvanized steel leg.

E. No splices shall be made, except as shown on approved Shop Drawings or approved in writing by the Engineer.

F. The placement of reinforcement shall be observed by the Engineer before pouring of concrete. Should there by any delay in the work, reinforcement previously placed shall be reinspected and cleaned if necessary before concrete placement is resumed.

G. Metal reinforcement shall be protected by concrete cover. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

Footings	3" clear sides and bottom
Slabs	3/4" clear, top and bottom
Beams	2" clear, all around
Walls	2" clear, both faces
Columns & Piers	2" clear

H. All splicing or reinforcement not shown shall be approved by the Engineer. Splices shall not be made at a point of maximum stress and shall provide sufficient lap to transfer the stress between bars by bond. Hook and bending details, column tie arrangements, etc., shall be as shown by the S.R.A.I. Manual or the ACI Detail Engineering Manual.

I. Wire mesh reinforcing shall be placed one inch from top of concrete slabs on ground. Lap all joints 12 inches and extend mesh to within 1 inch of sides and ends of slabs.

3.03 CONCRETE MIXING AND PLACING

A. Ready-mix concrete shall conform to ASTM C94. Not more than one hour shall elapse between the time mixing water is added to the batch and the concrete is poured. No water shall be added on the job.

B. No concrete shall be placed until all embedded items and reinforcing have been placed in the forms and observed by the Engineer. At least 24 hour notice shall be given the Engineer of an impending pour, so that he may observe the work, prior to placing.

C. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent segregation or loss of materials.

D. Concrete shall be deposited in its final position to avoid segregations and separation do to rehandling or flowing. The placing shall be carried on at such a rate that concrete is at all times plastic and flows readily into the spaces between bars. When placing is once started, it shall be carried on as a continuous operation, until placement of that section is completed.

E. Concrete shall be worked into and around bars and embedded items with spades, rods, trowels and vibrators, so as to produce a solid homogeneous mass, free of voids, pockets or honeycombs.

F. Construction joints shall be installed and located as indicated. Where a joint occurs, the surface of the concrete shall be thoroughly cleaned and all laitance removed and shall be left rough or mechanically roughened, thoroughly wetted and slushed with a coat of neat cement grout immediately before placement of new concrete.

G. All embedded items, including anchor bolts and dowels, shall be in place, preset and held in position, before any concrete is placed.

H. No concreting shall be performed when ambient temperatures are below 40°F or if the temperature is predicted by the local U.S.Weather Bureau will fall below 40°F within 24 hours after the time of installation.

I. No concrete shall be installed against frozen ground. All foundation cavities and slab areas that have frozen, shall be thoroughly clean of all loose earth prior to pouring concrete.

J. All newly poured concrete shall be protected from freezing or near freezing weather during the cure period.

K. Hot weather precautions shall be taken whenever the maximum air temperature exceeds 80°F during the day. Hot weather concreting shall be performed in accordance with ACI 305.

3.04 EXPANSION/CONTROL JOINT INSTALLATION

A. Expansion joints shall be placed a maximum of 20 ft. intervals and at all intersections with steps, curbs other walks or abutting structures. Joints shall extend from the surface to the subgrade at right angles to the sidewalk.

B. Expansion joint filler shall be 1/2 inch thick and as wide as the full width and depth of the sidewalk.

C. Control joints (tooled or saw-cut) shall be placed at no less than 12 and no more than 15 ft. intervals, in a square grid, throughout the full length and width of the concrete

slab. All control joints shall be filled with semi-rigid epoxy, specifically manufactured for the sealing of control joints in concrete slab construction, to create a water tight slab.

3.05 ANCHORAGE

A. Slots, inserts, and connections elements for anchoring items to concrete shall be built into forms before placing concrete.

3.06 SLABS ON GRADE

A. Concrete shall be compacted, screeded to grade and prepared for the specified finish. Slabs shall be placed in panels in alternate checkerboard pattern or in alternate lanes divided into panels. Each panel shall be approximately square terminated by slab joints.

B. Contraction joints shall be true to line 1/8 inch wide, and of depth equal to approximately 1/4 of the slab thickness. Joints shall be sawed or formed.

3.07 CURING

A. Provisions shall be made for maintaining concrete in a moist condition for at least 10 days after the placement of the concrete, or by one of the following methods:

1. Spraying with water or ponding.

2. Using moisture retaining covers.

3. Concrete curing compound, W.R. Meadows CS-309 or Guardian Chemical Co., Master Builders or Triple-Cure by Cobra Chemicals.

B. The spraying water shall be applied on unformed surfaces within one hour after the forms are stripped and the spraying shall be continuous. The moisture retaining cover shall be applied on unformed surfaces immediately after the concrete is finished. If there is any delay, the concrete shall be kept moist until the application is made. If the surfaces are formed, the forms shall be removed and the concrete sprayed lightly with water before the cover is applied.

C. When concrete surfaces are to receive applied finishes of materials, all curing compounds shall be checked for compatibility with other material to be applied to the concrete surfaces before application.

3.08 CONCRETE FINISHES

A. All poured joints, voids, honeycombs and other imperfections shall be patched within the same working day that forms are removed.

B. Troweled Finish:

1. Troweled finish shall be applied to the surface of all floors unless ceramic tile, quarry tile or pavers are called for on finish schedule.

2. Floor slabs shall be screened to an even surface by the use of straight-edge and screeding strips accurately set to the proper grade. The concrete shall be floated with a wood float in a manner which will compact it and produce a surface free from depressions or inequalities of any kind. Floors shall be level with a tolerance of 1/8 inch in 10 feet except where drains are indicated. After the concrete has hardened sufficiently to prevent fine materials from working to the top and has been allowed to stand until all water sheen has disappeared, it shall be steel troweled. Final troweling shall be done after the concrete is hard enough that no mortar accumulates on the trowel and a ringing sound is produced as the trowel is drawn over the surface. The drying of the surface moisture before troweling shall proceed naturally and shall not be hastened by the dusting on of dry sand or cement.

C. Non-slip Finish: All exterior platforms and step treads shall be made non-slippery by application at not less than 1/4 lb. per sq. ft. of aluminum oxide or emery aggregate graded from particles retained on a #50 mesh screen to particles passing an 1/8 inch screen placed during the finishing process. Abrasive aggregate shall be sprinkled by hand as soon as the freshly placed cement will support the weight of workmen and floated into the surface.

D. Unfinished Slabs: Depressed slab areas to receive ceramic quarry tile or pavers shall be finished to remove all laitance and to leave a slightly roughened, surface to insure bond. The surface of the slab shall not vary in any direction more than 1/8 inch when tested with a ten foot straight edge. The straight edge shall be lapped one half its length as the test is being made.

3.09 CONCRETE FLOOR HARDENER

A. All concrete floor slabs shall be cured with concrete floor hardener, "Clear Bond", as manufactured by Guardian Chemical, "Triple-Cure: by Cobra Chemicals, or "Sealtight Cs-309 by W.R. Meadows. The floor hardener shall be applied in strict accordance with the manufacturer's recommendations.

B. Walks shall be tooled, full 1 inch deep into separate slabs as indicated. Surface edges of each slab shall be rounded to approximately 1/4 inch radius.

C. Final finish shall be a medium or light broom finish and all tool marks completely removed.

Part 1 General

1.01 Scope

This Section describes nonmetallic grout and grouting methods to be used in the setting of motors, compressors, pumps, aerators, vessels, tanks, pipe supports, structures and other miscellaneous items of equipment that require grout between their baseplate, bedplate or soleplate and the top of the concrete surface to which they are to be anchored.

1.02 General

A. The Contractor shall furnish all labor, grouting materials, water, equipment, forms and other items necessary or convenient to the Contractor for the proper preparation, placement and curing of grout.

B. Nonshrink, epoxy and sand-cement grouts shall be stored, mixed, handled and placed in accordance with the recommendations of the grout manufacturer and the American Concrete Institute (ACI), as applicable.

C. No grout shall be placed until the place of grouting has been inspected and approved by the Engineer.

1.03 Submittals

A. Prior to placement of any nonshrink or epoxy grout, the Contractor shall submit to the Engineer complete engineering and product data on the grout, including manufacturer's recommendations for mixing, placement and curing.

B. The Contractor shall also submit to the Engineer written evidence that the grout, cement and aggregate is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the grout, cement and/or aggregate supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM or Corps of Engineers testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on samples of grout, cement and/or aggregate.

1.04 Storage

All grout shall be stored above ground and shall be protected at all times from moisture, high humidity, oil and extremes of temperature. Grout or cement which has been resacked or has become caked or lumpy shall not be used.

1.05 Safety

Proper precautions shall be taken to protect workers during handling of epoxy resins and hardeners. All mixing and placement of epoxy grouts shall be done in well-ventilated areas. The specific safety recommendations of the manufacturer shall be strictly adhered to.

Part 2 Products

2.01 Nonshrink Grout

Column baseplates, all pumps, compressors, motors and other heavy equipment items shall be grouted in place with a nonmetallic, noncorrosive, nongaseous, nonshrink grout requiring no cutback or protective coating. Nonshrink grout shall show zero shrinkage from the placement volume or initial expansion volume as determined by ASTM C 827, and shall have an initial set time at 70 degrees F of not less than 45 minutes as determined by ASTM C 191. When tested in accordance with ASTM C 109, nonshrink grout shall have a one-day compressive strength of not less than 2,000 psi and a 28-day compressive strength of not less than 8,000 psi at a flow of not less than 100 percent determined in accordance with Corps of Engineers Specification CRD-C-621. The grout shall contain no corrosive irons, calcium chloride, oxidizing catalysts, gas-forming agents, harmful aluminum or corrosive chemicals and shall be resistant to oil, water and sewage. The grout shall be premixed and shall require only the addition of water prior to placement. The grout shall be delivered to the job site in unopened, plastic-lined bags and shall have the manufacturer's mixing instructions printed on the back of each bag. Nonshrink grout shall be Masterflow 928 Grout as manufactured by Master Builders Company, or Five Star Grout as manufactured by Five Star Products, Inc.

2.02 Sand-Cement Grout

A. Pipe support baseplates, tanks and miscellaneous small items of equipment shall be grouted in place using a sand-cement grout consisting of one part Portland cement, two parts fine aggregate and a maximum of 4.5 gallons of water per sack (cubic foot) of cement. Portland cement shall be Type III conforming to ASTM C 150. Fine aggregate shall be natural siliceous sand, consisting of hard, clean, sharp, dense, durable and uncoated particles.

B. Fine aggregate shall be free from organic material and injurious amounts of deleterious substances and shall be graded as follows:

Sieve Size No.	Percent (by weight) Passing
4	100
8	95 - 100
16	60 - 100

Sieve Size No.	Percent (by weight) Passing
30	35 - 70
50	15 - 35
100	2 - 15

C. Except as modified herein, fine aggregate shall conform to the requirements of ASTM C 144.

D. Fine aggregate to be used with epoxy binders shall be dried prior to use to remove any free moisture.

2.03 Nonshrink Epoxy Grout

Nonshrink epoxy grout shall be used in special equipment grouting applications requiring high bonding or tensile strength where shown on the Drawings. This grout shall be a pre-measured and prepackaged product containing thermosetting epoxy resins and inert fillers; and shall be delivered to the work site in unopened containers. Nonshrink grout shall be Ceilcote 648 CP Grout (Master Builders, Inc.) or Five Star Epoxy Grout (Five Star Products, Inc.).

2.04 Water

Water used in the preparation of nonshrink and sand-cement grout shall be clean, potable water, free from oil, alkali, acid, organic matter and other deleterious substances.

Part 3 Execution

3.01 Foundation Preparation

A. Prior to setting equipment or placing grout, the foundation to receive grout shall be chipped or sandblasted so as to expose the coarse aggregate and create a roughened condition. All surfaces to be in contact with the grout, including the bottom of the baseplates or sole plates, shall be thoroughly cleaned until free of all oil, grease, laitance, dust, curing compounds and other foreign substances If the surface is to receive nonshrink or sand-cement grout, the roughened surface shall be washed with liberal amounts of clean water and shall be soaked for a least 24 hours immediately preceding grouting. Prior to placement, all free water shall be removed using an air hose or other suitable method.

B. Surfaces to receive an epoxy grout shall be completely dry and free from all visible moisture. Where it is impractical to obtain a moisture-free surface, the Engineer may authorize the use of epoxy grout on damp surfaces provided the epoxy formulation is moisture-compatible. When applying grouts to damp surfaces all free water shall be

removed and the epoxy formulation shall be carefully selected so that localized boiling of entrapped moisture due to excessive exotherm does not occur.

3.02 Mixing

A. The specific recommendations and instructions of the grout manufacturer shall be strictly adhered to in all proportioning, mixing and placing of grout. The grout shall be mixed as close to the point of use as is practical. A mechanical mortar mixer may be used for mixing large quantities of nonshrink or sand-cement grout. No more grout shall be mixed than can be placed in the time preceding initial set. Grout that has stiffened prior to placement shall be discarded. Only that amount of water required to produce the necessary degree of flowability shall be used. The grout mixture shall not be retempered by adding water.

B. Components of epoxy grout systems shall be accurately proportioned and thoroughly mixed so as to produce a uniform and homogeneous mixture. Accuracy of proportioning of epoxy compounds shall be $\pm$ five percent of the manufacturer's specified mixing ratio. Mixing of small quantities (up to one quart) of epoxy grout may be accomplished by hand using spatulas, palette knives, or similar devices. For larger volumes, mechanically driven tumbling or paddle type mixers shall be used. Paddle type mixers shall be driven by a low speed (400-600 rpm) motor to prevent introduction of excessive amounts of entrained air into the mixture. Mixing shall continue until the mixture is uniform and homogeneous, but in no case less than three minutes. The manufacturer's recommended temperature range for mixing the epoxy grout shall be followed in all field mixing.

C. After mixing, epoxy grout shall be allowed to stand for approximately five minutes to allow initial air release.

3.03 Placement

A. Grout shall be carefully placed by troweling, ramming, or pouring, as is most suited to the application, so that all voids and cavities between the foundation and equipment baseplate or bedplate are filled. Air-relief holes shall be provided, if necessary, to eliminate entrapped air. If a pourable or flowable grout is required, suitable forms shall be provided for containing the grout. Forms shall be securely anchored and caulked to prevent leakage of grout. Grout shall be placed from one side only. Forms shall be of sufficient height to allow at least 6-inches of head on the grout above the bottom of the baseplate on the side where the grout is to be placed. Grout shall be placed until it protrudes from the entire perimeter area. Baseplates shall be located so as to provide a minimum clearance of 1-inch between the foundation and the bottom of the baseplate. The temperature of the foundation and baseplate or soleplate shall be maintained above 45 degrees F during placement and for at least 24 hours thereafter. Heating of foundation and baseplate surfaces shall be accomplished using heated enclosures, heat lamps or radiant heaters so as to achieve uniform heating. Use of direct flame shall be prohibited. Concrete structures shall be heated a minimum of four hours prior to grouting to ensure proper heating of the concrete mass. Temperature of heated surfaces shall not exceed 100 degrees F at the time of placement. When placing nonshrink or sand-cement grout under unusually hot or cold weather conditions,

grouting practices shall comply with the requirements of ACI 305 and 306, respectively.

B. Epoxy grout formulations shall possess exotherm properties compatible with the anticipated substrate and placement conditions. Where large masses of epoxy are involved or if ambient or substrate temperatures are high, relatively low exotherm formulations shall be used. Conversely, where very small quantities or thin films of epoxy are involved or if ambient or substrate temperatures are low, a high exotherm formulation shall be used.

C. When placing epoxy grouts by pouring, care shall be taken to ensure that segregation of aggregate and epoxy binder or entrapment of entrained air does not occur prior to initial set. To prevent this condition, epoxy grout shall be placed in successive lifts under the baseplate or bedplate not to exceed 1-inch in thickness.

3.04 Finishing and Curing

A. Forms shall be left in place until the grout is hardened enough so that it cannot flow. Unconfined edges of grout shall be cut off flush or beveled and shall be troweled to produce a smooth finish. Wedges and shims used in levelling rotating, vibrating or other heavy items of equipment shall be removed after the grout has hardened three days. All voids shall be regrouted using the same grouting material. Removal of shims and wedges from column baseplates and pipe support baseplates is optional. Anchor bolts shall not be pulled up to final torques until shims and wedges have been removed and the grout is hard enough to permit equipment operation.

B. After placement, exposed edges of water-cured grout shall be wet cured by covering with wet burlap, wet sand, or polyethylene film for at least seven days. During cold weather grout shall be maintained at a temperature for a period of time following placement that will ensure proper hardening and curing.

END OF SECTION

Part 1 General

1.01 Scope

A. This Section covers all items fabricated from metal shapes, plates, sheets, rods, bars or castings and all other wrought or cast metal except component parts of equipment and items covered by other sections.

B. Fabricated metal items, which are detailed on the Drawings but not mentioned specifically therein, shall be fabricated in accordance with the applicable requirements of this Section.

C. Division 13 Section “Pre-Engineered Metal Buildings”.

1.02 Factory Testing

A. Prior to delivery, all basic materials specified herein shall be tested and inspected by an approved independent commercial testing laboratory. Payment for such services will be made by the Contractor. If approved by the Engineer, certified tests performed by the manufacturer's testing laboratory at no cost to the Owner will be acceptable.

B. If so desired by the Engineer, inspection of the fabrication shall be made at the place of manufacture. Access shall be permitted to all places where the work is being done.

1.03 Submittals

A. Detailed shop drawings, product data sheets and erection and installation details for miscellaneous metal items shall be submitted in accordance with Section 01340 of these Specifications.

B. All shop drawings shall be of the same size. Reproductions of the Drawings for use as shop drawings is not permitted. Submittals shall indicate thickness, type, grade, class of metal, dimensions and shall show construction details, reinforcement, anchorage, welds, fasteners and installation with relation to other construction.

C. Submittals shall be complete for each structure. Partial submittals are not permitted and will be returned unmarked. Each submittal shall clearly indicate the structure and Drawing numbers that the work is for. The identifying numbers of the shop drawings for each structure shall be in numerical order.

D. All shop drawings shall be checked by the fabricator and Contractor before being submitted to the Engineer. The shop drawings shall bear clear indication that they have been reviewed and approved by the Contractor.

E. Welding certificates.

1.04 Storage and Protection

A. Store structural metals above ground on platforms or other supports and protect from weather with suitable covering. Do not permit water ponding or moisture collection on stored items.

B. Handle steelwork to prevent damage to members and to shop paint coat and to prevent accumulation of mud, dirt or other foreign materials capable of interfering with field paint application.

1.05 Quality Assurance

A. Structural steel manufacturers shall provide written certification to the Engineer that all materials furnished comply with all applicable requirements of these Specifications.

B. Welding: Qualify procedures and personnel according to AWS Specifications for steel and aluminum welding.

C. Steel: Comply with applicable provisions of the following Specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges".

2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2".

3. AISC's "Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design".

4. AISC's "Specification for the Design of Steel Hollow Structural Sections".

5. AISC's "Specification for Allowable Stress Design of Single-Angle Members".

6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".

Part 2 Products

2.01 Materials and Construction

A. All materials shall be new and undamaged and shall conform to pertinent AISC, ANSI, ASTM or other industry standards. Unless specified otherwise in other sections, all materials in fabricated metal items shall conform to the following requirements:

1. Structural steel shapes shall conform to ASTM A992 Fy: 50 ksi.

2. Steel plates and bars shall conform to Specifications of Structural Steel ASTM A 36.

3. Structural steel tubing shall conform to ASTM A 500 Grade B. Steel pipe ASTM A53, Type E or S, Grade B.

4. Stainless steel shall conform to the following AISI Type 304 for sheets and plates; AISI Type 316 for bolts and stainless steel items in corrosive areas.

5. Galvanizing shall be hot dipped in accordance with Specifications for Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plate, Bars and Strip ASTM A 123.

6. Gray cast iron shall conform to ASTM A 48, Class 30B.

7. Ductile iron shall conform to ASTM A 536, Grade 65-40-18.

8. Aluminum alloy shall conform to the following Aluminum Association Specifications and designations:

   6061-T6 Structural Shapes, Tubes and Pipes in Corrosive Areas, Sheets, Plates, Wire, Rods, Bars, Bolts and Screws

   6063-T6 Tubes and Pipes in Non-Corrosive Areas

   6066-T6 Weldings and Extrusions

   6151-T6 Forgings and Forging Stock

9. High strength steel bolts, nuts and washers shall conform to ASTM A 325.

10. All embedded anchor bolts or anchor bolt materials shall be ASTM A 193, Grade B8; ASTM A 276, Type 304; or IFI-104, Grade 304 stainless steel, threaded per ANSI B1.1. Nuts shall be heavy hex nuts, ANSI B18.2, semi-finished pattern and shall be ASTM A 194, Grade 8 or IFI-104, Grade 304 stainless steel. Flat washers shall be 18-8 stainless steel and shall conform to ANSI B27.2.

11. Electrodes for welding structural steel shall conform to “Specification for Mild-Steel Covered Arc-Welding Electrodes”, AWS A5.1, E-70 series. Electrodes for welding aluminum shall conform to AWS A5.10.

B. Stairs and Platforms: Stairs and platforms shall be fabricated from steel conforming to ASTM A 36 and shall be hot dipped galvanized after fabrication, unless noted otherwise. Stair and platform design, fabrication and installation shall conform to OSHA regulations.

C. Checkered Floor Plates: Unless otherwise shown, checkered floor plates shall be 6061-T6 aluminum alloy with raised diamond pattern on the upper surface. Floor plate shall have a minimum thickness of 1/4-inch and shall be designed for a deflection of not more than 1/300 of span under a uniform load of 100 pounds per square foot. However, in no case shall the thickness of the floor plates be less than that shown on the Drawings for the specified clear span.

D. Welding and Brazing - General

1. All welds shall be sound and free from embedded scale and slag. All butt welds shall be continuous and where exposed to view shall be ground smooth. All continuous welds shall be gas and liquid-tight. Intermittent welds shall have an effective length of at least 2-inches and shall be spaced not more than 6-inches apart.

2. All welding of steel and aluminum, including materials, welding techniques, general safety practices, appearance and quality of welds and methods of correcting defective work, shall conform to the latest requirements of AWS Specifications. Structural steel welding shall conform to the requirements of the AWS Structural Welding Code. The general recommendations and requirements of the AWS Structural Welding Code shall also apply to welded aluminum structures. The welding process and welding operators shall meet qualification tests and welding performance tests in accordance with the latest provisions of ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications. Welding process and qualification procedures for welding of pipe shall conform to the latest requirements of ANSI B31.1, Section 327, Welding and Section 328, Brazing and Soldering. All costs associated with the qualification or testing of welders and welding operators shall be borne by the Contractor.

3. The Owner may inspect any weld by radiographic or other means. Welds not in accordance with the requirements specified herein shall be repaired or replaced at the Contractor's expense. Excessive porosity, non-metallic inclusions, lack of fusion, incomplete penetration and cracking shall constitute grounds for rejection of welds.

E. Shop Fabrication

1. Structural steel shall be fabricated in conformity with dimensions, arrangement, sizes and weights or thicknesses shown on the Drawings or stipulated in the Specifications.

2. All members and parts, as delivered and erected, shall be free of winds, warps, local deformations or unauthorized bends. Holes and other provisions for field connections shall be accurate and shop checked, so that proper fit will result when the units are assembled in the field.

F. Galvanizing

1. All galvanizing shall be done by the hot-dip process, after fabrication in conformity with requirements of ASTM A 123, A 153, A 384 and A 385. Articles to be galvanized shall be pickled before galvanizing.

2. Areas of galvanizing damaged by welding or burning or otherwise damaged shall be thoroughly stripped and cleaned and recoated with zinc to the required thickness by the hot-dip process.

3. Galvanized articles shall be free from uncoated spots, blisters, flux, black spots, dross, projections and other defects not consistent with acceptable galvanizing

practice.

4. Zinc and cadmium plating shall be subject to visual examination to determine uniformity of coating. The Engineer may require that the coating uniformity be tested in accordance with ASTM A 239.

Part 3 Execution

3.01 Installation

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Structural Aluminum

1. General Except as specifically noted on the Drawings, or specified herein, all materials and work for structural aluminum shall conform with the applicable provisions of the latest edition of “Specifications for Aluminum Structures”, published by the Aluminum Association, Inc., New York, New York.

2. Lay Out: Hole centers may be center punched and cutoff lines may be punched or scribed. Center punching and scribing shall not be used where such marks would remain on fabricated material. A temperature correction shall be applied where necessary in the layout of critical dimensions. The coefficient of expansion shall be taken as 0.000013 per degree F.

3. Cutting: Material 1/2-inch thick or less shall be sheared, sawed, or cut with a router. Material more than 1/2-inch thick shall be sawed or routed. Cut edges shall be true and smooth, and free from excessive burrs or ragged breaks. Edges or plates carrying calculated stresses shall be planed to a depth of 1/4-inch, except in the case of sawed or routed edges of a quality equivalent to a planed edge. Re-entrant cuts shall be avoided wherever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.

4. Heating: Structural material shall not be heated except as provided herein. Material may be heated to a temperature not exceeding 400 degrees F for a period not exceeding 30 minutes to facilitate bending. Such heating shall be done only when proper temperature controls and supervision are provided to ensure that the limitations on temperature and time are carefully observed. The Engineer shall be so informed if this method is to be used.

5. Punching, Drilling and Reaming: Rivet or bolt holes may be punched or drilled to finished size before assembly. The finished diameter of holes for unfurnished bolts shall be not more than 1/6-inch larger than the nominal bolt diameter. All holes shall be cylindrical and perpendicular to the principal surface. Holes shall

not be drifted in such a manner as to distort the metal. All chips lodged between contacting surfaces shall be removed before assembly.

6. Bolting: All bolts for bolting aluminum shall be Type 304 or 316 stainless steel as specified herein.

7. Welding

   a. Dirt, grease, forming or machining lubricants or any organic materials shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing. Additional operations to remove the oxide coating just prior to welding are required when the inert gas tungsten arc welding method is used. This may be done by etching or scratch brushing. The oxide coating need not be removed if the welding is done with the automatic or semi-automatic inert gas shielding metal arc. Suitable edge preparation to assure 100 percent penetration in butt welds shall be used. Oxygen cutting shall not be used. Sawing, chipping, machining or shearing may be used.

   b. Any welding of aluminum shall be done using a non-consumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG). No welding process that requires the use of a welding flux shall be used unless prior approval has been obtained from the Engineer. Preheating for welding is permissible provided the temperature does not exceed 400 degrees F for a total time of 30 minutes. Welding of any structure which is to be anodized shall be done using filler alloy rods which will not discolor when anodized.

   c. The welding process and welding operators shall both meet a qualification test conforming to the qualification methods described in the ASME Boiler and Pressure Vessel Code, Section IX, Welding Qualifications.

3.02 Preparation

Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.03 Erection

A. Structural Steel

1. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design".

2. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

    a. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.

    b. Weld plate washers to top of base plate.

    c. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do nor remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.

    d. Promptly pack grout solidly between bearing surfaces and base or bearing plates so not voids remain. Neatly finish exposed surfaces: protect grout and allow to cure.

3. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges".

4. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

    a. Level and plumb individual members of structure.

    b. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

5. Splice members only where indicated.

6. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

7. Do not use thermal cutting during erection.

8. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

B. Connections

1. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

    a. Joint Type: Snug tightened.

2. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

    a. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint or surfaces adjacent to field welds.

    b. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

    c. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.04 Painting

A. Aluminum surfaces to be placed in contact with wood, concrete, or masonry construction shall be coated with bitumastic coating.

B. Where aluminum surfaces come in contact with dissimilar metals, except stainless steel, the aluminum surfaces shall be kept from direct contact with said metal by the use of neoprene gaskets, 10 mil polyethylene film or insulating washers. Paint or galvanizing will not be considered as adequate protection.

C. Unpainted aluminum surfaces shall be cleaned of all fabrication marking, grease, dirt and oil. Anodized surfaces shall be cleaned with a mild soap and water solution and no acid, caustic or abrasive cleaning agents shall be used.

D. Structural and miscellaneous metals shall be cleaned, shop primed and painted in accordance with the requirements of Section 09900 of these Specifications.

3.05 Inspection and Testing

A. Testing Agency: Contractor will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

C. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts".

1. For bolts indicated as "snug tight", inspect to verify that connected elements are in direct contact.

D. Welded Connections:

1. Field welds that fail visual inspection will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.

b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.

c. Ultrasonic Inspection: ASTM E 164.

d. Radiographic Inspection: ASTM E 94.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 Cleaning

A. Prior to the acceptance of the work under this Section, thoroughly clean all installed materials, equipment and related areas in accordance with the requirements of Section 01710 of these Specifications.

B. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

C. Touchup Painting Structural Steel: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP3 power-tool cleaning.

2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION

Part 1 General

1.01 Scope

Furnish and install the cold formed steel structural framing as shown and noted on the Drawings and as specified in this Section, complete.

1.02 Referenced Publications

A. The publications listed below form a part of these Specifications.

1. American Iron and Steel Institute (AISI)

Specification for Design of Cold-Formed Steel Structural Members – 2007 Edition with Supplement No. 1.

1.03 Design Requirements

A. Where shown on the Drawings, framing shall be fabricated from cold formed steel structural members (CFSSM), galvanized, minimum 18 GA.

B. CFSSM framing shall have out to out dimensions as shown and noted on the Drawings. Unless noted otherwise, intermediate members shown on the Drawings are pictorial only and are not intended to size or locate such members.

C. Design loads: All dead load carried by CFSSM. All live loads as required by the International Building Code 2012 and all design conditions for erection of steel structures, as required by OSHA.

D. Design shall be based on elastic behavior.

E. Roof live loads shall not be reduced to any member.

F Equipment Load: Design each truss for 500# equipment load at any location along truss bottom chord.

1.04 Submittals

A. Provide for the design of the CFSSM by a structural engineer registered in the State of Georgia, who shall also seal and sign the submittals noted below.

B. Design Certification: Submit to the Engineer certification that the design of the CFSSM for this work is accomplished by the responsible registered structural engineer whose name, seal and signature appears on the certification.

C. Diagrams showing all the load conditions required by the building code noted on the Drawings and all other loads shown, indicated or noted on the Drawings. These diagrams shall also show all the reactions to the load conditions. The seal and

signature of the responsible registered structural engineer shall be applied on these diagram sheets. These diagrams shall be separate from the calculations required for the analysis and design of the structure. Calculations are not required to be submitted to, or reviewed by, the Engineer.

D. A complete set of erection and detail shop drawings, including, but not limited to, anchor bolt sizes and layout, all framing, all openings for vents and louvers. The submittal shall be made in one complete package. The seal and signature of the responsible registered structural engineer shall be applied to these drawings.

E. Certificates of Compliance: Attesting that all materials comply with the requirements of these Specifications.

F. The Engineer will review, comment and return to the Contractor the required number of marked copies of all items under paragraphs B, C, D, and E. For paragraph D., the Engineer will not comment on erection procedures and does not require their submittal. The Engineer's review and comments for paragraph D. will be for layout and clearances only and will not relieve the Contractor of the responsibility of providing a design and product that meets all the requirements of these Specifications.

G. Products for use on this work shall not be fabricated until all the required submittals have been made, reviewed by, and stamped by the Engineer with the notation "NO EXCEPTIONS TAKEN".

1.05 Delivery and Storage

Deliver, store and handle all building components so that they remain dry and undamaged.

Part 2 Products

2.01 Fabrication

The truss framing shall be shop fabricated and test assembled before shipment to the job site.

2.02 Materials and Construction

A. All materials shall be completely fabricated and prepared for shipment, including any necessary crating or handling provisions. All parts of the framing are to be accurately made so that in erection all parts will easily fit together. All cutting, punching and forming shall be performed at the shop. All shop connections shall be bolted. All parts shall be marked and referenced on erection drawings and instructions.

B. Connections

1. All field connections shall be bolted.
2. Type and location of anchors shall be included in the Submittal.

Part 3 Execution

3.01 Installation

A. The added roof framing shall be constructed by a steel erector regularly engaged in the construction of CFSSM. Construct the CFSSM in accordance with the shop/erection drawings and the printed instructions.

B. Keep primary members plumb and stayed in both directions and maintain a safe work place as required by all applicable codes, standards and all applicable OSHA regulations.

C. If defects or errors in fabrication or erection of any building component cannot be corrected in a manner acceptable to the Engineer, remove and provide non-defective components.

D. Field modifications shall not be made unless they are acceptable to the Engineer.

3.02 Inspection and Testing

A. Provide for inspection of the work by the responsible registered structural engineer and a certification by him, or her, that the framing has been installed according to his/her Drawings and Specifications. As an alternate, the special inspector for the project shall provide such documentation.

B. Provide suitable access to the work for inspection by the Engineer or a testing laboratory of the Engineer's choosing.

END OF SECTION

Part 1 General

1.01 Scope

The work under this Section includes, but is not necessarily limited to, the furnishing and installation of all miscellaneous metals and related items as indicated on the Drawings, herein specified and as necessary for the proper and complete performance of this work.

1.02 Submittals

A. Make all submittals in accordance with Section 01340 of these Specifications.

B. Shop Drawings

1. Submit shop drawings of all items to be furnished.

2. Shop drawings for steel members shall be as specified in Section 05120 of these Specifications.

3. Submit plan locating embedded connections in masonry and cast-in-place concrete for precast tees. (Precast supplier shall furnish locations unless noted otherwise on the Drawings).

1.03 Division of Work

A. General: The following list of items to be furnished under this Section is placed here to aid the various trades in estimating their portion of the Work. It is not a full and complete list and does not relieve the Contractor from providing a totally complete Project including all miscellaneous items.

B. Miscellaneous Metal Items

1. Loose angle and wide flange lintels.

2. Stairs and landings including posts, bearing plates, and integral support beams.

3. Beams, angles and other supporting grating over pipe trenches including embedded connections.

4. Embedded connections and plates in masonry and cast-in-place concrete for precast plank and tees.

5. Bumper posts and sleeves.

6. Bearing plates for other items specified herein.

7. Railings.

8. Edge angles cast-in-concrete.

1.04 Quality Assurance

A. Qualifications: For fabrication and erection of the work of this Section, use only personnel completely trained and experienced in the type of work being performed and thoroughly familiar with the original design and the approved shop drawings.

B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with applicable standards for materials design and construction of the following:

1. American Society for Testing Materials

2. American Institute of Steel Construction

3. American Iron and Steel Institutes "Specifications for the Design of Light Gage Cold Formed Steel Structural Members"

4. Occupational Safety and Health Act

5. American Welding Society

6. National Association of Architectural Metal Manufacturers

C. Conflicting Requirements: In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

Part 2 Products

2.01 Materials

A. General: Materials shall be new, top quality of their respective kinds, standard sizes and fabricated in a shop whose principal business is manufacturing the items specified in this Section. Materials shall be free of defect impairing strength, durability or appearance. Miscellaneous anchors, plates, clips, bolts, nuts and the like shall be provided as necessary to complete the work, whether or not they appear on the Drawings or in the Specifications.

B. Steel shall conform to ASTM A 36.

C. Cast iron shall be soft, gray iron, true to pattern, smooth and straight, free from defects impairing strength, durability or appearance.

D. Malleable iron shall be high grade white iron castings, fulling annealed and of uniform ductile structure throughout.

E. Use genuine wrought iron conforming to ASTM A 41 for bolts, rods, and bars; ASTM A 42 for plates, and ASTM A 162 for sheets.

F. Aluminum alloys shall be of uniform quality and free from injurious defects and meet the properties and applicable specifications of the Aluminum Company of America.

G. Stair Treads: Provide safety treads on all interior and exterior stairs and landings.

1. Acceptable Manufacturers

a. Specified Manufacturer: Wooster Products, Inc.

b. Acceptable Manufacturers: American Safety Tread Company, Inc,. or American Abrasive Metals Company.

2. General

a. Treads shall have extruded aluminum arrow base, heat treated for increased strength.

b. Treads shall be anchored into concrete by strap anchors double riveted to the aluminum base or by a continuous "arrow" anchor extruded as an integral part of the tread base. Strap anchors shall be located at the end of each section of tread and on maximum 12-inch centers between.

c. Treads shall have heavy duty factory applied protective tape applied to all finished surfaces.

3. Treads at Concrete Landings at the Top of Metal Stairs

a. Treads shall have a 1 x 1-inch nosing, be 6-inches wide, and the top of the tread shall align even with the top of the landing.

b. Treads shall be Type 104.

4. Treads at all Other Concrete Landings and Concrete Stairs

a. Treads shall be 1/4-inch thick, 6-inches wide and shall incorporate nosing 1/4-inch underside.

b. Dovetail slots 3/16-inch deep shall be filled with a black abrasive consisting of a blend of aluminum oxide and carborundum.

c. Treads shall be Type 161.

5. Coat all aluminum surfaces to be cast into concrete with a bitumastic coating. Set treads level, straight and flush with finished floor surface. Extend treads to within 3-inches of each end of stair tread. Miter all corners where nosing turns. Do not remove protective tape until all construction and cleanup is complete.

H. Manhole Steps: Steps shall be fabricated of plastic. Steps shall be 10-inches deep x 10-inches wide, 5-inch tread depths, 1 x 1-inch tread section with 2-inch rail height, and shall be reinforced with 3/8-inch steel rods.

I. Interior Trench Grating: Trench grating shall be light-duty grating equal to Neenah R-4468. Angle frame with integral cast anchor lugs shall be equal to Neenah R-4899.

J. Exterior Trench Grating: Grating shall be heavy-duty grating equal to Neenah R-4525 F. Angle frame with integral cast anchor lugs shall be equal to Neenah R-4899.

K. Bird screen shall be No. 2 mesh, brass or copper wire cloth, minimum wire diameter 0.063-inch.

L. All other materials not specifically described but required for a complete and proper installation of the work of this Section, shall be new, first quality of their respective kinds and as selected by the Contractor subject to approval of the Engineer.

2.02 Fabrication

A. General

1. Workmanship: Install items square and level, accurately fitted and free from distortion and defects.

2. Temporary Bracing: Make provision for erection stresses by temporary bracing; keep work in alignment.

3. Welding: Welding shall be continuous along entire area of contact. Welding shall be in accordance with "Code for Welding in Building Construction" of the American Welding Society. Grind exposed welds smooth and flush with adjacent finished surfaces.

4. Painting: Prime paint metal fabrications in accordance with Section 09900 of these Specifications.

5. Items fabricated from structural steel members which are to be architecturally exposed shall be given special attention for material selection with respect to rolling tolerances, surface finish and straightness.

6. Normal structural steel fabrication tolerances will not be acceptable where in conflict with the intent and requirements of this Section.

7. Straightness tolerance, additive to deflection, shall not exceed $\pm$1/16-inch to 10 feet.

8. All cope, mitre, and butt caps on exposed surfaces shall be made to the closest possible tolerances consistent with metal shop equipment and practice in order to provide a pleasing appearance.

9. Galvanizing: Items specified to be hot-dip galvanized shall be coated after fabrication.

10. Fastenings shall be concealed where practicable. Thickness or metal and details of assembly and supports shall give ample strength and stiffness. Joints exposed to weather shall be formed to exclude water. Provide holes and connections for the work of other trades.

B. Aluminum Stairs

1. Unless noted otherwise, all stairs shall be of the grating type. The top surfaces of all bearing bars shall be striated to provide a non-slip surface and the leading edges of all treads and landings shall receive a 1-inch abrasive aluminum nosing. Components shall be of aluminum alloy 6063-T6 or 6063-T5.

2. Design and fabrication shall be provided by the supplier in accordance with the Drawings. Minimum design live load is 100 pounds per square foot and a concentrated live load of 300 pounds per square foot. Recommended standards of NAAMM and AISC shall be followed. Refer to the Drawings for stairs and landings receiving brick or tile pavers.

C. Aluminum Ladder: Meet OSHA requirements.

Part 3 Execution

3.01 General

A. Workmanship: Install items square and level, accurately fitted and free from distortion and defects.

B. Coordination: Supply to appropriate trades, items requiring to be cast into concrete, embedded in masonry, complete with necessary setting templates.

C. Touch-Up: After installation, touch-up field welds and scratched and damaged surfaces.

D. Protection: Where required, provide approved protection against galvanic action between contacts of dissimilar metals or situations that will cause deterioration of metals in contact or associated in any way.

3.02 Painting

Painting shall be in accordance with Section 09900 of these Specifications.

3.03 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with Section 01710 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

A. Adhesive anchor bolts shall be provided for mechanical equipment where indicated on the Drawings or as required by equipment manufacturer's anchor bolt setting plan.

B. Expansion bolts shall be provided where indicated on the Drawings and as required to attach anchor ladders, handrails, stairs, ship's ladders and structural steel shapes to hardened concrete or masonry.

C. Embedded anchor bolts shall be provided where indicated on the Drawings or in the Specifications or where recommended by equipment manufacturers.

1.02 Material Storage

All material shall be stored in manner which will protect it from deterioration and damage.

Part 2 Products

2.01 Adhesive Anchor Bolts

A. Adhesive anchor bolts shall consist of a stainless steel threaded rod meeting the requirements of ASTM F 593 (AISI 304). Installation shall be in conformance with the manufacturer's instructions and under the supervision of a manufacturer's field representative for maximum pullout and shear strength.

B. All nuts shall be of stainless steel meeting requirements of ASTM F 594 Alloy Group I, Condition CW.

C. All washers shall meet dimensional requirements of ASTM F 436. Material for washers shall be stainless steel, Type 304, 305, 384 or MX7.

D. Adhesive anchor bolts shall be Epcon System Ceramic 6 Epoxy Adhesive by ITW Ramset/Red Head or HIT HY 150 Injection Adhesive by Hilti Fastening Systems.

2.02 Expansion Anchor Bolts

A. Expansion anchor bolts shall be stainless steel, AISI Type 304 or 316 and shall be of the wedge or self-drilling type. Expansion anchors shall conform to the applicable requirements of Federal Specifications FF-S-325. Installation methods shall be in conformance with the manufacturer's recommendations for maximum pullout and shear strength, but in no case shall the depth of the hole be less than five bolt diameters. The minimum distance between the center of the expansion anchor and an edge or exterior corner shall not be less than 6 times the diameter of the hole in which it is installed.

B. All nuts shall be of stainless steel meeting requirements of ASTM F 594 Alloy Group I,

Condition CW.

C. All washers shall meet dimensional requirements of ASTM F 436. Material for washers shall be stainless steel, Type 304, 305, 384 or MX7.

D. Expansion anchors shall be "Trubolt" by ITW Ramset/Red Head, or "KWIKBOLT II" by Hilti Fastening Systems.

2.03 Embedded Anchor Bolts

A. Embedded anchor bolts, except those used for equipment anchoring, shall be carbon steel unless stainless steel is required on the Drawings or Specifications. Embedded anchor bolts used for anchoring equipment shall be stainless steel.

B. Carbon steel anchor bolts shall meet the requirements of ASTM A 307 or ASTM A 193, Grade B8. Bolts shall be threaded per ANSI B1.1.

C. Stainless steel anchor bolts shall meet the requirements of ASTM A 276, Type 304.

D. All nuts shall be heavy hex nuts, ANSI B18.2, semi-finished pattern. Nuts for carbon steel bolts shall meet the requirements of ASTM A 194, Grade 8. Nuts for stainless steel bolts shall meet the requirements of ASTM A 276, Type 304.

E. All washers shall conform to ANSI B27.2 and shall be 18-8 stainless steel.

Part 3 Execution

3.01 Adhesive Anchor Bolt Installation

A. Drilled Holes: Holes for adhesive anchors shall be drilled with a rotary percussion hammer drill with a carbide tipped masonry drill bit conforming to ANSI B94.12-77. Hole diameter and depth shall be as specified by the manufacturer.

B. Hole Cleaning and Preparation: After drilling, dust and fragments shall be cleared out using a water jet, circular wire brush and compressed air. The hole may be damp but all water must be blown out.

C. Curing: Anchor shall be unloaded and allowed to cure for manufacturer's recommended curing time.

3.02 Expansion Bolt Installation

A. Drill expansion bolt holes into concrete through item being supported or locate by a template. Drill all holes by a tool designed by or approved by manufacturer of expansion anchors.

B. Installation of expansion anchors shall be in compliance with manufacturer's recommendations for maximum holding power, but in no case shall depth of hole be

less than four bolt diameters. Minimum distance between center of any expansion anchor and an edge or exterior corner of concrete shall be not less than 4-1/2 times diameter of hole in which it is installed.

3.03 Embedded Anchor Bolt Installation

Anchor bolts shall be properly located and built into connecting work. Bolts shall be preset by the use of templates or such other methods as may be required to locate the anchor bolts accurately. All base plate anchor bolt nuts shall be turned down tight.

END OF SECTION

Part 1 General

1.01 Scope

A. The work covered by this Section includes furnishing all labor, equipment and materials required to furnish and install component aluminum handrail and ladders, including all fittings, anchors, sleeves and accessories, as shown on the Drawings and specified herein.

B. Unless specifically designated on the Drawings, all handrails and ladders shall be a component system meeting the requirements of this section of the Specifications.

C. Handrails and ladders shall be furnished and installed where shown on the Drawings.

D. Handrails shall be furnished with a toeboard, except on the railings for stairs or where concrete curbs a minimum of 4-inches high are provided.

1.02 Design Requirements

A. Component aluminum handrail and ladder system, including railings, posts, rungs, and gates, shall be designed and constructed in strict compliance with the requirements of OSHA, the International Building Code and ANSI.

B. Component aluminum handrail system shall also be designed:

1. To withstand the working loads below with a minimum factor of safety of 1.5 based on the ultimate strength of the alloy used.

2. For a minimum safe working load of both of the following loads:

a. 50 pounds per linear foot applied horizontally to the top rail and a vertical load of 100 pounds per foot applied simultaneously.

b. A 200 pound concentrated load applied in any direction at any point on the railing.

C. Component ladder system shall also be designed as follows:

1. Ladder rungs shall be designed to withstand a concentrated load of 250 pounds plus 30 percent impact. Maximum rung deflection shall not exceed L/360. The design load shall be applied at the center of the rung on a 4-inch wide area.

2. Ladder side rails shall be designed to withstand a minimum live load of two 250 pound loads plus 30 percent impact concentrated between any two consecutive attachments.

D. Splice joints shall be designed and constructed to provide strength equivalent to a straight section of pipe.

1.03 Submittals

A. Submit complete shop drawings and product data in accordance with the requirements of Section 01340 of these Specifications.

B. Submit, in accordance with the requirements of Section 01730 of these Specifications, manufacturer's recommendations and procedures for maintaining and repairing handrail, including methods, cleaning materials, refinishing materials and precautions as to the use of materials which may be detrimental to handrail finish.

C. Submit certifications as required in Article 1.05 below.

1.04 Storage and Protection

A. Keep handling to a minimum and maintain protective covering on handrail until the work is complete. The Contractor shall take care in handling the rails during shipment, unloading, erection, and during construction to prevent damage to the railing.

B. Railing and post components shall be individually wrapped in paper or plastic film sleeves to protect the finish during shipment and installation and shall not be covered with any protective paper or other covering which can adhere to, or damage, the components.

1.05 Quality Assurance

A. The Contractor shall provide the Engineer with written certification that the aluminum handrail, ladders and accessories are designed and manufactured in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the aluminum handrail and ladder supplier may be considered evidence of compliance, provided such tests are performed in accordance with the appropriate ASTM testing standards by experienced, competent personnel. Tests for ladders shall show that design loads have been applied and released a minimum of 200,000 times to demonstrate fatigue resistance and a safe extended service life. Deflection shall be checked periodically and shall not exceed L/360 at any time under full design load. At completion of testing, the rung and attachments to the side rail shall be inspected for cracks, looseness, distortion, bending (permanent set) or other obvious damage. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on certified sample of handrail stock.

B. Furnish a manufacturer's inspection certificate stating that the handrail and ladder system as installed meets the requirements of these Specifications and the Manufacturer's written instructions. Contractor shall correct all inadequacies found during the inspection process.

Part 2 Products

2.01 Acceptable Manufacturers

Component aluminum handrail and ladder system shall be “Tuf Rail” as manufactured by Thompson Fabricating Company of Birmingham, Alabama, or “AlumaRail” as manufactured by Alumagard of Denver, Colorado, “Interna-Rail” as manufactured by Hollaender Manufacturing Co. of Cincinnati, Ohio and “Wes Rail II” as manufactured by Moultrie Manufacturing Company of Moultrie, Georgia.

2.02 Materials and Construction

A. Railing: Handrail railing and ladder side rails shall be an extruded tube manufactured from an aluminum alloy in accordance with ASTM B 221, Alloy 6105, Temper T5 or Alloy 6063, Temper T6. Railing shall have a minimum outside diameter of 1.90-inches. Railings shall have a minimum wall thickness of 0.145-inch.

B. Handrail Posts

1. Posts shall be an extruded tube manufactured from an aluminum alloy in accordance with ASTM B 221, Alloy 6105, Temper T5. Posts shall have a minimum outside diameter of 1.90-inches. Posts shall have a minimum wall thickness of 0.20-inch.

2. The posts shall have an internal reinforcing dowel to assist in the transfer of the loadings from the post to the base. The dowel length shall extend 12-inches (or longer if required by the manufacturer to meet criteria) above the walking surface and recessed 1/4-inch from bottom of post and shall be tack welded in two locations to secure dowel in the post.

C. Ladder Rungs: Rungs shall be designed to provide a non-slip power grip surface with a flat 1-inch wide serrated top surface and a semi-circular bottom. The straight sides and semicircular bottom shall have striations at approximately 5/16-inch centers for gripping surface. The rung shall be an aluminum extrusion, Alloy 6063-T6, of sufficient section modulus and moment of inertia to withstand the design loads. Finish shall be mill finish.

D. Adhesive Anchor Bolts: Adhesive anchor bolts shall be designed with a safety factor of 4 on ultimate withdrawal and shear in 4,000 psi concrete. Adhesive bolts shall be spaced a minimum of 10d apart with 5d minimum edge distance without reduction of withdrawal and shear values used in calculations. Adhesive bolts shall be stainless steel.

E. Fasteners: Handrail and ladder system shall be assembled using components that make rigid joints. Railing joints shall be assembled using stainless steel set screws. Other joints shall be assembled using stainless steel fasteners. No pop riveted, glued systems, or welded railing will be allowed.

F. Anodizing: Unless noted otherwise, all railing and posts, and their components, shall be clear anodized on all exposed surfaces conforming to AAM12C22A41 (Class I), 0.7 mil.

G. Brackets and Bases

1. Side mount brackets shall be non-welded extrusions attached to posts with stainless steel set screws.

2. Top mounted bases shall be al-mag castings, anodized. Castings shall be permanent mold or die cast. If bases are sand castings or machined, they shall be finished smooth prior to anodizing to approximate the finish of permanent molds or diecast satisfactory to the Engineer. Castings shall be attached to the post with stainless steel set screws and pressure plate. Cast bases shall slip over the outside of the pipe post so that the pipe and integral internal dowel may function together in transferring the load to the base flange. Aluminum bases of welded construction are not acceptable.

H. Handrail system shall provide for draining of entrapped water from the railing systems by minimum 15/64-inch diameter weep holes or other approved means.

I. Toeboards: Toeboards shall be of the same material and finish as the rails and posts. Toeboards shall be extruded design that clamp to the post to allow expansion and contraction. Toeboards shall have a minimum height of 4-inches.

J. Gates: Gates shall be of the same material and finish as the rails and posts. Gates shall be equipped with a spring to assist in closing.

K. Fall Prevention: Where the floor-to-floor vertical distance exceeds eight feet, provide a fall prevention system as follows:

1. Manufacturer: 'SAF-T-CLIMB" fall Prevention System as manufactured by North Safety Products, Brea, California, (800) 421-3841.

2. Construction: System components shall be made of 6061-T6 aluminum alloy with a mill finish.

3. SAF-T-PIVOT Dismount Section: At the top of all ladders which do not terminate at a floor door or roof scuttle, such as one at a mezzanine or tank, install an 8-foot long SAF-T-PIVOT dismount section. The top of the dismount section shall be 4 ½-feet above the floor at the top of the ladder and shall have a removable stainless steel pin which, when removed, will allow the sleeve to slip off the top. The pin shall be configured to firmly stay engaged to the dismount section and shall have an attached stainless steel ring attached to one end of a stainless steel chain. The other end of the chain shall be attached to the bolt at the top of the guide rail. Install two additional rung clamps on the top two or three ladder rungs for additional support as recommended by the manufacturer.

4. Eyebolts: At the top of all ladders which terminate at roof scuttles or floor doors, furnish and install a stainless steel closed eyebolt in the center of each top ladder

rail bracket. The eyebolt shall be made of 3/8-inch diameter steel, shall have an inside opening width of 2 ¼-inches, shall be oriented vertically, and shall have all of the excess threaded portion removed and ground smooth.

5. Harness Sets: Provide one harness set in each of the five available sizes, total five sets, each of which shall be comprised of a Saf-T-Harness No. 730-201-XXX, a Saf-T-Lanyard No. 732-201-071, and a Saf-T-Lok Sleeve No. 602-100-001. Also provide five heavy duty aluminum hooks equal to Ives Model 405-A14. Hooks shall be installed at a location within the Project as directed by the Engineer and in a manner to support a vertical load of 50 pounds without noticeable deflection. Harness Sets are available from: North Safety Products, 26 Dansk Court, Toronto, Ontario M9W5V8, Tel: (800) 836-8006. Hooks are available from any Finish Hardware supplier.

Part 3 Execution

3.01 Installation

A. General: Handrail and ladder system shall be assembled and installed in strict compliance with the manufacturer's instructions. Maximum post spacing shall be 6'-0". The handrail manufacturer may use less than 6'-0" if their system requires closer spacing to meet design criteria.

B. Shop Assembly: Handrail manufacturer shall shop assemble the handrail and ladders in shippable modules not to exceed 30 feet in length. Field manufacturing of handrail and ladder modules will not be permitted.

C. Set handrail modules plumb within 1/8-inch of vertical and align horizontally to within 1/8-inch in 12 feet. Set stair rail modules plumb within 1/8-inch of vertical and set rake rails aligned horizontally to 1/8-inch in 12 feet. Set ladder modules plumb within 1/8-inch of vertical.

D. Handrail mounting shall be embedded, top mounting base, or side mounted as shown on the Drawings. Install expansion bolts to proper depth to develop full withdrawal and shear values. Check all fasteners and bolts in base connections and splices for tightness.

E. Handrail and ladder components coming into contact with concrete or dissimilar metals shall be coated with bituminous protective coating or installed with a vinyl isolation gasket.

F. Splice joints to facilitate removal of pipe railing shall be provided at all intersections, changes in direction or at intervals not to exceed 30 feet in straight runs of railing.

G. Adequate provisions for expansion and contraction shall be incorporated in the rails. Expansion joints shall be placed at 60 foot intervals. Handrail shall not be continuous across concrete expansions joints.

H. Open rail ends shall be closed by terminal end fittings.

I. Unless noted otherwise, gates shall be provided in all handrail and ladder openings. Chains will not be permitted at handrail and ladder openings.

J. Toeboards shall be shipped loose and field assembled to posts with clamps. The attaching system shall be such that contraction and expansion can occur while maintaining a straight line. Toeboards shall be set so that the bottom of the toeboard is within 1/4-inch above the walking surface.

K. All defective, damaged or otherwise improperly installed handrail, ladders, gates, and fall prevention systems shall be removed and replaced with material that satisfies the requirements of this Section.

3.02 Cleaning

Following installation, aluminum handrail, ladders, gates and fall prevention systems shall be cleaned using soap and clean water. Acid solutions, steel wool or harsh abrasives shall not be used. If stains remain after cleaning, remove finish and restore in accordance with the manufacturer's written instructions to the satisfaction of the Engineer.

END OF SECTION

Part 1 General

1.01 Scope

A. The work covered by this Section includes furnishing all labor, equipment and materials required to furnish and install all aluminum gratings and stairway treads, including all supporting angles, anchors and incidental fastenings where shown on the Drawings or specified herein.

B. Unless specifically designated otherwise on the Drawings, all gratings and treads shall be aluminum.

1.02 Design Requirements

Aluminum grating shall be designed for an extreme fiber stress in bending of not more than 10,000 psi and a deflection of not more than 1/300 of the span length or 0.25-inch, whichever is smaller, under a uniform live load of 100 pounds per square foot. The depth and thickness of the main bearing bars shall not be less than that shown on the Drawings (1-inch minimum) and the clear spacing between main bearing bars shall not exceed 1-1/8-inches.

1.03 Submittals

Complete shop drawings and engineering data shall be submitted in accordance with the requirements of Section 01340 of these Specifications.

1.04 Storage and Protection

Aluminum gratings shall be stored and protected in accordance with the requirements of Section 01640 of these Specifications.

1.05 Quality Assurance

The Contractor shall provide the Engineer with written certification that the aluminum grating and treads are in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the grating or stair tread supplier may be considered evidence with the appropriate ASTM testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on certified samples of aluminum bar stock. Cost for this testing to be borne by Contractor.

Part 2 Products

2.01 Acceptable Manufacturers

Grating shall be IKG, Seidelhuber, Liskey or Ohio Grating.

2.02 Aluminum Gratings

A. Aluminum gratings shall be fabricated of I-shaped or rectangular 6061-T6 or 6063-T6 aluminum alloy bars welded or pressure locked together into rigid panels. Grating and banding bars shall be machine cut. Top surfaces of main bearing bars shall be grooved or serrated to provide a non-slip surface.

B. Grating panels shall be simply supported by shelf angles on two sides of the openings and shall be reversible. The gratings shall be of the type that can be made in panels of the widths and lengths appropriate to the openings shown on the Drawings, no gratings will be accepted which require individual panels to be made up by binding narrow panels together with end or intermediate binding strips welded thereto. The ends of all grating panels and the edges of all openings shall be provided with banding strips of the same depth and thickness of the main bars, welded thereto and neatly finished at the intersections with the bars. After installation, there shall not be more than 1/4-inch clearance between sides of adjacent panels. Panels shall be furnished in sizes that weight does not exceed 80 pounds.

C. The top surface of all bars shall be flush and all gratings shall lie flat with no tendency to rock when installed. Cross bars and edge bars of adjacent panels shall align for neatness. Maximum spacing between adjacent panels shall not exceed 1/4-inch. All main bearing bars shall be parallel. Cross bars shall be cut off flush with outside face of side bars.

D. Grating panels shall be securely anchored in place with stainless steel "J" bolts or aluminum saddle or hook clamps. Galvanized hardware shall not be acceptable. A minimum of two fasteners over each support shall be provided.

E. Main bearing bars shall be supported by aluminum shelf angles of the size and thickness as shown on the Drawings. There shall not be more than 1/4-inch clearance between the ends of the grating panels and the inside vertical face of the shelf angle.

F. Grating panels shall be within 3/16-inch, plus or minus of authorized length and width, and shall have a maximum difference in length of opposite diagonals of 3/16-inch. Spacing of bearing bars shall be within 1/32-inch of authorized spacing.

G. All surfaces shall be sound, smooth, clean and free from defects. Completed sections shall be level and true so as to rest firmly on the bearing angles along the entire contact surface. Openings, where required, shall be neatly and accurately made to the dimensions required as shown on the Drawings. Poorly fitted or damaged grating shall be replaced. All angular, circular or reentrant cuts shall be made by sawing or shearing. Flame cutting will not be permitted.

H. Unless otherwise shown, openings to be covered with grating shall be bound on all four sides with a continuous shelf angle frame having welded corners and sufficient strap anchors for anchorage into the concrete.

I. Where changes in channel direction, openings for gates, ends of grating runs, etc., prohibits adequate support for grating, additional cross angles shall be furnished to provide a seating surface.

J. Grating shall be laid out so that openings in the gratings are centered on a joint between adjacent panels. Where joints occur normal to the direction of span, they shall be centered on structural support with not more than 1/8-inch between ends of adjoining panels.

K. Solid plank grating shall be I-bar reinforcing designed to meet the deflection requirements specified herein. The solid plank shall have a non-slip surface.

Part 3 Execution

3.01 Installation

A. Gratings shall be installed in accordance with the manufacturer's recommendations and instruction.

B. Gratings shall have no tendency to shift, rock or rattle and shall not exhibit excessive deflection under normal foot traffic.

C. Stair treads shall be installed at the proper spacing and alignment and shall be level. Stairs shall not sway or vibrate under ordinary foot traffic. Additional bracing or supports shall be provided, if necessary.

3.02 Surface Preparation and Shop Painting

A. Surface preparation and shop painting shall be in accordance with the requirements of Section 09900 of these Specifications.

B. Aluminum surfaces to be embedded in concrete or otherwise placed in contact with masonry construction shall be given a heavy shop coat of a zinc chromate primer in accordance with Federal Specification TT-P-645. The paint shall be applied as received from the manufacturer without the addition of any thinner.

C. Where aluminum surfaces come in contact with dissimilar metals, except stainless steel, the aluminum surfaces shall be kept from direct contact with said metal by the use of neoprene gaskets, 10 mil polyethylene film or insulating washers. Paint or galvanizing will not be considered as adequate protection.

3.03 Field Painting

Field painting shall be in accordance with the requirements of Section 09900 of these Specifications.

3.04 Cleaning

Prior to the acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with the requirements of Section 01710 of these Specifications.

END OF SECTION

Part 1 General

1.01 Scope

Provide the structural design of and furnish and install the platforms as shown and indicated on the Drawings. Member sizes shown on these Drawings are minimum requirements.

1.02 Design Requirements

A. Code: International Building Code, 2000, Edition.

B. Design Loads

1. Grating for platform, 150 psf.

2. Beams supporting grating, 150 psf for each square foot of contributing area in addition to the dead load of the structure, all piping (empty or filled with water) and dead load plus live load of all equipment shown on the Drawings.

3. All seismic and wind loads required by the referenced code.

C. Design shall be based on elastic behavior. Deflections on walkway beams shall be limited to L/300. Lateral deflection shall be limited to H/500.

D. Compression flanges of walkway beams shall be stabilized by suitable struts and/or bracing. The use of the grating to support compression flanges is prohibited.

E. The design, fabrication and erection of each of the components furnished under this Section of the Specifications shall meet the applicable requirements of Section 05120, Structural Metals.

F. Handrails shall meet the requirements of Section 05524, Component Aluminum Handrails.

G. Aluminum gratings shall meet the requirements of Section 05530, Aluminum Gratings.

H. Design shall be in accordance with the Aluminum Association, Inc. Specifications.

I. Field connections shall be bolted.

1.03 Submittals

A. Provide for the design of the aluminum platforms, and walkways by a structural engineer registered in the state in which this Project is located who shall seal and sign the submittals noted below.

B. Design Certification: Submit to the Engineer certification that the design of the aluminum platforms, and walkways for this work is accomplished by the responsible registered structural engineer whose name, seal and signature appears on the certification.

C. Diagrams showing all the load conditions required by the building code noted and all other loads shown, indicated or noted on the Drawings and as specified in this Section of these Specifications. These diagrams shall also show all the reactions to the load conditions. The seal and signature of the responsible registered structural engineer shall be applied on these diagram sheets. Calculations are not required to be submitted to, or reviewed by, the Engineer.

D. A complete set of erection and detail shop drawings, including, but not limited to, anchor bolt sizes and layout, all framing and connections. The submittal shall be made in one complete package. The seal and signature of the responsible registered structural engineer shall be applied to these drawings.

E. Certificates of Compliance: Attesting that all materials comply with the requirements of these Specifications.

F. The Engineer will review, comment and return to the Contractor the required number of marked copies of all items under paragraphs B, C, D and E. For paragraph D., the Engineer will not comment on erection procedures and does not require their submittal. The Engineer's review and comments for paragraph D. will be for layout and clearances only and will not relieve the Contractor of the responsibility of providing a design and product that meets all the requirements of these Specifications.

Part 2 Products

2.01 Materials

A. All products shall be new and undamaged.

B. Framing members and grating shall conform to the Aluminum Association, Inc. (AAI) Specification 6061-T6.

C. Connection bolts and anchor bolts shall conform to AISI Type 316 stainless steel.

D. Base plates shall conform to AAI 6061-T6 or AISI Type 304 stainless steel.

E. Shop welding shall conform to AAI 6066-T6.

Part 3 Execution

3.01 Installation

Fabrication and installation shall be in accordance with Section 05120, Structural Metals.

END OF SECTION

Part 1 General

1.01 Scope

A. The work under this Section includes, but is not necessarily limited to, the furnishing and installation of all dampproofing as indicated on the Drawings, herein specified and as necessary for the proper and complete performance of this work.

B. The bituminous dampproofing materials specified herein shall be surface applied as follows:

1. Do not apply to the outside of concrete tanks which contain water.

2. Apply to wall behind exterior wythe as indicated on the Drawings.

C. Provide all labor, materials, equipment and appliances as required for the proper installation of dampproofing as follows:

1. Prepare all surfaces as specified herein to receive dampproofing.

2. Provide dampproofing at all vertical and horizontal surfaces shown on the Drawings.

3. The manufacturer shall provide all certifications, test data, affidavits or samples requested by the Engineer.

4. Perform all installations to comply with local rules, ordinances and regulations, OSHA Requirements and EPA Statutes complying with environmental protection.

5. Perform all installations in accordance with the approved construction progress schedule or at such times necessary for the orderly and expeditious completion of the Project.

6. Upon completion of dampproofing, remove all waste or rubbish resulting from dampproofing operations and all equipment used for same.

1.02 Submittals

Submit approved manufacturer's product literature for dampproofing materials including all special details and recommended application procedures in accordance with the requirements of Section 01340 of these Specifications.

1.03 Product Handling

A. Protection: Use all means necessary to protect dampproofing materials before, during and after installation and to protect the installed work and materials of all other trades, contiguous to the dampproofed surfaces. Packaged containers shall be stored on wood skids, 6-inches off the ground and covered with heavy plastic sheeting which

shall remain in place at all times.

B. Replacement: All broken containers and their contents shall be removed from the premises, discarded in a legal fashion and replaced with new materials at no additional cost to the Owner.

1.04 Coordination

A. Review all Drawings and details of installations of other adjoining materials and cooperate with the respective trades.

B. The applicator's particular attention is directed to the requirement to properly prepare surfaces for the attachment of other materials and to chip out and repack surfaces at all attachments.

1.05 Quality Assurance

A. Qualifications of Installers

1. The applicators performing this work must have a minimum of five years experience in this type of dampproofing and be able to show that they have successfully carried out contracts of a similar nature, size and scope.

2. Provide at least one person who shall be present during execution of this portion of the work and who shall be thoroughly experienced in installation of the specified products and shall direct all work performed under this Section.

B. Manufacturer's Certification: Prior to start of installation of the work of this Section, arrange a visit to the job site by a representative of the manufacturer of the dampproofing materials used, who shall inspect and certify:

1. That the surfaces to which dampproofing is to be applied are in condition suitable to receive dampproofing.

2. That the materials to be installed comply in all respects with the requirements of this Section.

3. That the applicator has the experience to install said materials in complete accordance with the manufacturer's current recommendations.

1.06 Warranty

Furnish a written warranty, warranting materials and workmanship for a period of five years after acceptance of the work of this Section and binding the Contractor to repair and make good, at no additional cost to the Owner, all defects which appear during this period.

Part 2 Products

2.01 Acceptable Manufacturers

Cold-applied, asphalt emulsion dampproofing shall be equal to Chem Rex, Inc., Sonneborn, or W.R. Meadows.

2.02 Bituminous Dampproofing

A. General: Provide products recommended by manufacturer for designated application.

B. Cold-Applied, Asphalt Emulsion Dampproofing: Asphalt-based emulsions recommended by the manufacturer for dampproofing use when applied according to the manufacturer's instructions. Trowel grade shall be emulsified asphalt mastic, prepared with mineral-colloid emulsifying agents suitable for application in a relatively thick film, complying with ASTM D 1187, Type I.

2.03 Primer

Asphalt primer complying with ASTM D 41, for asphalt-based dampproofing.

Part 3 Execution

3.01 Installation

A. Apply all dampproofing materials in strict accordance with manufacturer's instructions and recommendations and this Section.

B. Before backfilling against dampproofing, repair all damaged surfaces.

3.02 Preparation

A. Clean substrate of projections and substances detrimental to work; comply with recommendations of prime materials manufacturer.

B. Install accessories as recommended by prime materials manufacturer even through not shown.

C. Fill voids, seal joints, and apply bond breakers, if any, as recommended by prime materials manufacturer, with particular attention at construction joints.

D. Install separate flashings and corner protection stripping, as recommended by prime materials manufacturer, where indicated to precede application of dampproofing. Comply with details shown and with manufacturer's recommendations. Pay particular attention to requirements at building expansion joints, if any.

E. Prime substrate as recommended by prime materials manufacturer.

F. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog

drains and conductors. Prevent spillage and migration onto other surfaces of work by masking or otherwise protecting adjoining work.

3.03 Installation, General

A. Comply with manufacturer's recommendations except where more stringent requirements are indicated and where Project conditions require extra precautions to ensure satisfactory performance of work.

B. Application: Apply dampproofing to the following surfaces:

1. Exterior surface of inside wythe of double-wythe, exterior masonry walls above grade, to prevent water-vapor penetration through the wall.

2. Where indicated on the drawings.

3.04 Cold-Applied, Asphalt Emulsion Dampproofing

Trowel-Grade: Trowel apply a coat of mastic asphalt emulsion dampproofing onto substrate at a minimum rate of 7 gallons per 100 square feet, to produce an average, dry-film thickness of 60 mils but not less than 30 mils at any point.

3.05 Protection and Cleaning

Remove overspray and spilled materials from surfaces not intended to receive dampproofing.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section includes furnishing all labor, materials and equipment required to furnish and install all building insulation as specified herein and/or shown on the Drawings.

1.02 Submittals

A. Complete product data shall be submitted to the Engineer.

B. Certified Test Reports: With product data, submit copies of certified test reports showing compliance with specified performance values, including R-values, fire performance and sound abatement characteristics.

1.03 Storage and Protection

Insulation shall be stored indoors in a dry location in accordance with the manufacturer's instructions.

1.04 Quality Assurance

A. All insulation shall be delivered to the site in unopened packages. Packages shall be clearly marked with the manufacturer's name, type, quantity of insulation and "R" value (where applicable).

B. Installer Qualifications for Foamed-In-Place Masonry Insulation: Engage an experienced dealer/applicator who has been trained and licensed by the product manufacturer and which has not less than three years direct experience in the installation of the product used.

Part 2 Products

2.01 Foamed-In-Place Masonry Insulation

A. Foamed-In-Place Masonry Insulation: Two component thermal insulation produced by combining a plastic resin and catalyst foaming agent surfactant which, when properly ratioed and mixed, together with compressed air produce a cold-setting foam insulation in the hollow cores of hollow unit masonry walls.

1. Fire-Resistance Ratings: Minimum four (4) hour fire resistance wall rating (ASTM E-119) for 8-inch and 12-inch concrete masonry units when used in standard two (2) hour rated CMUs.

2. Surface Burning Characteristics: Maximum flame spread, smoke developed and fuel contributed of 0, 5 and 0 respectively.

3. Combustion Characteristics: Must be noncombustible, Class A building material.

4. Thermal Values: "R" Value of 4.91/inch at 32 degrees F mean; ASTM C-177.

5. Sound Abatement: Minimum Sound Transmission Class ("STC") rating of 53 and a minimum Outdoor Indoor Transmission Class ("OITC") rating of 44 for 8-inch wall assembly (ASTM E 90-90).

2.02 Batt Insulation

Batt insulation shall be nominal 24-inch wide Kraft paper faced fiberglass Batts with a thickness as shown on the Drawings.

2.03 Vapor Barrier

Vapor barrier shall be 0.006-inch thick polyethylene film membrane in a width as wide as practical.

Part 3 Execution

3.01 Installation of Foamed-In-Place Insulation

A. General: Install foamed-in-place insulation from interior, or as specified, prior to installation of interior finish work and after all masonry and structural concrete work is in place; comply with manufacturer's instructions.

B. Installation: Fill all open cells and voids in hollow concrete masonry walls where shown on Drawings. The foam insulation shall be pressure injected through a series of 5/8-inch to 7/8-inch holes drilled into every vertical column of block cells (every 8 inches on center) beginning at an approximate height of four (4) feet from finished floor level. Repeat this procedure at an approximate height of ten (10) feet above the first horizontal row of holes (or as needed) until the void is completely filled. Patch holes with mortar and score to resemble existing surface.

3.02 Installation of Vapor Barrier

Install vapor barrier directly over fill and perimeter insulation. Where joints in membrane occur, lap a minimum of 18-inches. Exercise care not to puncture the membrane. Where punctures occur, patch so as to maintain a continuous membrane. Install concrete slab floor directly over the vapor barrier.

3.03 Cleaning

Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section consists of furnishing all labor, equipment and material required to install all sheet metal work, including metal flashing and counterflashing, flashing transitions, wall flashing, gutters, downspouts, scuppers, copings, and related work as described herein and/or shown on the Drawings.

1.02 Submittals

A. Submittals shall be made to the owner for approval via P.C. Simonton & Associates, Inc.

B. Submit written information regarding material proposed and installation instructions for the use substantiating compliance with Specification requirements. Submit two samples, 8-inches long, of each type of flashing or sheet metal fabrication and each accessory specified.

C. Samples for Verification of each type of exposed finish indicated in manufacturer's standard sizes. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

D. Submit shop drawings, showing manner of forming, jointing and securing flashings, guttering and accessories. Detail waterproof connections to adjoining work and at obstructions and penetrations. Shop drawings shall indicate thickness and dimensions of all parts, fastening and anchoring methods, details and locations of all seams, joints and other provisions necessary for thermal expansion and contraction.

1.03 Storage and Protection

A. Sheet metal materials and accessories shall be stored and protected in accordance with the requirements of these Specifications.

B. The Contractor shall protect all stainless steel materials from exposure to chlorides and muriatic acids. Wash affected areas immediately with five percent soda solution and rinse with clear water.

C. Sheet metal work shall be handled with sufficient care to prevent damage to surfaces, edges and ends. All material at site shall be stored above ground in a covered, dry location. Damaged material that cannot be restored to its original condition will be rejected and shall be replaced at no additional cost to the Owner.

1.04 Quality Assurance

The manufacturer shall provide written certification to the Engineer that all products furnished comply with all applicable requirements of these Specifications.

1.05 Warranty

A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied finish within the specified warranty period and agreeing to repair finish or replace components that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

C. Finish Warranty Period: 20 years from date of Substantial Completion.

Part 2 Products

2.01 Metals

A. Aluminum Extrusions: ASTM B 221, 6063-T5 alloy and temper, or as recommended by the manufacturer for use intended and as required for proper application of finish indicated.

B. Aluminum Sheet: ASTM B 209, alloy and temper as recommended by the aluminum producer and finisher for use intended and finish indicated, with not less than the strength and durability of alloy and temper designated below.

1. Alloy 3003-H14, with a minimum thickness of 0.040-inch, unless otherwise indicated, for aluminum sheet with mill finish.

2. Alloy 5005-H14, with a minimum thickness of 0.050-inch for aluminum sheet with other than mill finish.

C. Galvanized Steel Sheet: ASTM A 653, G90 coating designation; commercial quality; at least 0.034-inch thick, unless otherwise indicated.

D. Stainless Steel Sheet: ASTM A 666, Type 304, soft annealed, with No. 2D finish, unless harder temper is required for forming or performance; at least 0.0187-inch thick, unless otherwise indicated.

2.02 Gutter and Downspouts

A. Provide gutters and downspouts in shapes and sizes indicated, with mitered and welded corners. Install steel straps formed from at least 0.028-inch thick, galvanized steel sheet; hangers, or other attachment devices; screens; end plates; and trim and other accessories indicated or required for a complete installation.

B. Provide gutters and downspout components fabricated from formed aluminum sheet in thickness indicated, but not less than the following:

1. Gutter Thickness: 0.050-inch.

2. Downspout Thickness: 0.025-inch.

2.03 Copings

Provide copings in shapes and sizes indicated, with shop-fabricated corners. Coping shall be Petersen Aluminum TITE-LOC Coping System UL-I90, fabricated from formed aluminum sheet, not less than 0.050-inch thick. Color as indicated on Drawings.

2.04 Parapet Scupper and Conductor Heads

Provide parapet scuppers and conductor heads as indicated on Drawings. Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch wide wall flanges to interior and base extending 4-inches beyond cant or tapered strip into field of roof. Fabricate conductor heads with flanged back, stiffened top edge, and built-in overflows. Fabricate conductor heads and scuppers from 0.0320 aluminum. Finish to match metal coping.

2.05 Accessories

A. General: Provide manufacturer's standard accessories designed and manufactured to match and fit roof edge treatment system indicated.

B. Exposed Fasteners: Stainless steel, non-magnetic, of manufacturer's standard type and size for product and application indicated. Match finish of exposed heads with material being fastened.

C. Concealed Fasteners: Same metal as item fast or other non-corrosive metal as recommended by the manufacturer.

D. Galvanizing Repair Paint: High-zinc-dust content paint for regalvanizing weld in steel, complying with SSPC-Paint 20.

E. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15 mil dry film thickness per coat.

F. Mastic Sealant: Polyisobutylene; non-hardening, non-skinning, non-drying, non-immigrating sealant.

G. Foam-Rubber Seal: Manufacturer's standard foam.

H. Adhesives: Type recommended by the manufacturer for substrate and Project conditions, and formulated to withstand a minimum of 60 pounds per square foot wind up-lift force.

I. Splash Blocks: Splash blocks shall be reinforced precast concrete, 3,000 psi, 30 x 16 x 4-inches thick.

J. Bituminous Plastic Cement: Where bituminous plastic cement is specified or shown on the Drawings, use cement conforming to Federal Specification SS-C-153, Type I.

K. Solder: Solder shall be ASTM B 32, Alloy grade 58, composed of 50 percent tin and 50 percent lead.

L. Flux: Flux used on stainless steel shall be a phosphoric acid base flux equal to "MicroFlex Soldering Flux" by Washington Steel Corporation or Type "MA" by Lake Chemical Co.

2.06 Finishes - General

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective coating before shipment.

C. Finish manufactured roof specialties after fabrication and assembly if products are not fabricated from pre-finished metals.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

2.07 Aluminum Finishes

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

2.08 Metal Finishes

A. General: Apply coating either before or after forming and fabricating flashing and sheet metal as required by coating process and as required for maximum coating performance capability. Protect coating promptly after application and cure by application of strippable film or removable adhesive cover, and retain until installation has been completed.

B. Fluoropolymer Coating: Full-strength, 70 percent “Kynar 500” coating baked-on for 15 minutes at 450 degrees F in a dry film thickness of 1.0 mil, 30 percent reflective gloss (ASTM D 523), over minimum 0.2 mil baked-on modified epoxy primer.

C. Durability: Provide coating which has been field tested under normal range of weathering conditions for a minimum of 20 years without significant peel, blister, flake, ship, crack, or check in finish, and without chalking in excess of 8 (ASTM D 659), and without fading in excess of 5 NBS units.

D. Color: As selected from manufacturer’s standard colors, and as indicated on the Drawings.

Part 3 Execution

3.01 Inspection

A. Verify that substrates are smooth and clean to extent needed for sheet metal work.

B. Verify that reglets, nails, cants and blocking to receive sheet metal are installed and free of concrete and soil.

C. Do not start sheet metal work until conditions are satisfactory.

3.02 Preparation

A. Before installing sheet metal, verify shapes and dimensions of surface to be covered.

B. Promptly remove protective film, if any, from exposed surfaces of finished metals. Strip with care to avoid damage to finish.

C. Prepare concrete, concrete masonry block, cement plaster, and similar surfaces to receive roof edge system specified. Install blocking, cleats, water dams, and other anchoring and attachment accessories and devices required.

3.03 Installation

A. General

1. Install all flashing and sheet metal work in accordance with the "Architectural

Sheet Metal Manual" by SMACNA.

2. Install work watertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction.

3. Hem exposed edges except edges forming drip lips.

B. Seams

1. Common Lock Seams: 5/8-inch finished width; four-ply loose lock.

2. Flat Lock Seams: 3/4-inch finished width; four-ply flat lock, malleted tight; sweated full with solder.

3. Drive Lock Seams: Fold back abutting edges; cover joint with 1/8-inch wide loose drive cap.

4. Single Corner Seams: 5/8-inch finished width; three-ply loose lock; corners lapped and soldered.

5. Double Corner Seams: 5/8-inch finished width; four-ply double lock

6. Lap Seams: 7/8-inch finished width.

7. Soldered Lap Seams: 1-inch finished width; sweated full with solder.

C. Gutters

1. Install inside straps at 30-inches on center, riveted to rear of gutter and locked into beaded front edge.

2. Support lower edge of gutter with heavy duty support brackets at 30-inches on center. Alternate with inside straps.

D. Downspouts

1. Hangers shall conform with SMACNA, minimum 0.028 x 1-inch flat stock galvanized steel.

2. Downspout shall be securely fastened to the wall with aluminum bands located not more than five feet apart. Anchorage shall be made with 1/4-inch stainless steel machine bolts into noncorrosion anchors.

E. Conductor Heads and Scuppers: Conform design and installation with SMACNA.

F. Soldering

1. Other Materials: Clean and flux metals prior to soldering. Sweat solder completely through seam width.

3.04 Painting

All exposed galvanized items shall be factory-painted in accordance with the requirements of Section 09900 of these Specifications. After installation, the galvanized items shall be touched up with identical paint supplied from the factory.

3.05 Inspection

Damaged work shall be repaired or replaced. The Contractor shall make, at Contractor's own expense, all necessary changes, modifications and/or alterations required to ensue a satisfactory installation.

3.06 Cleaning

A. As work progresses, neutralize excess flux with 5 to 10 percent washing soda solution, and thoroughly rinse.

B. Prior to acceptance of the work of this Section, clean all installed materials and affected work areas in accordance with the requirements of Section 01710 of these Specifications.

END OF SECTION

Part 1 GENERAL

1.01 SECTION INCLUDES

A. Preformed, prefinished metal roofing and flashings.
B. Miscellaneous trim, flashing, closures, drip flashing, and accessories.
C. Sealant.
D. Fastening devices.

1.02 RELATED SECTIONS

A. Section 05120: Structural Steel Framing.
B. Section 05500: Miscellaneous Metal Fabrication.
C. Section 06100: Rough Carpentry.
D. Section 07631: Flashing and Sheet Metal Gutters.
E. Section 07900: Sealants.

1.03 REFERENCES

A. American Iron & Steel Institute (AISI) Specification for the Design of Cold formed Steel Structural Members.
B. ASTM A-653-09 Steel Sheet, Zinc-Coated (Galvanized)
C. ASTM 792-86 AZ-50 Aluminum Zinc Alloy Coated Steel (Galvalume Sheet Metal
D. ASTM E-1680
E. ASTM E-1646
F. ASTM E-1592
G. Spec Data Sheet - Aluminum Zinc Alloy Coated Steel (Galvalume) Sheet Metal by Bethlehem Corp.
H. SMACNA - Architectural Sheet Metal Manual.
I. Building Materials Directory - Underwriter’s Laboratories, Test Procedure 580 - UL-90.

1.04 ASSEMBLY DESCRIPTION

A. The roofing assembly includes preformed sheet metal panels, related accessories, valleys, hips, ridges, eaves, corners, rakes, miscellaneous flashing and attaching devices.

1.05 SUBMITTALS

A. Submit detailed shop drawings showing layout of panels, anchoring details, joint details, trim, flashing, and accessories. Show details of weatherproofing, terminations, and penetrations of metal work at 0’-3”= 1’-0” scale.
B. Submit a sample of each type of roof panel, complete with factory finish.
C. Submit results indicating compliance with minimum requirements of the following performance tests:

1. Air Infiltration - ASTM E 1680
2. Water Infiltration - ASTM E 1646
3. Wind Uplift - UL 90

D. Submit calculations with registered engineer seal, verifying roof panel and attachment method resist wind pressures imposed on it pursuant to applicable building codes.

1.06 QUALITY ASSURANCE

A. Manufacturer: Company specializing in Architectural Sheet Metal Products with ten (10) years minimum experience.
B. No product substitutions shall be permitted without meeting specifications.
C. Substitutions shall be submitted 10 days prior to bid date and acceptance put forth in an addendum.
D. No substitutions shall be made after the bid date.

1.07 DELIVERY, STORAGE AND HANDLING

A. Upon receipt of panels and other materials, installer shall examine the shipment for damage and completeness.
B. Panels should be stored in a clean, dry place. One end should be elevated allowing moisture to run off.
C. Panels with strippable film must not be stored in the open, exposed to the sun.
D. Stack all materials to prevent damage and to allow adequate ventilation.

1.08 WARRANTY

A. Paint finish shall have a twenty-year warranty against cracking, peeling and fading (not to exceed 5 N.B.S. units).
B. Galvalume material shall have a twenty-year warranty against failure due to corrosion, rupture or perforation.
C. Roofing Installer shall furnish guarantee covering watertightness of the roofing system for the period of two (2) years from the date of substantial completion.
D. When required, Roofing Installer to furnish, Manufacturer’s standard watertightness warranty; Roofing Installer to comply with Manufacturer’s watertightness warranty program and submit to manufacture all required documents. Watertightness warranty program to include roofing installation inspections which Roofing Installer shall participate.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Berridge Manufacturing Company, San Antonio, Texas.
B. Substitutions shall fully comply with specified requirements.

2.02 SHEET MATERIALS

A. Prefinished metal shall be Aluminum-Zinc Alloy Coated (AZ-50 Galvalume®) Steel Sheet, 24-Gauge or 22-Gauge*, ASTM 792-08, Grade 40, yield strength 40 ksi min.

B. Finish shall be full strength Kynar 500® or Hylar 5000™ fluoropolymer coating applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.75 ± 0.05 mil over 0.20 ± 0.05 mil prime coat, to provide a total top side dry film thickness of 0.95 ± 0.10 mil. Bottom side shall be coated with a primer (non-metallics only) and beige urethane coating with a total dry film thickness of 0.35 ± 0.05 mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500® or Hylar 5000™ finish supplier.

C. Strippable film shall be applied to the top side of all prefinished metal to protect the finish during fabrication, shipping and field handling. This strippable film MUST be removed immediately before installation.

D. Unpainted metal shall be Aluminum-Zinc Alloy Coated (AZ-55 Acrylic Coated Galvalume®) Steel Sheet, 24-Gauge or 22-Gauge*, ASTM 792-08, Grade 40, yield strength 40 ksi min., with clear acrylic coating on both sides of material.

E. Field protection must be provided by the contractor at the job site so stacked or coiled material is not exposed to weather and moisture.

F. Flashing maybe factory fabricated or field fabricated. Unless otherwise specified all exposed adjacent flashing shall be of the same material and finish as panel system.

2.03 ACCESSORY MATERIALS

A. Fasteners: [Galvanized Steel] or [Stainless Steel] with washers at exposed fasteners where approved by architect.

B. Sealant: Sealant shall be an ultra low modulus, high performance, one-part, moisture curing silicone joint sealant. [Tremco Spectrum One] or [Dow 790] or [Pecora 890NST] or [Duralink] or [Titebond Metal Roof Sealant] (Do not use a clear sealant or sealants which release a solvent or acid during curing).

C. Sealant must be resistant to environmental conditions such as wind loading, wind driven rain, snow, sleet, acid rain, ozone, ultraviolet light and extreme temperature variations.

D. Features must include joint movement capabilities of +100% & -50% ASTM C-719, capable of taking expansion, compression, transverse and longitudinal movement, service temperature range -65ºF to 300ºF (-54ºC to 149ºC), Flow, sag or slump: ASTM C-639; Nil, Hardness (Shore A): ASTM C-661; 15, Tensile strength at maximum elongation: ASTM D-412; 200 psi, Tensile strength at 100% elongation: ASTM D-412; 35 psi, Tear strength, (die “C”); ASTM D-624; 40 pli, Peel strength (Aluminum, Glass, Concrete): ASTM C-794; 30 pli

E. Vinyl Weatherseal Insert.

2.04 FABRICATION

A. All exposed adjacent flashing shall be of the same material and finish as the roof panels.
B. Hem all exposed edges of flashing on underside, ½ inch.

2.05 BERRIDGE ZEE-LOCK STANDING SEAM PANEL

1. 2” high vertical legs shall be spaced at 16” on-center and shall have no exposed fasteners.
2. Panels shall be [site-formed with the Berridge Model SP-21-X Portable Roll Former in continuous lengths from ridge to eave] or [factory-formed to 40’ max].
3. [Continuous Zee Rib shall be 1 3/8“ wide and 2 1/8” in height. Rib shall be connected to purlin with two #12-14 x 1” self-drilling/tapping fasteners] or [Zee Clips spaced at 3’-0”].
4. Optional Vinyl Weatherseal (U.S. Patent 5134825) shall be factory-installed over Continuous Zee Rib.
5. Sidelap shall be mechanically seamed with a powered seamer.
6. When required, panel assembly to bear Underwriters Laboratories Label UL90, pursuant to [Construction No. 312 for open framing conditions, either uninsulated or with blanket insulation] or [Const. No. 335 or 335 (mod.) with rigid board insulation] or [Const. No. 403 over solid substrate] and applicable Fire Ratings.
7. Certification shall be submitted, based on independent testing laboratory, indicating no measurable water penetration or air leakage through the system when tested in accordance with ASTM E-1680 and E-1646.

PART 3 EXECUTION

3.01 INSPECTION

A. Substrate

1. Examine plywood or metal deck to ensure proper attachment to framing.
2. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves or projections, level to ¼” in 20’ and properly sloped to [valleys] (or) [eaves].
3. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.
4. Verify deck is dry and free of snow or ice. [Flutes in steel deck to be clean and dry] or [joints in wood deck to be solidly supported and nailed].

B. Underlayment:

1. Verify [#30 unperforated asphalt saturated roofing felt underlayment has been installed over solid plywood or OSB sheathing and fastened in place] or [ice & water shield membrane on metal deck].

2. One (1) layer of #30 asphalt roofing felt paper for roof slopes of 3:12 and up, two (2) layers for roof slopes of 1:12 - 3:12 in moderate climates (check with Berridge).
3. Ice & Water Shield underlayment to be used on all curved applications and on low (less than 1:12) slope or complex roofs per Berridge recommendation.
4. Underlayment materials approved by Berridge for a watertightness warranty include - Grace Ice & Water Shield (40 mil), Grace Ultra (30 mil), Tamko TW Underlayment (40 mil), Tamko TW Metal & Tile (75 mil), Carlisle WIP 300 HT (40 mil), Soprema Lastobond Shield HT (40 mil), Polyglass Polystick MTS (60 mil), and Mid-States Asphalt Quik-Stick HT Pro (60 mil) *PLEASE NOTE, NO OTHER MID-STATES ASPHALT PRODUCTS WITH SIMILAR NAMES OR OTHERWISE ARE APPROVED FOR THE BERRIDGE WATERTIGHTNESS WARRANTY PROGRAM
5. Ensure felt installed horizontally, starting at eave to ridge with a 6” minimum overlap and 18” endlaps.
6. Ensure that all nail heads and felt caps are totally flush with the substrate. Fasteners shall be galvanized roofing nails or zinc-coated fasteners with Berridge Coated Felt Caps.

3.02 INSTALLATION

A. Comply with manufacturers standard instructions and conform to standards set forth in the Architectural Sheet Metal Manual published by SMACNA, in order to achieve a watertight installation.
B. Install panels in such a manner that horizontal lines are true and level and vertical lines are plumb.
C. Install starter and edge trim before installing roof panels.
D. Remove protective strippable film prior to installation of roof panels.
E. Attach panels using manufacturer’s standard clips and fasteners, spaced in accordance with approved shop drawings.
F. Install sealants for preformed roofing panels as approved on shop drawings.
G. Do not allow panels or trim to come into contact with dissimilar materials.
H. Do not allow traffic on completed roof. If required, provide cushioned walk boards.
I. Protect installed roof panels and trim from damage caused by adjacent construction until completion of installation.
J. Remove and replace any panels or components which are damaged beyond successful repair.

3.03 CLEANING

A. Clean any grease, finger marks or stains from the panels per manufacturer’s recommendations.
B. Remove all scrap and construction debris from the site.

3.04 FINAL INSPECTION

A. Final inspection will be performed by a firm appointed and paid for by the owner in accordance with section 01410.

END OF SECTION

Part 1 General

1.01 Scope

The work covered by this Section consists of furnishing all labor, equipment and material required to apply all sealants and related work as described herein and/or shown on the Drawings.

1.02 Submittals

Complete engineering and product data shall be submitted to P.C. Simonton & Associates, Inc. in accordance with the requirements of these Specifications. Color samples shall be submitted for approval by the Owner.

1.03 Storage and Delivery

A. Materials shall be stored in strict conformance with the manufacturer's instructions and in accordance with the requirements of these Specifications.

B. Materials shall be delivered to the job site in sealed containers, with the manufacturer's original labels attached and accompanied by written certification indicating compliance with the requirements of these Specifications.

1.04 Quality Assurance

The manufacturer shall provide P.C. Simonton & Associates, Inc. with written certification that all products furnished comply with all applicable requirements of these Specifications.

1.05 Warranty

A. Provide a warranty against defective materials and workmanship in accordance with the requirements of these Specifications.

B. The following types of failures will be considered defective work requiring replacement: leakage, hardening, cracking, crumbling, melting, shrinking or running of caulking compound or staining of adjacent work by caulking compound.

Part 2 Products

2.01 Silicone Sealant

A. Acceptable Products: Dow Corning Corporation (#790), or General Electric Company (Silpruf).

B. Type: One part low modulus silicone rubber.

C. Colors: To be selected from manufacturer's standard.

2.02 One-Part, Non-Sag Polyurethane Sealant

A. Acceptable Products: Mameco International, Vulken (#116), Sonneborn Building Products, Sonolastic (NP-1), or Tremco, Inc. (Dymeric).

B. Colors: To be selected from manufacturer's standard.

2.03 Two-Part, Pourable Polyurethane Sealant

A. Acceptable Products: A.C. Horn, Inc. (Daraseal-U), Memeco International, Vulkem (#245), Tremco, Inc. (THC-900), or W.R. Meadows, Inc. (Pourthane).

B. Colors: To be selected from manufacturer's standard.

2.04 Acrylic Sealant

A. Acceptable Products: A.C. Horn, Inc. (Daraseal A.R.), DAP, Inc. (DAP Acrylic), Protective Treatments, Inc. (#737), Tremco, Inc. (Mono), or W.R. Meadows, Inc. (Solaply).

B. Type: One part acrylic polymer sealant.

C. Colors: To be selected from manufacturer's standard.

2.05 Joint Backing

Joint backing, where indicated or required, shall be equal to "Tremco Joint Backing" by Tremco Mfg. Company or "Ethafoam SB" backer rod by Dow Chemical Company. Application shall be in accordance with sizes listed below:

Joint Size, inches	Rod Diameter, inches
3/16	1/4
1/4	3/8
3/8	1/2
1/2	5/8
5/8	3/4
3/4	1

2.06 Colors an Durability

A. Color of sealant or caulking shall be as selected by P.C. Simonton & Associates, Inc.

B. Caulking shall have a minimum life expectancy of 20 years and shall be resistant to the effects of sunlight, abrasion, oils, mild chemicals, cleaning agents and immersion in water.

Part 3 Execution

3.01 Preparation

A. All joints or channels shall be cleaned and free of dirt, oil, grease, moisture, old paint, loose mortar and other foreign matter.

B. Metal surfaces shall be wiped with material equal to Zylol or Mek and then dried.

C. Masonry surfaces shall be cleaned with a wire brush and then blown clean. Any waterproofing treatments contaminating the joint must be completely removed.

D. Where joints are 1/2-inch wide, they should be backed to 1/2-inch of the surface. All 3/4-inch wide joints shall be backed to 1/4-inch of the surface. Size of joint backing shall be large enough so that it can be compressed by at least 30 percent before inserting into the joint.

E. Surface of concrete or masonry shall be primed in accordance with the manufacturer's printed instructions.

3.02 Caulking Schedule

A. Silicone Sealant: All exterior joints and interior expansion and control joints, except horizontal floor joints.

B. One-Part, Non-Sag Polyurethane Sealant: Interior joints, except as otherwise scheduled.

C. Two-Part, Pourable Polyurethane Sealant: Horizontal floor and pavement joints.

D. Acrylic Sealant: Interior sealant joints to be painted, except joints in drywall construction of less than 1/8-inch in width.

3.03 Application

A. The Contractor shall caulk all joints (both inside and outside of jambs, heads and sills) between the metal doors, windows, louvers, etc. and masonry throughout the buildings, as indicated on the Drawings, or otherwise required, so as to leave the building weathertight.

B. Apply sealant with hand or air gun under sufficient pressure and through nozzle openings of such a diameter so that a full bead of sealant is run into the joint and fills the opening completely.

C. Apply joint backer with a blunt rounded tool in accordance with manufacturer's instructions so it will not stain the sealant.

D. All beads should be tooled immediately after application to insure firm and full contact with the interface of the joint.

E. Work shall be of highest quality and in accordance with the manufacturer's current printed instructions.

3.04 Cleaning

Remove all excess material and smears adjacent to joint as work progresses.

END OF SECTION

SECTION 08800
GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Interior borrowed lites.

B. Related Sections include the following:

1. Division 8 Section “Mirrored Glass”.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer’s written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer’s written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer’s written instruction. Defects include edge separation, delamination

materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFOMANC E REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.

1) Basic Wind Speed: 110, as indicated on structural drawings.>
2) Importance Factor:
3) Exposure Category: B, as indicated on structural drawings.

b. Specified Design Snow Loads: As indicate, but not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0," Snow Loads."

c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.

1) Load Duration: 60 seconds or less.

d. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.

e. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

f. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified base on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:

a. U-Factors: NFRC 100 expressed Btu/sq.ft. x h x deg F.
b. Solar Heat Gain Coefficient: NFRC 200.
c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 12-inch square Samples for glass.

1. Wired glass.
2. Insulating glass for each designation indicated.

C. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass and insulating glass.

C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

D. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and , for wired glass, ANSIZ97.1.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where

Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.9 WARRANTY

A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In order Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality –Q3; of class indicated.

1. Ultra-Clear (Low-Iron) Float Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.

a. Available Products:

1. AFG Industries Inc.; Krystal Klear.
2. Pilkington Building Products North America; Optiwhite.
3. PPG Industries, Inc.; Starphire

B. Wired Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Quality-Q-6; and of form and mesh pattern specified.

C. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.

1. Provide Kind FT (fully tempered) glass lites where safety glass in indicated.
2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measure perpendicularly from outer surfaces of glass lites at unit's edge.
3. Sealing System: Dual seal, with primary and secondary sealants as follows:

a. Manufacturer's standard sealants

4. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.3 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastmeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.4 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind Smooth and polish exposed glass edges and corners.

2.5 MONOLITHIC FLOAT-GLASS UNITS

A. Uncoated Clear Float-Glass Units MG-: Class 1 (clear) annealed or Kind HS (heat-strengthened) float glass where heat strengthening is required to resist thermal stresses induced by differential shading of individual glass lites and to comply with system performance requirements.

1. Thickness: 6.0 mm.

2.6 MONOLITHIC WIRED-GLASS UNITS

A. Polished Wired-Glass Units WG-: Form 1 (wired glass, polished both sides), Quality-Q6, Mesh 1 (M1) (Diamond), 6.0 mm thick.

2.7 INSULATING-GLASS UNITS

A. Passive Solar Low-E Insulating –Glass Units IG-:

1. Basis-of-Design Product: Visteon Versalux Bronze or a comparable product:
2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6.0 mm.
3. Interspace Content: Air.
4. Outdoor Lite: Class 2 (tinted) float glass complying with ceramic-coated vision-glass requirements:

    a. Tint Color: “Versalux Bronze” by Visteon.
    b. Annealed.

5. Indoor Lite: Class 1 (clear) float glass.

    a. Annealed.

6. Low-E Coating or Film: Pyrolytic or sputtered on second or third surface or low-e-coated film suspended in the interspace.
7. Visible Light Transmittance: 47 percent minimum.

8. Winter Nighttime U-Factor: 0.48 maximum.
9. Summer Daytime U-Factor: 0.57 maximum.
10. Solar Heat Gain Coefficient: 0.49 maximum.
11. Outdoor Visible Reflectance: 8 percent maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, and determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets

and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to product a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writng by glass manufacturer.

END OF SECTION 08800

SECTION 09900
PAINTING AND FINISHING

PART 1 - GENERAL

1.01 SCOPE

A. The work required under this section consists of all painting and related items necessary to complete the work indicated on the drawings and described in these specifications.

B. In general items to be painted include:

1. Exposed piping and valves.

2. Exposed metal surfaces.

3. Interior concrete surfaces of valve pits.

4. Interior concrete surface of precast wetwell, influent structure and manholes.

C. Work not included:

1. Do not include painting, which is specified under other Sections.

2. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require painting under this section except as may be specified herein.

3. Do not paint any moving parts of operating units; mechanical or electrical parts such as valve operators, linkages, sensing devices and motor shafts unless otherwise indicated.

4. Do not paint over any required labels or equipment identification, performance rating, name or nomenclature plates.

D. Definitions: The term "paint", as used herein means all coating systems materials including primers, emulsions, epoxy, enamels, sealers, fillers and other applied materials whether used as prime, intermediate or finish coats.

E. All piping shall be coated with colors to meet “Recommended Standards for Wastewater facilities (The “Ten States Standards”).

1.02 QUALITY ASSURANCE:

A. Qualification of Manufacturer: Products used in the work of the Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production.

B. Qualifications of Workmen:

1. Provide at least one person, who shall be present at all times during execution of the work of this section, who shall be thoroughly familiar with the specified requirements and the materials and methods needed for their execution and who shall direct all work performed under this Section.

2. Provide adequate numbers of workmen skilled in the necessary crafts and properly informed of the methods and materials to be used.

3. In acceptance of rejection of the work of the Section, no allowance will be made for lack of skill on the part of workmen.

C. Paint Coordination:

1. Provide finish coats, which are compatible with the prime coat used.

2. Review other sections of these specifications as required, verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrata.

3. Upon request, furnish information on the characteristics of the specific finish materials to ensure that compatible prime coats are used.

4. Provide barrier coats over incompatible primers, or remove the primer and reprime as required.

1.03 PRODUCT HANDLING

A. Delivery of materials: Deliver all materials to the job site in original, new and unopened containers bearing the manufacturer's name and label showing at least the following information:

1. Name or title of the material.

2. Fed, Spec. number if applicable.

3. Manufacturer's stock number.

4. Manufacturer's name.

5. Contents by volume for major constituents.

6. Thinning instructions.

7. Application instructions.

B. Storage of Material: Provide proper storage to prevent damage to and deterioration of, paint materials.

C. Protection: Use all means necessary to protect the materials of this section before, during and after installation and to protect the work and materials of all other trades.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

1.04 JOB CONDITIONS

A. Surface Temperatures: Do not apply solvent-thinned paints when the temperature of the surfaces to be painted and the surrounding air temperature are below 45°F, unless otherwise permitted by the manufacturer's printed instructions.

B. Weather Conditions: Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85% or to damp or wet surfaces; unless otherwise permitted by the manufacturer's printed instructions. Applications may be continued during inclement weather within the temperature limits specified by the paint manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.01 PAINT MATERIALS

A. PIPING, VALVES AND MISCELLANEOUS METALS

1. Design is based on use of paint products manufactured by Pittsburgh Paints (PPG), and the materials of that manufacturer are named in the Painting Schedule. Equal products of Prat Lambert or Sherwin-Williams or Benjamin Moore may be substituted.

2. General: Provide the best quality grade of the various types of coatings as regularly manufactured by paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard best grade project will not be acceptable.

3. Durability: Provide paints of durable and washable quality. Do not use paint materials which will not withstand normal washing as required to remove pencil marks, ink, ordinary soil and similar material without showing discoloration, loss of gloss, staining or other damage.

4. Colors and Glosses: The Owner will select colors to be used in the various types of paint specified and will be the sole judge of acceptability of the various glosses obtained from the materials proposed to be used in the work.

5. Undercoats and Thinners: Provide undercoat paint produced by the same manufacturer as the finish coat. Use only thinners recommended by the paint manufacturer and use only to the recommended limits. Insofar as practicable, use undercoat, finish coat and thinner material as parts of a unified system of paint finish.

6. Standards: Provide paint materials, which meet or exceed the standards, listed for each application in the painting schedule in Part 3 of this section.

B. INTERIOR CONCRETE SURFACES

1. The interior concrete surfaces of the valve pits shall be coated with two coats of bituminous coating.

2. The coating shall be manufactured by Tnemec as stated in the paint schedule.

C. INTERIOR CONCRETE SURFACES EXPOSED TO RAW SEWAGE

1. Spectra Shield Structural Liner System shall be applied, in accordance with the manufacturer's recommendations, to the extremely corrosive environments such as the pumping station wetwell, influent structure, and manholes. This shall be a three layer system.

D. SUBMERGED OR EXPOSTED METAL COATING SYSTEM

1. Design is based on use of paint products manufactured by Devoe Bar-Rust 233H, Tnemec N140 or 100, Sherwin-Williams Tank Clad HS B62-80, PPG AQUAPON® LT NSF Low Temperature Epoxy Coating 95-172.

2. Coating System: Apply the manufacturer's recommended number of coats to attain the specified minimum coating thickness.

3. Surface preparation shall conform with the SSPC specifications Near-White Blast Cleaning.

E. All surfaces in the process will be coated as follows. The system identified as based on "Induron" protective coating system. Similar systems manufactured by Tnemic or other manufacturers with a long history in the wastewater industry may be utilized at the discretion of the engineer.

Wastewater:

Submerged Steel:	Surface Preparation=SSPCSPIO Ceramic Epoxy Ceramasafe 90 15 to 40 mils
Submerged Concrete:	Surface Preparation=Tech Data Sheet Ceramic Epoxy Ceramasafe 90 15 to 40 mils
Non-Submerged Steel:	Surface Preparation=SSPCSP10 Epoxy/Urethane PE-70 or RC-70 Induraguard 3 to 5mils
Non-Submerged Concrete:	Surface Preparation=Tech Data Sheet Acrylic AC403 Elastomeric 6 to 12 mils

2.02 APPLICATION EQUIPMENT

A. General: For application of the approved paint, use only such equipment as is recommended for application of the particular paint by the manufacturer of the particular paint and as specified in Part 3.

B. Compatibility: Prior to actual use of application equipment use all means necessary to verify that the proposed equipment is actually compatible with the material to be applied and that the integrity of the finish will not be jeopardized by use of the proposed application equipment.

2.03 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation of the work of this section, shall be new, first quality of their respective kinds and as selected by the Contractor subject to the approval of the Owner.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection: The painter shall inspect all new surfaces prepared by other trades and verify that such surfaces are satisfactory.

B. Concrete structures to receive coatings shall be drained, dried and cleaned to the manufacturers specifications prior to application. The contractor shall submit manufacturers surface requirements with the shop drawings.

C. Do not proceed until unsatisfactory areas have been corrected.

3.02 MATERIALS PREPARATION

A. General:

1. Mix and prepare painting materials in strict accordance with the manufacturer's directions.

2. Store materials not in actual use in tightly covered containers.

3. Maintain containers used in storage, mixing, and application of paint in a clean condition, free from foreign materials and residue.

B. Stirring: Stir all materials before application to produce a mixture of uniform density and as required during the application of materials. Do not stir unto the material any film, which may form on the surface. Remove the film and if necessary strain the material before using.

3.03 SURFACE PREPARATION

A. General:

1. Perform all preparation and cleaning procedures in strict accordance with the paint manufacturer's recommendations.

2. Remove all removable items which are in place and are not scheduled to receive paint finish or provide surface-applied protection prior to surface preparation and painting operations.

3. Following completion of painting in each space or area, reinstall the removed items by using workmen skilled in the necessary trades.

4. Clean each surface to be painted prior to applying paint or surface treatment.

5. Remove oil and grease with clean cloths and cleaning solvents of low toxicity and a flash point in excess of 38°C (100°F) prior to start of mechanical cleaning.

6. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall onto wet, newly painted surfaces.

B. Preparation of Wood Surfaces:

1. Clean all wood surfaces until they are free from dirt, oil and all other foreign substances.

2. Smooth all finished wood surfaces exposed to view, using the proper sandpaper. Where so required, use varying degrees of coarseness in sandpaper to produce a uniformly smooth and unmarred wood surface.

3. Apply putty to all nail holes and open joints. Bring up to a smooth surface and sand.

4. Fill open grain woods with paste wood filler.

5. Touch up knots and resinous spots with shellac before applying primer coat of paint.

C. Preparation of Metal Surfaces:

1. Thoroughly clean all surfaces until they are completely free from dirt, oil and grease.

2. On galvanized surfaces, use solvent for the initial cleaning and then treat the surface thoroughly with phosphoric acid etch. Remove all etching solution before proceeding.

3. Allow to dry thoroughly before application of paint.

D. Preparation of Concrete Surfaces:

1. Thoroughly clean the surface until they are completely free of all grease, oil, dirt, oxidation or other contamination.

2. The surface should dry to a point acceptable to the manufacturer for application of the coating. Testing for moisture content shall be by a manufacturer and Engineer approved method.

3. If blasting is necessary, the Contractor shall use brush off blasting that will remove foreign substance but will take care to expose as little aggregate as possible. Blasting should be performed sufficiently close to the surface to open up surface voids, air pockets and other subsurface irregularities. Dry, oil free air should be used for blasting.

4. After cleaning the surfaces shall be brushed and ground to remove irregular surfaces that might not accept a thorough coating.

5. If acid etching is recommended for cleaning by the manufacturer's representative, strict adherence to an approved procedure will be required.

3.04 PAINT APPLICATION

A. General

1. Apply coats of materials in strict accordance with manufacturer's recommendations unless otherwise specified.

2. Sand and dust between enamel coats to remove all defects visible to the unaided eye from a distance of five feet.

3. On all removable panels and all hinged panels, paint the back sides to match the exposed sides.

B. Drying: Allow sufficient drying time between coats. Modify the period as recommended by the material manufacturer to suit adverse weather conditions.

C. Brush and roller Application: Brush out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness and other surface imperfections will not be acceptable.

D. Spray Application:

1. Confine spray application to metal framework and similar surfaces where hand brushwork would be inferior.

2. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of two coats in one pass.

E. Completed work shall match the approved samples for color, texture and coverage. Remove, refinish or repaint all work not in compliance with specified requirements.

3.05 PAINT SCHEDULE

A. Galvanized Metals: (Exterior)

1 coat primer - #6-209 2 coats enamel - #6-277

B. Galvanized Metals and Ferrous Metals: (Interior)

1 coat primer - #6-209 2 coats enamel - #6-90

C. Ferrous Metals: (Exterior)

1 coat primer - #6-203 2 coats enamel - #6-252

D. Factory Primed Metals:

Touch up primer 2 coats enamel - #6-252

E. Wood (Painted)

1 coat primer - #6-6 (Interior) #6-9 (Exterior)
2 coats enamel - #6-90

SECTION 09906
CAST IN PLACE TACTILE / DETECTABLE WARNING SURFACE TILES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section includes Specifications for furnishing and installing permanently embedded Cast In Place Tactile / Detectable Warning Surface Tiles (CIP) with an in-line truncated dome pattern embedded in all curb ramps at the locations and to the dimensions shown on the Drawings, in accordance with the Contract Documents and as directed by the Engineer.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 1 Specifications, apply to this Section.

B. Americans with Disabilities Act (ADA) Title 49 CFR Transportation, Part 37.9 Standards for Accessible Transportation Facilities, Appendix A, Section 4.29.2 Detectable Warnings on Walking Surfaces. FHA Memo (5-06-02) titled Truncated Domes. Federal Register Volume 71, No. 209, 49 CFR Part 37 (10-30-06), ADA Standards for Transportation Facilities (11-29-06, DOT): Sections 406, 705, and 810. ADA Standards for Accessible Design – 2010 (9/05/11, DOJ), ADAAG: Sections 705 and 810. Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Rights of Way (7/23/11, Access Board), PROWAG: Sections R208, R304, R305, R308, and R309.

C. American Society for Testing and Materials (ASTM) Test Methods B117, C501, C1028, D543, D570, D638, D695, D790, G151, G155, and E84.

D. American Association of State Highway and Transportation Officials (AASHTO): Test Method AASHTO-H20.

E. California Code of Regulations (CCR 2007) Title 24 Part 1 Articles 2, 3 and 4, and Part 2 Section 205 definition of “Detectable Warning”, Section 1127B.5 for “Curb Ramps”, and Section 1133B.8.5 for “Detectable Warnings at Hazardous Vehicle Areas”. California Department of Transportation Detectable Warning Surface Authorized Material List. Division of the State Architect IR 11B-3 (1/26/05) and IR 11B-4 (1/01/11). IR 11B-4 (1/01/11) removed the requirement for a “staggered” pattern and now calls for the “square grid” (in-line) pattern.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s literature describing products, installation procedures and maintenance instructions.

B. Samples for Verification Purposes: Submit two (2) Tactile Warning Surface samples minimum 8” x 8” of the kind proposed for use. Samples shall be properly labeled and shall contain the following information: Name of Project, Submitted by, Date of Submittal, Manufacturer’s Name, and Catalog Number.

C. Shop Drawings: Submit Standard Manufacturer Shop Drawings showing all pertinent characteristics of the Composite Shell Cast In Place Tactile Warning Surface Tile (CIP), including profile, sound on cane contact amplification feature and installation methods.

D. Material Test Reports: Submit current test reports from qualified, accredited independent testing laboratory in accordance with ASTM guidelines and indicating that materials proposed for use are in compliance with specification requirements and meet the properties indicated. All test reports submitted shall be representative of the Composite Shell Cast In Place Tactile Warning Surface Tile (CIP) delivered to the Project.

E. Maintenance Instructions: Submit copies of manufacturer's specified maintenance practices for each type of Tactile Warning Surface Tile and accessory.

1.04 QUALITY ASSURANCE

A. Provide Cast In Place Tactile Warning Surface Tiles (CIP) and accessories as produced by a single manufacturer with a minimum of five years experience in manufacturing Cast In Place Composite Shell Tactile Warning Surface Tiles.

B. Installer's Qualifications: Engage an experienced installer certified in writing by the Tactile Warning Surface manufacturer, who has successfully completed Tactile Warning Surface installations similar in material, design, and extent to that indicated for the Contract.

C. Cast In Place Tactile Warning Surface Tiles (CIP) must be compliant with ADAAG, PROWAG, and California Title 24 requirements. Division of the State Architect IR 11B-3 (1/26/05) and IR 11B-4 (1/01/11). IR 11B-4 (1/01/11) removed the requirement for a "staggered" pattern and now calls for the "square grid" (in-line) pattern.

D. Cast In Place Tactile Warning Surface Tiles (CIP) shall meet or exceed the following test criteria using the most current test methods:

   a. Water Absorption: Not to exceed 0.20%, when tested in accordance with ASTM-D570.

   b. Slip Resistance: 0.80 minimum combined wet/dry static coefficient of friction when tested in accordance with ASTM C1028.

   c. Compressive Strength: 25,000 psi minimum, when tested in accordance with ASTM D695.

   d. Tensile Strength: 10,000 psi minimum, when tested in accordance with ASTM D638.

   e. Flexural Strength: 25,000 psi minimum, when tested in accordance with ASTM D790.

   f. Chemical Stain Resistance: No reaction to 1% hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, and antifreeze, when tested in accordance with ASTM D543.

g. Abrasion Resistance: 300 minimum, when tested in accordance with ASTM C501.

h. Flame Spread: 25 maximum, when tested in accordance with ASTM E84.

i. Accelerated Weathering of Tactile Warning Surface when tested by ASTM-G155 or ASTM G151 shall exhibit the following result: $\Delta E<5.0$ at 2,000 hours minimum exposure.

j. AASHTO-H20 Load Bearing Test: No Damage at 16,000# loading.

k. Salt and Spray Performance of Tactile Warning Surface: No deterioration or other defects after 200 hours of exposure, when tested in accordance with ASTM-B117.

1.05 DELIVERY, STORAGE AND HANDLING

A. Cast In Place Tactile Warning Surface Tiles (CIP) shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy wrappings.

B. Storage Facility

a. Store CIP Tiles in an area that is within an acceptable temperature range (40-90 degrees).

b. Maintain Storage Facility in a clean dry condition to prevent contamination or damage to CIP Tiles.

1.06 GUARANTEE

A. CIP Tiles shall be guaranteed in writing for a period of five (5) years from date of Contract's final completion. The guarantee includes manufacturing defects, breakage, and deformation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Composition: CIP Tiles shall be manufactured using a matte finish exterior grade homogeneous (uniform color throughout thickness of product) glass and carbon reinforced polyester based Sheet Molding Compound (SMC) composite material. Truncated domes must contain fiberglass reinforcement within the truncated dome for superior structural integrity and impact resistance. A matte finish will be required on the Tactile Warning Surface for superior slip resistance performance superior to that offered by a gloss finish. Use of Tactile Warning Surface Products employing coatings or featuring layers of material with differing composition, performance, or color properties is expressly prohibited under this Section.

B. Color: Color shall be homogeneous throughout CIP Tile.

a. Federal Yellow (Y) per Federal Standard 595B Table IV, Color No. 33538.

b. Brick Red (R) per Federal Standard 595B Table IV, Color No. 20109.

c. Clay Red (CR) per Federal Standard 595B Table IV, Color No. 22144.

d. Safety Red (SR) per Federal Standard 595B, Table IV, Color No. 31350.

e. Black (B) per Federal Standard 595B Table IV, Color No. 37038.

f. Dark Gray (G) per Federal Standard 595B Table IV, Color No. 36118.

g. Safety Blue (B) per Federal Standard 595B Table IV, Color No. 15187.

h. White (W) per Federal Standard 595B Table IV, Color No 37925.

i. Seattle Yellow (SY) per Federal Standard 595B Table IV, Color No. 23594.

j. Houston Beige (Pantone #7529C).

C. Domes: Square grid pattern of raised truncated domes of 0.2”nominal height, base diameter of 0.9” and top diameter of 0.45”. The Federal Code of Regulations permits a truncated dome spacing range of 1.6”-2.4.” For superior wheelchair, walker and shopping cart mobility, the preferred truncated dome spacing shall have a center-to-center (horizontally and vertically) spacing of 2.35”, measured between the most adjacent domes on square grid.

D. Configuration: CIP Tile sizes shall be as indicated on the Contract Drawings. For superior load bearing capacity, CIP Tile shall feature internal embedment ribs at 3” (nominal) on center maximum. The field area shall consist of a non-slip textured surface with a minimum static coefficient of friction of 0.80, wet and dry. At a minimum, CIP Tile thickness shall measure 0.20” (nominal).

a. The field area shall consist of a non-slip textured surface with a minimum static coefficient of friction of 0.80, wet and dry.

E. Truncated Dome Surface of Composite CIP Tile shall be protected with factory installed plastic sheeting for cleanliness during the installation process. Basic Installation Guidelines shall be printed on the plastic sheeting in both English and Spanish for customer convenience.

F. Dimensions: Cast In Place Tactile Warning Surface Tiles shall be held within the following dimensions and tolerances:

a. Length and Width:
1.67” Dome Spacing: [24”x36”] [24”x48”] [24”x60”] [36”x48”] [36”x60”]
2.35” Dome Spacing: [24”x36”] [24”x48”] [24”x60”] [36”x48”] [36”x60”]

Specifiers Note: Edit section by selecting desired length and width. Delete non-relevant dimensions.

G. Cleaning materials used on site shall have code acceptable low VOC solvent content and low flammability.

H. The Specifications of the concrete, sealants, and related materials shall be in accordance with the Contract Documents and the guidelines set by their respective manufacturers.

2.02 MANUFACTURERS

A. Available manufacturers, subject to compliance with these Specifications include, but are not limited to, the following:

   a. ADA Solutions Inc. of Chelmsford, MA (Phone: 800-372-0519, Fax: 978-262-9125, Web Site: www.adatile.com , E: info@adatile.com), or approved equal.

   b. Requests for Approved Equal Status must be submitted and approved by the Owner during the Bid Phase of the Project.

2.03 EQUIPMENT

B. Contractor shall provide all tools, equipment and services required for satisfactory installation per manufacturer's instruction as Incidental Work. Equipment, which may be required include typical mason's tools, a 4-foot long level with electronic slope readout, 25-pound weights, vibrator and rubber mallet with 2" x 4" x 10" wood tamping plate, and a device for cutting the Tactile Warning Surface Product.

PART 3 – EXECUTION

3.01 PREPARATION

A. During all concrete pouring and CIP Tile Installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.

B. The physical characteristics of the concrete shall be consistent with the Contract Specifications while maintaining a slump range of 4 - 7 to permit solid placement of the CIP Tile. An overly wet mix will cause the CIP Tile to float. Under these conditions suitable weights such as 2 concrete blocks or sandbags (25 pounds) shall be placed on each CIP Tile.

C. The physical characteristics of the concrete shall be consistent with the Contract Specifications while maintaining a slump range of 4 - 7 to permit solid placement of the CIP Tile. An overly wet mix will cause the CIP Tile to float. Under these conditions suitable weights such as 2 concrete blocks or sandbags (25 pounds) shall be placed on each CIP Tile.

3.02 INSTALLATION

A. Contractor will not be allowed to install Tactile Warning Surface Tiles until all submittals have been reviewed and approved by the Engineer.

B. CIP Tile shall be installed per manufacturer's instructions.

C. To the maximum extent possible, the CIP Tiles shall be oriented such that the rows of in-line truncated domes are parallel with the direction of the ramp. When multiple CIP Tiles regardless of size are used, the truncated domes shall be aligned between the tactile warning surface Tiles and throughout the entire tactile warning surface installation.

D. In accordance with the Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Rights of Way (7/23/11, Access Board): Sections 304 + 305), Tactile

Warning Surface Tile shall be located relative to the curb line as shown within Sections 304+305 of the Guidelines.

E. CIP Tiles shall be tamped or vibrated into the fresh concrete to ensure that there are no voids or air pockets, and the field level of the CIP Tile is flush to the adjacent concrete surface or as the Drawings indicate to permit proper water drainage and eliminate tripping hazards between adjacent finishes.

F. Cutting and Setting of CIP Tiles shall be cut into size and configuration indicated on the Drawings using a 60 tooth carbide blade on a table saw or equivalent cutting device. Minimize any cantilever effect (to the maximum extent practicable) when cutting between successive embedment ribs as concrete will tend to flow up and over the CIP Tiles. The top of the body of the CIP Tiles shall be fully seated and flush with the adjacent concrete substrate. For specific instructions for cutting and setting refer to Tactile Warning Surface manufacturer's written instructions.

3.03 CLEANING AND PROTECTING

A. Protect CIP Tiles against damage during construction period to comply with CIP Tiles manufacturer's Specifications.

B. During and after the CIP Tiles installation and the concrete curing stage, it is imperative that there are no walking, leaning, or external forces placed on the CIP Tiles to rock the CIP Tile, causing a void between the underside of the CIP Tile and the concrete.

C. Remove Protective Plastic Sheeting from CIP Tile within 24 hours of installation of the CIP Tile. Particularly under hot weather conditions (80 degrees or higher), plastic sheeting will adhere strongly (resulting in difficult removal of same) to Tactile Warning Surface Tile when not removed quickly.

D. If requested by the Project Manager, clean CIP Tiles not more than four (4) days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project. Clean CIP Tile by method specified by Tactile Warning Surface Products

SECTION 11501

OPEN CHANNEL GRAVITY FLOW
ULTRAVIOLET ("UV") DISINFECTION EQUIPMENT

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish for installation by the owner an open channel, gravity flow, ultraviolet (UV) light system for disinfection of wastewater, complete, in place as shown on the Drawings as specified herein.

B. The unit(s) shall be furnished (to be installed by the owner) with all necessary accessory equipment including but not limited to the UV lamp assemblies, power distribution centers, monitor and/or system controls, automatic Cleaning system as an option if available, lifting system and other auxiliaries, whether specifically mentioned in this Section or not, as required for an installation incorporating the highest standards for the type of service including field testing and instructing the regular operating personnel in the care, operation and maintenance of all equipment.

C. For purposes of standardization, and to achieve a common operator interface for control systems within the facility, the major items of instrumentation and process control equipment provided for the UV disinfection system local control panels shall be sufficient for full operation. The proposal shall be complete and require only power in accordance with 2.06 to become fully operational.

   This equipment shall include but not be limited to system monitor and operator interface devices.

D. The UV system shall be capable of disinfecting existing effluent as well as future flows to meet the water quality standards listed in this Section.

E. Each proposer shall supply a list of at least three comparable installations, of current technology within the United States of America.

1.02 SUBMITTALS

A. Complete shop and installation drawings of all materials and equipment furnished under this Section shall be submitted for approval in accordance with The Request For Proposal. Submittals shall include, but not be limited to, the following:

1. Complete description in sufficient detail to permit an item comparison with the specifications.

2. Detailed drawings showing all details of construction of the UV system and installation details of all equipment.

3. Detailed schematic and layout drawings and a description of operation of all control panels.

4. Detailed schematic and layout drawings and a description of operation of all control panels.

5. All interconnections and interface requirements, dimensions, and locations of all major elements of the UV system including critical clearance requirements.

6. Basis of design, including background data, calculations, operational plant data and other information showing the development of the proposed design and that it will conform to the requirements of Paragraph 1.04D.
7. The startup/performance testing report and manufacturer's certification as required in Part 3.

8. Complete operation and maintenance manuals shall be submitted. The manuals shall recognize that UV disinfection technology is not common knowledge to most plant operators, so the manuals shall be thorough and instructive to such personnel. O&M manuals shall be delivered 2 weeks before delivery of system.

9. Pre-qualification Requirements:

   Demonstrate that the dose required in the performance specification is being met or exceeded in an effluent at 50 degrees Fahrenheit. The UV equipment manufacturer will provide both EPA and bioassay calculation. The bioassay calculation, as the name implies, will be based on an independently produced bioassay report on the proposed UV equipment. The Bioassay calculation will be conducted at the full scale systems per lamp flow. Both EPA and bioassay calculation will demonstrate that the proposed UV system design will deliver the intended dose.

   In order to verify the lamp output assumption made in the EPA calculation, the UV equipment manufacturer will provide a UV Lamp Output Graph. This UV output graph will be verified by an independent agency. The proposed electronic ballast for the full scale system will be calibrated against the Jefferson 60 Hz electromagnetic ballast, Model Number 300-2171-650, and will have a minimum operating current of 425 mA. The curve will show the output of the identical lamp individually

being driven by both ballasts, while immersed in a liquid over the operating temperature range of 40 to 100 degrees Fahrenheit. The most recent radiometer calibration documentation, as used in the test procedure, and complete procedural description will be supplied with the calculations.

The Engineer shall reserve the right to require that the test be modified and repeated if the protocol used is not satisfactory.

1.03 SYSTEM STARTUP

A. The ultraviolet light system supplier shall provide a representative for startup services once the installation is complete.

B. Manufacturer's Representative

1. The manufacturer's representative shall inspect the construction plans and the installation and recommend any required modifications, additions, or other changes required to allow the manufacturer to certify that the complete installation is appropriate and is expected to operate as expected.

2. The manufacturer's representative shall instruct the Owner's and Engineer's personnel on the operation and maintenance of the UV disinfection system. The instruction shall include classroom training on UV technology, and field training on proper operation and maintenance procedures, along with complete demonstrations of same.

3. The manufacturer's representative shall supervise the performance testing of the installation.

4. The manufacturer's representative shall provide minimum services in accordance with the following table:

Purpose	No. of Days
Installation Supervision	As required for proper installation
Functional Testing	2
Performance Testing	3
Operator Training	1

5. The number of days indicated above shall be provided on an 8-hour-day on-site basis and shall be in addition to travel time.

1.04 DESCRIPTION OF THE SYSTEM

A. The equipment specified herein shall be low or medium pressure, low or high output ultraviolet light disinfection equipment designed to reduce the fecal coliform micro-organisms of a domestic wastewater treated to secondary

standards utilizing aerated lagoon and constructed wetland treatment system with influent characteristics as specified in Paragraph 1.04B so that the final effluent shall meet the effluent discharge conditions as specified in Paragraph 1.04D. The UV system shall be hydraulically rated for at least 0.7 mgd peak flow.

B. Influent Characteristics to Disinfection Channels

1. The UV disinfection system shall be designed to disinfect an influent at the flow rates and with the characteristics as shown below.

a. Peak Flow (mgd)	500,000 US GPD
b. Total Suspended Solids (mg/l)	30 mg/L
c. 5-day B.O.D. (mg/l)	30
d. UV Transmittance at 253.7 nm	50%
e. Annual Effluent Temperature Range	33° to 85° F
f. Effluent Standards to be Achieved	200/100 ml fecal coliform, based on 30 day geometric mean of daily samples

C. UV Channel Configuration

1. The system shall be installed in open channels having the characteristics shown on the attached Drawings.

2. The minimum design requirements of the UV system supplied shall be as follows:

a. Number of UV Channels at each site	1
b. Number of UV banks per channel	1
c. Number of UV lamp modules per bank	4
d. Number of lamps in each UV lamp module	4
e. Total number of lamps	16
f. Minimum and maximum water levels above channel floor shall be specified as part of the proposal	

These requirements are considered minimum. Each supplier shall present the specific number of units proposed for his installation.

D. Bacteriological Inactivation Requirements

1. Flow Characteristics

a. Number of channels in service 1
b. Total average flow (mgd) Initial=0.12 mgd

2. Fecal Coliform Testing Criteria
a. 30-day geometric mean of daily samples 200 per 100 ml

3. Grab samples of the influent to and effluent from the UV disinfection system shall be collected during the performance testing period specified in Part 3 of this Section. The samples shall be tested for fecal coliform content in accordance with the procedures recommended in "Standard Methods."

E. Performance Requirements:
The UV dose produced by the system will not be less than 24,900 µWatt.secs/CM² after one year (8, 760 hours) of lamp operation. To be measured in an effluent with a 50% UV transmission at 253.7 nm. Lamp output to be at 80% of its initial level, after one year of operation, and there will be no fouling on the lamp sleeves.

1.05 MAINTENANCE

A. Spare parts shall be provided with the UV disinfection system. The parts shall not be consumed by the manufacturer or Contractor and shall be in the hands of the Owner upon Substantial Completion. The parts shall be provided in sturdy containers, labeled on all sides with information concerning the contents and suitable for long term storage in a room without environmental controls.

B. Spare Parts
The following spare parts shall be provided:
Four (4) "UV" Lamps
Four (4) Lamp Sleeves

Four (4) Lamp Holders

C. Operators Kit:
The following items will be furnished:

One (1) face shield to protect operator from "UV" light.

One (1) gallon of cleaning solution. (Lime-A-Way manufactured by Ecolab)

1.06 WARRANTY

A. The equipment furnished under this section shall be free of defects in materials and workmanship, including damages that may be incurred during

shipping, storage, and installation for a period of one year from the date of the startup or for one and half years from the date of shipment.

B. The UV lamps shall be warranted for a period of 12,000 hours at full power.

PART 2- PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General

1. The physical layout of the system shown on the engineering drawings and the equipment specified herein are based upon the Trojan UV 3000PTP System, as manufactured by Trojan Technologies, Inc. and/or the Wedeco Ideal Horizons TAK C Series system or an equivalent system.

2. To be acceptable, the UV system must operate in an open channel, be of modular design, use electromagnetic ballasts or electronic solid state ballast.

3. The UV system including the stainless steel channel must be designed to fit within the channel dimensions shown on the attached drawing.

4. The system to be furnished shall include the latest components and equipment available at the time of shipment.

5. The UV system shall consist of low or medium pressure mercury vapor UV lamps, oriented horizontally and parallel to flow, arranged in modules and installed inside flow-through reactor chamber in open channels. UV lamps that differ significantly from the mercury vapor will be considered, but must be available for purchase from more than one source. 90% of "UV" output will be within the wavelengths of 233.7 to 273.7 nm.

6. All metal components exposed to or in contrast with plant effluent, including all anchoring hardware, shall be Type 316 stainless steel. Threading of stainless steel fasteners shall be dine using an approved non-galling application, similar to Loctite. All materials exposed to UV light shall be unaffected by prolonged exposure to same and shall be Type 316 stainless steel, Type 214 quartz or a suitable UV resistant material. All wiring exposed to UV light shall be Teflon coated.

7. All metal components not in contact with plant effluent and/or UV light shall be Type 304 stainless steel.

8. The UV system shall be able to continuously provide disinfection under reduced flow conditions while replacing UV lamps, quartz sleeves, and ballasts and while cleaning the UV lamp sleeves.

2.02 ULTRAVIOLET LAMPS

A. The UV lamps shall be operated with a non variable power lamp system. Variable power operating systems may be submitted as an alternative.

B. Changing of lamps and sleeves shall be easily performed by the operating personnel at the plant. Systems whereby the lamp assemblies have to be returned to the factory for lamp replacement will not be acceptable.

C. The ballasts shall be of electromagnetic design or solid state electronic and specifically designed for the lamps proposed. The design mean time between failure shall be at least 10 years.

2.03 ULTRAVIOLET LAMP SLEEVES

A. UV lamp sleeves shall be provided around each UV lamp to prevent the UV lamps and electrical connections from coming in contact with the wastewater.

B. The UV lamp sleeves shall be Type 214 clear fused quartz tubing circular envelopes and shall be rated for "UV" transmission of 89% with wall thickness of 1.0 to 2.0 mm.

C. One end of each sleeve shall be closed and the other end sealed by a lamp end seal holder and the electrical wires emanating from the lamps shall be enclosed in the stainless steel frame and not exposed from the effluent. The closed end of the sleeve shall be held in place by means of retaining rods or threaded locking nut. A double seal shall be provided consisting of a gasket and O-ring. The sleeve nut shall have a knurled surface to allow positive handgrip for tightening. The sleeve nut will not require any tools for removal.

2.04 UV MODULE

A. Each UV lamp module will consist of 4 lamps and their corresponding electronic ballast. To be considered as an alternate, ballasts housed in a separate enclosure located external to the channel will be equipped with a suitable air conditioning system, supplied by the UV manufacturer, to maintain internal enclosure temperatures below 80°F. No forced air ventilation will be allowed.

B. Each lamp will be enclosed in its individual quartz sleeve, one end of which will be closed and the other end sealed by a lamp end seal and holder.

C. The electrical wires connecting the lamps and electronic ballasts will be enclosed in the stainless steel frame and not exposed to the effluent. To be considered as an alternate, wires that are exposed to the effluent will be warranted for 15 years and will be Teflon™ coated to prevent degradation under constant exposure to UV light.

D. Each UV module will be provided with a standard 120 Volt plug and weatherproof cable for connection to a receptacle. The cable will be no longer than 10 feet. A total of 6 UV modules will be supplied. Lamp status will be displayed on top of each UV module by watertight LED indicator lights.

E. Modules will be approximately 68 inches long, 20 inches high and 2.8 inches wide, weighing approximately 38 lbs. Materials of construction will be stainless steel type 316, anodized aluminum, quartz 214, and Teflon.

F. All circuits shall be fully protected from electrical overload. Fuses shall be easily accessible.

2.05 CLEANING SYSTEM

A. The base bid must include a manual cleaning system where the UV lamp module will be cleaned by removing from the effluent channel and hand wiping the sleeve with an acid solution, using a non-abrasive cloth. This system will include a maintenance rock. The maintenance rack shall be type 304 stainless steel. The rack shall be designed to facilitate the servicing operation of the UV modules.

B. Optional Automatic Cleaning System

1. An automatic and integral lamp cleaning system shall be provided as part of the UV system. The cleaning system shall use mechanical wiping, using a stainless steel brush, to de-scale the lamp sleeves. The cleaning system shall be fully operational without requiring either lamps or modules to be placed out of service.

2. The cleaning cycle shall be field adjustable from the range of twelve times per hour to once per month. The cleaning cycle shall be activated automatically from the control system or manually at the operator interface.

3. The materials used for the wiper shall be resistant to high intensity UV radiation, temperature. The wiper shall be designed in such that it will remove the deposit effectively.

2.06 ELECTRICAL

A. The UV disinfection system will be divided into 6 UV modules.

B. Interconnecting Cables to be standard 120 Volt, weatherproof, 10 feet long and will be suitable for outdoor installation.

C. Receptacles:
   1. 120 Volt receptacles rated for continuous use will be used. Receptacles will be of the duplex type complete with ground fault circuit interrupter.

D. Power Consumption: Maximum power draw to UV System will be 2,100 watts.
   1. All electrical supplies will be 120 Volt, 60 Hz., single phase.
   2. A separate 120 volt, 5 amp, supply may be required per monitoring system.
   3. Equipment requiring three phase power or differing power must include accommodations to convert power from that specified.

E. All electrical controls or elements shall be placed in weatherproof, stainless steel enclosures.

2.07 MONITORING SYSTEM

A. A submersible UV sensor will continuously monitor the UV intensity produced in the bank of UV lamp modules. The sensor will measure only the germicidal portion of the light emitted by the UV lamps.

B. UV intensity in mW/sq.cm will be indicated on a 3 character display.

C. Elapsed time in hours will be indicated on 5 character display.

D. Both displays will utilize 7 segment LEDs and will be visible through the panel door.

E. A dry contact will be provided for Low UV intensity alarm.

F. Monitoring System will be enclosed in fiberglass Type 4X wall mounted panel.

G. To be located less than twelve (12) feet from the UV Module (LED end).

2.08 TRANSITION CONNECTIONS:

A. Inlet and outlet transition connections will be supplied.

B. Transition boxes change channels connection from a square flange to a round flange conforming to ANSI standards.

C. The material used for these parts will be stainless steel type 304, 14 gauge, manufactured as per dimensions indicated in accompanying diagrams.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The City of Blakely will obtain a qualified contractor to install the ultraviolet system in strict compliance with manufacturer's instructions and recommendation.

3.02 GENERAL TESTING REQUIREMENTS

A. The manufacturer shall furnish the services of a factory trained engineer as given in Paragraph 1.03 to supervise start-up and testing of the system. The system shall operate to the specified requirements. If the system fails to meet specified requirements, it shall be adjusted, repaired, and/or replaced at no additional cost to the Owner.

3.03 FUNCTIONAL TESTING

A. Prior to startup, a manufacturer's representative shall inspect the installed UV disinfection system for proper alignment, correct operation, proper connection, and satisfactory function of all components, including ground fault circuit interrupters and a safety inspection of wet cable connectors. The manufacturer's representative shall approve the installation and provide certification that the system components have been installed correctly and are ready for operation.

B. Proposed functional testing shall be developed by the manufacturer and submitted to and reviewed by the Engineer prior to scheduling and performing the functional test.

3.04 PERFORMANCE TESTING

A. Tests shall be performed by an Independent Certified Testing laboratory. Testing shall commence after installation and start-up of the UV system. Samples will be collected at times when the flow through the plant is at or near the peak flow rating of the UV system.

1. The samples collected shall be analyzed for the following, using standard testing procedures.

a. Fecal coliform count just prior to disinfection.
b . Fecal coliform count just after disinfection.
c. Suspended solids prior to disinfection.

d. BOD5 prior to disinfection.
e. Percent transmission at 254 nm prior to disinfection.

2. The duration of the performance testing shall be three days and the frequency of sample collection will be three times per 24 hour period at intervals directed by the Owner. The data obtained shall be recorded and included in the formal test report.

B. Analytical Method. Test and sample preservation methods for test contaminants shall be in accordance with the latest revisions of AWWA Standards Method for Examination of Water and Wastewater.

C. An allowance for testing shall be included in the proposal.

SECTION 12360
LABORATORY CASEWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Wood laboratory casework.
2. Filler and closure panels.
3. Laboratory countertops.
4. Shelves.
5. Laboratory sinks.
6. Water, laboratory gas, and electrical service fittings.

B. Related Sections:

1. Division 11 Section “Laboratory Fume Hoods” for fume hoods, including base cabinets and countertops under fume hoods.

2. Divisions 15 and 16 Sections for installing service fittings specified in this Section, including connecting service utilities.

1.03 DEFINITIONS

A. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inched above floor, and visible surfaces in open cabinets or behind glass doors.

1. Ends of cabinets, including those installed directly against walls or other cabinets are defined as “exposed.”

2. Ends of cabinets indicated to be installed directly against and completely concealed by walls or other cabinets are defined as “concealed.”

B. Semiexposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; interior faces of doors. Tops of cabinets 78 inches or more above floor are defined as “semiexposed.”

C. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

D. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or

particleboard core, joined with adhesive faced both front and back with hardwood veneers.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, details, and attachments to other work.

1. Indicate locations of hardware and keying of locks.
2. Indicate locations and types of service fittings.
3. Indicate locations of blocking and reinforcements required for installing laboratory casework.
4. Include details of exposed conduits, if required, for service fittings.
5. Indicate locations of and clearances from adjacent walls, doors, windows, and other building components, and other laboratory equipment.
6. Include coordinated dimensions for laboratory equipment specified in other Sections.

C. Samples for Initial Selection: For factory-applied finishes and other materials requiring color selection.

D. Qualification Data: For qualified manufacturer.

E. Product Test Reports for Casework: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory casework with requirements of specified product.

F. Product Test Reports for Countertop Surface Material: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating compliance of laboratory countertop surface materials with requirements specified for chemical and physical resistance.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8.

B. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated. Obtain countertop sink accessories and service fittings from casework manufacturer.

C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with the Specifications may be considered. Refer to Division 1 Section "Product Requirements."

D. Casework Product Standard: Comply with SEFA 8, "Laboratory Furniture – Casework, Shelving, and Tables – Recommended Practices."

E. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, by qualified testing agency, and marked for intended location and application.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet work are complete and dry, and temporary HVAC system is operation and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.08 COORDINATION

A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.

B. Coordinate installation of laboratory casework with installation of fume hoods and other laboratory equipment.

PART 2 – PRODUCTS

2.01 WOOD CABINET MATERIALS

A. General:

1. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
2. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core, unless otherwise indicated.
3. MDF: ANSI A208.2, Grade 130.
4. Particleboard: ANSI A208.1, Grade M-2.
5. Hardboard: AHA A135.4, Class 1 Tempered.
6. Edgebanding for Wood-Veneered Construction: Minimum 1/8-inch thick, solid wood of same species as face veneer.

B. Exposed Materials:

1. General: Provide materials that are selected and arranged for compatible grain and color. Do not use materials adjacent to one another that are noticeably dissimilar in color, grain, figure, or natural character markings.
2. Plywood: Hardwood Plywood with face veneer of species indicated, selected for compatible color and grain. Grade A exposed faces at least 1/50 inch thick, and Grade J crossbands. Provide backs of same species as faces.

   a. Face Veneer Cut: Plain sliced.

3. Solid Wood: Clear hardwood lumber of species indicated and selected for grain and color compatible with exposed hardwood plywood.

C. Semiexposed Materials:

1. Solid Wood: Sound hardwood lumber, selected to eliminate appearance defects, of any species similar in color and grain to exposed solid wood.
2. Plywood: Hardwood plywood of any species similar in color and grain to exposed plywood. Grade B faces and Grade J crossbands. Provide backs of same species as faces.
3. Provide solid wood or hardwood plywood for semiexposed surfaces unless otherwise indicated.

D. Concealed Materials

1. Solid Wood: Any species, with no defects affecting strength or utility.
2. Plywood: Hardwood plywood. Provide backs of same species as faces.
3. Particleboard
4. MDF.
5. Hardboard.

2.02 COUNTERTOP SHELF and SINK MATERALS

A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Colors, Patterns & Finishes: As selected by Architect from plastic-laminate manufacturer's full range.

B. Core Materials for Plastic Laminate: Particleboard, ANSI A208.1, Grade M-2.

C. Adhesive for Bonding Plastic Laminate: Manufacturer's standard waterproof adhesive.

D. Epoxy: Factory –molded, modified epoxy-resin formulation with smooth, nonspecular finish.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Durcon Company (The).
b. Epoxyn Products.
c. Laboratory Tops, Inc.
d. Prime Industries, Inc.

2. Physical Properties:

a. Flexural Strength: Not less than 10,000 psi.
b. Modulus of Elasticity: Not less than 2,000,000 psi.
c. Hardness (Rockwell M): Not less than 100.
d. Water Absorption (24 Hours): Not more than 0.02 percent.
e. Heat Distortion Point: Not less than 260 deg F.

3. Chemical Resistance: Epoxy-resin material has the following ratings when tested with indicated reagents according to NEMA LD 3, Test Procedure 3.4.5.

a. No Effect: Acetic acid (98 percent), acetone, ammonium hydroxide (28

percent), benzene, carbon tetrachloride, dimethyl formamide, ethyl acetate, ethyl alcohol, ethyl ether, methyl alcohol, nitric acid (70 percent), phenol, sulfuric acid (60 percent), and toluene.

b. Slight Effect: Chromic acid (60 percent) and sodium hydroxide (50 percent).

4. Color: As selected by Architect from manufacturer's full range.

2.03 WOOD CABINETS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advanced Lab Concepts, Inc.
2. CampbellRhea.
3. CiF Furniture Ltd.
4. Collegedale Casework, LLC.
5. Diversified Woodcrafts, Inc.
6. Fisher Hamilton, L.L.C.
7. Keur Industries, Inc.
8. Kewaunee Scientific Corporation; Laboratory Products Group.
9. Laboratory Design & Supply.
10. Leonard Peterson & Company, Inc.
11. Sheldon Laboratory Systems.
12. South Texas Woodmill, Inc.
13. Terrill Manufacturing Company.

B. Design: Reveal overlay with radiused edges. Provide 1/8-inch reveals between doors and drawers that are adjacent.

C. Grain Direction:

1. Vertical on both doors and drawer fronts, with continuous vertical matching.
2. Lengthwise on face frame members.
3. Vertical on end panels.
4. Side to side on bottoms and tops of units.
5. Vertical on knee-space panels.
6. Horizontal on aprons and table frames.

D. Veneer Matching:

1. Provide veneers for each cabinet from a single flitch, book and running matched. Provide continuous matching of adjacent drawer fronts within each cabinet.

E. Construction: Provide wood-faced laboratory casework of the following minimum construction:

1. Bottoms of Base Cabinets and Tall Cabinets: ¾-inch thick veneer-core hardwood plywood.
2. Tops and Bottoms of Wall Cabinets and Tops of Tall Cabinets: 1-inch thick

veneer-core hardwood plywood.
3. Ends of Cabinets: ¾-inch thick hardwood plywood.
4. Shelves: 1-inch thick veneer-core hardwood plywood
5. Base Cabinet Top Frames: ¾-by-2-inch solid wood with mortise and tenon or doweled connections, glued and pinned or screwed.
6. Backs of Cabinets: ¾-inch thick, particleboard- or MDF-core hardwood plywood where exposed, ¼ -inch thick, hardwood plywood dadoed into sides, bottoms, and tops where not exposed.
7. Drawer Fronts: ¾-inch thick, particleboard- or MDF-core hardwood plywood or solid hardwood.
8. Drawer Sides and Backs: 1/2-inch thick, solid hardwood or veneer-core hardwood plywood, with glued dovetail or multiple-dowel joints.
9. Drawer Bottoms: ¼-inch thick, veneer-core hardwood plywood glued and dadoed into front, back and sides of drawers. Use ½-inch thick material for drawers more than 24 inches wide.
10. Doors 48 Inches High or Less: 3/4 inch thick, with particleboard or MDF cores, solid hardwood stiles and rails, and hardwood face veneers and crossbands.
11. Doors More than 48 Inches High: 1-1/8 inches thick, with particleboard cores and hardwood dace veneers and crossbands.

F. Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.

1. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.

2.04 WOOD FINISH

A. Preparation: Sand lumber and plywood before assembling. Sand edges or doors, drawer fronts, and molded shapes with profile-edge sander. Sand after assembling for uniform smoothness at least equivalent to that produced by 220-grit sanding and without machine marks, cross sanding, or other surface blemishes.

B. Staining: Remove fibers and dust and apply stain to exposed and semiexposed surfaces as necessary to match approved Samples. Apply stain in a manner that will produce a consistent appearance. Apply wash-coat sealer before applying stain to closed-grain wood species.

1. Stain Color: As selected by Architect from manufacturer’s full range.

C. Chemical-Resistant Finish: Apply laboratory casework manufacturer’s standard three-coat, chemical-resistant, transparent finish. Sand and wipe clean between coats. Topcoat(s) may be omitted on concealed surfaces.

1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.

2.05 HARDWARE

A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: Stainless-steel, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 for doors 48 inches high or less and 3 for doors more than 48 inches high.

C. Hinges for Wood Cabinets: Frameless concealed hinges (European type) complying with A156.9, Type B01602, 170 degrees of opening, self-closing.

D. Hinged Door and Drawer Pulls: Solid aluminum, stainless steel, or chrome-plated brass back-mounted pulls. Provide 2 pulls for drawers more than 24 inches wide.

1. Design: Wire pulls.
2. Overall size: 1-1/4 by 4-1/2 inches.

E. Sliding Door Pulls: Stainless-steel or chrome-plated recessed flush pulls.

1. Design and Size: As selected from manufacturer's full range.

F. Pulls: Recessed aluminum pulls. Provide 2 pulls for drawers more than 24 inches wide.

G. Pulls for Wood Cabinets: Full-width, recessed solid hardwood channels; matching exposed wood of cabinets.

H. Door Catches: Dual, self-aligning, permanent magnet catches. Provide 2 catches on doors more than 48 inches high.

I. Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.

1. Provide Grade 1HD-100; for drawers not more than 6 inches high and 24 inches wide.
2. Provide Grade 1HD-200; for drawers more than 6 inches high or 24 inches wide.
3. Standard Duty (Grade1): Full-extension type, with polymer rollers.
4. Heavy Duty (Grade 1HD-100 and Grade 1 HD-200): Full-overtravel-extension, ball-bearing type.

J. Drawer Slides for Wood Cabinets: Hardwood runners under centers of drawers with polymer guides fastened to backs of drawers.

K. Label Holders: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches, attached with screws or rivets. Provide on all drawers.

L. Locks for Wood Cabinets: Cam type with 5-pin tumbler, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281 or E07261.

1. Provide a minimum of two keys per lock and two master keys.
2. Provide on all drawers and doors.

3. Keying: Key locks within each room alike, key each room separately.
4. Master Key System: Key all locks to be operable by master key.

M. Sliding-Door Hardware Sets: Laboratory casework manufacturer's standard, to suit type and size of sliding-door units.

N. Adjustable Shelf Supports for Wood Cabinets: Power-coated steel shelf rests complying with BHMA A156.9, Type B04013.

O. Adjustable Shelf Supports for Wood Cabinets: Mortise-type, powder –coated steel standards and shelf rests complying with BHMA A156.9, Types B04071 and B04112.

2.06 COUNTERTOPS, SHELVES, TROUGHS, AND SINKS

A. Countertops, General: Provide units with smooth surfaces in uniform plane free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch, with continuous drip groove on underside ½ inch from edge.

B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Architect.

1. Outlets: Provide with strainer and tailpieces, NPS 1-1/2, unless otherwise indicated.
2. Overflows: For each sink except cup sinks, provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches less than sink depth. Provide in same material as strainer.

C. Plastic-Laminate Shelves:

1. Plastic-Laminate Shelves: Plastic laminate shop bonded to both faces and all edges of 1-inch thick core. Sand surfaces to which plastic laminate is to be bonded.

a. Shelf Core: ParticleboardUrea-formaldehyde-free particleboardExterior-glue particleboardstraw-based particle board or exterior plywood.
b. Plastic-Laminate Grade for Shelves: HGL.

D. Epoxy Countertops and Sinks:

1. Countertop Fabrication: Fabricate with factory cutouts for sinks, holes for service fittings and accessories, and with butt joints assembled with epoxy adhesive and concealed metal splines.

a. Countertop Configuration: Flat, ¾ inch thick, with beveled or rounded edge or corners, and with drip groove and integral coved or applied backsplash.
b. Countertop Construction: Uniform throughout full thickness.

2. Sink Fabrication: Molded in 1 piece with smooth surfaces, coved corners, and bottom sloped to outlet, ½-inch minimum thickness.

a. Provide with polypropylene strainers and tailpieces.

b Provide integral sinks in epoxy countertops, bonded to countertops with invisible joint line.
c. Provide manufacturer's recommended adjustable support system for table- and cabinet-type installations.

3. Water settling will not be permitted in clay soils. It may be required at the option of the Engineer in sandy soils.

2.07 WATER AND LABORATORY GAS SERVICE FITTINGS

A. Service Fittings: Provide units that comply with SEFA 7, "Laboratory and Hospital Fixtures – Recommended Practices." Provide fittings complete with washers, locknuts, nipples and other installation accessories. Include wall and deck flanges, escutcheons, handle extension rods, and similar items. Provide units that comply with "Vandal-Resistant Faucets and Fixtures" recommendations in SEFA 7.

B. Materials: Fabricated from cast or forged red brass unless otherwise indicated. Reagent-Grade Water Service Fittings: Polypropylene, PVC, or PVDF for parts in contact with water.

C. Finish: Acid- and solvent-resistant powder coating in laboratory casework manufacturer's standard metallic brown, aluminum, white or other color as approved by Architect.

D. Water Valves and Faucets: Provide units complying with ASME A112.18.1, with renewable seats, designed for working pressure up to 80 psig.

1. Vacuum Breakers: Provide ASSE 1035 vacuum breakers on water fittings with serrated outlets.
2. Aerators: Provide aerators on water fittings that do not have serrated outlets.
3. Self-Closing Valves: Provide self-closing valves where indicated.

E. Hand of Fittings: Furnish right-hand fittings unless fitting designation is followed by "L."

PART 3- EXECUTION

3.01 INSTALLATION OF CABINETS

A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:

1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

B. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24

inches. o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Where base cabinets are installed from walls, fasten to floor at toe space at not more than 24 inches o.c and at sides of cabinets not less than 2 fasteners per side.

C. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches. o.c.

D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.

E. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.03 INSTALLATION OF COUNTERTOPS

A. Comply with installation requirements in SEFA 2.3. Abut top and edge surfaces in one true plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints only where shown on Shop Drawings.

B. Field Jointing: Where possible, make in same manner as shop-made joints using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Prepare edges in shop for field-made joints.

C. Fastening: Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches. o.c. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to countertop in chemical resistance, hardness and appearance.

D. Provide required hole and cutouts for service fittings.

E. Provide scribe moldings for closures at junctures of countertop, curb and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

3.04 INSTALLATION OF SINKS

A. Comply with installation requirements in SEFA 2.3.

B. Underside Installation of Epoxy Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table-and cabinet-type installations. Set top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing compound or adhesive and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

3.01 INSTALLATION OF SERVICE FITTINGS:

A. Comply with installation requirements in Division 15 and 16 Sections for installing water and laboratory gas service fittings and electrical devices.

B. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink and countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

3.06 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c

SECTION 15060
WALKWAYS AND WORK PLATFORMS

PART 1 - GENERAL

1.01 SCOPE

A. The work for this section involves the furnishing and installing of walkways and work platform structures necessary for a complete installation in corrosive environments (e.g., wastewater treatment plants, pump stations, etc.).

1.02 SUBMITTAL OF INFORMATION

A. Submit manufacturers data showing:
   1. Dimensions of structure
   2. Materials of construction
   3. Calculations of explected deflections of structure

B. Submit shop drawings showing the structure's installation, layout, and dimensions.

C. Submit Operation and Maintenance Manuals, which include specific instructions for receiving and handling, disassembly, installation repair and service, and a full parts list.

PART 2 - PRODUCTS

2.01 FLAT CHANNEL COVERS

A. The flat channel covers shall be at a minimum designed of 3/16" thick aluminum diamond tread plate. Fiberglass maybe used as an alternative with the project engineers agreement. Alternate prefabricated aluminum cover systems such as the Thermacon Enviro Covertite system shall be acceptable.

B. Acceptable covers shall be of airtight and watertight construction.

C. Cover systems shall use gaskets between panels and channel edges to obtain a tight seal.

D. No caulking or any type of secondary sealant may be used.

E. Gaskets shall be Neoprene Mil R900 or equal.

F. Covers shall fit into the existing channel with no modification of the channel itself. The top of the cover shall be flush with the top of the channel with no exposed ridges protruding.

G. The covers shall be supported by a structural grid support system having the following properties:
   1. Shall be able to withstand concentrated loads of at least 350 lbs. and uniform loads of at least 25 psf.
   2. Shall have a deflection rate of L/240 or lower, where L is the overall cover length.

H. Covers must meet all O.S.H.A. regulations for walkways and work platforms.

I. Fiberglass covers must be able to resist the corrosion affects of UV lights.

J. Covers shall be removable by plant personnel without special lifting equipment.

K. All bolts and fasteners shall be type 316 stainless steel and comply with ASTM A167.

L. No more than six (6) bolts shall need to be removed to remove any panel within the cover system.

M. No more than two (2) other panels shall be disturbed when removing a single panel from any location.

N. Multiple covers shall not be allowed for any given span.

2.02 STAIRS AND PLATFORMS

A. Stairs and platforms shall be constructed of 1" minimum tubular aluminum frame.

B. The walking surface shall be constructed of 3/16" minimum aluminum plate. The aluminum plate shall have a reverse stamped pattern covering the entire work surface.

C. All joints and panels shall be welded in place according to the American Welding Society's standard for aluminum.

D. The tubular frame and plate system shall be able to withstand concentrated loads of 500 lbs. and uniform loads of at least 30 psf. The system shall also have a minimum deflection rate of L/240, where L is the overall member or span length.

E All stairs and platforms shall strictly conform to all O.S.H.A. regulations for walkways and work platforms.

SECTION 15176
PNEUMATIC TANK

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section covers the pneumatic steel water tank including the pneumatic tank and controls furnished, erection, painting, testing, sterilization, and placing into service.

B. The controls shall start the pump when the pressure in the tank drops below 40 psi and stop the pump when the pressure reaches 60 psi or the water level reaches a preset water level.

1.02 SUBMITTALS

A. The procedure for shop drawing approval is as required under Section 01001, General Requirements of these specifications, regardless of manufacturer.

PART 2 - MATERIALS

2.01 PNEUMATIC TANK

A. Tank shall be a 5,000 gallon tank designed in accordance with ASME Boiler and Pressure Code.

B. The tank shall be capable of operating on a 70 psi internal pressure.

C. The tank shall have an 11" x 15" manhole at one end and flanged connections for inlet and outlet piping.

D. Tank shall be equipped with a pressure relief valve set at 65 psi, a 5/8" x 18" water glass gauge, crane #610 or equal and a 6" dial, 0-75 psi pressure gauge.

E. Tank shall bear a plate showing manufacturer, manufactured date, pressure rating, and capacity.

2.02 CONTROLS

A. An integrated air charging system consisting of air compressor, liquid level switch and pressure switch shall automatically maintain the proper charge of air in the tank.

B. The air compressor motor shall be minimum of 1/6 HP, 230 volt, single phase.

C. A combination magnetic starter with H-O-A switch and two overload relays shall be furnished in NEMA-1 enclosure.

2.03 COATING

A. The tank coating shall comply with AWWA D100.

B. Interior and exterior systems shall be Polyamid Epoxy systems of either Rust-Oleum, Koppers or Tnemec with a dry film thickness for total coating system not less than 6.0 or more than 9.0 dry mils.

1. The prime coat shall be polyamid epoxy, 2 component zinc rich designed for potable water contact. Zinc content to be 90 + % in dry film. Volume solids =41.5%.

2. Intermediate coat shall be unmodified .2 component, polyamide epoxy designed for potable water contact. Volume solid = 43.2%.

3. Unmodified 2 component polyamide epoxy designed for potable water contact. Volume solids = 40%.

C. Any system submitted as alternate must have a letter from the factory technical department which verifies that the product is designed for the intended use and that the technical information is the latest information available and accurate.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The tank shall be installed as shown on the plans and in accordance with the manufacturer's recommendations.

B. All surfaces to be coated shall be sand blasted to a near white grade in accordance with SSPC-SPIO-63 (NACE-2). All surfaces must be coated with primer the same day as blasted. Minimum abrasive blast profile (anchor pattern) 1.0 mils. Maximum abrasive blast profile (anchor pattern) 2.5 mils.

C. The interior epoxy coating shall be applied by the manufacturer and certified to be in full compliance with applicable sections of AWWA D100.

D. All connections to the tank shown on the plans shall be completed.

E. The pneumatic tank shall be disinfected in accordance with Section 391-3-5-12 of the Rules for Safe Drinking Water.

SECTION 15200
PUMPS

PART 1 - GENERAL

1.01 SCOPE

The work of this section involves furnishing and installing submersible sewage pumps complete with controls, access covers, and accessories necessary for a complete installation. Controls shall be as specified in paragraph 2.03, below.

1.02 SUBMITTAL OF INFORMATION

A. Submit characteristic curves for pumps, showing total dynamic head, efficiency and brake horsepower plotted against capacity in gpm for all conditions of head and capacity.

B. Submit manufacturers data showing dimensional information and materials of construction for pumps, discharge elbows, access covers, guide bars and brackets, cable holders, control panels, floats and all other accessories. Control panel drawings shall include wiring diagrams.

C. Submit shop drawings showing equipment installation, layout, and dimensions.

D. Submit six Operation and Maintenance Manuals which include specific instructions for receiving and handling, disassembly, wiring, installation repair and service troubleshooting pumps and controls, and a full parts list.

PART 2 - PRODUCTS

2.01 PUMPS

	EFFLUENT P.S.
A. Quantity:	2
B. Manufacturer:	FLYGT NP3127
C. Operating Conditions:	
1. Capacity (GPM):	500
2. Total Dynamic Head(ft):	35
3. Minimum motor hp:	7.5HP
4. Speed (max.):	1750 RPM
5. Base Elbow Size:	4”
6. Liquid:	SLUDGE

D. Materials of Construction:

1. Casing: Cast Iron

2. Impeller: Cast Iron

3. Shaft: Stainless steel, integral pump and motor supported by upper and lower ball bearings.

4. All exposed fasteners: Stainless Steel

E. Impeller

1. Semi-open, non-clog

2. Keyed to shaft

3. Dynamically balanced while pumping

F. Motors

1. Motor to be protected from water by double mechanical rotating shaft seal system running in an oil reservoir. The shaft sealing system shall be capable of operating submerged to depth of 50 feet or out of the pumps liquid environment without damage.

2. The motor shall be 230/460 volts, 3 phase, induction type operating in a water tight casing. The motor shall be continuous duty NEMA Design B. However, output torque and speed characteristics shall be adequate to start and operate the pump over the entire recommended range without exceeding its allowable current and/or temperature rating.

3. The motor shall be furnished with a minimum of 35 feet of 4 conductor, water proof cable sized for the motors furnished. The cable shall be routed to the control panel without need for splicing.

4. All motors shall be rated for Class I, Division I, Group D hazardous locations.

5. Each motor shall be provided with thermal switches embedded in the motor stator. A moisture (leakage) sensor shall be provided to detect water in the stator chamber. Waterproof cables, minimum length 35 feet shall be provided for thermal switch and leakage sensor. These cables shall be routed to the control panel without need for splicing.

6. All electrical materials, equipment, and installation must be in accordance with the National Electrical Code.

7. Motors shall be equipped with circuit breakers for unbalanced three phase loads.

2.02 ACCESSORIES

A. General:

The pump manufacturer shall furnish a lifting and sealing system and station hardware such that the pump unit will be automatically and firmly connected to the discharge piping when lowered into place on the discharge elbow, permanently installed in the wet well. The pump shall be easily removable for inspection or service requiring no nuts, bolts, or other fasteners to be disconnected. As a minimum, the system shall provide the following at each station:

1. Non sparking sliding guide bracket and machined discharge flange cast integrally with the pump volume.

2. Discharge elbow and pump mounting base.

3. Access frame and cover, complete with hinges and lockable hasp, upper guide bar holder and level sensor cable holder.

4. Guide bars of 316 stainless steel pipe. Size of guide bars per pump manufacturer.

5. Safety chain and hook to be stainless steel.

6. The pump station shall have water service through a 1" freeze proof anti siphon hydrant and backflow prevention device.

7. The contractor shall supply a separate NEMA 4X stainless steel enclosure for the remote transmitting unit as specified in the control section and shown on the electrical plan.

2.03 CONTROL PANELS

A. Enclosure:

The enclosure shall be a NEMA-4x stainless steel. The enclosure shall be a wall mount type with a minimum depth of 8" sized to adequately house all the components. The door gasket shall be rubber composition with a retainer to assure a positive weatherproof seal. The door shall open a minimum of 180 degrees.

B. Inner Dead Front Door:

A polished aluminum dead front shall be mounted on a continuous aircraft type hinge, contain cutouts for mounted equipment, and provide protection of personnel from live internal wiring. Cutouts for breaker handles shall be provided to allow operation of breakers without entering the compartment. All control switches, indicator pilot lights, elapsed time meters, duplex receptacle and other operational devices shall be mounted on the external surface of the dead front. The dead front shall be open a minimum of 150 degrees to allow access to equipment for maintenance. A 3/4" break shall be formed around the perimeter of the dead front to provide rigidity.

C. Each panel shall be equipped for automatic switch over to standby power. The panel shall be equipped with an emergency generator connector that matches the City's generator hookup.

D. Back Plate:

The back plate shall be manufactured of 12 gauge sheet steel and be finished with a primer coat and two (2) coats of baked on white enamel. All hardware mounted to the subpanel shall be accomplished with machine thread tapped holes. Sheet metal screws are not acceptable. All devices shall be permanently identified.

E. Power Distribution:

The panel power distribution shall include all necessary components and be wired with stranded copper conductors rated at a minimum of 90 degrees C. All conductor terminations shall be as recommended by the device manufacturer.

F. Circuit Breakers:

All circuit breakers shall be heavy duty thermal magnetic or motor circuit protectors similar and equal to Square D type FAL. Each motor breaker shall be adequately sized to meet the pump motor operating characteristics and shall have a minimum interrupting capacity of 22,000 amps at the power service voltage. The control circuit and the duplex receptacle shall individually be controlled by heavy duty breakers.

Circuit breakers shall be indicating type, providing "ON-OFF-TRIP" positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position indicating "TRIP".

Thermal magnetic breakers shall be quick-make and quick-break on both manual and automatic operation and have Inverse time characteristics secured through the use of bimetallic tripping elements supplemented by a magnetic trip.

Breakers shall be designed so that an overload on one pole automatically trips and opens all legs. Field installed handle ties shall not be acceptable.

Provide two 20 ampere, one pole circuit breakers in the panel for the owner's 120V miscellaneous electrical loads.

G. Motor Starters:

Motor starters shall be full voltage, non-reversing type with individual overload protection in each leg. If required by the power company and indicated on the electrical schematic, the motor starters shall be solid state reduced voltage type with soft start and current limit features. The solid state starters shall be Allen Bradley Bulletin 150 smart motor controllers or equivalent.

H. Transformers:

Control transformers shall provide the 120 VAC and/or 24 VAC for control circuits. Transformers shall be fused on the primary and secondary circuits. One leg of the secondary shall be grounded. The 120V control transformer shall have additional 500VA capacity for owners 120V miscellaneous electrical loads.

I. Phase Monitor:

A line voltage rated, adjustable phase monitor shall be installed to sense low voltage, loss of power, reversed phasing, and loss of a phase. Control circuits shall be de-energized upon sensing any of the faults and shall automatically restore service upon return to normal power.

J. Alarm System:

1. The alarm light shall be a weatherproof, shatterproof, red light fixture with a 40 watt bulb to indicate alarm conditions. The alarm light shall be turned on by the alarm condition.

2. The alarm horn shall be mounted on the exterior of the cabinet. The alarm horn shall provide an aural signal of not less than 90db at 10 feet.

3. An alarm silence switch shall deactivate the alarm horn; however, the alarm light shall flash until the alarm condition ceases to exist. Provide an alarm system connection and equipment to meet City's current monitoring requirements.

K. Control System:

The pump control panel shall provide the following functions.

1. Multitrode control system shall be the primary system control for an "ON/Off" pumping facility with settings for "PUMPS OFF", "START LEAD", "START LAG", "HIGH LEVEL ALARM", and "LOW LEVEL ALARM". In addition backup system shall include floats "HIGH WATER ALARM", "LOW WATER ALARM", and "PUMP ON AT HIGH WATER ALARM". Each float shall be provided with minimum 35 feet of waterproof cable.

2. Provide six digit non-settable elapsed time meters for indication of pump run times.

3. Intrinsically Safe Duplex Controller:

The duplex controller shall be a UL listed, plug-in, programmed, solid state unit. The controller shall include the following listed functions:

(a) Alternator
(b) Hand-off-Auto (HOA) switches
(c) Time delay relays
(d) Alternator selector switch
(e) Float indicating LED's
(f) Output LED's
(g) Alternator test switch

All AC inputs and outputs shall be protected against transients induced by inducted loads. The controller shall be UL listed as a control device with intrinsically safe output level of 630 microwatts at 5 VDC applied to the float regulators assuring adherence to UL913 Publication for Division 1, Class 1, and Intrinsically Safe Apparatus.

L. Miscellaneous:

1. Drawings: A final as built drawing encapsulated in Mylar shall be attached to the inside of the front door. A list of all legends shall be included.

2. Panel Markings: All component parts in the control panel shall be permanently marked and identified as they are indicted on the drawing. Marking shall be on the back plate adjacent to the component. All control conductors shall be identified with wire markers as close as practical to each end of conductors.

3. Testing: All panels shall be tested to the power requirements as shown on the plans to assure proper operation of all the components. Each control function shall be activated to check for proper operation and indication.

4. Guarantee: All equipment shall be guaranteed for a period of one (1) year from date of acceptance. The guarantee shall be effective against all defects in workmanship or defective components. The warranty is limited to replacement or repair of the defective equipment.

5. Manufacturer: The manufacturer shall be a UL listed shop for industrial control systems and shall provide evidence of such on request from the Engineer or using authority.

6. All cables shall be enclosed in electrical conduit from the control panel through the wet well wall. Conduit shall be sized to allow easy removal of the cables and shall be sealed at both ends.

7. Site lighting shall be accompanied with a 150-watt floodlight mounted on a service pole 12’ above ground on a separate breaker.

8. All pump stations shall include a SCADA system provided by the developer to meet the requirements of the City’s current system reporting to the treatment facility that will accept the wastewater from the project. The system shall be by radio communication supplied by New Technology Systems, Warner Robins, GA. Any submittals by a different shall be reviewed by the City and its current supplier prior to design of the system.

SECTION 15201
VERTICAL TURBINE PUMP AND PIPING SYSTEM

PART 1 - GENERAL

1.01 APPLICABLE STANDARDS

A. American Water Works Association (AWWA):

E101 Well Pumps

1.02 SUBMITTALS

A. Six (6) copies of manufacturer's standard drawings and catalog cuts of the following items shall be submitted for approval by the Engineer:

1. Name, type, and model number of pump & motor.

2. Size of bowls, discharge column, pump shaft, screens and screen openings, and any other size necessary for the complete evaluation of the units.

3. Dimension drawing of complete unit.

4. Characteristic curves certified by the manufacturer including capacity, total head, required horsepower and set pump hydraulic efficiency.

5. Electric motor information.

6. Electrical Diagram to include Input/Output for SCADA system monitoring and operation.

B. Failure to submit the above information will be grounds for rejection of the installation.

PART 2 - PRODUCTS

2.01 PUMP

A. The pumps shall be designed and constructed to meet all those applicable portions of AWWA E101-77.

B. Pump shall be manufactured by Peerless, Goulds or other comparable manufacturer that has experience and a proven track record in the water and wastewater industry.

a. Pump capacity shall 500 GPM @ 152’ TDH.

C. The pump outer housing shall be suitable for containing the pump diffusers and impellers and shall serve to support the entire weight of the complete pumping assembly. It shall be constructed of high quality seamless steel tubing capable of bearing the maximum head shut-off pressures of the pump and also include an adequate safety factor.

D. The pump diffusers shall be accurately machined from a single piece of suitable metal, cast iron, or equal. The bushing surface of the diffusers shall be designed to provide maximum alignment for the impeller.

E. The pump impellers shall be of solid bronze meeting ASTM description B145. They shall be the enclosed type held rigidly in place by tapered drive sleeves or other approved means.

F. The pump shaft shall be stainless steel, so sized that an adequate safety factor for the work to be performed exists.

G. With electric power the pump motor shall be of the full-voltage starting, vertical hollow-shaft squirrel- cage induction type, and shall comply with ANSI C50.2. The connection to the top shaft shall be through a coupling or clutch in the motor head. The motor shall be of the proper size to drive the pump continuously over the specified operating range without the load exceeding the name plate rating on the motor. The motor shall be rated as dip proof with class B insulation and with a 1.15 service factor. Motor thrust bearing shall be precisely aligned and shall be sized to carry all residual pump thrust and still provide an adequate safety factor. The motors shall not "drag" during the startup but shall reach full operating speed within 21 cycles after being energized.

2.02 DISCHARGE PIPE

A. The discharge pipe shall be the size and material shown on the drawings.

B. The pipe shall be of such size to be compatible with the pump selected.

2.03 ELECTRICAL CONTROLS

A. The Contractor shall furnish electrical controls compatible with the pump motor furnished, the plant electrical design, and the SCADA and instrumentation requirements included in the project.

B. All electrical controls shall meet the requirements of the National Electrical Code.

C. The pump shall be equipped with combination circuit breaker magnetic starter with quick trip relays and hand-off automatic switch in NEMA - 1 enclosure suitable for manual or automatic operation.

D. For the three phase motor, provide three line protection.

E. Overload relays shall be equipped with properly sized heaters and shall be ambient compensated.

F. A phase failure relay which operates on phase current unbalance shall be provided in the starter enclosure for protection against single phasing condition.

G. The relay shall have adjustable pick-up value and an adjustable time delay of 0-30 seconds in order to prevent nuisance tripping on transient disturbances.

PART 3 - EXECUTION

3.01 PUMP

A. The pump shall be installed by the Contractor to the manufacturer's instructions.

B. The pump bowl shall be set as shown on the plans.

3.02 DISCHARGE PIPING

A. The piping shall be handled and installed in such a manner that the pipe will not be damaged, and shall be installed in accordance with manufacturer’s recommendations.

B. All piping shall be installed as shown on the plans.

3.03 ELECTRICAL CONTROLS

A. Installation of any electrical equipment will conform to the electrical section of these specifications.

SECTION 15202

FACTORY-BUILT 12X12 ABOVE GROUND PUMP STATION
WITH DUPLEX OR TRIPLES SELF-PRIMING PUMPS
(IN-PLANT PUMP STATION)

PART 1 – GENERAL

1.01 Section Includes

A. Work under this section includes, but is not limited to installing three factory built pump station units as indicated on the project drawing, herein specified, as necessary for proper and complete performance.

1.02 Reference

A. Publications listed below form part of this specification to extent reference in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

1. American Nation Std. Institute (ANSI) / American Water Works Assoc. (AWWA)
   a. ANSI B16.1 Cast iron pipe flanges and flanged fittings.
   b. ANSI/AWWA C115/A21.21 Cast/ductile iron pipe with threaded flanges.
   c. ANSI 253.1 Safety Color Code for Marking Physical Hazards.
   d. ANSI B40.1 Gages, Pressure, and Vacuum.
   e. AWWA C508 Single Swing Check Valves.

2. American Society for Testing and Materials (ASTM)
   a. ASTM A48 Gray Iron Castings.
   b. ASTM A126 Valves, Flanges, and Pipe Fittings.
   c. ASTM A307 Carbon Steel Bolts and Studs.
   d. ASTM S36 Structural Steel.

3. Institute of Electrical and Electronics Engineers (IEEE)
   a. ANSI/IEEE Std 100 Standard Dictionary of Electrical Terms.
   b. ANSI/IEEE Std 112 Test Procedure for Polyphase Induction.
   c. IEEE Std 242 Protection of Industrial and Control Power Systems.

4. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)
   a. NEC National Electric Code.
   b. NEC 701 National Electric Code article 701.
   c. NEMA Std MG1 Motors and Generators.

5. Miscellaneous References
   a. Ten-State Standards Recommended Standards for Sewage Works.
   b. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
   c. NMTBA and JIC Std National Machine Tool Builders Association and Joint Industrial Council Standards.

d. ISO 9001 International Organization for Standardization.

1.03 System Description

A. Contractor shall furnish and install one factory built above ground, automatic pump station. The station shall be complete with all equipment specified herein, factory assembled in a fiberglass reinforced polyester resin enclosure.

B. In addition to the station enclosure, principle items of equipment shall include two horizontal, self-priming, centrifugal sewage pumps, V-belt drives, motors, internal piping valves, motor control panel, automatic liquid level control system, and internal wiring.

C. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed under PART 2 – PRODUCTS of this section.

1.04 Performance Criteria

A. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pump station shall have **12″** suction connection, and **12″** discharge connection. Each pump shall be selected to perform under following operating conditions:

1. Capacity (GPM) **4,965**
2. Total Dynamic Head (FT) **47′**
3. Total Dynamic Suction Lift (FT) **15.2′**
4. Maximum Repriming Lift (FT) **13.0′**
5. Maximum Static Suction Lift (FT) **15.0′**
6. Total Discharge Static Head (FT) **41.5′**
7. Minimum Submergence Depth (FT) **2.00′**

B. Site power furnished to pump station shall be **3** phase, **60** hertz, **460** volts, **4** wire, maintained within industry standards. The available fault current provided at the pump station control panel is **14** kA rms symmetrical. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

1.05 Submittals

A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit six (6) copies of submittal data for review and approval.

2. Submittal shall include shop drawings, electrical ladder drawings, and support data as follows: Catalog cut sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump

characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

3. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

B. Operations and Maintenance Manuals

1. Operation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplies at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

2. Documentation shall be specific to the pump station supplies and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

   a. Functional description of each major component, complete with operating instructions.

   b. Instructions for operating pumps and pump controls in all modes of operation.

   c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

   d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

   e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA 79. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. Mechanical layout drawing of the pump station and components, prepared in accordance with food commercial practice, shall provide installation dimensions and location of all pumps, motors, valves, and piping.

3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instruction must be specific to equipment supplied in accordance with these specifications.

1.06 Quality Assurance

A. The pumps and pump station manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activites.

B. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment, and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

C. In order to unify responsibility for proper operation, it is the intent of these Specifications that all system components are furnished by a single supplier (unitary source) and that source shall be the pump manufacturer. The pumps must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

D. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. "Reverse-engineered" products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.

E. The term "pump manufacturer" or "pump station manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump station manufacturer" and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.

F. Pump Performance Certifications

1. All internal passages, impeller vanes, and recirculation ports shall pass a **3″** spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

2. Reprime Performance

   a. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.

   b. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.

   c. Pump must be capable of repriming **13´** vertical feet at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:

      1) A check valve is to be installed downstream from the from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.

      2) A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to the atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.

      3) The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90° elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.

      4) Impeller clearances shall be set as recommended in the pump service manual.

      5) Repeatability of performance shall be demonstrated by testing five consecutive cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.

      6) Liquid to be used for reprime test shall be water.

3. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

G. Factory System Test

1. All internal components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed, and horsepower. Factory operational test shall simulate actual performance anticipated for the complete station.

2. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of his choice, at the manufacturer's facility.

H. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.07 Manufacturer's Warranty

A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.

2. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for warrant of the station and all components.

B. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

C. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.

D. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report competed by an authorized manufacturer's representative must be received by manufacturer within thirty (30) day of initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

PART 2 – PRODUCT

2.01 In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

2.02 Manufacturer

A. The pump station system integrator must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of the determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

C. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.

D. Holes through the base shall be provided for suction and discharge lines, air release lines, and level control line. Holes for the suction and discharge lines shall be provided with a grout dam incorporated in a grout retention cavity which the contractor shall fill at installation with suitable grout to seal each pipe-to-base joint against the entrance of hazardous gases from the wet well.

E. Station base shall incorporate a suitable flange designed for securing the pump station to the concrete pad in accordance with the station plans.

2.03 PUMP DESIGN

A. Pump shall be horizontal, self-priming centrifugal type, designed specifically for handling raw unscreened domestic sanitary sewage or industrial waste. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 – GENERAL of this section.

B. The pump manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

C. Materials and Construction Features

1. Pump casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:

    a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.

    b. Fill port coverplate, 3 ½″ diameter, shall be opened after loosening a positive lock clamp bar assembly. In consideration for safety, capscrew threads must provide slow release of pressure, and the clamp bar shall ve retained by détente lugs. A non-metallic gasket shall prevent adhesion of the fill port cover to the casing while assuring a reliable seal.

    c. Casing drain plug shall be at least 1 1/4″ NPT to insure complete and rapid draining.

    d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 – GENERAL of this section.

2. Coverplate shall be cast iron Class 30. Design must incorporate the following maintenance features:

    a. Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.

    b. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS. Wearplate shall be self-cleaning design ensuring that debris is cleared away and does not collect on the impeller vanes.

    c. In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 PSI.

    d. Two O-rings of Buna-N material shall seal coverplate to pump casing.

    e. Pusher bolt capability to assist in removal of coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.

    f. Easy-grip handle shall be mounted to face of coverplate.

3. Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, seal plate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate the following features:

    a. Seal plate and bearing housing shall be cast iron Class 30. Anti-rotation ribs shall be cast into the sealplate to reduce internal wear and maximize component life. Separate oil filled cavities, vented to atmosphere, and shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

1) The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

2) The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.

3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

b. Impeller shall be ductile iron, two vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall be statically or dynamically balanced. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.

c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.

d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.

e. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be silicon carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design. An external O-ring secures the stationary seat to the sealplate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be Viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 – GENERAL of this section.

f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

4. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.

a. Clearances shall be maintained by a four point external shimless coverplate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or

accidental operator contact. The four point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than for points will not be considered.

b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel tabbed spacers from the rotating assembly side of the pump shall allow for further adjustment as described above.

c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

5. An externally removable suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished from the top of pump without disturbing the suction piping or completely draining the casing. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

6. Pump shall include flange kit consisting of two ASA spool flanges that shall be one piece cast iron class 30 suitable for attachment to suction and discharge ports. Each spool shall have one 1 – 1/4″ NPT and one 1/4″ NPT tapped hole with pipe plugs for mounting gauges or other equipment.

D. Serviceability

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.

2. No special tools shall be required for replacement of any components within the pump.

E. Drain Kit:

1. Pumps to be supplied with a drain kit for east of maintenance. The kit to contain 10′ length of reinforced plastic hose with female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel ball valve and aluminum male quick connect fitting.

F. Spare Parts Kit:

1. The following minimum spare parts shall be furnished with the pump station:
   a. One spare pump mechanical seal (complete with shaft sleeve)
   b. One cover plate O-ring

c. One rotating assembly O-ring
d. One set of rotating assembly spacers

2.05 Valves and Piping:

A. Each pump shall be equipped with a full flow type check valve, capable of passing a 3″ spherical Solid, with flanged ends and be fitted with an external lever and spring. 316 stainless steel body ring shall be threaded into the valve port. Valve clapper shall be cast iron, rubber face, and shall swing completely clear of waterway when valve is full open. The seating shall be by a resilient field replaceable ring on the valve disc contacting a bronze or stainless seat ring in the valve body. Hinge pin shall be of 18-8 stainless steel construction and shall be utilized with bronze bushings and packing type seal. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve shall be rated at 175 psi water working pressure, 350 psi hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3″spherical solid shall not be acceptable.

B. Plug valves shall be of the non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connection drilled in ANSI 125 lb. Standard. Valves shall have ports designed to pass spherical solids equal to the pumps capability. Valves shall be furnished with a drip-tight shutoff plug mounted in stainless steel or Teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface.

C. Automatic air release valves:

1. An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.

2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric-reinforced neoprene or similar inert material.

3. A cleanout port, three inches in diameter, shall be provided for east of inspection, cleanout and service.

4. Valves shall be field adjustable for varying discharge heads.

5. Connection of the air release valves to the station piping shall include stainless steel fittings.

D. Gauge Kit

1. A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum.

2. Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.

E. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.

2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be in angular alignment within 1/2°between flanges. Flanges shall be faced with a gasket finish.

F. Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

2.06 Drive Unit

A. Motors (Note: Maximum motor frame size is 405T open drip-proof.)

1. Pump motors shall be **100** HP, **3** phase, **60** hertz, **24**VAC, horizontal ODP, 1,750 RPM, NEMA design B with cast iron frame with copper windings, induction type, with Class F insulation and 1.15 service factor for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.

2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std 112.

2.07 Drive Transmission

A. Power to pumps shall be transmitted through V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.

B. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor if 1.5. Single belt drives or systems with a safety factor of less than 1.5 are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer.

C. Precise alignment tolerances of the drive assemblies shall be achieved by means of a belt/sheave laser alignment system resulting in the reduction of vibration, accelerated wear, and premature failure.

D. The pump manufacturer shall submit power transmission calculations which document the following:

1. Ratio of pump/motor speed.

2. Pitch diameter of driver and driven sheaves.

3. Number of belts required per drive.

4. Theoretical horsepower transmitted per belt, based on vendor's data.

5. Center distance between pump and motor shafts.

6. Arc-length correction factor applied to theoretical horsepower transmitted.

7. Service factor applied to established design horsepower.

8. Safety factor ratio of power transmitted/brake horsepower required.

E. Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member and braced to the unit base.

1. Guards must be completely removable without interference from any unit component, and shall be securely fastened and braced to the unit base.

2. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches. Tack welds shall not exceed four inch spacing.

3. The guard shall be finished in accordance with Section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

2.08 Pumps, piping and exposed steel framework shall be cleaned prior to painting. Exposed surfaces to be coated with one coat gray W.R. non-lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be lop VOC, alkyd based, high solids, semi-gloss white enamel for optimum illumination enhancement, incorporating rust inhibitive additives. The finish coat shall be 1.0 to

1.2 MIL dry film thickness (minimum), resistant to oil mist exposure, solvent contact, and salt spray. The factory finish shall allow for over-coating and touch up after final installation.

2.09 Electrical Control Components

A. General

1. The pump control system shall be supplied by the pump manufacturer to assure a complete unit and total system responsibility. The pumps, motors, and control system shall be set-up and tested as unit at the pump manufacturer's facility.

2. This specification includes a modified Gorman-Rupp duplex pump control system using Allen-Bradley model PowerFlex 70 or 700 variable torque drives. The drives and level/logic control are an integrated system utilizing factory wired and tested with the motors, pumps, valves and other equipment. The control system is mounted in a NEMA 1 stainless steel motor control center. The level/logic control includes an Allen-Bradley programmable logic control utilizing a MicroLogix 1500, digital and analog I/O and PanelView 550 operator interface. Wet well level is measured using a submersible pressure transducer 4-20mA transmitter in conjunction with a PLC analog input.

B. System Power Characteristics

1. Electrical power to be furnished to the site will be **3** phase, **60** hertz, **4** wire, **460** volts, maintained within plus or minus 10 percent. Control voltage shall not exceed 132 volts.

C. Panel Enclosures

1. Enclosures shall be constructed in conformance with applicable section of National Electrical Manufacturer's Association (NEMA) standards for type 1, stainless steel enclosures. Enclosure shall be fabricated of steel having a minimum thickness of not less than 0.075 inch (14 gauge). Interior and exterior surfaces shall be enamel over phosphatized surfaces.

D. Door

1. Enclosure shall be equipped with a hinged door held closed with clamps that are quick and easy to operate. The door shall accommodate the mounting of switches and indicators.

E. Mounting

1. All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators, and instruments shall be mounted through the control panel door. Self-tapping screws shall not be used to mount and components.

2. Wiring Class

a. All motor control center wiring to be NEMA call IIB including interwiring and interlocking between units and the liquid level control. Units shipped separately because

of shipping requirements shall be equipped with wiring harnesses with match-marked and keyed connectors for field assembly.

b. Complete control system engineering shall be supplied by the pump manufacturer and shall include system drawings showing all control units as they are interwired. Diagrams of individual units will not be acceptable.

3. Main Connections

a. Each control assembly shall be furnished with main terminals and ground lug for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the loads. The main terminals shall be mounted to allow incoming wire bending space in accordance with article 373 of the National Electric Code (NEC). A separate terminal strip shall be provided for 115 volt, single phase control power and shall be segregated from the main terminals. The percent of the control terminals shall be furnished as spares.

F. Branch Circuit Components

1. Motor branch components to be of highest industrial quality, secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; Self-tapping screws shall not be used to mount any components.

2. Circuit Breakers and Operating Mechanisms

a. A properly sized heavy duty motor circuit breaker, with RMS interrupting rating of **14,000** amperes at **460** volts, shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.

b. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position.

3. Starting Equipment

a. The inverter shall be suitable for operation of NEMA Design B, 4 pole motors. The inverter will have a diode bridge rectifier on the input to minimize the generation of electrical noise back into the line and provide near unity power factor. Output devices shall be transistors.

b. Bypass: When the start ramp time is complete, the starter shall energize an integral bypass contactor. When in the bypass mode, the bypass contactor shall carry the motor load to minimize internal heating in the electrical enclosure.

4. Environment Conditions

a. The inverter shall be capable of operation under any combination of the following conditions without mechanical or electrical damage. Temperature: 0 to +40 degrees C.

b. Relative Humidity: Less that 95% non-condensing

c. Altitude: Less than 1,000M (3300 ft) above sea level

d. Vibration: .006 inches displacement, 1G peak

e. Shock: 15G peak for 11mS (+/- 1.0mS)

5. Control Specification

a. Control System: Sinusoidal pulse width modulated voltage waveform

b. Frequency Accuracy: +/- 0.4% of max. frequency

c. Volts/Hertz Ratio: V/Hz user programmable

d. Operation Frequency: 0 to 400 Hz

e. Overload Capacity: 110% Overload capability for up to 1 minute, 150% Overload capability for up to 3 seconds.

G. Digital Readout and Monitor

1. See Scada & Instrumentation Spec.

H. Protection

1. The variable speed drive system shall include a diode or fully gated bridge rectifier, capacitor filter, and transistorized inverter section. Base driver signals to control firing of the power transistors will be designed with optically coupled isolators for maximum protection of the control circuits from high voltage and noise. The output will be a sinusoidal, pulse width modulated, voltage waveform for reduced harmonic heating in the motor.

2. The system protection will provide the following:

a. Intermittent overload – 50 to 150%

b. Current linit – 50 to 115%

c. Overcurrent- 220-300% of rated output current

d. Inverse time overload – 50 to 100 %

e. Short circuit – Phase to phase or phase to ground

f. Overvoltage – 10% above input line or DC bus voltage

g. Undervoltage – 10% below line voltage

h. Power loss ride-through – 500 mS

3. When the inverter trips out on a fault, the fault relay shall activate and the display shall indicate the reason for the trip as follows:
   a. Overcurrent
   b. Short Curcuit
   c. Overload
   d. Overvoltage
   e. Undervoltage
   f. Overheat
   g. Ground fault
   h. Motor stalled
   i. Power supply fault

4. Auto restart occurs when the inverter faults. Auto restart shall be adjustable up to 9 attempts with a 0.5 to 30 second interval. Auto restart will not be attempted for ground fault, output shorted, transistor shorted or internal microprocessor fault but will trip out immediately, activate the fault relay and make the appropriate indication on the display. At the last attempt to run on VFD, run the pumps via the bypass contactor.

5. In the event of a fault trip, the microprocessor shall save the status of the inverter at the time of the fault and make that information available on the digital display. Information regarding the last 4 faults is maintained in even of a power loss.

6. Operational Function:

   a. Acceleration and deceleration time independently adjustable from 0.1 to 3600.0 seconds (selectable ranges),

   b. Volts/Hertz patterns user selectable.

   c. Maximum and minimum frequency limit adjustments.

I. Secondary Lightning Arrestor:

1. The control panel shall be equipped with a secondary lightning arrestor to minimize damage to the pump motors and control from transient voltage surges. The arrestor shall utilize silicon-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps, and a Joule rating of 1500.

J. Phase Monitor:

1. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. An integral time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.

K. Control Circuit Components

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.

2. Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the drive fault. Selector switches to be heavy duty, oil-tight design with contacts rated NEMA A300 minimum.

3. Six digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in “hours” and “tenths of hours”.

4. The PLC shall be a CompacLogix Model L2 with Panel View 6. The PLC shall be equipped with CPU with 14k of user memory, and two configurable RS-232-C communication ports. One is used for connection to the electronic operator interface. The remaining RS-232 port is reserved for future customer use.

5. The PLC shall operate a 120 VAC power and be equipped with the communication devices, digital and analog I/O necessary to accomplish the specified operation. A minimum of 10% spare of the I/O used shall be supplied.

6. The program logic shall be stored in battery backed random access memory, as well as on a programmable, read only memory module. The memory module shall auto load and run when installed in the programmable control processor and is included to facilitate field repair or replacement of the programmable control hardware without the use of programming terminals or personal computers.

7. The power supply to the programmable control shall include an active tracking filter protection system to minimize the effects of electrical noise. Each motor starter or contactor shall be equipped with a surge suppressor.

8. Electromechanical relays and timers, when used shall be equipped with 120vac coils and contacts rated NEMA A-300 minimum. Timers shall be pneumatic or synchronous motor driven.

9. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.

L. Control Logic

1. See Scada & Instruction Section

M. Auxiliary Power Transformer:

1. The lift station shall be equipped with a 5 KVA stepdown transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door and a padlockable operator handle shall be secure on the exterior surface. Interlocks must prevent opening the door until circuit breaker are in "OFF" position.

N. Wiring

1. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.

2. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specification on the National Electric Code (NEC).

3. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

   a. Line and Load Circuits, AC or DC power ……Black
   b. AC Control Circuit Less Than Line Voltage……...Red
   c. DC Control Circuit……..Blue
   d. Interlock Control Circuit from external source……...Yellow
   e. Equipment Grounding Conductor……..…Green
   f. Current Carrying Ground…….……White
   g. Hot with Circuit Breaker Open……...Orange

4. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 18 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.

5. Motor branch and other power conductors shall be sized to carry the circuit load without exceeding either the conductor ampacity or the temperature rating of the connecting termination. Wires shall be clearly numbered or identified at each end. All wires in the control panel shall be bundled and tied or routed in ducts. All wires extending from components on the door shall terminate at a terminal block mounted on the back panel. All wiring extending outside the control panel shall terminate in a terminal without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

O. Conduit

1. Factory installed conduit shall conform to following requirements:

    a. All conduit and fittings to be UL listed.
    b. Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
    c. Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
    d. Conduit shall be sized according to the National Electric Code.

P. Grounding

1. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.

2. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

Q. Equipment Marking

1. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:

    a. Equipment serial number
    b. Supply voltage, phase and frequency
    c. Current rating of the minimum main conductor
    d. Electrical wiring diagram number
    e. Motor horsepower and full load current
    f. Motor overload heater element
    g. Motor circuit breaker trip current rating
    h. Name and location of equipment manufacturer

2. Control components shall be permanently marked using the same indentification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.

3. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

2.10 Liquid Level Control (Primary Control)

A. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.

B. The level control system shall be capable of operating as a Multitrode Level Sensing Unit.

C. The level control system shall continuously monitor the wet well level, permitting the operator to read wet well level at any time.

D. The level control system shall utilize the PLC sequencer to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle or if one pump runs as the lead pump for an excessive time.

E. *Level and speed controls shall include logical comparator setpoints. Setting shall be provided to control the levels at which the pumps start and stop as well as level endpoints for minimum and maximum speed. Two sets of speed setpoints shall be provided. The first set will be enabled when a single pump is running. The second set shall be enabled when two pumps are running. Each of the settings shall be adjustable and accessible to the operator without opening the control panel. Controls shall be provided to permit the operator to read and adjust the selected levels and speeds on the operator interface. Setpoint adjustments which require hard wiring, the use of electronic test equipment or artificial level simulation are not acceptable.*

F. *Upon operator selection of automatic operation, the PLC shall start the motor for one pump when the liquid level in the wet well rised to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the PLC shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the PLC shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating.*

G. When a single pump is running and the wet well is equal to the "1 pump minimum level", the drive will run at the "1 pump minimum speed". As the level rises, drive speed will increase to the "1pump maximum speed" when the wet well level is equal to the "1 pump minimum level". Likewise, when two pumps are running, the "1 pump" settings will be disabled and the control will use the "2 pump" level and speed settings.

H. *Level control range shall be o to 12.0 feet of water. Speed control range shall be 40.0 to 60.0 hertz. Overall repeat accuracy shall be (plus/minus) 0.1 feet of water or hertz.*

I. Alarms and shutdown routines shall operate as follows:

1. Conditional abnormal: The general alarm pilot light will quick flash until silenced, then slow flash until reset, then glow steady until condition returns to normal, then off. The operator interface will display the alarm when acknowledged. The external alarms will be active until silenced, and then off.

2. Condition abnormal then returns to normal: The general alarm pilot light will quick flash until silenced, the slow flash until reset, then off. The operator interface will display the alarm when acknowledged. The external alarms will be active until silenced, and then off.

3. Subsequent alarms will re-alarm when silenced or reset.

2.11 Liquid Level Control (Backup Control)

A. The backup liquid level control system shall be an independent redundant float control system.

B. The system works independent of the primary level control, and utilizes a small PLC. The control consists of: a relay, a small PLC and two non-mercury float switches. The low level float (pump off) is placed below all primary pump off set-points. The high level float (pump start) is placed above all primary on set-points. If either float condition is achieved, a "Float Control Timer" begins to count. When the timer expires, the float control is latched in, and the floats become active causing an indicating light to become illuminated on the front of the control panel. If the high level float is achieved a pump will start, if the level persists the second pump will start after an adjustable time period. When the wet well level reaches the low level float, both pumps will shut off. The float control includes alternation. Dry contacts wired to terminal blocks will be provided for the float control active alarm circuit. The float control system will remain latched until reset. The redundant float control is mounted in a separate Nema 4X enclosure. Float system includes a PVC chain and weight.

2.12 Alarm Light (Exteernal):

A. Station manufacturer will supply one 115 VAC NEMA 4X alarm light fixture with red globe, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.

2.13 Alarm Horn (External):

A. Station manufacturer will supply one 115 VAC weatherproof alarm horn with projector, conduit box, and mounting base. The design must prevent rain water from collecting in any part of the horn. The alarm horn will be shipped loose for installation by the contractor.

2.14 Automatic Telephone Dialer (Existing):

A. The station has an existing automatic telephone dialer system. The existing system must be protected.

B. The Contractor shall re-use the existing automatic dialer system for the new pump station.

PART 3 – EXECUTION

3.01 Examination

A. Contractor shall off-load equipment at installation using equipment of sufficient size and design to prevent injury or damage. Station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.02 Installation

A. Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Suction pipe connections must be vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve, or pump drain lines) as required in wet well.

C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.

D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence, and ground before actual start-up.

E. After all anchor bolts, piping, and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

3.03 Field Quality Control

A. Operational Test

1. Prior to acceptance by owner, and operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable: it is safe and in optimum working condition: and conforms to the specified operating characteristics.

2. After construction debris and foreign material has been removed from the wet well, contractor shall supply water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gauge readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems.

B. Co-ordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. The technician will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

C. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material, or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap, and debris.

D. The pump station should be placed into service immediately. If operation is delayed, station is to be stored and maintained per manufacturer's written instructions.

END OF SECTION

SECTION 15280

CHEMICAL FEED SYSTEM
20% SODA ASH (Na_2CO_3)
49% ALUM (POTASSUM ALUM)

PART 1 - GENERAL

1.01 GENERAL

A. The work described in this section consists of furnishing and installing a complete chemical feed system for the 20% Soda Ash and Alum feed system. The chemical feed system shall be as manufactured by ProMinent or approved equal. Work shall include, but not be limited to, furnishing and installing all piping, chemical feed tanks, pumps, controls and appurtenances, heat tracing, all trenching, excavation and backfill, installing all concrete structures and complete surface restoration and clean-up.

1.02 SUBMITTALS

A. Six copies of manufacturer's drawings and catalog cuts of the following items shall be submitted for approval by the Engineer:

1. Duplex Chemical Feed Package
2. Chemical feed controls
3. Chemical storage tanks
4. Pipe and appurtenance
5. Heat Tracing

PART 2 - PRODUCTS

2.01 DUPLEX CHEMICAL FEED PACKAGE

A. Duplex Chemical Feed Package shall be furnished as manufactured by ProMinent.or USFilter/Wallace & Tiernan Encore 700 or approved equal.

B. The chemical feed pumps shall have a capacity range of 0.96GPM-25GPM

C. The pumps shall be self priming capable of suction lifts, when dry, up to twenty feet.

D. The flow rate of each pump shall be adjustable based on a 4-20 mA signal.

E. Pump suction and discharge shall be 3/4" I.D.

F. Pump skid shall be 110 volt, 60 Hz, single phase.

G. Electrical service for this system shall be provided from the existing electrical control panel at the site location shown on drawing. Contractor to verify condition of homerun and breakers to panel LP1-25 and replace if necessary to include running all wiring and conduit as needed.

2.02 CHEMICAL FEED CONTROLS

A. Provide and install an EZautomation 3.5” color touch screen display model EZ-T4C-FS or approved equal to the existing PLC located in recirculation pump station location shown on drawings. This screen will allow operators to change set points for the chemical feed system.

B. Provide and install Phoenix radio system to send 4-20 mA signals from UV flow meter and ammonia probe to plc located in recirculation pump station locations shown on drawings.

C. Program existing PLC in panel located in recirculation pump station to receive signal from ammonia probe to start the chemical feed system at an adjustable set point and to pace the chemical feed system at a rate based on the signal from the flow meter from the UV system.

D. Add 24 volt power supply to power signal from UV flow meter

E. Install ammonia monitor at UV basin.

F. Provide all wiring, conduit required for power as needed from local existing UV cabinet.

2.03 CHEMICAL STORAGE TANKS

A. Provide one molded, seamless, filament wound, FRP tank with a capacity of 6,000 gallons. The tank shall be placed above ground on a concrete containment basin as shown on the drawings.

B. The tank shall have one 24" bolted manway, 3 - 3" flanged nozzles and 1 -6” "U" vent with screened opening.

C. The tank shall have a level gauge of 1½" clear PVC sight glass. The tank shall have one 2" PVC filler line located in the top of the tank terminating with a 2" ball valve and stainless steel camlock male coupling with a PVC cap mounted on a stainless steel shelf within the containment area.

D. The chemical storage tank shall be insulated and heat stripped. The head tracing system shall use an econotrace cable with dual thermostats. The system shall be 115 VAC. The heat panels must be able to maintain the chemical at 80° F. One thermostat shall be used for control and one shall be used for overload safety. Both thermostats shall be set by the Owner. The insulation shall be 2" of polyisocynurate insulation with a vinyl acrylic weather barrier (Mastic WC-5).

E. Shop drawings for fiberglass chemical storage tank shall be stamped by an engineer registered in Georgia.

2.04 PIPING AND APPURTENANCES

A. All piping, suction and discharge shall be 3/4" schedule 80 PVC. All valves, fittings and connectors shall be schedule 80 PVC.

B. All fill line pipes shall be 2" schedule 80 PVC. All fill line valves, fittings and connectors shall be schedule 80 PVC.

C. Fill line shall have a 2" stainless steel male camlock with a 2" plastic female camlock cap. There shall be a spill containment basin and an HDPE piping sump for the fill port.

D. All casing pipe and appurtenances shall be schedule 80 PVC.

2.05 HEAT TRACING

A. Provide heat tracing with controls for all PVC lines on the chemical system

B. Heat tracing to maintain a temperature of 80° F and should be self-regulating

C. All exposed PVC lines to receive UV resistant pipe insulation.

D. Heat tracing to be weather proof for outside installation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for the complete installation which must be in accordance with equipment manufacturer's recommendation.

B. The manufacturer should furnish supervision of all installation and supply a qualified service representative to instruct the Owner in the operation and servicing of the equipment.

C. All pipe penetrations through walls shall be cored and cased with schedule 80 PVC pipe. All penetrations shall be insulated and waterproofed.

D. Check valve shall be installed at end of chemical feed pipe run prior to discharge into wetwell.

E. All piping shall be adequately supported with pipe clips and supported from frames constructed of galvanized steel, anchored to concrete. Support of the piping shall be at the minimum of ever 6’ of pipe run. All piping shall be installed plumb and level.

F. Support piping adjacent to chemical pump skid such that no weight is carried on pump skid.

G. Safety Items: Provide gloves, goggles and apron suitable for use with the chemical involved. Provide signage to be mounted outside of door of chemical room as required by OSHA. Paint all tripping hazards with safety yellow paint.

SECTION 15281
HYDROGEN SULFIDE ODOR CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. These specifications provide for furnishing a complete odor control system (system) for the removal of wastewater generated gas phase Hydrogen Sulfide (H_2S) concentrations. The system will be installed at the Headworks at the wastewater treatment facility on Hero Road on Fort Stewart, GA. 31314.

B. The complete system shall include the following items: packed tower scrubber, polypropylene ductwork and stack, fan, scrubber electrical control panel, and all fittings, gaskets, and fasteners.

C. The manufacturer shall be required to field verify the actual airborne H_2S concentrations by continuous sampling for 48 hours and design the system based upon 99% removal of the maximum hourly recorded concentration; however, the minimum design H_2S concentration shall not be less than 30 PPM.

D. Equipment furnished and installed under this section shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by the engineer.

1.02 SUBMITTALS

A. Complete shop and installation drawings of all materials and equipment furnished under this Section shall be submitted by the Contractor for approval in accordance with the bid document. Submittals shall include, but not be limited to, the following:

1. Complete description in sufficient detail to permit an item comparison with the specifications.

2. Detailed drawings showing all of the details of construction pertaining to the odor control system. This shall include installation details of all equipment associated with this system.

3. Detailed schematic and layout drawings and a description/narrative explaining the operation of all control panels.

4. All interconnections and interface requirements, dimensions, and locations of all major elements of the odor control system including critical clearance requirements.

5. Basis of design, including background data, calculations, operational plant data and other information showing the development of the proposed design and that it will conform to the requirements of this specification.

6. The startup/performance testing report and manufacturer's certification as required in Part 3.

1.03 CODES AND STANDARDS

A. Equipment specified herein shall meet or exceed the applicable sections of the following codes and standards authorities.

1. AGMA, American Gear Manufacturers Association.

2. ASME, American Society of Mechanical Engineers.

3. ASTM, American Society of Testing and Materials.

4. ANSI, American National Standards Institute.

5. IEEE, Institute of Electrical and Electronics Engineers.

6. NEC, National Electrical Code.

7. U.L., Underwriters Laboratories.

8. AWS, American Welding Society

1.04 SYSTEM STARTUP

A. It is the responsibility of the contractor to ensure that the odor control system manufacturer will provide a representative for startup services upon completion of the systems installation. The following activities shall be provided by the manufacturer.

B. Manufacturer's Representative

1. The manufacturer's representative shall inspect the construction plans and the installation, and recommend any required modifications, additions, or other changes required to allow the manufacturer to certify that the complete installation is appropriate and will operate as expected and intended.

2. The manufacturer's representative shall instruct the Owner's and Engineer's personnel on the operation and maintenance of the system. The instruction shall include both classroom and field training on proper operation and maintenance procedures, accompanied with complete demonstrations.

3. The manufacturer's representative shall supervise the performance testing of the installation.

4. The manufacturer's representative shall provide at a minimum, services in accordance with the following table:

Purpose	No. of Days
Installation Supervision	As required for complete installation
Start-up and Calibration	1
Testing and Maintenance Instruction	1
Follow-up Instruction and Optimization	As Needed

5. The number of days indicated above shall be provided on an 8-hour-day on-site basis and shall be in addition to travel time.

1.05 DESCRIPTION OF SYSTEM

A. The Manufacturer shall furnish a complete, pre-engineered Odor Control System. The Manufacturer of the Odor Control System shall be responsible for the design and fabrication of the complete system within the limits specified herein. Site preparation shall be the responsibility of the Owner as described and as specified.

B. The following minimum design parameters shall be incorporated into the Manufacturer's design:

1.	Average Influent concentration:	>30 ppm Hydrogen sulfide (H_2S)
2.	Airflow Rate:	550 CFM
3.	Removal Rate:	>99.0% H_2S
4.	Design carbon life:	>1 year

1.06 QUALITY ASSURANCE

A. To assure unity of responsibility, all equipment and material specified in this Section of the Specifications shall be furnished and coordinated by the Odor Control System Manufacturer.

B. All equipment furnished under this Specification shall be new and unused and shall be the standard product of manufacturers having a successful record of operation, manufacturing, and servicing similar equipment and systems.

C. All components of the odor control system shall be of high quality and sized to accommodate, without failure or compromise, all forces encountered during fabrication,

installation, and operation. Compliance with the performance requirements of the specification shall not relieve the contractor of his responsibility to supply equipment having the specific structural, mechanical, operational, and surface corrosion protection features as specified herein.

D. The odor control system shall be factory assembled and tested prior to shipment to ensure proper operation.

1.07 WARRANTY

A. The equipment furnished under this section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, storage, and installation for a period of one year from the date of the startup. In the event that any equipment failure occurs during this time period, it is the responsibility of the manufacturer to repair and/or replace the equipment at no cost to the owner.

1.08 SUBSTITUTIONS

A. Any substitutions or deviations in equipment or arrangement from those specified herein shall be the responsibility of the Manufacturer. Any deviations must be accompanied by detailed structural, mechanical, and electrical drawings and data for review by the Engineer. All costs associated with review of substitutions or deviations and costs associated with project drawing changes as a result of approval of such shall be borne by the Manufacturer. There shall be no additional costs to the Owner due to substitutions or deviations.

1.09 PRODUCT HANDLING

A. All equipment items shall be properly protected so that no damage or deterioration will occur from the time of shipment until installation is completed and the units and equipment are ready for operation.

B. All exposed blower and equipment openings shall be protected.

C. Proper care shall be taken to protect mechanical parts from the entrance of water during shipment, storage, and handling.

D. Each box or package shall be properly marked to show its contents.

PART 2 – PRODUCTS

2.01 GENERAL

A. All equipment furnished shall be new and suitable for the conditions of service to which they will be subject. Workmanship shall be of the highest quality and shall be carried out by competent and experienced workmen. All parts shall be protected so that no damage may occur during a long delay from time of shipment to time of completion of installation.

B. Operating Conditions - The odor control system shall be suitable for long-term operation under the following operating conditions.

1. Duty: Continuous or cycle timed, per electrical design requirement.

2. Ambient environment: Exterior

3. Ambient Temp. (°F): 20-110

4. Project site elevation (ft. MSL): 60

5. Total air flow (SCFM): 550

6. Average influent H2S conc. (ppm): 30

7. Maximum influent H2S conc. (ppm): <100 ppm, intermittent

8. Removal required (%): >99.0% H2S

2.02 MULTI-STAGE ORDOR CONTROL SYSTEM

A. System Components

1. The system shall consist of the following components:

a. Ductwork (installing contractor supplied)
b. Fan
c. Vertical FRP Vessel
d. Activated Carbon
e. Inert Biotrickling filter media
f. Water Recirculation system
g. Water panel
h. Electrical Control panel

B. Ductwork

1. The scrubber-blower connection duct system shall be fabricated from black polypropylene, or equal (must be approved by the engineer) and be UV resistant.

2. All ductwork and fittings shall be fabricated using the hot gas fusion method utilizing PVC filler rod as manufactured for the purpose.

3. All cutting and fitting of welded joints shall be made using a state of the art Computer Aided Router.

4. All joints shall be joined using an Automated Butt Welder to insure leak free joints and uniform construction.

5. All ductwork and fittings will be built and reinforced by standards set by SMACNA and SPI standards.

6. All duct sections will include specific trim lengths for field installation based upon mandatory site field visits and sketches by manufacturer or representative.

7. Ductwork connecting the scrubber and air volume source shall be fabricated from PVC, and be UV resistant.

8. Ductwork will connect to headworks at to points as shown on drawings

9. 2 butterfly valves will be installed for air flow equalization.

C. Fan

1. The fan will be equipped with a premium efficiency motor.

2. The fan housing will be manufactured of black polypropylene or equal (must be approved by the engineer) and must be UV resistant.

3. The fan inlet shall include a close tolerance inlet cone precisely fitted to insure efficient fan operation and shall include a flexible inlet coupling.

4. Shaft bearings shall be ball bearings with grease fittings for lubrication. Bearings will be located outside the air stream to ensure long life.

5. The fan shall be both static and electronically balanced with an electronic vibration analyzer to insure smooth operation.

6. The drive will conform to all OSHA standards.

7. The fan motor will be totally enclosed, fan cooled, ball bearing type, mounted on an adjustable base to allow for belt tensioning and alignment.

8. The fan cover shall be PVC or other non-corrosive material.

9. The fan shall be recommended by the manufacturer based upon the specific conditions described below:

	Headworks
Ventilating	H_2S
Capacity	550 CFM
Minimum Motor Horsepower	1HP TEFC
Voltage	460 V, 3 Phase, 60 Hertz

D. Vertical FRP Vessel

1. The unit shall be of a low maintenance vertical design and constructed of FRP or equivalent, as approved by the engineer, and be UV resistant.

2. Open orifice spray nozzles shall be constructed of polypropylene. The spray header shall be easily removed for servicing.

3. Access openings will be included to ease of operation/maintenance.

4. Lifting lugs and hold down lugs shall be included.

5. Re-circulation system shall be a self-contained sump. The recycle system shall use a high efficiency recirculation pump.

6. The pump shall have the capability of running dry without damage. The pump shall come equipped with a high efficiency chemical duty motor for continuous operation.

7. The sump shall contain a high-level overflow drain with a ball valve to facilitate installation and operation.

8. Lifting lugs shall be provided.

9. Quick opening access doors and view port shall be standard.

10. All necessary hardware and gaskets for complete installation and operation will be provided. Hardware will be 316 stainless steel and all flange gasket material shall be PVC.

11. The scrubber design basis and operating conditions shall be as follows:

    a. Contaminants – H_2S
    b. Capacity – 550 CFM (Headworks)
    c. Vertical unit
    d. Self-Contained Recirculation
    e. Liquid Flow Rate – 40 GPM
    f. Make-up Water Rate – 0.4 GPM
    g. Packing Type – Biotrickling filter media 55ft^3 , Enduro Bioscrub XL
    h. Material Type – FRP
    i. Recirculation Pump – 1 HP, 230/460 V,

E. Scrubber Control Panel

1. Panel enclosure will be stainless steel NEMA 4x and will include motor starters for scrubber pump and system fan and Hand-Off-Auto selector switch with illuminated bulbs and emergency stop button. All system components will be NEMA rated.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for the complete installation of each of the odor control systems. Installation shall not be considered to be complete until the equipment

has been tested under normal and peak loading conditions for the facility, and has been proven to successfully handle such loadings.

B. The odor control system shall be received onsite in as few parts as possible and it shall be the responsibility of the Contractor to install the system as it is received.

C. It shall be the Contractor's responsibility to ensure a safe installation, free from: flaws in equipment alignment, damage, and damage to any of the existing structures or components. If damage to the system, any of its equipment, or any of the existing structures (e.g., sump, building, piping, etc.) does occur, it is the Contractors responsibility to repair these items to their original specifications at no charge to the owner. If the equipment or structure is deemed to be beyond repair by the engineer's representative, it shall be the responsibility of the Contractor to replace the item at no charge to the Owner.

D. Each odor control system shall be attached to the sump as shown in the construction drawings and as specified by the manufacturer's and engineer's representative. The attachment method shall be by means of bolting, the bolts shall be torqued to that specified by the manufacturer to ensure a securely anchored support for the system.

E. It is the responsibility of the Contractor to make all specified pipe connections. These connections shall be seated properly and free of all leaks. Piping for the system shall be installed as specified in the construction drawings, and shall include all required pipe lengths and spacings.

F. The Contractor shall be responsible for assembly and installation of all electrical and accessory equipment required by the manufacturer and engineer for successful and efficient equipment operation. Installation of all electrical equipment shall be performed by a licensed qualified electrician and in accordance with the NEC and all federal, state, and local regulations.

3.02 GENERAL TESTING REQUIREMENTS

A. The manufacturer shall furnish the services of a factory-trained engineer as given in Paragraph 1.04 to supervise start-up and testing of the system. The system shall operate to the specified requirements as set forth by the manufacturer and engineer. If the system fails to meet the specified requirements, it shall be adjusted, repaired and/or replaced at no additional cost to the Owner.

3.03 FUNCTIONAL TESTING

A. Proposed functional testing shall be developed by the manufacturer and submitted to and reviewed by the Engineer two (2) weeks prior to installation. If the proposed testing requirements are found to be insufficient by the engineer, the engineer will submit the changes that must be made in the testing program back to the manufacturer. The

manufacturer will then have two (2) working days to resubmit the testing program to the engineer for approval.

B. Prior to startup, a manufacturer's and engineer's representative shall inspect the system for proper alignment, correct operation, proper connection, and satisfactory function of all components. When final approval of system is given, the manufacturer's and engineer's representative shall provide certification that the system components have been installed correctly and are ready for operation. Until such time as written approval is given by both the manufacturer's and engineer's representative, it is the Contractors responsibility to make the required repairs, changes, and adjustments to the ensure delivery of an odor control system free from defects of any kind.

3.04 PERFORMANCE TESTING

A. Testing shall be performed by the manufacturer. Testing shall commence immediately after start-up activities and installation approval of the system. Testing shall commence over a period of two (2) weeks and as specified by the engineer, when the flow rate through the facility is at or near the peak flow rating of the facility. At each of these intervals, testing will be accomplished to ensure that all of the performance requirements specified herein are met or exceeded. If the contractor desires, he may engage an independent certified testing laboratory to perform simultaneous testing.

SECTION 15301
GATES

PART 1 - GENERAL

1.01 SCOPE

The work of this section includes furnishing and installing all gates and gates for the piping systems shown on the drawings, as specified herein or as required for equipment operation. The gates shall be capable of isolating flow from the structure under all conditions without leakage.

1.02 SUBMITTALS

The Contractor shall prepare and submit for approval, complete detailed drawings of all gates in accordance with the requirements of the appropriate section of these specifications. All gates of the same type shall be from a single manufacturer. Spare parts shall be furnished as specified under the proposal items. Special tools required for repacking or disassembling gates shall be provided.

PART 2 - PRODUCTS

2.01 ALUMINUM SLUICE GATES

A. The Contractor shall furnish and install aluminum sluice gates at the outlet structure of the sizes indicated.

B. The gate frames shall be a one piece 1/4 inch 6061 T6 aluminum extrusion with a continuous mounting flange suitable for surface mounting to a concrete wall. The extruded aluminum frame shall be mitered and welded continuously, and shall incorporate a one piece extruded polymer channel liner.

C. The gate shall be 1/4 inch aluminum and shall be reinforced to deflect no more than 1/360th of the span. The bottom edge of the gate shall be beveled for positive seating.

D. A cast aluminum handwheel shall be provided and shall work in conjunction with a brass lifting nut and a 1 1/2 inch stain-less steel acme rod. All hardware shall be stainless steel. The lifting nut shall be provided with a grease fitting for ease of lubrication. Polymer bearing pads shall be incorporated above and below the brass lifting nut.

E. The sluice gate assembly shall include a wall thimble to ensure a water tight seal under all operating conditions.

F. The sluice gate assemblies shall be manufactured by Rodney Hunt, Inc. or approved equal.

2.01 ALUMINUM STOP/ SLIDE GATES

A. The Contractor shall furnish and install aluminum stop gates at the location shown on the plans of the sizes indicated. The gate assemblies shall be manufactured by Rodney Hunt, Inc. or approved equal

B. The disc shall be aluminum plate ASTM B209 6061-T6 reinforced with structural aluminum shapes or extrusions welded to the plate. The disc shall not deflect more than $1/360^{th}$ of the span of the gate under the design head.

C. The guide shall be extruded aluminum plate ASTM B221 6061-T6. The guide shall be designed for maximum rigidity and shall have a weight of not less than 3.0 lbs. per linear foot. The guide shall be designed to embed into the face of the concrete and shall provided with keyways to lock them into the concrete.

D. A cast aluminum handwheel shall be provided and shall work in conjunction with a brass lifting nut and a 1 1/2 inch stain-less steel acme rod. All hardware shall be stainless steel. The lifting nut shall be provided with a grease fitting for ease of lubrication. Polymer bearing pads shall be incorporated above and below the brass lifting nut. Stem shall be ASTM A276 Type 304 stainless steel and shall have a rising stem cover of clear polycarbonate with vent holes.

E. The gate assembly shall include a wall thimble to ensure a water tight seal under all operating conditions. Leakage shall be limited to 0.1 gpm per foot of seating perimeter.

F. The seal shall be specifically extruded resilient neoprene mounted to the mounted to the bottom of the disc or installed into the invert member to provide flush bottom closure. The shape of the seal will produce a seating surface having a minimum surface having a minimum width of 314” and the seal shall extend into the secondary slot of the vertical guide.

PART 3 - INSTALLATION

3.01 All gates shall be carefully mounted in their respective positions free from all distortion and strain. All gates shall be properly packed and left in satisfactory operating condition at the completion of the project.

3.02 Mechanical joints shall be made in accordance with paragraph 3.01 (G) of Section 02555 of these specifications.

3.03 Flanged joints shall be made using full-face rubber gaskets 1/8" thick. Bolts and nuts the gate is shall be carbon steel conforming to ASTM A307.

3.04 Upon completion of the installation the contractor shall demonstrate that watertight from one side to the other and allows complete isolation of liquid.

SECTION 15302
FLOW METERING EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE

The work of this section involves furnishing and installing the propeller meter with flow indicator, totalizer, and recorder at the land application pumping station and the parshall flume with ultrasonic flow meter at the effluent of the constructed wetlands.

1.02 SUBMITTALS

A. Shop drawings shall be submitted in accordance with Section 01001, Paragraph 1.17 of these specifications.

B. Operation and maintenance manuals shall be submitted in accordance with Section 01001, Paragraph 1.18 of these specifications.

PART 2 - PRODUCTS

2.02 PROPELLER METER

A. Provide an 8" propeller type flow meter for measuring the flow of the land application system pump station.

B. The flow meter shall be flanged tube type with 150 lb. AWWA Class D flat face steel flanges.

C. The propeller shall be magnetically coupled with the driven mechanism through the sealed oil filled gearbox.

D. Provide an indicator/totalizer/transmitter on the meter. The transmitter shall be two-wire with 4-20 MA output.

E. Provide a strip chart recorder with 7 - digit totalizer in NEMA - 1 wall mounting type enclosure.

F. The propeller meter indicator, totalizer, transmitter shall be water specialties catalog number ML-04/TR16 or approved equal.

2.02 PARSHALL FLUME

A. The flume shall be a 12" parshall flume designed to measure flows from .078 MGD to 10.4 MGD. The flume shall be a molded structure of fiberglass reinforced polyester. The interior surface shall have a ten (10) to fifteen (15) mil white ultraviolet-resistant gel-coat backed by a rich layer of resin and chopped glass forming a water and chemical resistant surface. The remainder of the laminate shall be fiberglass reinforced polyester containing not less than thirty percent (30%) glass content by weight. The thickness of the walls and floor of the flume shall not be less than one-fourth inch (1/4"); and shall be reinforced with stiffeners down the sides and across the bottom on flumes with a throat width of three inches (3") or greater. The stiffeners shall be joined together at the knee to form a rigid dimensionally stable flume.

B. The flume shall be provided with anchoring clips fastened along the side of the flume to be used for anchorage into the concrete. Stiffeners made of FRP angle/channel shall be provided across the top of the flume to provide structural support during shipping and installation.

C. Flume dimensions shall be in accordance with the United States Department of Interior, Water Measurement Manual, and latest revision. The flume shall be as manufactured by TRACOM, Inc., or equal.

D. The flume shall be provided with a head gauge calibrated in tenths of a foot, molded into the side of the flume, at the point of measurement.

2.03 ULTRASONIC FLOW METER (Open Channel Flow)

A. There shall be furnished a recording, totalizing open channel flow meter suitable for portable or fixed-site monitoring. An ultrasonic sensor capable of measuring up to 10' shall be used to measure level. The flow meter shall be ISCO, Signature flow meter or equal and must be programmable for measuring flow based on the type flow monitoring device installed. Any application requiring level measurements over 10' shall be Rosemount Model 3108 Ultrasonic flow transmitter along with a Rosemount 3490 Series controller Unit.

B. The sensor shall consist of a single ultrasonic transducer housed in a corrosion resistant Xenoy plastic enclosure. The sensor shall include a temperature probe to automatically compensate for air temperature changes. The sensor shall automatically adjust its gain in response to echo strength to maximize performance in the presence of steam, foam, and turbulence. The sensor shall include variable blanking distance to ignore echoes from within a programmable distance from the sensor.

1. The level measurement span shall be from 0 to 10 feet (0 to 3.05 m) for ISCO or 0-39' for Rosemount. The level shall be measured with a maximum error of ±0.02 feet (±0.006 m) over a head change of 1 foot or less (0.31 m or less), and ±0.03 feet (±0.009 m) over a head change of 1 to 10 feet (0.31 to 3.05 m).

2. The sensor cable shall be 25 feet (7.62 m) long. The cable shall terminate in a sealed, military style connector so that the sensor can be easily replaced in the field. [An optional (25 ft. -7.62 m) extension cable shall be supplied.] A stainless steel mounting bracket shall be supplied for mounting the sensor and a sunshade. It shall be possible to suspend the sensor using only the cable.

C. Measured liquid level readings shall be converted into corresponding flow rate readings using internal conversion algorithms. The flow meter shall contain conversions for V-notch weirs, rectangular weirs with and without end contractions, Cipolletti weirs, and Parshall, Palmer-Bowlus, Leopold-Lagco, trapezoidal, H, HS, and HL flumes. For monitoring in applications using the Manning formula in round, U-shaped, rectangular and trapezoidal channels, the flow meter shall accept information for channel shape and size, and slope and roughness coefficient. The flow meter shall accept 4 sets of level-flow rate points, with up to 50 pairs of points in each set. The flow meter shall accept a two-term, level flow rate polynomial equation.

1. The flow meter shall be connected to tipping bucket rain gauge that tips every 0.01 inch (0.25 mm) or 0.004 inch (0.1 mm) of rainfall.

2. The flow meter shall include an input for a pH probe with a built-in temperature probe, a dissolved oxygen probe, and a temperature probe.

3. The flow meter shall be capable of activating a connected sampler based on an AND/OR combination of any two of level, flow rate, rainfall, pH or dissolved oxygen, and temperature.

4. The flow meter shall have a 12 volt pulse output for signaling a connected automatic sampler to collect flow proportioned samples. The flow meter shall have inputs to accept signals from the sampler indicating when a sample is collected and the bottle in which the sample is placed.

5. The flow meter shall contain a tactile keypad and a 2 line, 80 character, backlit alphanumeric liquid crystal display (LCD). The LCD shall visually prompt the user through the programming sequence. The LCD shall display level, flow rate, total flow, pH or dissolved oxygen, and temperature in user-selectable units of measure. The totalizer on the LCD shall be resettable. The flow meter shall include a non-resettable, mechanical totalizer. The LCD shall display the signal strength from the ultrasonic sensor to aid in installation and troubleshooting.

6. The flow meter shall contain a programmable transmitting unit that will allow output to the SCADA system.

7. The internal data storage memory in the flow meter shall have a capacity of 80,000 bytes, divided into up to 6 user-defined partitions. Each partition shall be programmable to store level, flow rate, rainfall, and pH or dissolved oxygen, temperate or sample data. Timing for the data storage shall be selectable in 1, 2, 5, 10, 15, 30, 60, or 120 minute intervals. Each partition shall be programmable to operate in either rollover, slate or triggered slate mode. Triggering events in slate mode shall be selectable from level, flow rate, rainfall, pH or dissolved oxygen and temperature.

8. The flow meter shall have a 4 to 20 mA output proportional to flow rate.

9. The flow meter shall have 2 form C relays with user-selectable trip points based on flow rate.

10. The program memory in the flow meter shall be non-volatile, programmable flash memory. The program memory shall be capable of being updated via the serial port on the flow meter without opening the enclosure.

11. The flow meter shall require 12 volt DC power for operation. Power shall be supplied from a rechargeable lead acid battery with solar panel battery charger.

12. The flow meter shall be housed in a rugged, lockable, watertight, dusttight, corrosion resistant (self-certified NEMA 4X and IP65) enclosure. The enclosure shall include a carrying strap, wall mounting bracket and a clear polycarbonate window for viewing flow data. An internal, easily replaceable, rechargeable desiccant canister shall keep the inside of the flow meter free of moisture.

2.04 ELECTRO-MAGNETIC FLOWMETER

A. Provide an electro-magnetic flow meter and converter (remote display) for installation as shown on the plan and shall be manufactured by ABB or Krohne.

B. Flow meter shall have an accuracy of 0.15%.

C. Flow meter shall match the size of the pipe shown on the plan.

D. Flow meter shall be designed to measure flow rates of the material contained in the pipe line (i.e. sludge, raw wastewater or partially treated wastewater).

E. Flow meter must be capable of submersible or buried environment.

F. Flow meter power consumption should be < 20VA with transmitter.

G. Meter lining shall be Teflon bonded (FEP)

H. Electrode shall be 316 stainless steel.

I. Flange shall be carbon steel.

J. Housing shall be ABS plastic up to 24", fabricated steel on larger units.

K. Flow meter shall not lose calibration if the pipe fails to stay full and will be capable of accurately measuring flow through the pipe at flows less than 100%.

L. Remote converter shall be mounted on a post at least 36" above ground and will have a rain shield mounted above.

M. Converter shall contain a keypad to allow changes to output information (to include flow rate, flow units) and must be compatible with SCADA system reporting flow.

N. The unit shall include a self test and diagnostic mode.

O. The converter must be the same manufacturer as the magmeter.

P. Output must be 4 – 20 mA signal to the SCADA system

SECTION 15520

GRIT SEPARATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section shall include furnishing, unloading at the jobsite, handling, storage and installing of a complete grit separation system. This system shall include two (2) spiral sand separation units, two (2) grit airlift units, and all ancillary equipment, as specified on the accompanying drawings and as required to meet the specified performance requirements.

B. Equipment furnished and installed under this section shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by the engineer.

1.02 SUBMITTALS

A. Complete shop and installation drawings of all materials and equipment furnished under this Section shall be submitted by the Contractor for approval in accordance with the bid document. Submittals shall include, but not be limited to, the following:

1. Complete description in sufficient detail to permit an item comparison with the specifications.

2. Detailed drawings showing all of the details of construction pertaining to the grit separation system. This shall include installation details of all equipment associated with this system.

3. Detailed electrical schematic and layout drawings and a description/narrative explaining the operation of all control panels.

4. All interconnections and interface requirements, dimensions, and locations of all major elements of the grit separation system including critical clearance requirements.

5. Basis of design, including background data, calculations, operational plant data and other information showing the development of the proposed design and that it will conform to the requirements of this specification.

6. The startup testing report and manufacturer’s certification as required in Part 3.

1.03 CODES AND STANDARDS

A. Equipment specified herein shall meet or exceed the applicable sections of the following codes and standards authorities.

1. AGMA, American Gear Manufacturers Association.

2. ASME, American Society of Mechanical Engineers.

3. ASTM, American Society of Testing and Materials.

4. ANSI, American National Standards Institute.

5. IEEE, Institute of Electrical and Electronics Engineers.

6. NEC, National Electrical Code.

7. U.L., Underwriters Laboratories.

8. AWS, American Welding Society

1.04 SYSTEM STARTUP

A. It is the responsibility of the contractor to ensure that the grit separation system supplier will provide a representative for startup services upon completion of the systems installation. The manufacturer shall provide the following activities.

B. Manufacturer's Representative

1. The manufacturer's representative shall inspect the construction plans and the installation, and recommend any required modifications, additions, or other changes required to allow the manufacturer to certify that the complete installation is appropriate and will operate as expected and intended.

2. The manufacturer's representative shall instruct the Owner's personnel on the operation and maintenance of the grit separation system. The instruction shall include both classroom and field training on proper operation and maintenance procedures, accompanied with complete demonstrations.

3. The manufacturer's representative shall provide at a minimum, services in accordance with the following table:

Purpose	No. of Days
Installation Supervision	As required for complete installation
Start-up and Calibration	1 per system
Initial Operation, Performance Test and Maintenance Instruction	1
Follow-up Instruction and Optimization	1

4. The number of days indicated above shall be provided on an 8-hour-day on-site basis and shall be in addition to travel time.

1.05 DESCRIPTION OF THE SYSTEM

A. The grit separation system shall consist of two (2) spiral separation units, two (2) grit airlift units and all accessories.

B. The minimum clearance requirements specified herein shall not relieve the contractor from allowing additional clearances for the proper installation, operation, and maintenance of the units. Should equipment other than that specified be proposed, the contractor shall be responsible for any redesign based on the requirements contained herein.

C. The grit removal device shall have less than ¼" head loss. The device shall be capable of removing grit from wastewater and depositing the grit in a storage chamber. The grit removal and storage device shall have no moving parts. Rotating turbines, blades, or submerged bearings are not acceptable. Baffling, if required, shall be constructed of fiberglass and installed according to the manufacturer's drawings.

1.06 SPARE PARTS

A. No spare parts shall be required for this system.

1.07 QUALITY ASSURANCE

A. General

1. Only manufacturers of sand separation units and grit airlift units of the type specified herein operating for a period of five years in a minimum of five wastewater treatment plants in the Southeastern United States shall be considered. Acceptable sand separation units shall be the Fluidyne FHG-14 Hydro-Grit or equal. Acceptable grit airlift units shall be the Fluidyne Aircirc or equal. Manufacturers not meeting the experience requirement shall not be acceptable.

2. All components of the grit separation system shall be of high quality and sized to accommodate, without failure or compromise, all forces encountered during fabrication, installation and operation. Compliance with the performance requirements of the specification shall not relieve the contractor of his responsibility to supply equipment having the specific structural, mechanical, operational and surface corrosion protection features as specified herein.

3. The sand separation unit and grit airlift unit shall be factory assembled and tested prior to shipment to ensure proper operation of all systems.

1.08 WARRANTY

A. The equipment furnished under this section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, storage, and installation for a period of one year from the date of the startup. In the event that any equipment failure occurs during this time period, it is the responsibility of the manufacturer to repair and/or replace the equipment at no cost to the owner

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General

1. The grit separation system must be designed to fit within the specified dimensions shown on the attached drawings and be of modular design.

2. The system to be furnished shall include the latest components and equipment available at the time of shipment.

3. All components exposed to or in contact with plant effluent, including all anchoring hardware, shall be comprised of corrosion/degradation resistant materials. Acceptable materials shall be as described in this section.

4. The grit separation system shall be able to continuously provide grit and water separation services under varying flow conditions for extended periods of service.

5. The individual unit of the grit separation and removal system shall have a hydraulic capacity of 7.15 MGD design and a peak flow of 14 MGD.

6. The system shall be capable of removing 95% of the grit greater than 50 mesh in size, 85% of the grit greater than 70 mesh in size, and 65% of the grit greater than 100 mesh in size.

B. Acceptable Materials

1. All materials used in the construction of the grit separation system shall be of the best quality and entirely suitable in every respect for the service intended by the engineer. All structural steel shall conform to the ASTM Standard Specification for Structural Steel, Designation A36/A36M. All iron castings shall conform to the ASTM Standard Specifications for Gray Iron Castings, Designation A48, and shall be of a class suitable for the purpose intended by the engineer. Other materials shall conform to the ASTM Specifications where such specifications exist and the use of such materials shall be based on continuous and successful use under similar conditions of service.

2. All electrical components shall be U.L. listed where such listings exist, and all electrical control panels shall be assembled in U.L. approved facilities.

2.02 SPIRAL SAND SEPARATION UNIT

A. Spiral Assembly

1. The spiral assembly will consist of a shaftless spiral bolted to a drive shaft attachment.

2. The spiral will be constructed of high-strength carbon steel bar stock, having a minimum thickness of 0.79 inches. The spiral will be prime coated for protection during shipment. The spiral will have a 9.0 inch minimum OD and a minimum flight height of 2.3 inches. The drive end of the spiral will be provided with a welded coupling plate.

3. The drive shaft will be welded to a coupling plate that bolts to the mating coupling plate on the spiral. The shaft will be a solid carbon steel shaft keyed for direct insertion into the hollow shaft of the gear reducer.

B. Trough Assembly

1. The trough assembly shall consist of the trough, trough liner, discharge section, drive system mounting flange, cleanout coupling and trough cover.

2. The U-shaped trough shall be fabricated, at a minimum, of 11 gauge type 304L stainless steel with a 10.24 inch ID. The trough will be mounted at a minimum 25 degree angle.

3. The trough liner shall be fabricated, at a minimum, of a 3/8 inch thick wear resistant rubber liner adhered to a 16 gauge type 316L stainless steel liner that shall be tack welded to the inside of the trough. Four (4) wear bars shall be longitudinally mounted and tack welded to the inside of the trough liner. Each wear bar shall be, at a minimum, made of 5/16 inch by 1 ¼ inch carbon steel bar stock. One (1) wear bar shall be supplied with a type 18-8 stainless steel cap screw

(removable from the outside of the trough), that shall be used as an indicator of the wear rate on the bars.

4. A bottom discharge section will be fabricated at the drive end of the trough. The discharge section will be, at a minimum, fabricated of 11 gauge type 304L stainless steel. A flexible neoprene discharge chute/guard will be fastened to the discharge section and shall guide discharged solids into the customer supplied receptacle. This discharge chute/guard shall not have to be removed or tampered with to empty the disposal receptacle.

5. The drive end of the trough will be capped off with a painted carbon steel plate that will serve as a mounting flange for the drive system.

6. The bottom end of the trough will be equipped with a 4 inch NPT drain. This drain shall be fitted with an aluminum valve and 3" male cam and groove coupling so that a hose drain line can be attached.

7. A 14 gauge type 316 stainless steel cover shall cover the trough from the tank to the drive.

C. Drive Assembly

1. The drive assembly will consist of a motor and gear reducer.

2. The motor shall be, at a minimum, a ¾ HP, 1200 RPM, 230/460 volt, 3 Phase, 60 Hz, TEFC, NEMA Design B motor with Class F insulation, 1.15 S.F. and rated for severe duty.

3. A shaft-mounted helical gear reducer shall be directly coupled to the motor. The cast iron reducer shall have an output speed of 6.6 RPM, produce 7160 inch-pounds of torque and have a 1.8 S.F. The gear reducer shall be fastened to the mounting flange on the trough assembly.

D. Tank Assembly

1. The tank assembly shall be mounted above the trough assembly and consist of a tank with an overflow chamber and tank covers. The tank assembly shall be designed to support the weight of the spiral and trough, as well as the imposed hydrostatic loads. Suitable provisions for lifting the tank shall be supplied by the Contractor.

2. The tank shall be fabricated of 11 gauge type 304L stainless steel, with sides sloped toward the trough assembly. The tank shall be welded to the top of the trough assembly.

3. An overflow chamber, fabricated of 14 gauge type 304L stainless steel, will be mounted inside of the tank assembly. An overflow chamber will be provided with a 6.63 inch OD plain-end discharge pipe stub. The discharge pipe will be located on the left-hand side of the unit, as viewed from the solids discharge end.

4. Tank covers shall be mounted on top of the tank assembly. The cover above the overflow chamber shall be hinged for viewing access. All other covers shall be bolted to the tank. The bolt-on cover section adjacent to the hinged cover shall be supplied with a 4.50 inch OD influent pipe stub. The influent pipe shall be a plain-end pipe connection, centered between the access doors and positioned as is shown on the construction drawing. The doors shall not interfere with the designed pipe configuration. All covers shall be fabricated of 11 gauge type 316 stainless steel and be gasketed.

E. Support Legs

1. Four (4) support legs shall be provided on the unit; two (2) attached to the trough assembly (near the discharge end), and two (2) attached to the tank assembly (near the influent end). Each support leg will be fabricated of 11 gauge type 304 or 316 stainless steel. A 5/16 inch thick mounting pad with a 0.63 inch diameter anchor bolt hole will be provided at the bottom of each support leg.

2. The installing contractor will furnish four (4) ½"-13UNC by 5½ inches long type 304 stainless steel expansion anchors.

F. Surface Finish

1. All welds in stainless steel subassemblies shall be electro-chemically cleaned or acid passivated after welding for corrosion resistance and to provide a superior surface finish. This shall be accomplished by electro-chemically removing heat tint and discoloration with a device designed for that purpose or by full dipping of weldments, or by using an acid passivation paste in the weld and heat effects areas and spray-on acid solutions elsewhere. After passivation, the weldments shall be thoroughly rinsed with clean water and allowed to air dry. No heat tint or carbon steel contamination shall be evident after this process. If there is contamination evident, the contaminated areas shall be cleaned by the above method and rechecked after rinsing and drying. Sandblasting, bead blasting or grit blasting of stainless steel surfaces shall not be allowed in lieu of the above procedures.

2. The spiral and wear bars shall be prime coated for protection during shipment.

3. The motor and reducer shall be provided with the manufacturer's standard finish.

4. The drive system mounting flange and drive shaft shall be finished with 3.0 mils DFT epoxy powder coating.

G. Emergency Stop

1. A unit mounted emergency stop push button shall be provided in a NEMA-4X polycarbonate enclosure. Emergency stop button to be located on support leg of unit near the grit discharge.

2.03 GRIT AIRLIFT UNIT

A. The grit airlift unit, air-liquid separation unit, circulating motive jet, and grit airlift shall be supported from the existing bridge work.

B. Air shall be introduced at the base of the unit so as to lift and recirculate water in the grit chamber for aerating and scouring. An air-liquid separation unit shall be provided at the top of the airlift unit to separate most of the air from the recirculation stream. The elevated water from the unit shall be used to drive the circulating jet motive nozzle. The jet motive nozzle shall be designed to impinge upon the sloped section of the transition section and provide circulation in the grit chamber.

C. The airlift pump shall be furnished to facilitate grit washing and removal. The diameter airlift pump shall be designed to be concentric with the unit. The airlift pump shall be suitable for manual or automated operation by control of the compressed air supply to the airlift unit. The air supply line shall terminate above the bridge work. The terminal end of the air supply pipe shall be furnished with a 1½" diameter automatic control valve. Air supply piping from the source of the air supply to the control valves shall be furnished by the contractor.

D. All parts that are submerged or partly submerged shall be produced of a corrosion resistant, structurally sound, fiberglass reinforced resin in accordance with National Bureau of Standards PS-15-69.

E. Regenerative blower with intake filter shall be provided to supply 110 SCFM at 2.5 psig. Unit shall be provided with a 3.0 HP, 460 V, 3 phase TEFC motor.

F. A positive displacement blower with intake filter, silencer and accessories shall be provided to supply 50 SCFM at 47 psig. The unit shall be provided with a 3.0 HP, 460 V, 3 phase TEFC motor.

2.04 Control Panels

A. One control panel shall be provided for each spiral sand separation unit. The control panel shall be a NEMA-4X stainless steel enclosure suitable for wall mounting. It shall contain the following devices for operation of the equipment:

1. Pump interlock contacts

2. Settling timer

3. Discharging timer

4. Repeat discharge cycle timer

5. Hand-off-auto selector switch

6. Run time meter

7. System start button

8. Fault reset button

9. Emergency stop push button

10. Indicating lights

11. Relays

12. 480/120 V control power transformer

13. Main disconnect switch motor starter and motor current monitor

The incoming power service to the control panel will be 480V, 3 Phase, 60 Hertz.

The spiral motor starter shall be provided with a hand-off-auto selector switch. In the "hand" position, the spiral shall rotate continuously.

When the AUTO mode is selected, an automatic cycle will be initiated upon receiving a signal from the customer's pump operation. AUTO cycle includes:

1. Tank fill (based upon pump signal)

2. Solids settling

3. Solids discharge (continuous or intermittent)

A fault condition (motor thermal overload or motor current overload) will disable the unit and illuminate a Fault light.

B. One control panel shall be provided for each Hydro-Grit Separation Unit. The control panel shall be a NEMA-4X stainless steel enclosure suitable for wall mounting.

The panel shall house starters for regenerative blower and airlift positive displacement blower. The control panel shall include a "Hand-Off-Auto" selector switch and indicating light for the airlift blower. In the "Auto" position, a 24 hour timer settable

in ten minute increments shall start the airlift blower, start a second timer and open the air scour solenoid. When the second timer times out, it shall close the air scour solenoid, open the air lift solenoid, and start a third timer. The third timer shall stop the airlift blower, close the airlift solenoid and reset when the contact on the 24 hour timer releases. Provide an auxiliary contact for airlift pump "run status" to interlock with the spiral sand separation unit specified elsewhere in these specifications.

The power service for the control panel will be 480 V, 3 phase, 60 Hertz.

2.05 FIBERGLASS REINFORCED POLYESTER GRIT PIPING

A. The grit slurry piping shall be cylindrical having an inner diameter of 4-inches and shall be internally smooth and free from protrusions which might collect solid material. The grit slurry pipe shall be fabricated of machine filament wound, fiberglass reinforced thermosetting resin pipe conforming to ANSI/ASTM Specification D-2996 and classified according to ASTM D-2310.

The piping shall use an isophthalic, corrosion resistant laminating resin; reinforced with glass fibers and a surfacing material of commercial grade chemical resistant glass having a coupling agent. The pipe shall have a 50 psig pressure rating. The piping shall have a minimum structural thickness of 0.375-inch. The piping shall include an abrasion resistant 20-mil internal liner. All piping shall be provided with an UV inhibiting gelcoat. FRP piping shall be provided by Fluidyne Corporation as part of the overall grit removal system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for the complete installation of each of the two grit separation systems. Installation shall not be considered to be complete until the equipment has been tested under normal and peak loading conditions for the facility, and has been proven to successfully handle such flow rates.

B. It shall be the responsibility of the Contractor to install each component of the system as it is received.

C. It shall be the Contractor's responsibility to ensure a safe installation, free from: flaws in equipment alignment, damage, and damage to any of the existing structures or components. If damage to the grit separation system, any of its equipment, or any of the existing structures does occur, it is the Contractors responsibility to repair these items to their original specifications at no charge to the owner. If the equipment or structure is deemed to be beyond repair by the engineer's representative, it shall be the responsibility of the Contractor to replace the item at no charge to the Owner.

D. It is the responsibility of the Contractor to make all specified pipe connections. These connections shall be seated properly and free of all leaks. Piping for the system shall be installed as specified in the construction drawings, and shall include all required pipe lengths and spacing.

E. The Contractor shall be responsible for assembly and installation of all electrical and accessory equipment required by the manufacturer and engineer for successful and efficient equipment operation. Installation of all electrical equipment shall be performed by a licensed qualified electrician and in accordance with the NEC and all federal, state, and local regulations.

3.02 GENERAL TESTING REQUIREMENTS

A. The manufacturer shall furnish the services of a factory-trained engineer as given in Paragraph 1.04 to supervise start-up and testing of the system. The system shall operate to the specified requirements as set forth by the manufacturer and engineer. If the system fails to meet the specified requirements, it shall be adjusted, repaired and/or replaced at no additional cost to the Owner.

3.03 FUNCTIONAL TESTING

A. Proposed functional testing shall be developed by the manufacturer and submitted to and reviewed by the Engineer two (2) weeks prior to installation of the grit removal system. If the proposed testing requirements are found to be insufficient by the engineer, the engineer will submit the changes that must be made in the testing program back to the manufacturer. The manufacturer will then have two (2) working days to resubmit the testing program to the engineer for approval.

B. Prior to startup, a manufacturer's and engineer's representative shall inspect the system for proper alignment, correct operation, proper connection, and satisfactory function of all components. When final approval of the system is given, the manufacturer's and engineer's representative shall provide certification that the system components have been installed correctly and are ready for operation. Until such time as written approval is given by both the manufacturer's and engineer's representative, it is the Contractors responsibility to make the required repairs, changes, and adjustments to the ensure delivery of a system free from defects of any kind.

SECTION 15530

SEWAGE SCREENING
AUTOMATIC SELF-CLEANING FILTER SCREEN EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section shall include furnishing, unloading at the jobsite, handling, storage and installing of a complete and fully automatic self-cleaning filter screen (filter screen) at the Hinesville Wastewater Treatment Plant (WWTP). The system shall include one (1) fully automatic self-cleaning filter screen, complete with accessory equipment (e.g. waste compaction system), as specified on the accompanying drawings and as required to meet the specified performance requirements.

B. The filter screen shall be suitable for installation and operation in the appropriate flow channel as specified in the attached drawings. The angle-of-inclination for both required filter screens shall be within 75 to 80 degrees from the horizontal, and the channel floor shall have a minimum recess of that specified by the manufacturer. The geometry of the channel shall be verified with the attached drawings, by the contractor prior to installation of the filter screen to ensure continuity between the existing and proposed filter screen installations.

C. Each screen shall fit in the existing opening with minimal channel wall modifications. Both filter screens shall be provided by the same manufacturer and be the same model. This will provide consistency for operations and maintenance. The filter screens shall be capable of presenting a clean filtration surface to the oncoming liquid stream at all times during continuous operation. Each filter screen shall meet the following criteria:

Parameter	WWTP
Avg. flow rate	3.79 MGD
Peak flow rate	8.0 MGD
Channel width	3.00 ft
Channel depth	5.00 ft
Screen angle	75^{o}
Element size	6.00 mm
Max. downstream water level	2.00 ft
Max. upstream water level	3.11 ft
Max. height above floor	N/A

D. Equipment furnished an installed under this section shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by the engineer.

E. Only equipment defined as a filter screen and meeting the requirements herein will be accepted. No bar screens, screw auger filtering devices, or the like will be accepted.

1.02 SUBMITTALS

A. Complete shop and installation drawings of all materials and equipment furnished under this Section shall be submitted by the Contractor for approval in accordance with the bid document. Submittals shall include, but not be limited to, the following:

1. Complete description in sufficient detail to permit an item comparison with the specifications.

2. Detailed drawings showing all of the details of construction pertaining to the filter screen system. This shall include installation details of all equipment associated with this system.

3. Detailed schematic and layout drawings and a description/narrative explaining the operation of all control panels.

4. All interconnections and interface requirements, dimensions, and locations of all major elements of the filter screen system including critical clearance requirements.

5. Basis of design, including background data, calculations, operational plant data and other information showing the development of the proposed design.

6. The startup/performance testing report and manufacturer's certification as required in Part 3.

1.03 CODES AND STANDARDS

A. Equipment specified herein shall meet or exceed the applicable sections of the following codes and standards authorities.

1. AGMA, American Gear Manufacturers Association.
2. ASME, American Society of Mechanical Engineers.
3. ASTM, American Society of Testing and Materials.
4. ANSI, American National Standards Institute.
1. IEEE, Institute of Electrical and Electronics Engineers
2. NEC, National Electrical Code.
7. U.L., Underwriters Laboratories.
8. AWS, American Welding Society

1.04 SYSTEM STARTUP

A. It is the responsibility of the contractor to ensure that the filter screen system supplier/manufacturer will provide a representative for startup services upon

completion of the systems installation. The following activities shall be provided by the manufacturer.

B. Manufacturer's Representative

1. The manufacturer's representative shall inspect the construction plans and the installation, and recommend any required modifications, additions, or other changes required to allow the manufacturer to certify that the complete installation is appropriate and will operate as expected and intended.

2. The manufacturer's representative shall instruct the Owner's and Engineer's personnel on the operation and maintenance of the filter screen system. The instruction shall include both classroom and field training on proper operation and maintenance procedures, accompanied with complete demonstrations.

3. The manufacturer's representative shall supervise the performance testing of the installation.

4. The manufacturer's representative shall provide at a minimum, services in accordance with the following table:

Purpose	No. of Days
Installation Supervision	As required for complete installation
Start-up and Calibration	1 per screen
Initial operation, Performance Test and Maintenance Instruction	3
Follow-up Instruction and Optimization	2

5. The number of days indicated above shall be provided on an 8-hour per day on-site basis and shall be in addition to travel time.

1.05 DESCRIPTION OF THE SYSTEM

A. The filter screen system shall consist of one (1) filter screen and all accessories.

B. Acceptable filter screen units shall be the Aqua Guard Filter Screen Model AG-MN-A 75^{o} as manufactured by Parkson Corporation with Rotopress Screening Compactor model RP-200.

C. Designs employing the use of cables, hydraulic cylinders, or rakes to remove debris from the channel shall not be considered acceptable. As well as, the use of two (2) or more motors to complete a screening cycle shall not be considered acceptable.

D. The design shall be such to ensure that all planned maintenance to the raking/screening mechanism can be accomplished at the operating floor level.

E. No moving parts shall be located permanently below the channel water surface at maximum design flow.

1.06 SPARE PARTS

A. The following spare parts shall be furnished with each of the filter screens and shall be of factory direct parts:

20 - Filter Elements
10 - Side Plates
10 - Snap Rings, 1 3/8" Dia.
10 - Snap Rings, 1 5/8" Dia.
4 - Rotating Brush Elements or Scraper Blade Elements

1.07 QUALITY ASSURANCE

A. Only manufacturers of fully automatic self-cleaning filter screens of the type specified herein operating for a period of five years in a minimum of five wastewater treatment plants in the Southeastern United States shall be considered. Manufacturers not meeting the experience requirement shall not be acceptable.

B. All components of the filter screen equipment shall be of high quality and sized to accommodate, without failure or compromise, all forces encountered during fabrication, installation and operation. Compliance with the performance requirements of the specification shall not relieve the contractor of his responsibility to supply equipment having the specific structural, mechanical, operational and surface corrosion protection features as specified herein.

C. The filter screen shall be factory assembled and tested prior to shipment to ensure proper operation of all systems.

1.08 WARRANTY

A. The equipment furnished under this section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, storage, and installation for a period of one year from the date of the startup.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General

1. The filter screen system must be designed to fit within the specified dimensions shown on the attached drawings and be of modular design.

2. The system to be furnished shall include the latest components and equipment available at the time of shipment.

3. All components exposed to or in contact with plant effluent, including all anchoring hardware, shall be comprised of corrosion/degradation resistant materials (see Paragraph 2.01B

4. The filter screen system shall be able to continuously provide waste separation services under varying flow.

B. All moving wetted parts, all wetted parts on which the moving parts ride, and all components under guiding, bearing or driving loads including, but shall not be limited to the shafts, links, and guide rails must be fully corrosion-resistant and shall be made of 304 stainless steel for the HPS filter screen, 316 stainless steel for the WWTP filter screen or wear resistant heat treated 400 series stainless steel for either screen, except as noted in the following:

1. The screening element shall be constructed of a material that will not shred trash or cause jamming due to the self-relieving nature of the material.

2. The roller and bushings shall be of 400 series heat treated stainless steel with a minimum Rockwell of 39C hardness for reduced wear and increase the long life of the equipment.

3. The stationary frame, main drive shaft and sprockets shall be constructed of 316 stainless steel for the WWTP.

4. The take-up screws shall be constructed of 316 stainless steel for the WWTP.

5. The front seal brush and rotating brush, if required, shall have nylon bristles.

6. The side seals shall be made of neoprene rubber with backing plates constructed of 316 stainless steel for the WWTP.

7. All nuts and bolts will be 316 stainless steel for the WWTP.

8. The discharge chute shall be 316 stainless steel for the WWTP.

9. All other appurtenances including chains, brush spockets, bearing housings, etc. shall be of the manufacturers standard coating material.

10. The WWTP filter screen shall have a 316 stainless steel removable outer covering. This outer covering shall not interfere with the machines separation and shall serve the intended purpose to trap all waste gases inside the machine. This cover shall fit with the proposed channel covering system and create an airtight barrier.

2.02 FILTER SCREEN MECHANICAL DETAILS

A. The screening rollers shall be at a minimum 1 ¾" diameter and shall ride on ½" thick 316 stainless steel at the WWTP. A submerged curved ½" thick stainless steel rail shall be provided at the foot of the screen. No submerged bearings or sprockets shall be allowed in order to eliminate maintenance required on submerged components.

B. To prevent deflection, the filter shafts shall have a minimum thickness of ¾" diameter and spaced on 4" centers in the travel direction of the belt; and shall be made of 316 stainless steel for the WWTP. This is required to insure structural integrity and smooth operation without jamming or binding.

C. The tension of the moving screen belt assembly shall be completely supported by a stainless steel link chain. The chain must connect the filter shaft ends, on both sides of the belt assembly, so that no weight is supported by the filter elements. The chain assembly shall provide a minimum cross section of 0.114 square inches, at the weakest point of any individual link.

D. No plastic elements shall be used as structural members for load bearing purposes.

2.03 SCREEN BELT CLEANING

A. The filter screen shall be automatically self-cleaning without requiring water or external mechanical devices. The drive mechanism shall be protected from the trash stream and the driving force must be transmitted to clean, trash free components to avoid mistracking or binding which may render the filter screen inoperable and thereby requiring manual cleaning and realignment. In addition, no auxiliary cleaning devices, which may cause trash to be dropped into the interior of the filtration belt will be allowed to prevent jamming of the filtration belt.

2.04 FILTER SCREEN MOUNTINGS

A. The filter screen shall require no mounting, or fastening to the sidewalls or bottom of the channel. Routine service shall be possible with the filter screen in the channel.

2.05 DRIVE UNIT

A. The drive unit shall be a hollow shaft, helical worm type reducer equipped with anti-friction bearings, and designed in accordance with AGMA recommendations for 24 hours, Class II service. Overload protection shall be provided by an electrical overload device that senses motor current draw. The motor shall have the following characteristics:
    1. Minimum of 0.5 HP, maximum of 5 HP
    2. 3 phase
    3. 230/460 volt
    4. 60 HZ

5. TEFC
6. NEMA Design B
7. Class F insulation
8. 40^{o} C ambient temperature rise
9. rated for severe duty

2.06 SCREENINGS COMPACTOR

A. General

1. Only compaction systems utilizing an auger type screw to transport the screenings through a compression/dewatering tube will be accepted.

2. The press housing shall be made of 316 stainless steel for the WWTP (ASTM 240).

3. The new press screw shall be made of 304 stainless steel (ASTM 240) or high strength carbon steel that has been coated for corrosion resistance. The screw shall be attached to the drive shaft in a manner, which allows for ease of maintenance.

4. The reject water trough and removable splash guard shall be of 316 stainless steel for the WWTP.

5. The spray filter shall be made of 316 stainless steel for the WWTP.

6. The drive shaft shall rotate on two axial/radial tapered roller bearings.

B. Support Structures

1. The support plates shall be integral to the main body of the unit and shall be made of 304 stainless steel (ASTM 240).

C. Drive Unit

1. The drive unit shall be a helical, worm gear reducer, hollow shaft, with a shrink disk.

2. The drive unit meet the following criteria:
   a. 230/400 V
   b. 3 phase
   c. 60 HZ
   d. minimum of 2 HP
   e. NEMA Design B
   f. Class F insulation

D. Solids Discharge Zone

The solids discharge zone shall be of a specified type and be one of the following:

1. A spring-loaded counterforce attached to the outside of the compactor and plate hinged at the outlet of the unit.

2. A stainless steel pipe extension flanged to the outlet to extend dewatering time and enhance frictional dewatering forces.

E. Dimensions of Compactor

1. The compactor shall be specifically manufactured and guaranteed by the Contractor to fit into the existing areas without any modifications to existing structures. The compactor and screen housings shall be connected for the main purpose of trapping all waste gases in an enclosed mechanical system.

F. Performance Capabilities

1. The compactor shall be capable of handling a minimum of 35 $ft.^3$/hr. (or $4m^3$/hr.) of wet screenings with a minimum feed concentration of 8-10% dry solids and shall be capable of compressing the screenings to achieve and 75% reduction in volume.

2.07 CONTROLS

A. A NEMA 4X stainless steel control panel shall be provided for operation of the filter screen/compactor combination. If secondary control panel(s) are utilized, they must also be of that specified for the primary.

B. The main control panel wiring shall contain all power and control devices shown on the drawings (wiring diagrams) which shall include, but not be limited to, the following:

1. One (1) Hand/Off/Automatic selector switch for manual operation of the filter screen drive.

2. One (1) Forward/Off/Reverse selector switch for manual operation. Spring return form reverse.

3. One (1) pilot light for “Screen Forward’ run status

4. One (1) pilot light for “Screen Reverse” run status

5. One (1) pilot light for control power

6. One (1) control power “Off/On” selector switch

7. One (1) 24 hour single channel electronic control timer to automatically initiate operation of the filter screen

8. Control relays, wiring and circuitry required to implement the control logic

C. Controls shall operate the screen and compactor on a timed, liquid level control signal or continuous basis.

D. Main Power Control

1. The control panel shall be totally enclosed, front access type with top/side/bottom entry. All controls shall be manufactured by a U.L. listed control panel facility.

2. Construction of the control panel shall be NEMA 4X, 304 stainless steel construction with indicating devices and switches mounted on the front door.

3. Main control panel wiring shall be neatly cabled and supported in nonflammable wiring raceways.

2.08 OVERLOAD PROTECTION

A. Positive overload protection against an object, which is too large to be passed over, shall be provided by the use of a control panel mounted, current sensitive relay (CSR). The CSR shall continuously monitor the motor current to prevent damage to the drive assembly due to a jam obstruction or system malfunction. Machines that rely solely on rake arm rotation in conjunction with mechanical limit switches or proximity switches to provide overtorque protection shall not be allowed. Designs that utilize shear pins are specifically excluded.

PART 3 - EXECUTION

3.01 PROPOSED FILTER SCREEN INSTALLATION

A. The Contractor shall be responsible for the complete installation of the bar screen. Installation shall not be considered to be complete until the equipment has been tested under normal and peak loading conditions for the facility, and has been proven to successfully handle such flow rates (as determined by representative of the engineer and manufacturer).

B. The filter screen will be received onsite as one unit and it shall be the responsibility of the Contractor to install the press as it is received.

C. It shall be the Contractor's responsibility to ensure a safe installation, free from flaws in equipment alignment, equipment damage, and damage to any of the existing structures or components. If damage to the filter screen, any of its equipment, or any

of the existing structures does occur, it is the Contractors responsibility to repair these items to their original specifications at no charge to the owner. If the equipment or structure is deemed to be beyond repair by the engineer's representative, it shall be the responsibility of the Contractor to replace the item at no charge to the Owner.

D. Each filter screen shall be attached to the channel as shown in the construction drawings and as specified by the manufacturer's and engineer's representative. If the attachment method is by means of bolting, the bolts shall be torqued to that specified by the manufacturer to ensure a securely anchored support for the screen and all of the associated equipment.

E. It is the responsibility of the Contractor to make all required pipe/hose connections as specified. These connections shall be seated properly and free of all leaks

F. The Contractor shall be responsible for assembly and installation of all electrical and accessory equipment required by the manufacturer and engineer for successful and efficient equipment operation. Installation of all electrical equipment shall be performed by a licensed qualified electrician and in accordance with the NEC and all federal, state, and local regulations.

3.02 GENERAL TESTING REQUIREMENTS

A. The filter screen shall be factory assembled and tested for minimum of 8 hours prior to delivery, and shall be delivered to the site as fully assembled as possible. It shall be capable of being set in place and field erected by the contractor with minimal assembly

B. The manufacturer shall furnish the services of a factory-trained engineer as given in Paragraph 1.04 to supervise start-up and testing of the system. The system shall operate to the specified requirements as set forth by the manufacturer and engineer. If the system fails to meet the specified requirements, it shall be adjusted, repaired and/or replaced at no additional cost to the Owner.

3.03 FUNCTIONAL TESTING

A. Proposed functional testing shall be developed by the manufacturer and submitted to and reviewed by the Engineer two (2) weeks prior to installation of the filter screen. If the proposed testing requirements are found to be insufficient by the engineer, the engineer will submit the changes that must be made in the testing program back to the manufacturer. The manufacturer will then have two (2) working days to resubmit the testing program to the engineer for approval.

B. Prior to startup, a manufacturer's and engineer's representative shall inspect filter screen system for proper alignment, correct operation, proper connection, and satisfactory function of all components. When final approval of the filter screen system is given, the manufacturer's and engineer's representative shall provide certification that the system components have been installed correctly and are ready for operation.

Until such time as written approval is given by both the manufacturer's and engineer's representative, it is the Contractors responsibility to make the required repairs, changes, and adjustments to the ensure delivery of a filter screen system free from defects of any kind.

SECTION 15560
TERTIARY CONCRETE FILTER
PILE CLOTH

PART 1 - GENERAL

1.01 SPECIFICATION PRECEDENCE

A. The specifications for equipment and controls under this section supersede specifications for equipment and controls specified elsewhere in the contract documents and drawings. Purchased components such as gear reducers, pumps, motors, valves, and actuators shall be provided with standard recommended manufacturers paint, unless otherwise specified within this section.

1.02 SERVICE

A. The equipment manufacturer shall furnish the services of a factory trained representative for a maximum of four (3) trips and fourteen (11), eight-hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance. The equipment manufacturer shall furnish the services of a factory trained representative for 1 trip and 3 eight hour days at the jobsite for performance testing.

B. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.

1.03 WARRANTY

A. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of one (1) year from the date the goods are put into service, or eighteen (18) months from shipment of equipment, whichever first shall occur. This warranty shall not apply to any goods or parts which have been altered, applied, operated or installed contrary to the Manufacturer's instructions or subject to misuse, chemical attack/degradation, negligence or accident.

1.04 **MANUFACTURING QUALIFICATIONS**

A. The filter supplier shall have experience in the design and manufacture of cloth media filters for a minimum of ten (10) years and shall be able to demonstrate a minimum of fifty (50) installations within the United States in municipal wastewater applications with cloth media.

PART 2 - PRODUCT

2.01 **AQUADISK TERTIARY FILTER**

A. There shall be three (3) Model ADFSC-54x10E-PC AquaDisk filters as manufactured by Aqua-Aerobic Systems, Inc., of Loves Park, Illinois. Contractor shall furnish all labor, materials, equipment and incidentals required for installation of the AquaDisk as shown on the drawings and as specified herein. Through the wall spool piping and all external piping shall be provided by the installing contractor. Effluent weir assembly shall be provided by the installing contractor.

Each unit will include:
Basin Mounting Brackets and Hardware
Drive Assembly
Centertube Assembly with Cloth Media Disks
Backwash System
Backwash/Waste Pump Assembly
Valves
Influent Weir
Pressure Transducer Assembly
Float Switch
Vacuum Transmitter
Electrical Controls with Internal Components

All motors, pumps, and bearings shall be designed for continuous duty and long operating life in a high humidity atmosphere. All motors and pumps shall be 460 volt, 60 hertz, 3 phase.

2.02 **PERFORMANCE AND DESIGN PARAMETERS**

A. The AquaDisk filter shall be capable of filtering effluent from an SBR process. Design shall be for:

7.15 MGD Average Daily Flow

10.725 MGD Maximum Daily Flow

B. Filter influent total suspended solids (TSS) concentration shall be 10 mg/l daily average and 15 mg/l maximum at average daily flow rate.

C. Filter effluent total suspended solids concentration shall not be greater than 5 mg/l based on a monthly average.

D. Filter effluent turbidity shall not be greater than 3 NTU based on a daily average.

2.03 FILTER DISK BASIN

Each filter shall be installed in a concrete basin. Each filter shall be provided with a 3" manually operated butterfly drain valve. Valve shall be provided with ductile iron body, aluminum bronze disk, stainless steel shaft and EPDM seat. Valve shall be Nibco or approved equal.

2.04 BASIN MOUNTING BRACKETS AND HARDWARE

A. Each filter basin shall be fitted with 304 stainless steel mounting brackets to accommodate attachment of the filter components to inside of the basin. All mounting brackets shall be attached to the inside of basin wall with 304 stainless steel wedge anchors and hardware. Through the wall spool piping and all filter external piping shall be provided by the Installing Contractor.

2.05 DRIVE ASSEMBLY

A. Each filter shall include an adjustable drive assembly with a gearbox, nylon drive sprocket, acetal drive chain with 304 stainless steel link pins, and a 304 stainless steel chain guard. The gearbox shall be parallel in-line helical type, AGMA Class 1 with a 3/4 HP drive motor rated for 460 volt, 3 phase, 60 Hz. Gear reducer shall be Nord or approved equal. Drive motor shall be Nord, Weg, Baldor, or approved equal.

B. To reduce energy demand, the drive assembly shall rotate the disks only during backwash. Systems requiring constantly rotating disks during filtration will not be acceptable. Belt drive systems or systems with multiple drive units per filter will not be acceptable.

C. If motors and gearboxes require routine maintenance, and are not accessible from the outside tank side walls, the equipment manufacturer shall provide an internal access platform between the tank side walls and motors and gearboxes.

2.06 **CENTERTUBE ASSEMBLY**

A. Each centertube assembly shall include a minimum 3/16" thick 304 stainless steel centertube weldment, driven sprocket, wheel assemblies, 304 stainless steel disk segment rods, and frame and cloth assemblies. Each centertube assembly shall also include a Viton v-ring effluent port seal which provides superior chlorine resistance. Materials other than Viton are not acceptable for seal materials. The driven sprocket shall be multi segment made of UHMW polyethylene. All fasteners shall be stainless steel.

2.07 **FILTER CLOTH ASSEMBLIES**

A. Each basin shall include ten (10) cloth disk assemblies. Each cloth disk assembly shall be comprised of six (6) individual segments, each consisting of a cloth media sock supported by an injection molded polypropylene co-polymer frame with corrosion resistant assembly hardware. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the centertube, without special tools, to allow for removal and replacement of the cloth at the point of installation. Systems requiring special tools and/or the return of media segments to the factory for replacement will not be considered.

B. Cloths shall be of fiber pile construction having a nominal filtration rating of 10 microns. Granular media and screens having structured identical openings shall not be allowed. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. Woven mesh or microscreen type media with no filtration depth are not acceptable.

C. Each filter unit shall have a total of**:** 538 square feet of minimum effective submerged filtration area.

D. Each cloth disk assembly shall have a minimum of 53.8 square feet of effective submerged filtration area. Effective submerged filtration area is defined as only the portion of the disk that is submerged during filtration. Any disk area that is not submerged shall not be considered as effective area. Each disk shall be divided into no more than six (6) segments and shall be easily removable for service.

E. If the wet weight of the filter disk segment is greater than 50 pounds, a lifting mechanism shall be provided.

F. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the disk to the inside. Systems with flow paths from the inside to the outside of the disk that collect filtered solids and debris on the interior surfaces of the disk will not be acceptable.

G. Only media area below the effluent weir elevation will be considered in the filtration area calculation since this is the only area that is submerged and available for filtration 100% of the time.

H. Submittal information shall include calculations that verify the effective filtration surface area. Media surface fused directly to support structure such that water cannot pass through the media shall not be included in these calculations

I. The operator shall be able to bring a drained filter on line by simply opening the influent isolation device. If the filter design is such that it must be filled with water before the influent isolation device is opened to prevent damage to the filter media, an automated process that sequentially brings the filter back on line with a single switch shall be provided to prevent accidental media damage. The automated process shall activate a minimum 6" diameter motorized valve to fill the filter with effluent or other clean water source in not more than five minutes, verify that the filter is full, and open the motorized influent isolation device.

J. Because of the frequency of the backwash and misting associated with spray systems, designs that utilize high pressure spray or a moving vacuum head as the sole means of solids removal will not be acceptable.

K. Submittals shall include a hydraulic profile through the filter showing the following:
- Influent weir length
- Influent weir elevation
- Infuent weir nappe at design and peak flow
- Effluent weir length
- Effluent weir elevation
- Effluent weir nappe at design and peak flow

2.08 **BACKWASH SYSTEM**

A. The backwash function shall incorporate a pump that draws filter effluent through the cloth as the media rotates past the fixed backwash shoe, thereby removing accumulated solids from the cloth surface. Each disk shall be cleaned by a minimum of two (2) backwash shoes, one on each side. The backwash shoes shall remain in a fixed position. Springs shall be used to maintain the proper tensioning of the backwash shoe against the media surface. Neither the cloth / support assemblies nor the backwash shoes shall

include any gridwork overlays or other interferences that would prevent direct contact of the backwash shoes with the cloth fibers.

B. The backwash system shall include 304 stainless steel backwash shoe supports with 316 stainless steel springs, UHMW backwash shoes, reinforced PVC flexible hose with stainless steel hose clamps, 304 stainless steel backwash manifold, and PVC sludge collection manifold. The backwash shoe shall be in direct contact with the cloth to ensure effective media cleaning. Systems utilizing media cleaning mechanisms that do not contact the filter media will not be acceptable.

2.09 **BACKWASH/WASTE PUMP ASSEMBLIES**

A. Each backwash/waste pump assembly shall include two (2) backwash/waste pumps, valves, and gauges. In the external piping shall be backwash and solids waste valves, two (2), 3" recirculation ball valves, 3" manually operated flow control gate valve for each pump, vacuum gauges, and pressure gauges.

B. The backwash/waste pumps shall be shipped loose for field installation by the installing contractor. Backwash piping between the filter basin and pumps as well as piping following the pumps shall be supplied by the installing contractor. Installing contractor shall supply unions or flanges for service, and interconnecting wiring.

C. The backwash/waste pumps shall be a Gorman Rupp model 12B20-B, externally mounted centrifugal pump. Pump shall be provided with a 2 HP, 460 volt, 3 phase, 60 Hz motor and operate at 1750 RPM. Pump shall be rated for 130 gpm at 23 ft TDH. Motor shall be Baldor, Teco, Weg or approved equal. Each pump shall be provided with a painted 304 stainless steel support stand with wedge anchors. Backwashing shall be initiated by basin water level, timer, or manually through the operator interface. Operator shall have the ability to specify backwash time interval elapses through the operator interface. The backwash water shall be pressurized by the filter's backwash/waste pump for discharging from the filter system. Systems utilizing non-pressurized backwash flow will not be accepted.

D. Pump manually operated threaded gate valve shall be class 125 bronze with screw in bonnet, non-rising stem, and solid wedge. Valve shall conform to MSS SP-80 and shall be Nibco or approved equal. The 3 inch threaded ball valves shall be a two-piece, full port, with a brass body. Valves and shall be Nibco or approved equal.

E. The vacuum gauges shall have a minimum 2.5" dial with all stainless steel welded construction, 0-30" Hg vacuum range, liquid filled, ¼" NPT process connection, 316 stainless steel bourdon tube and tip material, and bronze socket material, Ashcroft or approved equal.

F. The pressure gauges shall have a 2.5" dial with a black painted steel case, 0-15 psi, heat resistant polycarbonate window, ¼" NPT process connection, "C" shaped bronze bourdon tube, and brass socket material, Ashcroft or approved equal.

G. Filtering shall not be interrupted during normal backwashing and solids waste discharge.

2.10 VALVES

A. Each filter shall include five (5), 2" backwash valves. Valves shall be 2 piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.

B. Because of fouling that can be caused by stringy material, non-full port valves such as butterfly valves or plastic valves shall not be acceptable.

C. Each filter shall include one (1), 2" solids waste valve. Valve shall be 2 piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.

D. Each filter shall include a solids waste removal system consisting of perforated manifold, mounted on the floor of the filter basin. The manifold shall be designed to siphon settled solids for waste discharge through the backwash/waste pump. The operation of the solids waste removal system shall be automatic with user adjustable intervals and duration through the operator interface. Filters that are designed without a solids waste removal system will not be acceptable.

2.11 INDIVIDUAL FILTER ISOLATION

A. Each filter shall include isolation upstream provided by the installing contractor.

2.12 INFLUENT WEIR BOX

A. Each filter shall include a 304 stainless steel influent weir box. The weir box shall be mounted to the filter basin interior using 304 stainless steel wedge anchors and hardware. The basin wall must be smooth and plumb to facilitate a quality installation. Filter systems without influent weir box will not be accepted.

2.13 PRESSURE TRANSDUCER

A. Furnish one (1) KPSI Model 710 submersible pressure transducer unit constructed of stainless steel for each filter to monitor and report liquid level. Unit shall monitor the water level in the filter basin. Transducer shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid. Transducer output shall be a 4-20 mA signal over a 0-5 psi range. Electrical connection shall be 2-wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire. Pressure transducer shall be provided with a mounting bracket and hardware.

2.14 FLOAT SWITCH

A. A float switch shall be furnished to indicate emerging overflow level. The float switch shall be Anchor Scientific Model GSI 40NONC-STO or approved equal. The float shall contain a non-mercury switch, chemical resistant polypropylene casing hermetically sealed and a PVC #18 AWG three conductor cable. Switch rating shall be minimum 4.5 amps non-inductive at 120 VAC.

2.15 VACUUM TRANSMITTER

A. The vacuum transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 1 standard atmosphere to full vacuum. Transmitter shall be an IFM Effector PX series or approved equal.

2.16 AQUADISK MISC/SPARE PARTS

(2) Frame and cloth assemblies.
(1) Backwash/solids waste valve and actuator.
(1) Viton V-ring effluent port/centertube seal.

2.17 CONTROL SYSTEM

A. The automatic and manual controls for operation of the Aqua Disk® Filter system shall be furnished fully assembled, wired, and pre-programmed in a UL 508A Certified Industrial Control Panel. Controls shall be provided to control or monitor equipment as described in the contract drawings. The control system shall include the following control components and practices:

2.18 CONTROL PANEL WIRING AND ASSEMBLY

A. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 480VAC maximum.

B. All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum, with PVC insulation.

C. Wire colors are as follows:

208 VAC or higher	-	Black
120 VAC control power	-	Red
Neutral	-	White
Ground	-	Green
AC Power from remote source	-	Yellow
Neutral from remote source	-	White with Yellow Stripe
24 VDC (+)	-	Blue
24 VDC (-)	-	White with Blue Stripe
VDC (+) from remote source	-	Orange
VDC (-) from remote source	-	White with Orange Stripe
Intrinsically Safe	-	Light Blue

D. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.

E. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.

F. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

2.19 CONTROL PANEL QUALITY ASSURANCE

A. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:

Point to point testing of all wiring prior to application of power
Intended supply voltage shall be applied to the enclosure
All components shall be tested for proper operation and calibration
The PLC and operator interface program shall be loaded and functionally checked
All components shall be checked to confirm proper mounting specifications have been followed
Enclosure shall be inspected for defects and repaired if necessary
All labeling of wires and devices are correct, properly installed and clean

B. The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above. This document must be signed by Engineering, prior to release for shipment.

C. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e. finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

2.20 CONTROL ENCLOSURE

A. The automatic controls shall be provided in a UL listed, NEMA Type 4X 304 stainless steel (14 gauge) wall mounted enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors. Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal. An internal 3-point latch and 316SS padlocking POWERGLIDE® handle shall be provided. Enclosures shall be unpainted, with a smooth #4 brushed finish. Enclosure shall include a painted white mild steel (12 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal.

B. The control enclosure shall be mounted remotely.

2.21 CORROSION INHIBITOR

A. Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion

inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.

The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

2.22 MAIN DISCONNECT CIRCUIT BREAKER

A. A UL listed, automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s). The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The disconnect breaker shall have a door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The disconnect circuit breaker shall be a Square D/FAL, HDL, JDL, LAL, MGL, PGL or approved equal.

2.23 MOTOR STARTER

A. A full voltage non-reversing Integrated Motor Starter-Controller shall be provided for motor applications up to 15 kW. Each starter shall provide control, protection, and monitoring functions for the motor. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a 42kA @ 480 VAC rated breaking capacity on short circuit. The starter shall have a mechanical durability of 15 million operations. The starter shall provide short circuit trip, thermal overload trip with selectable tripping class, under current trip and phase imbalance trip.

2.24 TRANSFORMER

A. A step-down multi-tap transformer shall be supplied when there is a necessity to reduce incoming 3-phase power to 120 VAC single-phase. The transformer power wire connections (incoming and outgoing) shall be protected with a finger-safe cover to protect against accidental contact. Primary and secondary fuse protection shall be provided. Transformer shall be UL listed and of continuous wound construction with vacuum impregnated with non-hygroscopic thermosetting varnish. Transformer shall be Square D 9070T or approved equal.

2.25 TRANSFORMER PRIMARY AND SECONDARY FUSE

A. Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer. Each fuse shall be equipped with a thermoplastic cover to

protect against accidental contact. Clip style fuse block shall be rated up to 600 VAC and 100 amps, dual element, time delay fuses shall be rated up to 600 VAC. Fuse blocks and fuses shall be UL listed. Fuses shall be Littelfuse Class CC or approved equal. Fuse blocks and fuse covers shall be manufactured by Marathon or approved equal.

2.26 CIRCUIT BREAKER

A. All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

2.27 FUSE

A. Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

2.28 OPERATOR DEVICE

A. Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for manual operation of the filter. Transformer type push-to-test pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be a 6 VAC incandescent type lamp. Color coding shall be applied as required and is as follows:

   Amber – Alarm active, caution
   Green – Valve open, motor running
   Red – Valve closed
   White - Information

B. All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Allen-Bradley 800H, Square D 9001, or approved equal.

2.29 HIGH FREQUENCY NOISE FILTER

A. A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120/240VAC operating at 47 to 63 Hz. The unit shall reduce normal mode transients to plus or minus 2 volts, provide surge capacity of 45,000 amps and protect in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be an Islatrol IC+ or approved equal.

2.30 GROUND FAULT DUPLEX RECEPTACLE

A. A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

2.31 24 VOLT DC POWER SUPPLY

A. A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

2.32 CONTROL RELAY

A. UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating, and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

2.33 TERMINAL BLOCK

A. Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

2.34 PROGRAMMABLE LOGIC CONTROLLER

A. Automatic operation of the Filter shall be controlled through a Allen Bradley MicroLogix 1400 programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a base unit, expansion I/O modules, and memory module. All input and output points supplied (including unused) shall be wired to terminal blocks. The PLC user memory shall consist of a minimum of 20K words of program and data. All PLC hardware shall be UL listed and operate at an ambient temperature of -4° to 140° F (-20° to 60° C).

2.35 BASE UNIT

A. The base unit shall house embedded inputs, outputs, power supply, and communication (Ethernet, RS-232, RS-485) ports. The base unit shall also provide the interface to expansion I/O when required by an application.

B. The power supply input range shall be 100 to 240V AC at 47 to 63 Hz with a maximum power consumption of 100 VA.

C. The embedded discrete inputs shall be rated for 120V AC and the discrete (relay) outputs shall be rated for 265V AC/125V DC. Embedded analog I/O shall be voltage (±10 V) inputs and outputs. Each I/O point shall have LED status indication.

D. The base unit shall have one (1) RS-232-C serial port, one (1) RS-485 serial port, and one (1) RJ-45 port which supports 10/100 Mbps EtherNet/IP. These ports shall be capable of local and remote programming, troubleshooting, and data manipulation.

E. The PLC base unit shall be an Allen Bradley 1766-L32AWAA or approved equal.

2.36 DIGITAL EXPANSION INPUT MODULE

A. The expansion digital input module shall have an operating voltage of 79 to 132V AC at 47 to 63 Hz. The module shall have an LED status indication of each point. The digital expansion input module shall be an Allen Bradley 1762-IA8 or approved equal.

2.37 MEMORY MODULE

A. The controller shall be shipped with a memory module for user program and data backup. The memory module shall be an Allen Bradley 1766-MM1 or approved equal.

2.38 ETHERNET SWITCH

A. An Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface, and plant networking. The switch shall support both 10 and 100 Mbit/s operation and provide for store and forward switching mode. The switch shall have five (5) 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation, and auto-polarity. Maximum distance for twisted pair cable shall be 100m.

B. The unit shall be DIN rail mounted and require 24VDC/100mA power. Diagnostic LEDs for power, link status, data, and data rate shall be provided. The Ethernet switch shall be UL listed and manufactured by Hirschmann/Spider 5TX, or approved equal.

2.39 HUMAN MACHINE INTERFACE OVERVIEW

A. The control system shall be equipped with a UL listed operator interface that provides control display screens. These screens shall be used by the operator to monitor and control filter status, setpoint and alarm information.

B. The Interface shall allow the Operator access to adjust the following operating parameters:
   - Backwash interval, Backwash duration, Solids Waste interval, Solids Waste duration Number of Backwashes between Solids Waste interval.

C. The operator interface shall provide information to assist the Operator in assessing the status of the filter system. The interface screen shall display, at minimum, the following parameters:
   - Water level in the filter, Time since last Backwash, Time since last Solids Waste withdrawal, Elapsed time on the Drive Motor, Elapsed time on the Backwash/Waste

Pump(s), Total Backwash time and cycles, Total Solids Waste withdrawal time and cycles.

D. The operator interface shall allow the Operator to:
   - Initiate Backwash
   - Control all electric actuated valves

E. The interface shall display the alarm history. The alarm history shall include the time and date of the most recent 25 alarms along with the description of the alarm.

F. The interface shall also display current alarms, including the date, time and a description of the alarm.

G. As a diagnostic aid to the Operator, the interface shall display the time between Backwashes for the most recent 40 Backwashes.

2.40 HUMAN MACHINE INTERFACE

A. The operator interface shall be a NEMA Type 12, 13, 4X rated, 6.5" diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution. The rated operating temperature shall be 32° to 131° F (0° to 55° C). The operator interface shall be an Allen Bradley PanelView Plus 6 700.

2.41 HUMAN MACHINE INTERFACE SUN SHIELD

A. A sun shield constructed of 304 stainless steel shall be mounted over the operator interface to provide protection and visibility of operator screens in outdoor applications.

PART 3 – INSTALLATION

3.01 PERFORMANCE TESTING

A. The Engineer will select one of the Filters for performance testing. The filter shall meet the following performance criteria:

B. Flow
   - Average Daily Flow 2.38 MGD per filter
   - Maximum Daily Flow 3.575 MGD per filter

C. Influent Total Suspended Solids (TSS) Concentration
- 10 mg/l, Average Daily.
- 15 mg/l, Maximum Daily.

D. Effluent TSS Concentration,
- 5 mg/l at Average Daily Flow and Average Daily TSS.

E. Maximum Solids Loading Rate
- Maximum Solids Loading Rate, 0.83 #/day/sf,
- At no time during the testing should the solids loading to the filter exceed the Maximum Solids Loading Rate.

F. The Performance Test shall include three conditions:
- Two, 24 hour periods at Average Daily Flow, no solids addition.
  - Within each 24 hour period, one three hour test at Maximum Daily Flow conditions, no solids addition.
- One, 3 hour test at Maximum Solids Loading Rate at the Average Daily Flow rate.

3.02 **TEST PROTOCAL**

1. The actual plant flow at the time of the testing may not be available to achieve each of the test conditions. Flow to other filters in the system may be throttled to increase the flow to the filter being tested. The Owner shall be responsible for maintaining the flow rate required during the test periods.

2. Flow through the filter will be calculated using the nappe over the effluent weir. The nappe will be measured using a calibrated pressure transmitter mounted in the effluent chamber. The flow will be logged throughout the test period.

   The flow will be calculated using the following formula:

   $$\text{Flow (MGD)} = 2.163 * \text{Weir Length (feet)} * \text{Weir Nappe}^{3/2}\text{ (feet)}$$

3. For conditions requiring solids addition to achieve a specific influent solids concentration, stabilized activated solids waste shall be added to the influent.

4. Owner shall provide an estimate of the influent and activated solids waste suspended solids concentration the day prior to the performance testing.

5. The Manufacturer shall use the estimated activated solids waste concentration and influent TSS concentrations to calculate the required activated solids waste feed flow rate to achieve the desired Maximum Solids Loading.

6. Each Maximum Flow test condition shall be run for a three hour period.

7. For the Maximum Solids Loading Rate test:
   - Actual flow and load conditions should be recorded at the beginning of the test.
   - Add solids as necessary until Maximum Solids Loading Rate is achieved.
   - Operate at Maximum Solids Loading Rate for 3 hour duration.
   - Record flow and load during testing.
   - For solids addition, activated solids waste samples shall be taken at 10 minute intervals and analyzed for TSS

8. Composite samples consisting of a minimum of 4 samples per hour during the test period shall be taken. Samples will be taken upstream of the influent weir (mid-depth) and from the effluent chamber (mid-depth). Composite samples shall be tested for TSS according to the latest edition of Standard Methods for the Examination of Water and Solids Wastewater. Sample analysis shall be conducted by a local certified laboratory facility using personnel and equipment provided by the lab.

9. The Owner shall furnish all labor, materials, power, water, equipment, lab services, instrumentation, and any other equipment and services necessary for conducting the field performance testing.

10. The influent flow and influent and effluent TSS data shall be collected and presented by the Manufacturer in a report. The data shall be presented to clearly verify performance compliance.

11. At a minimum, the report must include;

Average Daily Flow Test (for each day of testing)
- 24 hour flow total
- Influent TSS composite sample concentration
- Effluent TSS composite sample concentration

Maximum Daily Flow Test (for each of the two three hour test periods)
- 3 hour flow total
- Monitor and record any flow bypassing

Maximum Solids Loading Rate (for the one, 3 hour test)
- 3 hour flow total (upon achieving solids concentration necessary for Maximum Solids Loading Rate)
- Calculated Influent Solids concentration based on activated solids waste samples
- Calculated Solids Loading Rate

3.03 **ACCEPTANCE**

1. For the Average Daily Flow test conditions,
   - If the influent concentration is below the specified value and the effluent concentration is below the specified value, the test is successful.
   - If the influent concentration is above the specified value and the effluent concentration is below the specified value, the test is successful.
   - If the influent concentration is above the specified value and the effluent concentration is above the specified value, no conclusion can be reached and the test must be re-run.
   - If the influent concentration is below the specified value and the effluent concentration exceeds the specified value, the test is unsuccessful.
   - If either of the two 24 hour tests are unsuccessful, the overall Average Daily Flow test is unsuccessful.

2. For the Maximum Daily Flow test conditions,
   - If the Maximum Daily Flow is passed through the filter without bypassing and the Influent Solids concentration is at or below the Maximum Daily concentration, the test is successful.
   - If the Maximum Daily flow is passed through the filter without bypassing and the Influent Solids concentration is above the Maximum Daily concentration, the test is successful.
   - If the Maximum Daily Flow is not passed through the filter without bypassing and the Influent Solids concentration is at or below the Maximum Daily concentration, the test is unsuccessful.
   - If either of the two (3) hour tests are unsuccessful, the overall Maximum Daily Flow test is unsuccessful.

3. For the Maximum Solids Loading Rate test conditions, the actual solids concentration results shall be used to calculate the actual solids loading rate.
   - If the solids loading rate is greater than or equal to the specified Maximum Solids Loading and flow does not bypass the filter at any time during the test, the test is successful.
   - If the solids loading rate is greater than the specified Maximum Solids Loading and any portion of the flow bypasses the filter during the test, the test results are disregarded since the solids loading rate exceeded the design.
   - If the solids loading rate is less than or equal to the specified Maximum Solids Loading and any portion of the flow bypasses the filter during the test, the test is unsuccessful.

4. The by-passing of flow during any of the test conditions is not permitted. If by-passing occurs during testing, the test must be restarted. Three by-passing events during the formal test period will constitute an unsuccessful test.

5. In the event the performance testing is deemed unsuccessful, the Manufacturer shall have the option to modify the filter(s) as necessary to achieve the guaranteed performance. The maximum cumulative liability to the Manufacturer for the modification or supply of additional equipment shall be limited to 100% of the purchase price of the equipment supplied.

SECTION 15570
SBR EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section shall include unloading at the jobsite, handling, storage and installing of four AquaSBR System including digester and post equalization equipment manufactured by Aqua-Aerobic Systems, Inc., of Rockford, Illinois. Contractor shall furnish all labor, materials, equipment and incidentals required for installation of the AquaSBR as shown on the drawings and as specified herein. Through the wall spool piping and all external piping shall be provided by the installing contractor.
The system shall include:

1. SBR EQUIPMENT

4	60 HP Mixers with Moorings
4	7.5 HP Sludge Pumps
5	125 HP Blowers
4	Influent Valves with Moorings
8	Decanter Actuators
8	Decanter Valves
7	Air Control Valves
4	4-20 mA D.O. signals
4	4-20 mA Pressure Transducers
4	Level Sensors
1	Common Alarm
44	Retrievable Fine Bubble Diffusers

2. DIGESTER EQUIPMENT

2	125 HP Blowers
2	4-20 mA Pressure Transducers
2	Level Sensors

3. POST SBR EQUIPMENT

2	25 HP Blower
1	4-20 mA Pressure Transducer
1	Level Sensor

All motors, pumps, and bearings shall be designed for continuous duty and long operating life in a high humidity atmosphere. All motors and pumps shall be 460 volt, 60 hertz, 3 phase.

B. Equipment installed under this section shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by the engineer.

1.02 SUBMITTALS

A. Complete shop and installation drawings of all materials and equipment furnished by the City under this Section shall be submitted to the Contractor for approval in accordance with the bid document. Submittals shall include, but not be limited to, the following:

1. Detailed drawings showing all of the details of construction pertaining to the filter screen system. This shall include installation details of all equipment associated with this system.

2. Detailed schematic and layout drawings and a description/narrative explaining the operation of all control panels.

3. All interconnections and interface requirements, dimensions, and locations of all major elements of the filter system including critical clearance requirements.

4. Basis of design, including background data, calculations, operational plant data and other information showing the development of the proposed design.

5. The startup/performance testing report and manufacturer's certification as required in Part 3.

1.03 CODES AND STANDARDS

A. Equipment specified herein shall meet or exceed the applicable sections of the following codes and standards authorities.

1. AGMA, American Gear Manufacturers Association.
2. ASME, American Society of Mechanical Engineers.
3. ASTM, American Society of Testing and Materials.
4. ANSI, American National Standards Institute.
1. IEEE, Institute of Electrical and Electronics Engineers
2. NEC, National Electrical Code.
7. U.L., Underwriters Laboratories.
8. AWS, American Welding Society

1.04 SYSTEM STARTUP

A. It is the responsibility of the contractor to coordinate with the filter system supplier/manufacturer for startup services upon completion of the systems installation. The following activities shall be provided by the manufacturer.

B. Manufacturer's Representative

1. The manufacturer's representative shall inspect the construction plans and the installation, and recommend any required modifications, additions, or other changes required to allow the manufacturer to certify that the complete installation is appropriate and will operate as expected and intended.

2. The manufacturer's representative shall instruct the Owner's and Engineer's personnel on the operation and maintenance of the filter system. The instruction shall include both classroom and field training on proper operation and maintenance procedures, accompanied with complete demonstrations.

3. The manufacturer's representative shall supervise the performance testing of the installation.

4. The equipment manufacturer shall furnish the services of a factory trained representative for a maximum of 3 trips and 12 eight-hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance.

5. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.

1.05 SBR FUNCTIONAL REQUIREMENT

A. The AquaSBR shall be capable of treating influent from a inplant pump station. Design shall be for:

1. 7.15 MGD Average Daily Flow
   10.725 MGD Maximum Daily Flow

2. Filter influent total suspended solids (TSS) concentration shall be 10 mg/l daily average and 15 mg/l maximum at average daily flow rate.

3. Filter effluent total suspended solids concentration shall not be greater than 5 mg/l based on a monthly average.

4. Filter effluent turbidity shall not be greater than 3 NTU based on a monthly average.

5. The filter screen system shall consist of one (1) filter screen and all accessories.

6.

1.06 SYSTEM SOURCE & QUALITY ASSURANCE

A. The SBR System shall be supplied by a company of good reputation that is regularly engaged in the manufacture and fabrication of SBR wastewater treatment systems. The manufacturer's experience shall include a minimum of ten (10) installations where equipment of similar size and design has been in operation successfully in a similar process for a minimum of five (5) years. As a minimum, the supplier shall be the manufacturer of the following components: mixers, decanters, diffusers, and controls.

B. The Contractor shall assign full responsibility for the functional operation of all SBR System components to a Single Source Supplier. This Supplier shall be responsible for all engineering necessary in order to select, furnish, inspect the installing contractor's equipment installation and connections, calibrate, and place into operation the SBR System along with all other equipment and accessories as specified herein.

1.07 ELECTRICALLY ACTUATED VALVE QUALITY ASSURANCE

A. Actuated valves shall be tested to Aqua-Aerobic Systems test protocol prior to shipment. Testing shall consist of the following:

1) Project and nameplate data verification per assembly documentation
2) Limit switch and torque switch setup and cycle test
3) Hydrostatic test (two pressurization cycles) for all plug and butterfly valves

1.08 MIXER QUALITY ASSURANCE

A. The floating mixer(s) shall be shop inspected and tested prior to shipment. Testing shall consist of the following:

1) Project and nameplate data verification per assembly documentation.
2) Dynamic balancing
3) Final Inspection

1.09 CONTROL PANE QUALITY ASSURANCE

A. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:

1) Point to point testing of all wiring prior to application of power.

2) Intended supply voltage shall be applied to the enclosure.
3) All components shall be tested for proper operation and calibration.
4) The PLC and operator interface program shall be loaded and functionally checked.
5) All components shall be checked to confirm proper mounting specifications have been followed.
6) Enclosure shall be inspected for defects and repaired if necessary.
7) All labeling of wires and devices are correct, properly installed and clean.

B. The manufacturer shall finalize the factory panel checkout by completing a controls checklist to document all testing completed above. This document must be signed by a Professional Electrical Engineer.

PART 2 - PRODUCTS

2.01 SBR STRUCTURE

A. The system shall be field erected in four basins as shown on the contract drawings:

Inside Dimensions: 95 ft. x 95 ft.

Side Water Depth:

Minimum Operating Level:	15.1 ft. SWD
Maximum Operating Level:	23 ft. SWD
Top Of Wall:	25 ft.

2.02 INFLUENT PLUG VALVE

A. Furnish one (1), 24 inch diameter electrically operated flanged plug valve for each basin to control the influent flow.

B. Valves shall be a Milliken 601-N0 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with an SA14.5, 460 volt, three phase, 60 cycle open/close service electric actuator. The valve shall be a non-lubricated type with a port area of at least 80% of full pipe size. Valve actuator shall include a compartment heater.

C. Each valve shall include a manual override with limit switch feedback to the micro-processor in both the open and closed positions. Field wiring and junction/box disconnect shall be provided by the installing contractor.

D. Provisions for valve access shall be provided by the installing contractor.

E. Each valve shall include a 10 ft. valve stem extension constructed of painted steel. Intermediate valve supports and hardware required for mounting of the extension shall be provided by the installing contractor.

2.03 ENDURA® SERIES DDM MIXER

A. Furnish one (1) AquaDDM® mechanical floating mixer and related equipment accessories as described herein for each basin. Each mixer shall consist of a motor, direct-drive impeller driven at a constant speed, an integral flotation unit, and impeller volute. The Endura Series shall incorporate design enhancements that provide for five (5) years without routine maintenance (greasing).

B. The entire rotating assembly including the motor rotor, shaft, shaft accessories, and impeller shall be dynamically balanced within 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing. Measurements shall be taken at a frequency equivalent to the motor RPM. Measurements shall be taken with the motor in a vertical, shaft down position with the entire power section mounted on resilient pads.

2.04 MIXER DRIVE MOTOR

A. The motor shall be rated for 60 horsepower at 900 RPM and wired for 460 volt, 60 hertz, three-phase service. The motor shall be standard efficiency, vertical P base design, totally enclosed fan cooled TEFC, and generally rated for severe duty. The motor shall in all cases equal or exceed standard NEMA specifications. A minimum service factor of 1.15 shall be furnished.

B. The motor winding shall be nonhygroscopic, and insulation shall equal or exceed NEMA Class "F". A labyrinth seal shall be provided below the bottom bearing to prevent moisture from penetrating around the motor shaft. A condensate drain shall be located at the lowest point in the lower-end bell housing. Unit shall have a one-piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the propeller. The shaft shall be manufactured from 17-4 PH stainless steel.

C. Motor bearings shall be regreasable. Sealed bearings are not acceptable. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open. The top and bottom motor bearings shall be of combined radial and axial thrust type. The lower motor bearing inner brace shall be locked to the motor shaft via a special washer and locking nut arrangement. The shaft shall be threaded just below the lower bearing and shall have a keyway cut into the motor shaft. This key shall accept a tab from the inner diameter of the locking washer, and the locking nut shall have recesses to accept a tab from the outer diameter of the locking washer to prevent the nut from backing

off. Snap ring type bearing retainers will not be acceptable.

D. Submerged motors, jet pumps, submerged gear motors or gearboxes shall not be acceptable.

2.05 MOTOR MOUNTING BASE

A. The motor shall be securely mounted onto a solid 304 stainless steel base which is integral with the motor base extension. All submersed wetted motor mounting base components shall be constructed of 304 stainless steel.

B. The upper portion of the motor mounting base, immediately below the lower motor bearing, shall include two independent acting air seals. The two seals shall be capable of sealing off the flow of air from the suction action of the pumped flow, and prevent backflow of liquid during impeller reversal. The lower end of the motor base extension shall be provided with a rotating backflow seal that will prevent grit from being introduced into the anti-deflection insert reservoir, but shall allow liquid to contact the shaft. The backflow seal shall not require scheduled lubrication or maintenance.

2.06 FLOATATION

A. Each unit shall be equipped with a modular float constructed of 304 stainless steel with a central float passage of a size to allow installation and removal of the pump impeller. The minimum diameter of the float shall be 114-5/8 inches and the minimum thickness 16 inches. The float shall be foamed full of polyurethane foam of the closed cell type, and shall be totally sealed to prevent the foam from being in contact with the external environment.

B. The minimum reserve buoyancy shall be 2535 pounds.

2.07 IMPELLER

A. The impeller shall be designed to pump the liquid from near the surface and direct it down toward the vessel/basin bottom. The impeller shall be a two-blade marine type precision casting of 316 stainless steel and shall be specifically designed for the application intended. It shall be dynamically and hydraulically balanced. The propeller must be attached to the motor shaft with a hardened stainless steel pin and set screw. Impeller shall be capable of being reversed to cause back flow liquid movement without causing damage to the mixer chassis and without causing upflow liquid damage to the motor bearing and windings. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will

be allowed.

2.08 INTAKE VOLUTE ASSEMBLY

A. The impeller shall operate in a volute made of 304 stainless steel plate, minimum 3/16 inch thick.

2.09 CABLE MOORING SYSTEM

A. Each unit shall be provided with a maintenance cable mooring system complete with mooring cable, clips, thimbles, quick disconnects, anchors, and extension springs as shown on the drawings. Mooring cable, anchors, and hardware shall be 304 stainless steel. Field attachment of mooring points to the tank shall be the responsibility of the installing contractor.

2.10 CABLE MOORING ELECTRICAL SERVICE CABLE

A. Each unit shall include #2-four conductor power cable wired into the motor conduit box and terminating at the basin wall. Electrical cable shall be supplied with kellems grips at the float, and basin wall terminations. Electrical cable aerial cable ties for attachment of electrical service cable to the mooring cable shall be provided. Attachment of cable and supply of junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

B. 304 stainless steel adhesive anchors for attachment of mooring system components to the basin wall shall be provided.

2.11 DECANTER ASSEMBLY

A. Furnish two 8x7 mechanical floating decanters and related equipment accessories as described herein for each basin. Each decanter shall consist of an integral flotation unit, a stainless steel movable weir assembly, and an electric motor-driven actuator to open and close the weir.

B. Each decanter shall be capable of withdrawing decant fluid from 4-6 inches beneath the liquid surface, regardless of liquid depth, down to the minimum allowable water level specified below. The decant liquid shall be drawn through an adjustable weir opening of 2-6 inches. The weir shall be circular in shape and permit liquid to enter the decanter from the entire 360 degrees without obstruction.

C. Maximum allowable water level in the basin is 23 ft. Minimum allowable water level in the basin is 15.1 ft. The centerline of each decant pipe must be located 2 ft. below the low water level by the installing contractor.

D. Each decanter shall be rated for an average flow of 3724 gallons per minute.

E. Weir actuator shall include a reversible electric motor operated linear actuator. The actuator shall be capable of operating with a closing force of 1500 lbs. and shall operate from a 115 volt, single phase, 60 hertz source. Adjustable limit switches shall be included to permit adjustment of the weir opening. A spring shall be included to provide for travel after the weir has closed and provide desired closure pressure. A corrosion resistant removable cover shall be included to provide protection to the actuator and motor during normal operation. The power section is painted steel. #14 AWG ten-conductor power cable shall be provided from the NEMA 4X junction box of the unit to the basin wall. Supply of junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

2.12 WEIR

A. The weir shall be constructed of 304 stainless steel, be circular in shape, and shall include vortex control baffles permanently affixed to the weir. The weir shall be attached to the actuator through a removable single shaft or linkage which shall also function as the torque restraint.

2.13 FLOTATION

A. Each unit shall be equipped with a modular float constructed of fiberglass filled with closed cell polyurethane foam having a minimum 2.0 lbs./ft3 density. Float shall be completely sealed to prevent the foam from being in contact with the external environment. Float shall have 875 lbs. reserve buoyancy to ensure stability and to provide support flotation required during decanter servicing. A urethane type seal shall be molded into the bottom of the float assembly to receive the decanter weir.

2.14 DECANTER DISCHARGE PIPE

A. Each decanter shall include a 304 stainless steel elbow with 14" diameter 304 stainless steel discharge pipe complete with Vanstone flange. The installing contractor shall provide a ¾" valve with hose bib connection on the decant line between the decanter and the decant valve.

B. Each decanter shall include two 14" diameter stainless steel flex joints. Flex joints shall be constructed of 304L stainless steel flanges and 321 stainless steel bellows. Flex joints shall utilize heavy duty 304L stainless steel hinges with over-travel stops and full perimeter welds. Flex joints shall carry a minimum rating of 50,000 cycles per EJMA calculations, the Elastic Joint Manufacturer's Association. Flex joints shall be full port diameter, and not reduce flow area of the nominal pipe size. Flex joints shall be fully crated and provided with shipping bars that immobilize and protect the flex joint prior to final installation. Flex joints constructed of plastic or rubber material are not acceptable.

C. All piping, supports, gaskets, and hardware beyond the terminating flange of the decant pipe flexible joint shall be supplied by the installing contractor.

2.15 DECANTER RESTRAINED MOORING SYSTEM

A. Each decanter shall include a galvanized steel mooring frame attached to the float. One 4" diameter Schedule 40 galvanized steel mooring post assembly with base plate shall be provided to assure consistent location of the decanter in the basin. Mooring post shall be filled with concrete by the installing contractor.

B. Galvanized steel dewatering support posts consisting of two - 4" diameter Schedule 40 vertical pylons with base plates shall be provided. Each support with base plate shall be affixed to the basin floor with 304 stainless steel adhesive anchors.

C. Top and bottom mooring post supports constructed of galvanized steel shall be provided for attachment to the basin wall by the installing contractor.

2.16 DECANT FLOW CONTROL VALVE

A. Furnish two 14" diameter electrically operated butterfly valves for each basin to control the decant rate.

B. Valves shall be a Milliken Fig. 511A AWWA C-504 Class 150B electrically operated butterfly valves with ANSI Class 125# flanged end ASTM A-536 ductile iron body, ductile iron disk with a 316 stainless steel edge, fully lined EPDM seat vulcanized in the body, 304 stainless steel shaft assembled and tested with an Auma SA10.1, 460 volt, three phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater. Each valve shall include a manual override with limit switch feedback to the microprocessor in both the open and closed positions. Field wiring and junction/box disconnect shall be provided by the installing contractor.

C. Provisions for valve access shall be provided by the installing contractor.

D. Each valve shall include a 10 ft. valve stem extension constructed of painted steel. Intermediate valve supports and hardware required for mounting of the extension shall be provided by the installing contractor.

2.17 TRANSFER PIPE

A. Furnish one submersible non-clog sludge pump for each basin. Each pump shall be equipped with 7.5 HP, submersible electrical motor connected for 460 volt, three phase, 60 hertz operation. Pump housing shall be painted cast iron. Pump shall include an adequate length of multi-conductor chloroprene jacketed type SPC cable suitable for submersible pump applications. The power cable shall also be sized according to NEC and ICEA standards. The pump shall be supplied with a mating cast iron discharge elbow and be capable of delivering 535 GPM at 26 TDH. Each unit shall be fitted with an adequate length of galvanized steel lifting chain of adequate

strength to permit raising and lowering the pump.

B. The 4" diameter discharge connection elbow shall be permanently installed with the discharge piping. The pump shall be automatically connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service. There shall be no need for personnel to enter the basin or pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump.

C. A galvanized steel upper guide bar bracket shall be provided with each pump. The entire weight of the pumping unit shall be guided by galvanized steel guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact. No sealing of the discharge interface by means of a diaphragm, O-ring, or other devices shall be acceptable. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 ft.

D. Supply of all discharge piping, supports, gaskets, and hardware beyond the flanged connection of the pump discharge connection elbow shall be the responsibility of the installing contractor.

E. Each pump shall include a manually operated discharge valve to control the design transfer flow rate.

F. Valve shall be a 4" diameter Milliken 601-N0, 125# flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug. The valve shall be a non-lubricated type with a port area of at least 80% of full pipe size.

G. Each pump shall include a 4" diameter Nibco F-918-B check valve with cast iron body and bronze disk to prevent backflow.

H. Valves shall be provided loose for installation within the discharge piping by the installing contractor. Valve gaskets and hardware shall be supplied by the installing contractor.

I. Adhesive anchors of 304 stainless steel shall be provided for anchoring the pump.

2.18 RETRIEVABLE FINE BUBBLE Aqua EnduraTube® JF Series AIR DIFFUSER ASSEMBLIES

A. The aeration system shall be a fine bubble diffused air system and shall be a retrievable configuration as shown on the contract drawings. The aeration system shall be capable of delivering 3068 SCFM per basin.

B. Furnish eleven (11) retrievable air diffuser assemblies for each basin. Each assembly shall consist of membrane diffusers, frame assembly, manifold weldment, vertical air column, track/beam, flexible airline, isolation valve, and lifting mechanism. A total of 25 diffuser tube assemblies shall be provided for each diffuser rack. The diffuser assembly shall consist of two sheaths of ultraviolet inhibiting, EPDM material held in place by stainless steel band clamps over support pipes. Each diffuser shall be fixed to the stainless steel air distribution manifold via one connection coupling. Each diffuser length shall require one air manifold boring and shall be secured by a mounting saddle/grommet fitting. Each meter of diffuser membrane shall have a minimum effective aeration area of 0.16 square meters. The diffuser design gassing rate shall not exceed 12.0 SCFM per diffuser assembly. The head loss through an individual diffuser shall not exceed 20" @ 6 SCFM. Upon the loss of air pressure the perforations shall close and the membrane shall seat tightly over the air supply working as a check valve. The 4" diffuser manifold weldment shall be constructed of 304 stainless steel. The entire assembly shall be located such that each diffuser centerline is twelve (12) inches above the basin floor.

C. The vertical air column shall be constructed of galvanized steel. Each diffuser assembly shall include a 3" diameter wire reinforced EPDM flexible air line with quick disconnect end fittings, and a galvanized steel threaded flange, elbow and ny-glass quick disconnect adapters. All air distribution piping, gaskets, and hardware beyond the threaded flange shall be supplied by the installing contractor. The vertical track/beam assembly and intermediate supports shall be galvanized steel. The vertical track/beam shall support the lifting mechanism assembly during operation and servicing.

D. Each assembly shall include a galvanized steel diffuser hoist assembly with base socket to receive a portable electric winch. A total of one (1) portable electric winch shall be provided for the diffuser assemblies. The winch mechanism shall be of sufficient design capacity to raise the diffuser rack assembly to the servicing position. The portable electric winch shall operate from a 115 volt, single phase, 60 hertz electrical supply rated for 12.6 full load amps. The winch shall be provided with a total of 8 feet of electrical cable. Supply of electrical power supply, wiring and junction box for winch shall be the responsibility of the installing contractor.

E. Each diffuser assembly shall include a 3" diameter manually operated isolation butterfly valve for connection to the main air distribution piping by the installing contractor. Valve gaskets and hardware are to be provided by the installing contractor.

F. Valve shall be a Wafer style butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one piece stainless steel shaft.

G. Adhesive anchors of 304 stainless steel shall be provided for anchoring the diffuser assemblies to the basin.

2.19 BLOWERS

A. There shall be furnished five 125 HP, Roots 616, 460 volt, 60 cycle, three phase rotary lobe type, positive displacement blowers with premium efficient, T.E.F.C. U.S. Electric, Teco or equal motor. Each blower shall be capable of delivering 1534 SCFM of air at a discharge gauge pressure of 11.5 psig. The blowers shall be manifolded for individual and/or combined operation.

B. Each blower assembly shall be complete and mounted on a base weldment with four-corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.

C. Equipment shall include a blower, electric motor, belts and sheaves, inlet filter, inlet silencer, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, 8" butterfly discharge isolation valve, and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.

2.20 DISCHARGE PRESSURE GAUGE

A. Provide a discharge liquid filled pressure gauge to be equivalent to U.S. Gauge, Ashcroft, or approved equal.

Range: 0-15 psig.
Dial: 2 ½", 270 degree scale.
Case: 300 Series stainless steel.
Accuracy: ±3-2-3% of span (Grade B)

2.21 AIR CONTROL VALVES

A. Furnish a total of seven (7) 10" diameter electrically operated butterfly valves to control the air flow.

B. Valves shall be a Milliken Fig. 511A AWWA C-504 Class 150B electrically operated butterfly valves with ANSI Class 125# flanged end ASTM A-536 ductile iron body, ductile iron disk with a 316 stainless steel edge, fully lined EPDM seat vulcanized in the body, 304 stainless steel shaft assembled and tested with an Auma SG12, 115 volt, single phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater. Each valve shall include a manual override with limit switch feedback to the microprocessor in both the open and closed positions. Field wiring and junction/box disconnect shall be provided by the installing contractor.

C. Provision for valve access shall be provided by the installing contractor.

2.22 DISSOLVED OXYGEN CONTROLLER

A. Furnish one (1) Hach SC200 Multi Parameter Probe Module(s) per basin. The SC200 shall receive the digital input from a maximum of two devices. The controller will communicate with the main PLC via 4-20 mA signals. The SC200 will have a NEMA 4X/IP66 metal enclosure with a corrosion-resistant finish and shall be AC powered from a 100-230VAC, 60Hz power source.

2.23 DISSOLVED OXYGEN SENSORS

A. Furnish one (1) Hach LDO series dissolved oxygen sensor per basin. The probe shall be a continuous-reading probe utilizing luminescent sensor technology, and shall provide electrolyte-free operation without requiring sample conditioning. Sensors shall be suspended on a removable mounting pipe assembly. 304 stainless steel pipe, 304 stainless supports and 304 stainless steel anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. Field wiring, conduit, and installation of cable shall be the responsibility of the installing contractor.

2.24 PRESSURE TRANSDUCER

A. Furnish one (1) KPSI Model 700 submersible pressure transducer unit constructed of stainless steel for each basin. Transducer shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid. Transducer output shall be a 4-20 mA signal. Electrical connection shall be 2-wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire. Transducers shall be suspended on a removable mounting pipe assembly. 304 stainless steel pipe, 304 stainless supports and 304 stainless steel anchors shall be provided. Field attachment of the pipe and supports to the basin shall be the responsibility of the installing contractor. A moisture excluding aneroid bellows shall be supplied loose for installation in the junction box/ disconnect. Attachment and supply of the junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

B. Adhesive anchors of 304 stainless steel shall be provided for anchoring.

2.25 LEVEL SENSORS

A. Furnish one (1) level sensor assembly consisting of an Anchor Scientific model GSI 40NONC float switch with a smooth, chemical resistant polypropylene casing, and 316 stainless steel mounting bracket for each basin. Each float switch shall be provided with a three conductor electrical cable. Electrical cable shall terminate at a junction box/disconnect located at the basin wall. Field wiring and junction box/disconnect shall be provided by the installing contractor.

B. Adhesive anchors of 304 stainless steel shall be provided for anchoring the level sensor mounting bracket.

2.26 POST-EQUALIZATION BASIN STRUCTURE

A. The Post-Equalization/Holding basin shall be field erected in one basin as shown on the contract drawings:

Inside Dimensions: 192 ft. x 16 ft.

Side Water Depth:

Minimum Operating Level:	3 ft. SWD
Maximum Operating Level:	13 ft. SWD
Top Of Wall:	25 ft.

2.27 MATERIALS AND FABRICATION

A. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240, 554, 774, 778. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276. Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc inert gas welding processes. Provide a cross section equal to or greater than the parent metal. Clean all welded stainless steel surfaces and welds after fabrication to remove weld splatter and finish clean all interior and exterior welds by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.

2.28 DROP PIPES

A. Provide a minimum 12 ga. stainless steel drop pipe from the air main connection to a point 3 feet above the air distribution header. Provide a stainless steel flange with a 150-pound drilling at the top connection. Provide a stainless steel gasketed coupling for connection to the air distribution header.

2.29 AIR DISTRIBUTION HEADERS

A. Provide minimum 12 ga. stainless steel air distribution headers for connection to the drop pipe. Fabricate air distribution headers with flanged joints or expansion joints. Design piping with eccentric reducers for changes in diameter to maintain constant invert elevation. Provide piping with removable or welded end caps. Design piping, pipe joints and supports to resist expansion/contraction thrust forces of the air distribution headers over a temperature range of 125° F.

2.30 PIPE SUPPORTS

A. Provide each section of air distribution header with a minimum of two supports. Support spacing to be limited to a maximum of 18 feet. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125° F and to minimize stress build up in the piping system. Design supports to be adjustable without removing the air distribution header from the support. Design supports to include hold down guide straps, support structure and two anchor bolts. Design guide straps with a 2 inch minimum width to eliminate point load on piping and minimize binding. Design support for a total of 1 inch lateral adjustment and 4 inch vertical adjustment for leveling within 3/8 inch of a common plane. Attach supports to tank floor with stainless steel anchor bolts.

2.31 DIFFUSER ASSEMBLIES

A. Furnish diffuser assemblies including diffuser, diffuser connector and air flow control orifice.

2.32 AIR DIFFUSER

A. Design diffuser with cast stainless steel alloy equivalent to 316L stainless steel schedule 80 – ¾ inch NPT threaded nozzle, air reservoir, air exit ports and bottom deflector. Design diffuser with a minimum air release perimeter of 48 inches. Locate exit ports discharging air into liquid on horizontal planes at two levels. Provide deflector below each diffuser for its full length and width. Design deflector to direct the liquid being aerated along the diffuser reservoir walls so that the air exits through the ports and is sheared into small bubbles and distributed into the liquid.

2.33 DIFFUSER CONNECTORS

A. Design diffuser connector for two diffusers. Furnish PVC plugs for all unused diffuser connectors. Design diffuser connector with cast stainless steel alloy equivalent to 316L stainless steel. Provide connector so that air exiting the diffusers does not interfere with the air distribution header. Factory weld connector to the invert centerline of the air distribution header with a full penetration butt weld. Reinforce the connector header weld joint by providing and continuously welding gussets between the vertical side wall of the header and the connector ends to limit long term flexure failure. Minimum gusset thickness to be 1/8 inch. Design connector to resist a vertical dead load applied to the threaded end of the connector that results in a bending moment of 1000 inch-lbs without exceeding 24,000 psi design stress in any part of the air distribution header wall or connector.

2.34 ANCHOR BOLTS

A. Design a mechanical or adhesive anchor bolt system for embedment in 4000 psi concrete with a pullout safety factor of 4.

2.35 BLOWERS

A. There shall be furnished one 25 HP, Roots 68, 460 volt, 60 cycle, three phase rotary lobe type, positive displacement blowers with premium efficient, T.E.F.C. U.S. Electric, Teco or equal motor. Each blower shall be capable of delivering 462 SCFM of air at a discharge gauge pressure of 6.4 psig. The blowers shall be manifolded for individual and/or combined operation.

B. Each blower assembly shall be complete and mounted on a base weldment with four-corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.

C. Equipment shall include a blower, electric motor, belts and sheaves, inlet filter, inlet silencer, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, 4" butterfly discharge isolation valve, and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.

2.36 DISCHARGE PRESSURE GAUGE

A. Provide a discharge liquid filled pressure gauge to be equivalent to U.S. Gauge, Ashcroft, or approved equal.
Range: 0-15 psig.
Dial: 2 ½", 270 degree scale.
Case: 300 Series stainless steel.
Accuracy: ±3-2-3% of span (Grade B)

2.37 PRESSURE TRANSDUCER

A. Furnish one (1) KPSI Model 700 submersible pressure transducer unit constructed of stainless steel for each basin. Transducer shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid. Transducer output shall be a 4-20 mA signal. Electrical connection shall be 2-wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire. Transducers shall be suspended on a removable assembly consisting of PVC support pipe and EPDM hose. Removable assembly shall be supported by 304 stainless steel supports and guide rail, and 304 stainless steel anchors. Field attachment of the guide rail and supports to the basin shall be the responsibility of the installing contractor. A moisture excluding aneroid bellows shall be supplied loose for installation in the junction box/ disconnect. Attachment and supply of the junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

B. Adhesive anchors of 304 stainless steel shall be provided for anchoring.

2.38 LEVEL SENSORS

A. Furnish one (1) level sensor assembly consisting of an Anchor Scientific model GSI 40NONC float switch with a smooth, chemical resistant polypropylene casing, and 316 stainless steel mounting bracket for each basin. Each float switch shall be provided with a three conductor electrical cable. Electrical cable shall terminate at a junction box/disconnect located at the basin wall. Field wiring and junction box/disconnect shall be provided by the installing contractor.

B. Adhesive anchors of 304 stainless steel shall be provided for anchoring the level sensor mounting bracket.

2.39 AEROBIC DIGESTER/SLUDGE HOLDING BASIN STRUCTURE

A. The Aerobic Digester/Sludge Holding basin shall be field erected in two basins as shown on the contract drawings:

Inside Dimensions: 85 ft. diameter

Side Water Depth:

Maximum Operating Level:	20 ft. SWD
Top Of Wall:	23 ft.

2.40 MATERIALS AND FABRICATION

A. Fabricate all welded parts and assemblies from sheets and plates of 304L stainless steel with a 2D finish conforming to ASTM A240, 554, 774, 778. Fabricate non-welded parts and flanges from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276. Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc inert gas welding processes. Provide a cross section equal to or greater than the parent metal. Clean all welded stainless steel surfaces and welds after fabrication to remove weld splatter and finish clean all interior and exterior welds by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.

2.41 DROP PIPES

A. Provide a minimum 12 ga. stainless steel drop pipe from the air main connection to a point 3 feet above the air distribution header. Provide a stainless steel flange with a 150-pound drilling at the top connection. Provide a stainless steel gasketed coupling for connection to the air distribution header.

2.42 AIR DISTRIBUTION HEADERS

A. Provide minimum 12 ga. stainless steel air distribution headers for connection to the drop pipe. Fabricate air distribution headers with flanged joints or expansion joints. Design piping with eccentric reducers for changes in diameter to maintain constant invert elevation. Provide piping with removable or welded end caps. Design piping, pipe joints and supports to resist expansion/contraction thrust forces of the air distribution headers over a temperature range of 125° F.

2.43 PIPE SUPPORTS

A. Provide each section of air distribution header with a minimum of two supports. Support spacing to be limited to a maximum of 18 feet. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125° F and to minimize stress build up in the piping system. Design supports to be adjustable without removing the air distribution header from the support. Design supports to include hold down guide straps, support structure and two anchor bolts. Design guide straps with a 2 inch minimum width to eliminate point load on piping and minimize binding. Design support for a total of 1 inch lateral adjustment and 4 inch vertical adjustment for leveling within 3/8 inch of a common plane. Attach supports to tank floor with stainless steel anchor bolts.

2.44 DIFFUSER ASSEMBLIES

A. Furnish diffuser assemblies including diffuser, diffuser connector and air flow control orifice.

2.45 AIR DIFFUSER

A. Design diffuser with cast stainless steel alloy equivalent to 316L stainless steel schedule 80 – ¾ inch NPT threaded nozzle, air reservoir, air exit ports and bottom deflector. Design diffuser with a minimum air release perimeter of 48 inches. Locate exit ports discharging air into liquid on horizontal planes at two levels. Provide deflector below each diffuser for its full length and width. Design deflector to direct the liquid being aerated along the diffuser reservoir walls so that the air exits through the ports and is sheared into small bubbles and distributed into the liquid.

2.46 DIFFUSER CONNECTORS

A. Design diffuser connector for two diffusers. Furnish PVC plugs for all unused diffuser connectors. Design diffuser connector with cast stainless steel alloy equivalent to 316L stainless steel. Provide connector so that air exiting the diffusers does not interfere with the air distribution header. Factory weld connector to the invert centerline of the air distribution header with a full penetration butt weld. Reinforce the connector header weld joint by providing and continuously welding gussets between the vertical side wall of the header and the connector ends to limit long term flexure failure. Minimum gusset thickness to be 1/8 inch. Design connector to resist a vertical dead load applied to the threaded end of the connector that results in a bending

moment of 1000 inch-lbs without exceeding 24,000 psi design stress in any part of the air distribution header wall or connector.

2.47 ANCHOR BOLTS

A. Design a mechanical or adhesive anchor bolt system for embedment in 4000 psi concrete with a pullout safety factor of 4.

2.48 BLOWERS

A. There shall be furnished one 125 HP, Roots 616, 460 volt, 60 cycle, three phase rotary lobe type, positive displacement blowers with premium efficient, T.E.F.C. U.S. Electric, Teco or equal motor per digester basin. Each blower shall be capable of delivering 1580 SCFM of air at a discharge gauge pressure of 9.67 psig. The blowers shall be manifolded for individual and/or combined operation.

B. Each blower assembly shall be complete and mounted on a base weldment with four-corner anti-vibration mountings, designed for direct application on a concrete slab or other solid foundation. Each assembly shall be suitable for shipment as a complete unit, factory assembled (less discharge pipe fittings) as much as possible to facilitate shipping and handling.

C. Equipment shall include a blower, electric motor, belts and sheaves, inlet filter, inlet silencer, discharge silencer, discharge check valve, rubber inlet sleeve and discharge connection, pressure relief valve, 4" butterfly discharge isolation valve, and rubber expansion joint. A personnel protection guard shall be included over the belts and sheaves.

2.49 DISCHARGE PRESSURE GAUGE

A. Provide a discharge liquid filled pressure gauge to be equivalent to U.S. Gauge, Ashcroft, or approved equal.
Range: 0-15 psig.
Dial: 2 ½", 270 degree scale.
Case: 300 Series stainless steel.
Accuracy: ±3-2-3% of span (Grade B)

2.50 PRESSURE TRANSDUCER

A. Furnish one (1) KPSI Model 700 submersible pressure transducer unit constructed of stainless steel for each basin. Transducer shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid. Transducer output shall be a 4-20 mA signal. Electrical connection shall be 2-wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire. Transducers shall be suspended on a removable assembly consisting of PVC support pipe and EPDM hose. Removable

assembly shall be supported by 304 stainless steel supports and guide rail, and 304 stainless steel anchors. Field attachment of the guide rail and supports to the basin shall be the responsibility of the installing contractor. A moisture excluding aneroid bellows shall be supplied loose for installation in the junction box/ disconnect. Attachment and supply of the junction box/disconnect at the basin wall shall be the responsibility of the installing contractor.

B. Adhesive anchors of 304 stainless steel shall be provided for anchoring.

2.51 LEVEL SENSORS

A. Furnish one (1) level sensor assembly consisting of an Anchor Scientific model GSI 40NONC float switch with a smooth, chemical resistant polypropylene casing, and 316 stainless steel mounting bracket for each basin. Each float switch shall be provided with a three conductor electrical cable. Electrical cable shall terminate at a junction box/disconnect located at the basin wall. Field wiring and junction box/disconnect shall be provided by the installing contractor.

Adhesive anchors of 304 stainless steel shall be provided for anchoring the level sensor mounting bracket.

2.52 SBR CONTOL PANEL WITHOUT MOTOR STARTERS

A. The control system shall be designed to optimize the SBR process while minimizing operator attention and to accommodate the continuous maximum daily flow without adjusting cycle structures. The control software program shall be factory tested prior to installation at the jobsite.

B. The control system shall be a timer based system with level overrides and shall provide control, sequence, monitoring, and alarm annunciation capabilities. The operator shall be able to access the timer values and set points through the operator interface panel to allow for adjustment of cycle times and system flexibility. The control system shall be designed to automatically accommodate the plant's full range of loads and flows.

C. A complete control system shall be provided as described in the following and as shown on the contract drawings. The control system shall include 115 volt control circuit breaker, microprocessor control, operator interface display, indicator lights, and HAND-OFF-AUTOMATIC selector switches.

D. The incoming service of the control system shall be 115 volt, 60 hertz, single-phase. Controls for the equipment listed below shall be provided within the SBR control panel. Elapsed time indication shall be provided through the operator interface of the SBR control panel for equipment indicated by an asterisk(*).

QTY **SBR EQUIPMENT DESCRIPTION**

4	60 HP Mixers*
4	5 HP Sludge Pumps*
5	125 HP Blowers*
4	Influent Valves
8	Decanter Actuators
8	Decanter Valves
7	Air Control Valves
4	4-20 mA D.O. signals
4	4-20 mA Pressure Transducers
4	Level Sensors
1	Common Alarm

QTY	DIGESTER EQUIPMENT DESCRIPTION
3	125 HP Blowers*
2	4-20 mA Pressure Transducers
2	Level Sensors

QTY	POST SBR EQUIPMENT DESCRIPTION
1	25 HP Blower*
1	4-20 mA Pressure Transducer
1	Level Sensor

D. ENCLOSURE:

1. Free standing NEMA 12 steel enclosure - leg mounted.
2. Steel surfaces shall be cleaned, phosphate etched, and primed with a zinc rich enamel paint.
3. Finish paint shall be applied after all openings are completed and the surface is sanded and re-primed.
4. The exterior of the enclosure shall be painted with ANSI 61 Grey over a phosphatized surface.
5. The interior of the enclosure shall be painted white.
6. Lifting points shall be provided as required for convenient handling of the complete control enclosure.
7. The completed control panel shall meet NEMA 12 rating.
8. All seams shall be continuously welded and ground smooth.
9. All gasketing shall be oil resistant and securely held in place.
10. Dual door panels shall have a keyed handle operated three point latching mechanism with roller latch rods (two keys shall be provided).
11. Doors shall be mounted using continuous heavy gauge piano hinge.
12. Door and enclosure stiffeners shall be welded into the enclosure as required to maintain flat smooth surfaces.
13. One print pocket shall be provided on the control panel door. One complete set of electrical control drawings shall be provided in the pocket.
14. Panel shall be UL listed and labeled.

F. CONTROL RELAYS: UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating, 6 million mechanical life cycles and an operating temperature of -22°F to 131°F. Relays shall be Allen-Bradley 700-HK or approved equal.

G. GROUND FAULT DUPLEX RECEPTACLE: A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 125VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

H. CONTROL PANEL WIRING COMPONENTS: All wires entering or leaving the control panel shall attach to the terminal strip.
All control panel wire shall be 16 AWG multi-strand machine tool wire minimum.
Insulation shall be MTW.
Wiring color continuation shall be:

120 VAC control power	-	RED
Neutral	-	WHITE
Ground	-	GREEN
Power from remote source		YELLOW
24 volt DC (+)	-	BLUE
24 volt DC (-)	-	BLUE W/WHITE STRIPE

All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.

All terminals shall be strip mounted.
Voltage rating 600 volts.
Amperage rating 25 amps.
All terminals shall be numbered per the wiring schematic.
Wire terminations shall be tubular compression.

I. SWITCHES/PILOT LIGHTS: Selector switches shall be used on all automatic controlled equipment. Selector switches shall be rated NEMA 4X with contacts rated at 60 amp make, 6 amp break, 10 amp continuous. Pilot lights shall be 120/6 volt transformer type rated NEMA 4X. All switches and lights shall be clearly labeled with white plastic legend plates with black lettering.

J. PROGRAMMABLE LOGIC CONTROLLER: Automatic operation of the SBR shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a panel mounted rack or chassis, power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include an Ethernet and RS-232 communication port. All input and output points supplied (including unused) shall be wired to terminal blocks.

K. VENDOR/MODEL:
Allen-Bradley/ SLC 5/05 – Processor
Allen-Bradley/1746-A# – Chassis (# = 4, 7, 10 or 13 slots)
Allen-Bradley/1746-P4 – Power Supply
Allen-Bradley/1746-IA16 – Discrete input (16 point) modules
Allen-Bradley/1746-OW16 – Discrete output (16 point) modules
Allen-Bradley/1746-NI8 – Analog input (8 channel) modules

L. DESIGN DESCRIPTION-5/05 PROCESSOR:
Program memory size, 64K
High-speed performance – 0.90 ms/K typical scan time
Built-in Ethernet and RS-232 channels
Built-in real-time clock/calendar
Battery backed RAM
Keyswitch – Run, REMote, PROGram (clear faults)
Ambient operating temperature of +32 degrees F. to +140 degrees F.
UL Listed

M. DIGITAL INPUT MODULE (16 POINT MODULE):
Input voltage 120 Volt (nominal)
85 - 132 VAC
47 - 63 Hertz
Switching response 35 ms on - 45 ms off
16 status light indicators.
Removable wiring terminal strip.
UL and CSA approved.

N. DIGITAL OUTPUT MODULE (16 POINT):
16 relay outputs rated at 1.5 amps.
Load voltage 1800 VA make, 180 VA break
No leakage current in the open state.
16 status light indicators
UL and CSA approved

O. ANALOG INPUT MODULE (8 POINT MODULE) :

Input voltage:	4-20 mA
Resolution:	12 bit
Maximum ratings:	-45 mA to + 45 mA

Conversion time: 0.4 ms
8 status light indicators
Removal wiring terminal strip

P. REMOTE ACCESS ETHERNET MODEM:
A UL listed, remote access Ethernet modem shall be supplied to provide connection capability between the Ethernet PLC network to a standard analog phone line. The device shall be complete with 4 RJ-45 10/100 full/half duplex network ports with on RJ-12 modem port capable of line rates (V90) of 56K thru 28K bps. The unit shall have an operating temperature of 32°F – 122°F (0°- 50°C) and compliance with FCC Part 68, Part 15-Class b, UL/CSA/DOC Certified, REN 0.8B, CTR 21. Mounting shall be on 35 mm-din rail with 8-48VDC input power. The remote access Ethernet modem shall be a Rockwell Automation Model #9300-RADES.

Q. OPERATOR INTERFACE DISPLAY:
The operator interface shall be a NEMA Type 4X rated, 10.4" diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution, and 18-bit color graphics. The rated operating temperature shall be 32° to 131° F. The operator interface shall be an Allen Bradley PanelView Plus 1000.

The operator interface shall provide information to assist the Operator in assessing the status of the filter system. The interface screen shall display, at minimum, the following parameters: Process cycle current phase with time remaining in the phase, Cycle structure presets, Aeration cycle presets, Alarm condition annunciation, and Auxiliary equipment presets.

R. SOFTWARE:
The PLC function shall be to control, sequence, and monitor the SBR.

PHASE CONTROL, the regulation of the process cycles of the SBR up to the maximum daily flow of the plant.

AERATION CONTROL, the regulation of the aeration and mixing systems to achieve optimum process control.

COMPONENT MONITORING, the monitoring of components for fault conditions and the orderly alarming and logging of the fault.

SECTION 16002
SCADA AND INSTRUMENTATION

Part I – GENERAL

1.1 Scope of Work

The work included in this Section consists of furnishing all labor, materials, equipment and incidentals required to manufacture, assemble, program, shop-test and terminate control panels as specified herein.

1.2 References

1.2.1 National Electrical Manufacturers Association (NEMA)
1.2.2 National Electric Code (NEC)
1.2.3 Underwriters Laboratories, Inc. (UL)
1.2.4 ANSI / TIA-568
1.2.5 Institute of Electrical and Electronic Engineers (I.E.E.E.)
1.2.6 Where reference is made to one of the above standards, the revision in effect at the time of bid shall apply.

1.3 Definitions

1.3.1 Provide: Furnish, connect and test.
1.3.2 Product Data: Catalog cuts and descriptive literature.
1.3.3 Shop Drawings: Factory prepared specific to the installation.
1.3.4 Indicated: Shown on the Drawings.
1.3.5 Noted: Indicated or specified elsewhere.
1.3.6 CSI: Control System Integrator

1.4 Quality Assurance
1.4.1 Assembly

1.4.1.1 All work by the CSI on Site shall conform to UL 508A standards.
1.4.1.2 All Equipment supplied under the contract with the CSI for the WWTP contract shall be assembled per UL 508A standards in the CSI shop

1.4.2 Testing

1.4.2.1 Control panels shall be shop tested prior to shipment and then thoroughly field tested after installation

1.4.2.1.1 All lamps and indicators shall function as designed

1.4.2.1.2 All signals isolators shall be calibrated and be within specification.
1.4.2.1.3 All digital relay signals shall be tested
1.4.2.1.4 PLC I/O shall operate as designed
1.4.2.1.5 Communications components shall operate as designed

1.4.3 CSI Prequalification's

1.4.3.1 The CSI shall have been in business continuously for the last 15 years and performed work in the state of Georgia continuously for that period.
1.4.3.2 The CSI shall maintain a 24 hour 7 day a week free troubleshooting phone support system for the customer that can provide enhanced phone support as well as PLC programming guidance over the phone.
1.4.3.3 A tech support system shall be in place that can send a tech to site at anytime the customer needs support. The tech shall be able to troubleshoot and bypass any systems including PLC programming and HMI / SCADA that is faulty to allow the system to maintain operation without an EPD violation. The Tech support system shall be able to drive to site in less than 3 hours.
1.4.3.4 The CSI shall be able to provide the components as specified on this Specification to allow the customer standardization in dealing with programs and spare parts.
1.4.3.5 All Control cabinets and panels shall be manufactured and assembled in the CSI UL508A certified factory and not subcontracted.
1.4.3.6 The CSI for the City of Hinesville is EMICC. Other CSI Firms must submit prequalification materials no later than 20 days prior to the original bid date set forth in the bid documents.
1.4.3.7 Qualification materials must show 4 Wastewater plant control automation projects with at least 2 projects tightly integrated with the Aqua-Aerobics SBR system. Listed projects should show Allen Bradley PLC and Wonder Ware programming and control with remote access for Wonder Ware in the past with contact information
1.4.3.8 There shall be no exceptions in the prequalification requirements for the CSI.

1.5 Submittals

1.5.1 Supply 2 copies of SCADA submittal manuals in paper format and 3 DVD's of the submittal manual in PDF format in a single file formatted exactly like the paper copies.
1.5.2 Labeled and signed shop drawings showing, at a minimum control functions, wiring diagrams showing all components located in panels as they are wired in the SCADA panels with customer terminal block connections. The customer connections shall be shown on a terminal block layout sheet to facilitate interconnections by the SCADA supplier.
1.5.3 Schematics and Mechanical drawings shall be printed on 11 x 17 Paper.
1.5.4 Separate schematics for each SCADA cabinet shall be supplied.
1.5.5 The overall communications and computer setup shall be shown on an individual drawing.

1.5.6 Cabinet layout Drawings with dimensions for panel mounted components and cabinet outline dimensions with mounting dimensions clearly labeled and identified.

1.5.7 All drawings shall be Autocad 2012 or newer.

1.5.8 A Bill of material shall also be supplied for each SCADA cabinet. Cut sheets for all components will be included.

1.5.9 Submit 2 paper copies of the O & M manual and 4 copies of the O & M manual in PDF format as a single PDF file formatted identical to the paper copies.

1.5.10 All changes made during installation and startup shall be incorporated in the data and documented on the drawings and other paperwork as revision changes. The information in the manual shall include all necessary information to trouble shoot problems with the PLC controls.

1.5.11 The network layout and termination drawing shall include placement of all switches, WIFI hubs, firewall and ports used on computers.

1.5.12 A logon shortcut sheet shall be included for ease of procedure to remotely logon to the Terminal Server.

1.6 Product Delivery, Handling and Storage

1.6.1 Delivery and Handling

1.6.1.1 Control panels shall arrive completely enclosed and sealed in wooden crates with suitable cushioning to prevent deformation and abrasion.

1.6.1.2 All loose parts shall be packaged separately and properly labeled.

1.6.1.3 Suitable lifting and transporting means shall be incorporated into the shipping crate so that the panel does not take movement stresses while being shipped.

1.6.2 Storage

1.6.2.1 Panels shall be stored in a clean, dry, heated area away from moving traffic which might bump or otherwise come in contact with the panels.

1.6.2.2 Shipping crates shall not be removed until just prior to actual installation into the area in which the panels are to be located.

1.6.3 Spare Parts

1.6.3.1 One set of recommended spare parts shall be delivered and labeled for the customer.

PART 2 – PRODUCTS

2.1 General

2.1.1 The panels shall contain indicator lights, indicators, other components, terminals and wiring as shown on the drawings.

2.1.2 All wiring shall be minimum AWG #18 for 24 VDC circuits and AWG #14 for 120 VAC. The wire will be tin plated stranded UL 1015 and run in wire ways, clearly marked at all terminations with Brady or equal markers. Field wiring shall terminate on 600 volt barrier, box type terminals. All interior devices and terminals shall be mounted on sub-panels on din rail. All terminals shall be clearly marked. Control panels shall have wire ways for all internal wiring. The wiring will be segregated based on digital, analog and power.

2.1.3 Wire colors shall be as follows:
Black: AC Line
White: Neutral
Yellow: External Powered
Red: Internal to cabinet AC
Blue: Internal to cabinet DC

2.1.4 Each power feed from the SCADA panel shall have a Circuit Breaker integral to the panel for disconnecting the 120 volt, 1 phase AC power from the instrument. The Circuit breakers shall be coordinated to prevent loss of power to the main panel. 24 VDC feed to instruments will be through a power supply isolated to external instruments only and through a 0.1 amp AGC fuse for each instrument.

2.1.5 Control panels shall be fabricated of 11 gauge steel, the cabinets shall be all welded construction with all seams ground smooth and buffed to a smooth finish. Outdoor and corrosive environment cabinets shall be NEMA 4X Stainless Steel with hasps. Indoor cabinets shall be NEMA 12 painted grey with quarter turn latch.

2.1.6 Thermal control in the SCADA cabinets shall be required. The internal temperature of the cabinets shall maintain 40 degrees F minimum to 120 degrees F maximum. Sun shields shall be required for the two outdoor cabinets.

2.1.7 All digital signals shall go through a relay for isolation. The PLC I/O shall be 24 VDC power. All indicating and control signals coming into the panel shall pickup a relay coil in the SCADA panel.

2.1.8 All relays shall be Finder relay 55 series with manual override and led indication. Relay bases shall be 94.04 4 pole base. RC networks shall be installed on AC powered coils. A diode shall be installed on DC powered coils. An exact replacement substitution will be allowed. Manual override, LED indication, RC networks and or Diodes are required.

2.1.9 PLC shall be Allen Bradley Micrologix and Compactlogix. No substitutions.

2.1.10 24 VDC power supplies shall be UL Listed and available through a local distributor for Hinesville, Ga.

2.1.11 Analog signal isolators shall have a minimum 1500 VDC isolation from input to output and power source.

2.1.12 Fiber Optic Switches shall be N-Tron brand 105FXE-SC-15 in all SCADA cabinets.

2.1.13 Fiber cable shall be 12 fiber count single mode Corning Freedm LST cable or preapproved equal and terminated with a fan out kit using SC connections. Pulling eyes will be installed on the fiber cables to facilitate installation in conduit. Cables must be tested after installation to verify continuity and signal loss. The loss shall be less than 1 db.

2.1.14 All 120 VAC Power entering and exiting the SCADA cabinet shall have UL 1449 listed 3rd edition or later edition surge protection. All analog signals of 4-20mA shall have 30 volt maximum rated UL listed surge protection.

2.2 Field Instruments

2.2.1 Influent flow shall be recorded from 2 sources. The ultrasonic flow meters shall read the flow from a Parshall flume and give a 4-20 mA signal for flow as well as a pulse output for totalization. Power shall originate in SCADA cabinet 1. The ultrasonic flow meter shall be a Pulsar Ultra 3 with dbmach3 ultrasonic transducer or ISCO Signature flow meter and TIENet 310 ultrasonic transducer or The Rosemount 3490 controller with the 3108 ultrasonic transducer.

2.2.2 The two Digesters require a level indication to control sludge flow. The ultrasonic level transducers shall be supplied by Aqua Aerobics. Loop powered from SCADA cabinet 4. 2 floats for high level digital signals shall be sent to the SCADA cabinet.

2.2.3 The effluent flow shall be recorded. The ultrasonic flow meter shall read the flow from a Parshall flume and give a 4-20 mA signal for flow as well as a pulse output for totalization. Power shall originate in SCADA cabinet 3. The ultrasonic flow meter shall be a Pulsar Ultra 3 with dbmach3 ultrasonic transducer or ISCO Signature flow meter and TIENet 310 ultrasonic transducer or The Rosemount 3490 controller with the 3108 ultrasonic transducer.

2.3 Field Wiring

2.3.1 Field wiring shall enter the panels through conduit and be properly restrained leading to the terminals. All signal cables shall be run in separate wire ways and run continuously, without splices from the transmitters to the receivers. Where splices are unavoidable because of length, the splice shall be made on 3 terminal blocks (per signal) in a water tight junction box.

2.3.2 Field wiring shall be minimum AWG #14 tin plated stranded single or multiple conductor, color coded. All terminations shall be clearly marked. All terminal blocks shall be clearly labeled.

2.3.3 All signal cables shall be shielded, twisted pairs minimum AWG #16 tin plated stranded with overall 300 volt suitable for wet or dry locations. Belden 5240F1or equal.

2.3.4 Pulling eyes will be installed on the fiber optic cable to facilitate installation in the conduit. Cable shall be tested after installation to verify continuity and signal loss.

2.4 Control Panels

2.4.1 The SCADA cabinets shall be assembled in a clean organized manner. Wire ways will be used to separate wire based on voltage level. Ethernet cables will be separated from other wire. Din rail shall be level and equal lengths in sections that separate relays, power supplies, isolators and terminal blocks.

2.4.2 Terminal blocks will be separated into groups based on voltage for digital signals and analog with shield ground terminations every 3 terminals. Ground all devices and shields according to the manufacturer's instructions.

2.4.3 All terminations shall be accessible from the front of the panel.

2.5 Third Party Vendor Requirements

2.5.1 General Requirements

2.5.1.1 All third party equipment without a PLC shall include dry contacts rated 120 VAC minimum for status, fault and power fail indications.

2.5.1.2 All third party equipment shall provide Dry contacts where required in the I/O Schedule in Section 3.9.

2.5.1.3 The preferred PLC for all packaged equipment is Allen Bradley. If the vendor is unable to supply an Allen Bradley PLC with their equipment, the project engineer shall be notified.

2.5.1.4 Vendor Equipment incorporating a PLC shall have an Ethernet port available to communicate to the HMI Network. The Ethernet interface shall accommodate a Single mode fiber terminated with an "SC" connector type.

2.5.1.5 If an Ethernet switch is required within the Vendor Equipment, the preferred switch is N-Tron 105FXE-SC-15.

2.5.1.6 Vendor shall supply an Excel spreadsheet containing all tag information required by the HMI system to monitor Alarm, Status, and Control information associated with the equipment. As a minimum, the spreadsheet shall contain the information listed in section 3.9 of this document. The vendor shall be prepared to supply the CSI with additional information during the integration phase of the project should the project engineers / CSI require.

2.5.1.7 A UPS or Battery backup system shall be included in the cabinet when a PLC is included to maintain the PLC and Ethernet switch power for annunciation on power fail.

2.5.1.8 All VFD's shall reset after a power failure and have a delayed restart.

2.5.1.9 Equipment shall be designed, programmed, & configured such that, when recovering from a power failure event, the plant and equipment returns to the operating state it was in prior to power fail event. If it is not possible to return to the prior operating state, an alert should be sent to the plant operators indicating any systems which did not resume the required operation.

2.5.1.10 All pump indications shall follow OSHA guidelines for motor status indications.

- RED for running
- Green for ready

- Amber(yellow) for failure

2.5.2 Specific Vendor PLC Requirements

2.5.2.1 Influent Pump Station

2.5.2.1.1 IP Address for Headworks related PLCs (Including the Influent MCP) shall be assigned in the range of 192.168.100.20-29.

2.5.2.1.2 The PLC in the Influent Pump MCP shall supply, as a minimum, the following information through the Ethernet Interface:

- Motor Run Status
- Motor Fault Status
- System Alarms
- Wet Well Level
- Wet Well High Level Alarm
- Motor Run Times

2.5.2.1.3 Any additional information that may be of use to the CSI shall be available in the Tag list supplied to the CSI.

2.5.2.2 SBR System

2.5.2.2.1 IP Address for SBR System PLCs shall be assigned in the range of 192.168.100. 30-39

2.5.2.2.2 The CSI shall have access to all of the tag information specified in section 3.9 of this document.

2.5.2.2.3 Any additional information that may be of use to the CSI shall be available in the Tag list supplied to the CSI.

2.5.2.3 Disk Filter System

2.5.2.3.1 IP Address for Disk Filter System PLCs shall be assigned in the range of 192.168.100. 40-49

2.5.2.3.2 The CSI shall have access to all of the tag information specified in section 3.9 of this document.

2.5.2.3.3 Any additional information that may be of use to the CSI shall be available in the Tag list supplied to the CSI.

2.5.2.4 UV System

2.5.2.4.1 IP Address for UV System PLCs shall be assigned in the range of 192.168.100. 40-49

2.5.2.4.2 The UV System vendor shall supply the CSI with a list of available tags for monitoring the operational and alarm status of the UV System.

2.5.2.4.3 The UV System shall accept a 4-20mA flow signal from the CSI Supplied SCADA Panel (SP#3).

2.5.2.4.4 The UV System shall provide the following contact closures:

- Bank #1 Active

- Bank #2 Active
- System Fault

2.5.2.4.5 Any additional information that may be of use to the CSI shall be available in the Tag list supplied to the CSI.

2.5.2.5 Other Systems Not Listed Above

2.5.2.5.1 IP Address's for third party PLC's not specifically listed above shall be assigned in the range of: 192.168.100. 50-69

PART 3 – SCADA SYSTEM

3.1 GENERAL

3.1.1 A pre-approved Control Systems Integrator (CSI) shall furnish all services and equipment specified herein. The final product shall conform to this specification and shall be the sole responsibility of the CSI.

3.1.2 The CSI shall design and coordinate the process control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications and with related existing equipment.

3.1.3 Applications programming and runtime software for the Programmable Logic Controllers (PLC), input/output modules and Human Machine Interface (HMI) computers shall be provided by the CSI. All programming, configuration and integration, including but not limited to loading of software on computers, operating system software configuration, Ethernet data highway communications between operator workstations, servers, firewalls, tablets and PLC's shall be provided by the CSI.

3.1.4 Auxiliary and accessory devices necessary for complete system operation and performance to interface with existing equipment or equipment provided by other suppliers under other sections of the specifications, shall be included whether or not they are shown on the drawings. These devices include but are not limited to, transducers, current isolators, signal conditioners and interposing relays.

3.1.5 In order to ensure interchangeability of parts, maintain quality, interface between other subsystems, and establish minimums with regard to ranges and accuracy, strict compliance with the requirements shall be maintained. System design shall allow removing devices from service without disrupting other devices in the process control system.

3.1.6 Equipment shall be fabricated, assembled, installed and placed in proper operating conditions in full conformity with detail drawings, specifications, engineering data, instructions and recommendations by the equipment manufacturers as approved by the Engineer.

3.1.7 To facilitate the Owner’s future operation and maintenance efforts, similar products shall be by the same manufacturer, as much as possible.

3.1.8 All equipment and installations shall be in accordance with Federal, State and Local codes, regulations and laws.

3.1.9 Where applicable, the CSI shall coordinate with other suppliers under other sections of these specifications.

3.1.10 The CSI shall be responsible for checking all conduit schedules and schematics for all instrumentation and controls prior to construction. Coordinate any needed changes with the engineer and other contractors to insure a trouble-free installation. Review, cross check and inspect underground and in-slab conduit runs before conduits are covered.

3.1.11 The CSI shall assist the engineer with review of vendor-supplied systems to insure that the proper input/output wiring and connections are supplied for a complete and working control system.

3.1.12 A meeting with the CSI, Engineer, and Owner shall be scheduled prior to submittals to finalize the SCADA system design and operation.

3.2 Plant Monitoring & Control

The Control Systems Integrator shall be responsible for designing and providing a complete and operative SCADA system at the Sewage Treatment Facility. The CSI shall supply the communications systems, interface hardware, and programming required to realize the HMI / SCADA functions specified in this document. In addition, the CSI shall interface with other equipment vendors supplying equipment associated with this project to insure that all interfaces, signals, and information from other vendor equipment is incorporated into the design.

3.2.1 The CSI shall make provisions in the SCADA system to facilitate the monitoring and control of the plant backup power system. Functions provided by the SCADA System include:

- Communications with the Generator / transfer switch system
- Communications with all systems that monitor & control equipment that must be controlled during power sequencing events.
- PLC monitoring and control of the plant power system to coordinate an orderly power up and shut down sequence in response to various power sequencing and power failure / recovery scenarios.

Additional detail is provided in Section 3.3.2 of this document.

3.2.2 The SCADA Alarm Notification System Shall be WIN911 it shall be installed on the Terminal Server Running Wonder Ware. A UPS shall be capable of powering the alarm reporting and Wonder Ware system for a minimum of 8 Hours. The alarm notification system shall be designed to continue attempting to notify the designated operator(s) until the notification alarm is acknowledged.

3.3 Major Plant Systems

The SCADA system shall provide the plant operators with Status, Alarm, & Control over the following areas of the plant:

- Communications Network
- Backup Generators
- Influent Station
- Grit Chamber and Bar Screen Monitoring
- SBR Control System Interface with Alarm Annunciation
- Digester Blower and Aerator Control
- Sludge Pump Monitoring
- Belt Press Monitoring
- Chemical Control
- Disc Filter Monitoring
- UV System Monitoring
- Effluent Monitoring
- ReUse Water System

3.3.1 Communications Network

3.3.1.1 General Requirements

3.3.1.1.1 The communications backbone for the WWTP SCADA system shall be an Ethernet based fiber optic system.

3.3.1.1.2 All Ethernet based communications transmission media and equipment shall support a minimum speed of 100 Mbps.

3.3.1.1.3 All Ethernet connections between the primary monitoring workstation and the functional areas of the plant shall be made via single mode fiber optic cable.

3.3.1.1.4 The Ethernet signal originating at the primary monitoring workstation shall be distributed to the remote sites by one or more unmanaged Ethernet switches. The Ethernet switches shall be equipped with a minimum of 5 spare ports to provide maintenance / troubleshooting access and expansion capability.

3.3.1.1.5 All electrical Ethernet cable shall be CAT 6.

3.3.1.1.6 All electrical Ethernet cable runs shall be installed in such a manner as to provide protection from physical damage due to mechanical, electrical, chemical, or sunlight exposure.

3.3.1.1.7 All electrical Ethernet cable shall be kept to minimal length.

3.3.1.1.8 All electrical Ethernet cable shall be routed to avoid areas prone to generate electrical noise which could be coupled into the cabling.

3.3.1.1.9 An “as built” network diagram shall be supplied by the CSI upon completion of the project. The diagram shall clearly depict all communications cable routing in the plant and include information such as (but not limited to):

- Network switches and their locations
- Ports in which each cable terminates
- IP addresses associated with each terminating piece of equipment
- Any additional information which facilitates in the maintenance, troubleshooting, or expansion of the communications network.

3.3.1.1.10 All communications cables shall be clearly labeled using a permanent and durable method. The cable labels should be referenced on the "as built" network diagram.

3.3.1.1.11 An in plant WIFI network shall be installed for the Tablet to have communications with the Terminal Server for monitoring and control. This in plant WIFI shall be dedicated to a separate Ethernet port in the Terminal Server.

3.3.1.1.12 The Internet shall come in to the Terminal Server through a dedicated firewall. The firewall will allow remote access to monitor and control the system. The firewall will be connected to a dedicated Ethernet port for the use of remote access.

3.3.1.2 Fiber Optic Network

3.3.1.2.1 Single Mode fiber optic cable shall be used to connect the primary monitoring workstation to each major functional node in the plant.

3.3.1.2.2 All fiber optic cables shall be terminated in a suitable dedicated fiber termination panel. An RTU or other equipment panel is not considered an acceptable fiber optic termination panel. No fiber shall be exposed where it is subject to incidental contact.

3.3.1.2.3 All fibers within the fiber optic cable shall be terminated with SC Type connectors and connected to a terminating fiber port within the enclosure. This includes all unused fibers.

3.3.1.2.4 A suitable fiber patch cord shall be used to connect the fiber termination panel to the target interface.

3.3.1.2.5 All fibers shall be permanently and durably labeled. The label shall indicate the equipment the cable terminates on as well as the transmit / receive ports for each fiber pair.

3.3.1.2.6 Fiber / connector terminations shall be inspected for workmanship and to insure that the fiber is flush with the surface of the terminating ferrules and are sufficiently polished.

3.3.2 Backup Generator System

The plant is equipped with two backup generators which provide power to the plant in the event of a utility system failure. The specifications for the backup generator system and the required control sequencing during power up, power down, and fault conditions are contained in section 16000 of the specification documents.

3.3.2.1 The CSI shall design and implement a control system which satisfies the requirements of section 16000 pertaining to the backup generator operation.

3.3.2.2 The CSI shall review the plant power system control design with the Electrical Engineer to insure that the control algorithms operate as intended.

3.3.2.3 The CSI shall coordinate efforts with the various equipment vendors to insure that the required commands or signal interfaces to support monitoring and control are incorporated into their equipment.

3.3.2.4 The HMI / Scada system shall be designed to alert the operators of power failures and power system status even in the event of a utility system failure and plant generator failure.

3.3.2.5 The CSI shall insure that power system equipment controlled by the SCADA system contain manual override capabilities.

3.3.2.6 Upon implementation of the Scada controlled backup system, the CSI shall supply documentation to the plant operators detailing the operation of the power backup system. The documentation shall include:

- Complete description of the equipment power-up, power-down, and fault mode sequences.
- Explanation of HMI power system related status, alarms, or alerts that may aid the operator in taking corrective actions when required.
- Instructions about how to test the automatic backup system to verify proper operation.

3.3.2.7 The communications to the generators and ATS will be through the MODLON II gateway supplied by Cummins installed in the Transfer Switch Cabinet. The SCADA2 cabinet PLC shall read all data Via the RS-232 port on the MODLON module.

3.4 Plant RTUs (SCADA Cabinets)

3.4.1 SCADA Cabinet 1

This cabinet is located next to the Grit control cabinet outdoors. This cabinet supplies power to the ultrasonic flow meters for Fort Stewart and City of Hinesville. This cabinet monitors the barscreen system, the flow signals, flow totals, the odor control system and the grit system. Power fails and motor fails are included in the monitoring. Fiber optic communications runs to SCADA cabinet 2. A Micrologix 1100 PLC shall be installed in this cabinet.

3.4.2 SCADA Cabinet 2

This cabinet is located in the new Electrical building indoors. Monitoring of both generator signals comes into this cabinet. Load shedding shall be controlled from the PLC in case one generator fails during a power outage. The control system shall send limits to the SBR system to limit digester blowers and pumps from overloading the generator. A Fiber Optic hub is located here for the SCADA system and SBR control PLC. A Compact logix PLC shall be installed in this cabinet for Data storage and signal consolidation for the SCADA system

3.4.3 SCADA Cabinet 3

This cabinet is located on the UV system Concrete pad outdoors. It supplies power to the effluent flow meter. This cabinet monitors flow signal and totals and the reuse control station signals. This cabinet provides a Fiber Optic hub for the control signals for the disc filter and UV system. This fiber hub also provides monitoring for the disc filters and the UV system. A Micro Logix 1100 PLC shall be installed in this cabinet.

3.4.4 SCADA Cabinet 4

This cabinet is located in the Digester control building on the wall indoors. This cabinet monitors the digester levels. Digital signals include high level floats in the digesters.

3.4.5 SCADA Cabinet 5

This cabinet shall be located in the existing HMI control room beside the back door behind the current MIMIC graphic control panel. The purpose of this cabinet is as follows:

- House the existing Autocon monitoring system
- House the existing AutomationDirect PLC
- House the existing radio system
- House any additional electronic systems which are currently in use. This includes any terminal blocks currently being used as “connection points” or termination points.
- House any new equipment located in this area which is specified as part of the new plant upgrades.
- Provide additional space to accommodate future expansion

The new cabinet shall provide a single enclosure to house all SCADA-related electronics. The existing systems and components shall be moved into the new enclosure. The CSI is not required to re-design any hardware or software for the existing systems. Work shall be performed in a systematic, organized fashion. Wiring and terminal blocks shall be installed in a neat and orderly fashion and shall be labeled where appropriate. There shall be no separate enclosures or displays in the room. It is the responsibility of the CSI to make a trip to the site to determine the required size of the enclosure to meet these requirements. The CSI shall perform the relocation of equipment with minimal disruption to the operation of the existing equipment. Relocation of existing equipment shall be coordinated in such a manner to restore normal operation of the affected systems while the CSI is not actively working on the relocation. All systems functionality shall be restored to normal operation during the nights & weekends. The CSI shall be responsible for insuring that the systems are operating properly at the end of each day and when the system completed. The CSI will provide a clean and neat cabinet layout when the system is complete. The new cabinet shall be installed with all relocated equipment functionality tested and verified before demolition of the existing MIMIC panel. The General contractor shall remove metal bracing, panels and doors off of the MIMIC panel back and front to provide the most work area for the CSI to perform the relocation of components.

3.5 HMI System – General Requirements

3.5.1 A computer server workstation using Wonder Ware software as the Human Machine Interface (HMI) shall be located in the Main Treatment Plant Building with one network ready color laser report printer. The system will be used to monitor, control, alarm, store and report all plant process conditions. The software will include 4 concurrent licenses to allow adequate monitoring by all necessary operators and management over the internet. A firewall will be included to give security to the terminal server for protection.

3.5.2 The current Wonder Ware license shall be upgraded to a terminal server license. The Wonder Ware screens shall be designed to allow for easy reading at the various resolutions that the remote users will access the computer. The reports generated with the existing screens will be expanded to include the same information as well as flow totals for the new WWTP.

3.5.3 The server computer shall be designed for use as a development and engineering workstation as needed. Password security levels will be required. Dynamic and historical data shall be available to the computer and remote users for monitoring, alarming, trending and reporting on all process conditions. The Terminal Server will have raid 1 hot swap drives and hot swap redundant power supplies.

3.5.4 The CSI shall also coordinate interfacing internet access with a firewall to the main plant, for remote monitoring and diagnostics of systems and equipment.

3.5.5 The CSI will provide a tablet and wireless Ethernet network with AES 128 bit security for the plant to allow the operator to monitor adjust settings and verify corrective actions anywhere in the plant.

3.6 HMI System Alarm Monitoring & Reporting

3.6.1 The HMI System shall be configured to provide alarm indications to the operator based on the occurrence of designated plant conditions.

3.6.2 Conditions resulting in alarm indications include those listed in this specification and additional conditions which may be identified during the course of the system integration process. Additional alarms shall be approved by the Project Engineers.

3.6.3 Alarms shall exist in one of the following states:

- Active and unacknowledged
- Active and acknowledged

3.6.4 Alarms shall cause an audible alert to sound from the HMI system.

3.6.5 Designated alarms shall cause a notification message to be sent out to designated operators via the remote notification system.

3.6.6 Alarms shall appear in a separate window on the HMI display and always display whenever an alarm is present – regardless of the alarm state.

3.6.7 An operator shall be required to acknowledge an active alarm either locally (at the HMI) or remotely (via a remote terminal). Acknowledging an alarm will silence the audible alarm and provide a visual indication to the operator showing the acknowledged alarm state. Acknowledging the alarm shall also terminate remote notification messages.

3.6.8 Designated alarms shall be time and date stamped and maintained in an electronic log on the HMI computer. A screen shall be provided to allow an operator to view and / or print the alarm log.

3.6.9 The HMI system shall also provide an alarm indication to the operator in the event of a communications failure. The alarm indication shall be communicated locally through the HMI as well as through the WIN911 system.

3.7 HMI Report Generation

3.7.1 The HMI system shall continuously log designated parameters to a hard disk drive on the main computer workstation every 60 seconds.

3.7.2 Designated parameters are, as a minimum, those listed in tables in section 3.9 and marked as being "logged" parameters. The CSI shall review logging requirements with the Project Engineers and Plant Operators to refine the list of logged parameters.

3.7.3 The logging computer shall contain enough sufficient hard disk storage to maintain 5 years of logged parameters.

3.7.4 The logged parameters shall be automatically backed-up on a secondary hard drive so that in the event of a hard drive failure logged data is not lost.

3.7.5 The HMI shall contain provisions which allow the operator to extract the logged data from the hard drive and store it in a ".CSV" formatted data file suitable for loading into an Excel Spreadsheet. (Referred to as a "CSV Generator Program".)

3.7.6 The CSV Generator Program shall allow the operator to specify the following parameters for extracting target data from the hard drives:

- Parameter Name(s) (can be multiple parameters)
- Start Time
- Start Date
- Span Time (ie, length of data to be retrieved)
- Source Directory (Where is log file retrieved from)
- Destination Directory & File Name

3.7.7 Operators shall be provided with instructions about how to archive the data from the hard drive onto another storage medium (eg, flash drive, USB Hard Drive, DVD, CD, etc.) for long term storage or to free hard drive space should the log files begin to fill the hard drive. Copying the native Wonderware log files is acceptable.

3.7.8 Operators shall be provided with instructions about how to retrieve archived data from long term storage (eg, flash drive, USB Hard Drive, DVD, CD, etc.) and extract the data to a CSV-formatted file.

3.7.9 A custom CSV generated file shall contain daily and monthly runtime and flow total data that can be exported to an excel spreadsheet. The file shall be created every month and include the daily information for that month. The format will show daily totals for all

measured and calculated flows with their identification. Daily and month runtimes for all critical motors shall be listed with identification.

3.8 HMI Screen Design

3.8.1 General

3.8.1.1 The HMI shall consist of graphics-based computer screens.

3.8.1.2 The screens shall be organized in a structured hierarchical manner.

3.8.1.3 Navigation between screens shall be implemented in a consistent and intuitive fashion.

3.8.1.4 Information shall be presented in a logical & uncluttered format.

3.8.1.5 Related information & functions grouped together on a common set of screens wherever practical.

3.8.1.6 HMI screen design is expected to make extensive use of the graphics and animation capabilities of the Wonderware system to achieve the following goals:

- Focus the operator's attention on critical alarm and status information as quickly as possible.
- Provide a graphical representation of the plant's process flow which displays real-time process information in an obvious fashion.
- Provide a graphical representation of each plant process area which contains detailed information associated with that area. For example, a screen may display a model of the influent pump station which shows the three influent pumps, the pump status for each pump, an animation making it obvious if the pump is running, stopped or failed. The same screen may also display color-coded site status such as communications failure to the site or power failure at the site. In addition to color, the screen may also make use of blinking indicators to draw attention to critical situations or newly active situations. These examples are not intended to dictate specific implementation techniques, but, rather, to illustrate examples of the potential uses for the animation features built into the HMI system.
- Provide a means to easily "drill down" into a screen for more detailed information.
- Make use of animations to show when pumps are running, valves are open or closed, current tank levels, water flowing, etc.
- Make use of colors to highlight alarms, faults, warnings, etc.. Colors should also be used to indicate status information.

3.8.2 Required Screens

This section contains a list of "screens" which must be available for display to the operator. This list is intended as a guide for the CSI. The exact design, number of screens, and information content shall be determined by the CSI based on Engineering input, Plant Operator input, and the

CSI's own experience. The information displayed within the basic screen structure presented below is listed in section 3.9 of this document.

3.8.2.1 The Primary logon screen shall allow the operator to pick which system he or she wishes to proceed to. These include the Fresh water system the remote lift stations or the WWTP.

The Waste Water Plant Shall include:

3.8.2.2 Plant overview containing system-wide status

3.8.2.3 Alarms Summary (Active and Acknowledged)

3.8.2.4 Diagram of the communications network. The diagram shall display the status of communications between the HMI computer and each device to which the computer communicates. The diagram shall be constructed in such a manner to show the location of the communications failure whenever possible.

3.8.2.5 Daily report of total production, chemicals used and total kilowatt hours

3.8.2.6 Treated water kilowatt/hours per day

3.8.2.7 Trend charts on all analytical instrumentation and water production

3.8.2.8 Power Distribution System Status and Alarms – Including Backup Generator

3.8.2.9 Headworks - including Influent Flow Rates, Bar Screen Status, Grit Chamber Status, Odor Control, Wet Well Level & Influent Pump Status

3.8.2.10 The SBR System including Setup Parameters, System Status, Alarms

3.8.2.11 Digester Tank Levels and Alarms

3.8.2.12 Blower Motor Status, Air Valves and Alarms

3.8.2.13 Chemical feed system including Tank Levels, Flow Rates,

3.8.2.14 The Disk Filter System and Alarms

3.8.2.15 The UV System Status and Alarms

3.8.2.16 Discharge Flow System and Flow Rates

3.8.2.17 ReUse Water System Status and Alarms

3.9 Summary of Information Displayed by HMI

3.9.1 Headworks

3.9.1.1 Influent Flow

Parameter	Description	Source	Type	Units	Alarmed	Logged	Trended	Notes
Influent #1 Flow Rate	Hinesville – Current Flow Rate	RTU #1	A	GPM		Y	Y	
Influent #1 Flow High	Hinesville - Flow Rate High Indicator	RTU #1	D		Y			
Influent #1 – Today's Flow Total	Hinesville - Daily Flow Total	RTU #1	A	KGallons		Y		Automatically zero'ed at midnight
Influent #1 – Yesterday's Flow Total	Hinesville – Yesterday's Flow Total	RTU #1	A	KGallons		Y		Updated daily at midnight
Influent #1 – Weekly Flow Total	Hinesville - Weekly Flow Total	RTU #1	A	KGallons		Y		Continuously updated Results transferred to "Last Week's Flow Total" on Midnight at beginning of Week. Register zero'ed after transfer
Influent #1 – Last Week's Flow Total	Hinesville – Last Week's Flow Total	RTU #1	A	KGallons		Y		Updated at the beginning of the Week Previous result overwritten
Influent #1 – Monthly Flow Total	Hinesville - Monthly Flow Total	RTU #1	A	KGallons		Y		Continuously updated Results transferred to "Last Month's Flow Total" on Midnight at beginning of month. Register zero'ed after transfer
Influent #1 – Last Month's Flow Total	Hinesville – Last Month's Flow Total	RTU #1	A	KGallons		Y		Updated at the beginning of the month Previous result overwritten
Influent #2 Flow	Ft Stewart Flow Rate	RTU #1	A	GPM			Y	
Influent #2 Flow High	Ft Stewart Flow Rate High	RTU #1	D		Y			
Influent #1 –	Ft Stewart - Daily Flow	RTU #1	A	KGallons		Y		Automatically zero'ed at midnight

Today's Flow Total	Total							
Influent #1 – Yesterday's Flow Total	Ft Stewart – Yesterday's Flow Total	RTU #1	A	KGallons		Y		Updated daily at midnight
Influent #1 – Weekly Flow Total	Ft Stewart - Weekly Flow Total	RTU #1	A	KGallons		Y		Continuously updated Results transferred to "Last Week's Flow Total" on Midnight at beginning of Week. Register zero'ed after transfer
Influent #1 – Last Week's Flow Total	Ft Stewart – Last Week's Flow Total	RTU #1	A	KGallons		Y		Updated at the beginning of the Week Previous result overwritten
Influent #1 – Monthly Flow Total	Ft Stewart - Monthly Flow Total	RTU #1	A	KGallons		Y		Continuously updated Results transferred to "Last Month's Flow Total" on Midnight at beginning of month. Register zero'ed after transfer
Influent #1 – Last Month's Flow Total	Ft Stewart – Last Month's Flow Total	RTU #1	A	KGallons		Y		Updated at the beginning of the month Previous result overwritten

3.9.1.2 Bar Screens

Parameter	Description	Source	Type	Alarmed	Logged	Trended	Notes
FS BS Level High	Fort Stewart	RTU #1	D		Y	Y	Separate float
FS Bar Screen Running		RTU #1	D			Y	
FS Bar Screen Fault		RTU #1	D	Y			
RotoPress Running		RTU #1	D				
RotoPress Fault		RTU #1	D	Y			
Hinesville BS Level High	Hinesville	RTU #1	D		Y	Y	Separate float
Hinesville Bar Screen Running		RTU #1	D			Y	
Hinesville Bar Screen Fault		RTU #1	D	Y			
RotoPress Running		RTU #1	D				
RotoPress Fault		RTU #1	D	Y			

3.9.1.3 Grit Chambers

Parameter	Description	Source	Type	Units	Alarmed	Logged	Trended	Notes
GS #1 – Pump Running		RTU #1	D			Y		
GS #1 – ReGen Blower Running		RTU #1	D			Y		
GS #1 – PD Blower Running		RTU #1	D			Y		
GS #1 - Screw Running		RTU #1	D			Y		
GS #1 – Pump Fault		RTU #1	D		Y	Y		
GS #1 – Re-Gen Blower Fault		RTU #1	D		Y	Y		
GS #1 – PD Blower Fault		RTU #1	D		Y	Y		
GS #1 - Screw Fault		RTU #1	D		Y	Y		
GS #1 –Pump RTH - Total		RTU #1	A	Hours (x 0.1)		Y		Continuous – Never Reset
GS #1 –Pump RTH - Today's		RTU #1	A	Hours (x 0.1)		Y		Updated at Midnight at beginning of each day
GS #1 – Pump RTH - Last month's		RTU #1	A	Hours (x 0.1)		Y		Updated at Midnight – first day of new month
GS #1 - ReGen Blower RTH - Total		RTU #1	A	Hours (x 0.1)		Y		Continuous – Never Reset
GS #1 – ReGen Blower RTH – Today's		RTU #1	A	Hours (x 0.1)		Y		Updated at Midnight at beginning of each day
GS #1 - ReGen Blower RTH –		RTU #1	A	Hours (x 0.1)		Y		Updated at Midnight – first day of new month

Last Month's								
GS #1 – PD Blower RTH - Total		RTU #1	A	Hours (x 0.1)		Y		Continuous – Never Reset
GS #1 – PD Blower RTH – Today's		RTU #1	A	Hours (x 0.1)		Y		Updated at Midnight at beginning of each day
GS #1 – PD Blower RTH – Last Month's		RTU #1	A	Hours (x 0.1)		Y		Updated at Midnight – first day of new month
GS #1 - Screw RTH - Total		RTU #1	A	Hours (x 0.1)		Y		Continuous – Never Reset
GS #1 - Screw RTH - Today's		RTU #1	A	Hours (x 0.1)		Y		Updated at Midnight at beginning of each day
GS #1 - Screw RTH - Last Month's		RTU #1	A	Hours (x 0.1)		Y		Updated at Midnight – first day of new month

3.9.1.4 Odor Control

Parameter	Description	Source	Type	Units	Alarmed	Logged	Trended	Notes
P1 Running		RTU #1	D			Y		
P2 Running		RTU #1	D			Y		
Blower Running		RTU #1	D			Y		
P1 Fault		RTU #1	D		Y			
P2 Fault		RTU #1	D		Y			
Blower Fault		RTU #1	D		Y			
Valve Irrigation		RTU #1	D					
Valve Purge		RTU #1	D					
P1 RTH - Total		RTU #1	A	Hours		Y		Continuous – Never Reset
P1 RTH - Today's		RTU #1	A	Hours		Y		Updated at Midnight at beginning of each day
P1 RTH - Last Month's		RTU #1	A	Hours		Y		Updated at Midnight – first day of new month
P2 RTH - Total		RTU #1	A	Hours		Y		Continuous – Never Reset
P2 RTH - Today's		RTU #1	A	Hours		Y		Updated at Midnight at beginning of each day
P1 RTH - Last Month's		RTU #1	A	Hours		Y		Updated at Midnight – first day of new month

3.9.1.5 Influent Pumps

Parameter	Description	Source	Type	Units	Alarmed	Logged	Trended	Notes
Wet Well Level		IP MCP	A	Ft	Y	Y		
P1 Running		IP MCP	D			Y		
P2 Running		IP MCP	D			Y		
P3 Running		IP MCP	D			Y		
P1 Fault		IP MCP	D		Y			
P2 Fault		IP MCP	D		Y			
P3 Fault		IP MCP	D		Y			
P1 RTH - Total		IP MCP	A	Hours		Y		Continuous – Never Reset
P1 RTH - Today's			A	Hours		Y		Updated at Midnight at beginning of each day
P1 RTH - Last Month's			A	Hours		Y		Updated at Midnight – first day of new month
P2 RTH - Total		IP MCP	A	Hours		Y		Continuous – Never Reset
P2 RTH - Today's			A	Hours		Y		Updated at Midnight at beginning of each day
P2 RTH - Last Month's			A	Hours		Y		Updated at Midnight – first day of new month
P3 RTH - Total		IP MCP	A	Hours		Y		Continuous – Never Reset
P3 RTH - Today's			A	Hours		Y		Updated at Midnight at beginning of each day
P3 RTH - Last Month's			A	Hours		Y		Updated at Midnight – first day of new month

3.9.2 SBR System

3.9.2.1 Process Status

This section contains a list of the SBR System's Process Status information displayed to the operator.

Parameter	Source	Type	Units	Alarmed	Logged	Trended	Notes
SBR #1 – Current Phase	SBR Panel	S					Flow Through, Mix Fill, React Fill, Settle, Decant, Sludge Waste, Idle, Offline
SBR #1 - Time Remaining in Current Phase	SBR Panel	S	Seconds				
SBR #1 – Basin Level	SBR Panel	A	Ft	Y			
SBR #1 – Aeration Mode	SBR Panel	S					Timed or DO
SBR #1 –Basin DO Level	SBR Panel	A	Mg/l				
SBR #1 – Basin Temp	SBR Panel	A	C				
SBR #2 – Current Phase	SBR Panel	S					Flow Through, Mix Fill, React Fill, Settle, Decant, Sludge Waste, Idle, Offline
SBR #2 - Time Remaining in Current Phase	SBR Panel	S	Seconds				
SBR #2 – Basin Level	SBR Panel	A	Ft	Y			
SBR #2 – Aeration Mode	SBR Panel	S					Timed or DO
SBR #2 –Basin DO Level	SBR Panel	A	Mg/l				
SBR #2 – Basin Temp	SBR Panel	A	C				
SBR #3 – Current Phase	SBR Panel	S					Flow Through, Mix Fill, React Fill, Settle, Decant, Sludge Waste, Idle, Offline
SBR #3 - Time Remaining in Current Phase	SBR Panel	S	Seconds				
SBR #3 – Basin Level	SBR Panel	A	Ft	Y			
SBR #3 – Aeration Mode	SBR Panel	S					Timed or DO

SBR #3 –Basin DO Level	SBR Panel	A	Mg/l				
SBR #3 – Basin Temp	SBR Panel	A	C				
SBR #4 – Current Phase	SBR Panel	S					Flow Through, Mix Fill, React Fill, Settle, Decant, Sludge Waste, Idle, Offline
SBR #4 - Time Remaining in Current Phase	SBR Panel	S	Seconds				
SBR #4 – Basin Level	SBR Panel	A	Ft	Y			
SBR #4 – Aeration Mode	SBR Panel	S					Timed or DO
SBR #4 –Basin DO Level	SBR Panel	A	Mg/l				
SBR #4 – Basin Temp	SBR Panel	A	C				

3.9.2.2 Phase Time Adjust

This section contains a list of the SBR System's Phase Times which can be modified by the operator. The operator shall be required to enter a password to make modifications to these values.

Parameter	Source	Type	Units	Notes
Current Configuration - # Basins	SBR Panel	A		1, 2, 3, or 4 basin operation
Current Configuration - Mix Fill Time	SBR Panel	A	Seconds	
Current Configuration - React Fill Time	SBR Panel	A	Seconds	
Current Configuration - React Time	SBR Panel	A	Seconds	
Current Configuration - Settle Time	SBR Panel	A	Seconds	
Current Configuration - Decant Time	SBR Panel	A	Seconds	
Single Basin Operation - Mix Fill Time	SBR Panel	A	Seconds	
Single Basin Operation - React Fill Time	SBR Panel	A	Seconds	
Single Basin Operation - React Time	SBR Panel	A	Seconds	
Single Basin Operation - Settle Time	SBR Panel	A	Seconds	
Single Basin Operation - Decant Time	SBR Panel	A	Seconds	
Single Basin Operation – SBR #1 Sludge Waste	SBR Panel	A	Seconds	
Single Basin Operation – SBR #2 Sludge Waste	SBR Panel	A	Seconds	
Single Basin Operation – SBR #3 Sludge Waste	SBR Panel	A	Seconds	

Single Basin Operation – SBR #4 Sludge Waste	SBR Panel	A	Seconds	
Dual Basin Operation - Mix Fill Time	SBR Panel	A	Seconds	
Dual Basin Operation - React Fill Time	SBR Panel	A	Seconds	
Dual Basin Operation - React Time	SBR Panel	A	Seconds	
Dual Basin Operation - Settle Time	SBR Panel	A	Seconds	
Dual Basin Operation - Decant Time	SBR Panel	A	Seconds	
Dual Basin Operation – SBR #1 Sludge Waste	SBR Panel	A	Seconds	
Dual Basin Operation – SBR #2 Sludge Waste	SBR Panel	A	Seconds	
Dual Basin Operation – SBR #3 Sludge Waste	SBR Panel	A	Seconds	
Dual Basin Operation – SBR #4 Sludge Waste	SBR Panel	A	Seconds	
Triple Basin Operation - Mix Fill Time	SBR Panel	A	Seconds	
Triple Basin Operation - React Fill Time	SBR Panel	A	Seconds	
Triple Basin Operation - React Time	SBR Panel	A	Seconds	
Triple Basin Operation - Settle Time	SBR Panel	A	Seconds	
Triple Basin Operation - Decant Time	SBR Panel	A	Seconds	
Triple Basin Operation – SBR #1 Sludge Waste	SBR Panel	A	Seconds	

Triple Basin Operation – SBR #2 Sludge Waste	SBR Panel	A	Seconds	
Triple Basin Operation – SBR #3 Sludge Waste	SBR Panel	A	Seconds	
Triple Basin Operation – SBR #4 Sludge Waste	SBR Panel	A	Seconds	
Quad Basin Operation - Mix Fill Time	SBR Panel	A	Seconds	
Quad Basin Operation - React Fill Time	SBR Panel	A	Seconds	
Quad Basin Operation - React Time	SBR Panel	A	Seconds	
Quad Basin Operation - Settle Time	SBR Panel	A	Seconds	
Quad Basin Operation - Decant Time	SBR Panel	A	Seconds	
Quad Basin Operation – SBR #1 Sludge Waste	SBR Panel	A	Seconds	
Quad Basin Operation – SBR #2 Sludge Waste	SBR Panel	A	Seconds	
Quad Basin Operation – SBR #3 Sludge Waste	SBR Panel	A	Seconds	
Quad Basin Operation – SBR #4 Sludge Waste	SBR Panel	A	Seconds	

3.9.2.3 Reactor Basins

This section contains a list of the Status Information that shall be displayed for each SBR vessel. The table lists the parameters for basin #1. This information shall be replicated for basins 2 – 4.

Parameter	Source	Type	Alarmed	Logged	Trended	Notes
SBR #1 – High Level	SBR Panel	D	Y	Y		Transducer
SBR #1 – Level Transducer Fault	SBR Panel	D	Y	Y		Transducer Out of Range
SBR #1 – High Level	SBR Panel	D	Y	Y		Float Signal
SBR #1 – Level Switch Fault	SBR Panel	D	Y	Y		Transducer Out of Range
SBR #1 – DO Tranducer Fault	SBR Panel	D	Y	Y		
SBR #1 – Influent Valve Open	SBR Panel	D				
SBR #1 – Influent Valve Closed	SBR Panel	D				
SBR #1 – Influent Valve Fail to Open	SBR Panel	D	Y	Y		
SBR #1 – Influent Valve Fail to Closed	SBR Panel	D	Y	Y		
SBR #1 – Air Valve Open	SBR Panel	D				
SBR #1 – Air Valve Closed	SBR Panel	D				
SBR #1 – Air Valve Fail to Open	SBR Panel	D	Y	Y		
SBR #1 – Air Valve Fail to Closed	SBR Panel	D	Y	Y		
SBR #1 – Decant Weir Open	SBR Panel	D				
SBR #1 – Decant Weir Closed	SBR Panel	D				

SBR #1 – Decant Weir Fail to Open	SBR Panel	D	Y	Y		
SBR #1 – Decant Weir Fail to Closed	SBR Panel	D	Y	Y		
SBR #1 – Decant Valve Open	SBR Panel	D				
SBR #1 – Decant Valve Closed	SBR Panel	D				
SBR #1 – Decant Valve Fail to Open	SBR Panel	D	Y	Y		
SBR #1 – Decant Valve Fail to Closed	SBR Panel	D	Y	Y		
SBR #1 – Mixer Running	SBR Panel	D				
SBR #1 – Mixer Failed	SBR Panel	D	Y	Y		
SBR #1 – Mixer MCP Trip	SBR Panel	D	Y	Y		
SBR #1 – Sludge Pump Running	SBR Panel	D				
SBR #1 – Sludge Pump Failed	SBR Panel	D	Y	Y		
SBR #1 – Sludge Pump MCP Trip	SBR Panel	D	Y	Y		
SBR #1 – Sludge Pump Overtemp	SBR Panel	D	Y	Y		
SBR #1 – Sludge Pump Seal Leak	SBR Panel	D	Y	Y		

3.9.2.4 Digesters

This section contains a list of the Status Information that shall be displayed for each Digester vessel. The table lists the parameters for basin #1. This information shall be replicated for basin #2.

Parameter	Source	Type	Alarmed	Logged	Trended	Notes
Digester #1 – High Level	SBR Panel	D	Y	Y		Transducer
Digester #1 – Level Transducer Fault	SBR Panel	D	Y	Y		Transducer Out of Range
Digester #1 – High Level	SBR Panel	D	Y	Y		Float Signal
Digester #1 – Level Switch Fault	SBR Panel	D	Y	Y		Transducer Out of Range
Digester #1 – Recirculation Pump Running	SBR Panel	D				
Digester #1 – Mixer Failed	SBR Panel	D	Y	Y		
Digester #1 PH	SBR Panel	D	Y	Y		
Digester #2 – High Level	SBR Panel	D	Y	Y		Transducer
Digester #2 – Level Transducer Fault	SBR Panel	D	Y	Y		Transducer Out of Range
Digester #2 – High Level	SBR Panel	D	Y	Y		Float Signal
Digester #2 – Level Switch Fault	SBR Panel	D	Y	Y		Transducer Out of Range
Digester #2 – Recirculation Pump Running	SBR Panel	D				
Digester #2 – Mixer Failed	SBR Panel	D	Y	Y		
Digester #2 PH	SBR Panel	D	Y	Y		

3.9.2.5 Blowers

Parameter	Source	Type	Alarmed	Logged	Trended	Notes
SBR Blower #1 Running	SBR Panel	D				
SBR Blower #1 Failed	SBR Panel	D	Y	Y		
SBR Blower #2 Running	SBR Panel	D				
SBR Blower #2 Failed	SBR Panel	D	Y	Y		
SBR Blower #3 Running	SBR Panel	D				
SBR Blower #3 Failed	SBR Panel	D	Y	Y		
SBR Blower #4 Running	SBR Panel	D				
SBR Blower #4 Failed	SBR Panel	D	Y	Y		
SBR Blower #5 Running	SBR Panel	D				
SBR Blower #5 Failed	SBR Panel	D	Y	Y		
Digester Blower #1 Running	SBR Panel	D				
Digester Blower #1 Failed	SBR Panel	D	Y	Y		
Digester Blower #2 Running	SBR Panel	D				
Digester Blower #2 Failed	SBR Panel	D	Y	Y		
Equalizer Blower #1 Running	SBR Panel	D				
Equalizer Blower #1 Failed	SBR Panel	D	Y	Y		
Equalizer Blower #2 Running	SBR Panel	D				
Equalizer Blower #2 Failed	SBR Panel	D	Y	Y		
SBR Air Valve #1 Open	SBR Panel	D				
SBR Air Valve #1 Fail to	SBR Panel	D	Y	Y		

Open						
SBR Air Valve #1 Closed	SBR Panel	D				
SBR Air Valve #1 Fail to Close	SBR Panel	D	Y	Y		
SBR Air Valve #2 Open	SBR Panel	D				
SBR Air Valve #2 Fail to Open	SBR Panel	D	Y	Y		
SBR Air Valve #2 Closed	SBR Panel	D				
SBR Air Valve #2 Fail to Close	SBR Panel	D	Y	Y		
SBR Air Valve #3 Open	SBR Panel	D				
SBR Air Valve #3 Fail to Open	SBR Panel	D	Y	Y		
SBR Air Valve #3 Closed	SBR Panel	D				
SBR Air Valve #3 Fail to Close	SBR Panel	D	Y	Y		
SBR Air Valve #4 Open	SBR Panel	D				
SBR Air Valve #4 Fail to Open	SBR Panel	D	Y	Y		
SBR Air Valve #4 Closed	SBR Panel	D				
SBR Air Valve #4 Fail to Close	SBR Panel	D	Y	Y		
SBR Air Valve #5 Open	SBR Panel	D				
SBR Air Valve #5 Fail to Open	SBR Panel	D	Y	Y		
SBR Air Valve #5 Closed	SBR Panel	D				
SBR Air Valve #5 Fail to Close	SBR Panel	D	Y	Y		
SBR Air Valve #6 Open	SBR Panel	D				
SBR Air Valve #6 Fail to Open	SBR Panel	D	Y	Y		

SBR Air Valve #6 Closed	SBR Panel	D				
SBR Air Valve #6 Fail to Close	SBR Panel	D	Y	Y		
SBR Air Valve #7 Open	SBR Panel	D				
SBR Air Valve #7 Fail to Open	SBR Panel	D	Y	Y		
SBR Air Valve #7 Closed	SBR Panel	D				
SBR Air Valve #7 Fail to Close	SBR Panel	D	Y	Y		

3.9.2.6 Chemical Feeds

Parameter	Source	Type	Alarmed	Logged	Trended	Notes
Alum Chemical Pump #1 Running	SBR Panel	D				Alum
Alum Chemical Pump #1 Fault	SBR Panel	D	Y			
Alum Chemical Pump #2 Running	SBR Panel	D				Alum
Alum Chemical Pump #2 Fault	SBR Panel	D	Y			
Alum Tank Level		A		Y	Y	
Alum Tank Low Level Alarm SP		A				PW Protect
Alum Tank Low Level Alarm		D	Y			
Alum Tank Level XDCR Fault		D	Y			
Caustic Chemical Pump #1 Running	SBR Panel	D				Caustic
Caustic Chemical Pump #1 Fault	SBR Panel	D	Y			
Caustic Chemical Pump #2 Running	SBR Panel	D				Caustic
Caustic Chemical Pump #2 Fault	SBR Panel	D	Y			
Caustic Tank Level		A		Y	Y	
Caustic Tank Low Level Alarm SP		A				PW Protect
Caustic Tank Low Level Alarm		D	Y			
Caustic Tank Level XDCR Fault		D	Y			

3.9.2.7 Motor Run Times

Parameter	Source	Type	Units	Alarmed	Logged	Trended	Notes
SBR #1 Mixer Motor	SBR Panel	A	Hrs				Should these follow use “Last Week / Last Month” Format? If they come from SBR Panel, will have to be derived in WW or SBR PLC Code will have to be modified.
SBR #1 Sludge Pump	SBR Panel	A	Hrs				
SBR #2 Mixer Motor	SBR Panel	A	Hrs				
SBR #2 Sludge Pump	SBR Panel	A	Hrs				
SBR #3 Mixer Motor	SBR Panel	A	Hrs				
SBR #3 Sludge Pump	SBR Panel	A	Hrs				
SBR #4 Mixer Motor	SBR Panel	A	Hrs				
SBR #4 Sludge Pump	SBR Panel	A	Hrs				
SBR Blower #1	SBR Panel	A	Hrs				
SBR Blower #2	SBR Panel	A	Hrs				
SBR Blower #3	SBR Panel	A	Hrs				
Digester Blower #1	SBR Panel	A	Hrs				
Digester Blower #1	SBR Panel	A	Hrs				
Chemical Pump #1	??	A	Hrs				
Chemical Pump #2	??	A	Hrs				

3.9.3 Filters

Parameter	Source	Type	Units	Alarmed	Logged	Trended	Notes
F1 – Current Phase	Filter panel	S					Filtering, BW
F1 – Basin Level	Filter panel	A	Ft				
F1 – Basin Level XDCR Fault	Filter panel	D		Y	Y		
F1 – Basin Level High	Filter panel	D		Y	Y		
F1 – Basin Level too Low for BW	Filter panel	D		Y	Y		
F1 – Suction Vacuum	Filter panel	A	In Hg				
F1 – Suction Level High	Filter panel	D		Y	Y		
F1 – Suction XDCR Fault	Filter panel	D		Y	Y		
F1 – Drive Motor Running	Filter panel	D					
F1 – Drive Motor Fault	Filter panel	D		Y	Y		
F1 – Backwash 1 Running	Filter panel	D					
F1 – Backwash 2 Running	Filter panel	D					
F1 – Backwash 1 Fault	Filter panel	D		Y	Y		
F1 – Backwash 2 Fault	Filter panel	D		Y	Y		
F1 – BW Valve #1 Open	Filter panel	D					
F1 – BW Valve #1 Closed	Filter panel	D					
F1 – BW Valve #2 Open	Filter panel	D					
F1 – BW Valve #2 Closed	Filter panel	D					
F1 – BW Valve #1 Fail to Open	Filter panel	D		Y	Y		
F1 – BW Valve #1 Fail to Close	Filter panel	D		Y	Y		
F1 – BW Valve #2 Fail to Open	Filter panel	D		Y	Y		
F1 – BW Valve #2 Fail to Close	Filter panel	D		Y	Y		

F2 – Current Phase	Filter panel	S					Filtering, BW
F2 – Basin Level	Filter panel	A	Ft				
F2 – Basin Level XDCR Fault	Filter panel	D		Y	Y		
F2 – Basin Level High	Filter panel	D		Y	Y		
F2 – Basin Level too Low for BW	Filter panel	D		Y	Y		
F2 – Suction Vacuum	Filter panel	A	In Hg				
F2 – Suction Level High	Filter panel	D		Y	Y		
F2 – Suction XDCR Fault	Filter panel	D		Y	Y		
F2 – Drive Motor Running	Filter panel	D					
F2 – Drive Motor Fault	Filter panel	D		Y	Y		
F2 – Backwash 1 Running	Filter panel	D					
F2 – Backwash 2 Running	Filter panel	D					
F2 – Backwash 1 Fault	Filter panel	D		Y	Y		
F2 – Backwash 2 Fault	Filter panel	D		Y	Y		
F2 – BW Valve #1 Open	Filter panel	D					
F2 – BW Valve #1 Closed	Filter panel	D					
F2 – BW Valve #2 Open	Filter panel	D					
F2 – BW Valve #2 Closed	Filter panel	D					
F2 – BW Valve #1 Fail to Open	Filter panel	D		Y	Y		
F2 – BW Valve #1 Fail to Close	Filter panel	D		Y	Y		
F2 – BW Valve #2 Fail to Open	Filter panel	D		Y	Y		
F2 – BW Valve #2 Fail to Close	Filter panel	D		Y	Y		
F3 – Current Phase	Filter panel	S					
F3 – Basin Level	Filter panel	A	Ft				
F3 – Basin Level XDCR Fault	Filter panel	D		Y	Y		

F3 – Basin Level High	Filter panel	D		Y	Y		
F3 – Basin Level too Low for BW	Filter panel	D		Y	Y		
F3 – Suction Vacuum	Filter panel	A	In Hg				
F3 – Suction Level High	Filter panel	D		Y	Y		
F3 – Suction XDCR Fault	Filter panel	D		Y	Y		
F3 – Drive Motor Running	Filter panel	D					
F3 – Drive Motor Fault	Filter panel	D		Y	Y		
F3 – Backwash 1 Running	Filter panel	D					
F3 – Backwash 2 Running	Filter panel	D					
F3 – Backwash 1 Fault	Filter panel	D		Y	Y		
F3 – Backwash 2 Fault	Filter panel	D		Y	Y		
F3 – BW Valve #1 Open	Filter panel	D					
F3 – BW Valve #1 Closed	Filter panel	D					
F3 – BW Valve #2 Open	Filter panel	D					
F3 – BW Valve #2 Closed	Filter panel	D					
F3 – BW Valve #1 Fail to Open	Filter panel	D		Y	Y		
F3 – BW Valve #1 Fail to Close	Filter panel	D		Y	Y		
F3 – BW Valve #2 Fail to Open	Filter panel	D		Y	Y		
F3 – BW Valve #2 Fail to Close	Filter panel	D		Y	Y		

3.9.4 UV System

Parameter	Source	Type	Alarmed	Logged	Trended	Notes
UV Bank #1 Active	SCADA 3	D		Y		These parameters from Trojan Factory
UV Bank #2 Active	SCADA 3	D		Y		
UV System Critical Alarm	SCADA 3	D	Y	Y		
UV System Major Alarm	SCADA 3	D	Y	Y		
UV System Minor Alarm	SCADA 3	D	Y	Y		
Lamp Intensity 1	UV PLC					
Lamp hours 1	UV PLC					
Lamp time since last clean 1	UV PLC					
Intensity Reference	UV PLC					
Lamp Intensity 2	UV PLC					
Lamp hours 2	UV PLC					
Lamp time since last clean 2	UV PLC					

3.9.5 Sludge / Belt Press

Parameter	Source	Type	Alarmed	Logged	Trended	Notes
Sludge Flow		A				
Pump Running		D				
Belt Running		D				
Press Fault		D	Y	Y		
Pump RT Hrs		D				
Belt RT Hrs		D				

3.9.6 Discharge Flume

Parameter	Description	Source	Type	Units	Alarmed	Logged	Trended	Notes
Discharge #1 Flow Rate	Current Flow Rate	RTU #3	A	GPM		Y	Y	
Discharge Flow High	Flow Rate High Indicator	RTU #3	D		Y			
Discharge – Today's Flow Total	Daily Flow Total	RTU #3	A	Gallons		Y		Automatically zero'ed at midnight
Discharge – Yesterday's Flow Total	Yesterday's Flow Total	RTU #3	A	Gallons		Y		Updated daily at midnight
Discharge – Weekly Flow Total	Weekly Flow Total	RTU #3	A	KGallons		Y		Continuously updated Results transferred to "Last Week's Flow Total" on Midnight at beginning of Week. Register zero'ed after transfer
Discharge – Last Week's Flow Total	Last Week's Flow Total	RTU #3	A	KGallons		Y		Updated at the beginning of the Week Previous result overwritten
Discharge – Monthly Flow Total	Monthly Flow Total	RTU #3	A	KGallons		Y		Continuously updated Results transferred to "Last Month's Flow Total" on Midnight at beginning of month. Register zero'ed after transfer
Discharge – Last Month's Flow Total	Last Month's Flow Total	RTU #3	A	KGallons		Y		Updated at the beginning of the month Previous result overwritten

3.9.7 Re-Use Water System

Parameter	Source	Type	Units	Alarmed	Logged	Trended	Notes
Tank Pressure	HCP[1]	A	Psi			Y	
Tank High Pressure	HCP	A		Y	Y		
Tank Low Pressure	HCP	A		Y	Y		
Tank Level	HCP	A	Ft				
Tank High Level	HCP	A		Y	Y		
Tank Low Level	HCP	A		Y	Y		
Lead Pump Running	HCP	D					
Lead Pump Fault	HCP	D		Y	Y		
Lag Pump Running	HCP	D					
Lag Pump Fault	HCP	D		Y	Y		
Compressor Running	HCP	D					
Compressor Fault	HCP	D		Y	Y		
System Fault	HCP	D		Y	Y		

[1] Hydropneumatic Control Panel

3.9.8 Electrical Service

Parameter	Source	Type	Units	Alarmed	Logged	Trended	Notes
Main Supply Total Power	Transfer Switch	A	kW		Y	Y	From MODLON II Module
Main Supply Total Amps (each phase)	Transfer Switch	A	Amps		Y	Y	
Main Supply Power Factor	Transfer Switch	A	Phase Angle		Y	Y	
Transfer Switch Status	Transfer Switch	A			Y		
Generator Run Status	Transfer Switch	A			Y		
Generator Fault	Transfer Switch	A		Y	Y		
Generator Total Power	Transfer Switch	A	kW		Y	Y	
Generator Total Amps (each phase)	Transfer Switch	A	Amps		Y	Y	
Generator Battery Voltage	Transfer Switch	A	Volts	Y	Y	Y	
Generator Oil Temp	Transfer Switch	A	Deg C	Y	Y	Y	
Generator Fuel Level	Transfer Switch	A	Gallons	Y			
Transfer ready to transfer	Transfer Switch	D	Contact	Y	Y	Y	15 second alarm to shutdown motor loads
2 Generators available	Transfer Switch	D	Contact	Y	Y	Y	
1 Generator available	Transfer Switch	D	Contact	Y	Y	Y	

3.9.9 Remote Sites (Existing Lift Stations)

Remote Site information that is available in the current HMI shall be retained in the upgraded plant HMI System. The screens shall be maintained and tied into the new system to allow remote access and monitoring. Alarms shall be added to the WIN911 system to allow adequate monitoring and protection from spills at the remote sites.

3.10 I/O Schedule

3.10.1 Head works

Device	Description	Type					
		Digital Input	Digital Output	Analog Input	Analog Output	Memory Bit	Memory Word
Influent Flow Transmitter No. 1	Influent Flow			X			
	Influent Flow Hi	X					
	Influent Flow HiHi	X					
	Influent Totalized Flow						X
Influent Flow Transmitter No. 2	Influent Flow			X			
	Influent Flow Hi	X					
	Influent Flow HiHi	X					
	Influent Totalized Flow						X
Influent Level Switch No. 1	Influent Level Hi	X					
Influent Level Switch No. 2	Influent Level Hi	X					

Odor Control	Blower running	X					
	Blower Fault	X					
	Pump running	X					
	Pump fault	X					
Circulation	Pump Running	X					
	Pump Fault	X					
	Fault	X					
	Valve irrigation	X					
	Valve purge	X					
Barscreen Rotopress 1	Screen Running	X					
	Screen Fault	X					
	Press Running	X					
	Press Fault	X					
Barscreen Rotopress 2	Screen Running	X					
	Screen Fault	X					
	Press Running	X					

	Press Fault	X					
Fluidyne Hydro-Grit No. 1	Pump Running	X					
	Regeneration Blower Running	X					
	Positive dis. Blower Running	X					
	Grit Screw Running	X					
Fluidyne Hydro-Grit No. 2	Pump Running	X					
	Regeneration Blower Running	X					
	Positive dis. Blower Running	X					
	Grit Screw Running	X					

3.10.2 UV / Filter / Reuse / Effluent Flow

Device	Description	Type					
		Digital Input	Digital Output	Analog Input	Analog Output	Memory Bit	Memory Word
Effluent flow	Effluent Flow			X			
	Effluent Flow Hi	X					
	Effluent Flow HiHi	X					
	Effluent Flow						X
Reuse	Pump Running	X					
	Pump Fault	X					
	Tank pressure	X		X			
	Tank Level			X			
Filter 1	Influent Level Hi	X					
Filter 2	Influent Level	X					

	Hi						
Filter 3	Influent Level Hi	X					

PART 4 – EXECUTION

4.1 Installation

4.1.1 All equipment and devices shall be installed in the locations shown on the drawings, in accordance with the manufacturer's instructions / recommendations and in compliance with these specifications.

4.1.2 The contractor shall be responsible for coordinating the installation of all equipment in the proposed locations with all other trades performing work on the project that mayh be affected.

4.1.3 All work performed in the installation of the equipment shall be executed according to accepted industry standards and practices and shall be executed in a neat, workmanlike manner.

4.2 Warranty

4.2.1 Warranty Period: One (1) year following the date of system acceptance.

4.2.2 Warranty Requirements: In accordance with Scope of Work and, in addition, the following:

4.2.2.1 Corrective hardware maintenance shall be performed by factory trained service technician(s) specifically trained to service the equipment involved. Technician shall be available, on site, within 24-hours after notification by the Owner.

4.2.2.2 Software maintenance shall be performed by suitably qualified individuals from the SI's software service staff. Representatives from third party software sources may additionally be involved, but the SI shall be represented at all on site services. Software service representative shall be available for consultation within 4-hours and, if required, on site within 16-hours after notification by the Owner.

4.3 Start-Up Service

4.3.1 Upon final completion of all components determine date of start-up jointly with Engineer, Owner and Contractor.

4.3.2 CSI to be responsible for placing of SCADA equipment and system in operation.

4.3.3 CSI to provide qualified personnel on the job site until successful operation of the system is attained.

4.4 System Testing

4.4.1 No equipment supplied by the CSI shall be placed into service without first performing system tests if the operation of the equipment could pose a risk of equipment damage or operator injury in the event of a malfunction.

4.4.2 All hardware installed by the CSI shall be exercised in its normal operational state under standard operating conditions to verify that the equipment operates as specified.

4.4.3 The CSI shall verify that the equipment interoperates properly with any equipment to which it interfaces.
4.4.4 The CSI shall verify that the equipment is rated to meet the environmental conditions to which it will be subjected.
4.4.5 The CSI shall verify that alarm and status information is properly detected and reported.
4.4.6 The CSI shall verify that all installed software systems operate as specified and meet the engineer / owners requirements.

4.5 Training

4.5.1 CSI shall provide training to plant personnel.
4.5.2 Training shall include CSI supplied equipment, operation and monitoring of other vendor equipment if CSI's equipment provides operator interface for the equipment, and operation of HMI system.
4.5.3 Training shall cover use of HMI system (both local and remote access), alarm reporting system including remote alarm reporting software, communications network architecture, and basic system maintenance and troubleshooting.
4.5.4 Training sessions shall be provided by the CSI at a time and place to be coordinated with the plant's supervisory staff.
4.5.5 CSI shall be available to answer questions about the system operation free of charge for a period of three Years after system acceptance.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PROFESSIONAL
15-Oct-14
ENGINEER
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SECTION 16010

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.02 SUMMARY

A. This division of the Specifications, Division 16 000, covers the complete interior and exterior electrical systems as indicated on the drawings or as specified herein. Provide all materials, labor, equipment and supervision to install electrical systems.

1.03 QUALITY ASSURANCE

A. All electrical work shall be in accordance with the following codes and agencies:
   1. The National Electrical Code (NFPA 70)
   2. The National Electrical Safety Code (ANSI C-2)
   3. The Life Safety Code (NFPA 101)
   4. The International Building Code
   5. Occupation Safety and Health Administration (OSHA)
   6. Manufacturer’s written requirements.
   7. Regulations of the local utility company with respect to metering and service entrance.
   8. State and municipal ordinances governing electrical work.

B. Material Standards: All material shall be new and shall conform to the standards where such have been established for the particular material in question. Publications and Standards of the organization listed below are applicable to materials specified herein.
   1. American Society for Testing and Materials (ASTM)
   2. Underwriters' Laboratories, Inc. (UL)
   3. National Electrical Manufacturer Association (NEMA)
   4. Insulated Cable Engineers Association (ICEA)
   5. Institute of Electrical and Electronic Engineers (IEEE)
   6. National Fire Protection Association (NFPA)
   7. American National Standards Institute (ANSI)
   8. Manufacturer’s Written Requirements

1.04 PERMITS

A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

1.05 WARRANTY

A. The Contractor warrants to the Owner and Engineer that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

1.06 DRAWINGS

A. The drawings indicate the arrangements of electrical equipment. Review civil drawings for door swings, cabinets, counters and built-in equipment; conditions indicated on civil plans shall govern. Coordinate installation of electrical equipment with structural system and mechanical equipment and access thereto. Coordinate installation of recessed electrical equipment with concealed ductwork and piping, and wall thickness.

B. Do not scale drawings. Obtain dimensions for layout of equipment from civil plans unless indicated on Electrical plans.

C. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the Engineer.

D. Equipment layout is based on one manufacturer's product. Where equipment selected by the Contractor for use on the job differs from layout, the Contractor shall be responsible for coordinating space requirements and connection arrangements.

1.07 SUBMITTALS:

A. Shop Drawings and Product Data:
   1. The Contractor shall submit for review by the Engineer data of materials and equipment to be incorporated in the work. Submittals shall be supported by

descriptive material, catalogs, cuts, diagrams, performance curves, and charts published by the manufacturer to show conformance to specification and drawing requirements; model numbers alone will not be acceptable. Provide complete electrical characteristics for all equipment. Submittals for lighting fixtures shall include Photometric data.

2. Refer to the individual sections for identified equipment and materials for which submittals are required.
3. Refer to the SHOP DRAWINGS, PRODUCT DATA AND SAMPLES section for required procedures.

B. Record Documents
1. Refer to Division 1 for record documents and related submittals.

1.08 OPERATION AND MAINTENANCE DATA AND INSTRUCTIONS

A. Refer to Division 1 for detail requirements.

B. Printed Material: Provide required printed material for binding in operation and maintenance manuals.

C. Instructions of Owner Personnel:
1. Before final inspection, as designated by the Engineer provide a competent representative to instruct Owner's designated personnel in systems under this division of the specifications. For equipment requiring seasonal operation, perform instructions for other season within six months unless requested otherwise.
2. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
3. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

1.09 EQUIPMENT REQUIRING ELECTRICAL SERVICE

A. Review all specification sections and drawings for equipment requiring electrical service. Provide service to and make connections to all such equipment requiring electrical service. Refer to ELECTRICAL CONNECTIONS FOR EQUIPMENT section for connection requirements.

B. Drawings indicate design loads and voltages and corresponding control equipment, feeders, and overcurrent devices. If equipment actually furnished have loads other than those indicated on the drawings or specified herein, control equipment, feeders, and overcurrent devices shall be adjusted in size accordingly at no additional cost to the Owner. Such adjustment shall be subject to the review of the Engineer.

C. Incidental items not indicated on Drawings or mentioned in Specifications but that can legitimately and reasonably be inferred to belong to the Work or be necessary in good practice to provide a complete system, shall be furnished and installed as though itemized here in detail. This includes connection requirements for air conditioning and refrigeration equipment as outlined by NEC Article 440.

1.10 SCHEDULING OF OUTAGES

A. Electrical work requiring interruption of electrical power which would adversely affect the normal operation of the other portions of the Owner's property, shall be done at time other than normal working hours. Normal working hours shall be considered eight A.M. to five P.M. Monday through Friday.

B. Schedule all work requiring interruption of electrical power two weeks prior to actual shutdown. Submit schedule in writing indicating extent of system to be de-energized, date and time when power is intended to be interrupted, and date and time power will be restored. Schedule shall be subject to the approval of the Engineer and the Representative of the Owner.

1.11 SITE INVESTIGATION

A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions which may affect the cost of the project. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems, shall be restored to their original condition, with the exception of the work under this contract, before the completion of this project.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials shall be new.

B. Furnish all materials specified herein or indicated on the drawings.

C. Materials of the same type shall be the product of one manufacturer.

D. All materials shall be UL listed and shall bear UL label. ETL listed material shall bear ETL label. ETL label shall be accepted in lieu of UL when the UL testing standards have been followed.

PART 3 - EXECUTION

3.01 PRODUCT DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Inspect materials upon arrival at Project and verify conformance to Contract Documents. Prevent unloading of unsatisfactory material. Handle materials in accordance with manufacturer's applicable standards and suppliers recommendations, and in a manner to prevent damage to materials. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact. Containers which are broken, opened, damaged, or watermarked are unacceptable and shall be removed from the premises.

B. All material, except items specifically designed to be installed outdoors such as pad mounted transformers or stand-by generators, shall be stored in an enclosed, dry building or trailer. Areas for general storage shall be provided by the Contractor. Provide temperature and/or humidity control where applicable. No material for installation, including conductors, shall be stored other than in an enclosed weathertight structure. Equipment stored other than as specified above shall be removed from the premises.

C. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Conditions shall be those for which the equipment or materials are designed to be installed. Equipment and materials shall be protected from water, direct sunlight, cold or heat and high humidity at all times. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

3.02 CLEANING AND PAINTING

A. Remove oil, dirt, grease and foreign materials from all raceways, fittings, boxes, panelboard trims and cabinets to provide a clean surface for painting. Touchup scratched or marred surfaces of lighting fixtures, panelboard and cabinet trims, motor control center, switchboard or equipment enclosures with paint furnished by the equipment manufacturers specifically for that purpose.

B. Do not paint trim covers for flush mounted panelboards, telephone cabinets, pull boxes, junction boxes and control cabinets unless required by the Engineer, National Electrical Code or other Sections of the specifications. Remove trim covers before painting. Under no conditions shall locks, latches or exposed trim clamps be painted.

C. Unless indicated on the drawings or specified herein to the contrary, all painting shall be done under the PAINTING Section of these Specifications.

D. Where plywood backboards are used to mount equipment provided under Division 16, paint backboards with two coats of light grey semi-gloss paint under Division 16.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

A. Perform all excavation to install conduits, duct banks, and handholes indicated on the drawings or specified herein. During excavation, pile material for backfilling back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. Provide shoring as required by OSHA Standards. Remove and dispose of all excavated materials not to be used for backfill. Grade to prevent surface water from flowing into trenches and excavation. Remove any water accumulating therein by pumping. Do all excavation by open cut. No tunneling shall be done unless indicated on the drawings or unless written permission is received from the Architect.

B. Grade the bottom of trenches to provide uniform bearing and support for conduits, or duct bank on undisturbed soil at every point along its entire length. Tamp overdepths with loose, granular, moist earth. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.

C. Backfill the trenches with excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale, free from large clods of earth and stones, deposited in 6" layers and rammed until the installation has a cover of not less than the adjacent ground but not greater than 2" above existing ground. Backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. Compaction of the filled trench shall be at least equal to that of the surrounding undisturbed material. Do not settle backfill with water. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore surface to grade and compaction indicated on the drawings, mounded over and smoothed off.

3.04 ELECTRICAL SYSTEMS OPERATIONAL TESTS, MANUFACTURERS SYSTEMS CERTIFICATION AND DESIGN AUTHORITY ASSISTANCE.

A. Testing
   1. Refer to the individual specification sections and the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of the specifications for test requirements.
   2. Prior to the final inspection, the systems or equipment shall be tested and reported as therein specified. Five (5) typewritten copies of the tests shall be submitted to the Engineer for approval.
   3. All electrical systems shall be tested for compliance with the specifications.

B. Manufacturers Certifications
   1. The electrical systems specified herein shall be reviewed for compliance with these specifications, installation in accordance with the manufacturers recommendations and system operation by a representative of the manufacturer. The manufacturer shall submit certification that the system has

been reviewed by the manufacturer is installed in accordance with the manufacturer's recommendations and is operating in accordance with the specifications.

2. Provide manufacturers certification for the following systems:
   a. Engine Driven EPSS.

C. Design Authority Assistance

1. The Contractor shall provide personnel to assist the Engineer or his representative during all construction review visits. The Contractor shall provide all necessary tools and equipment to demonstrate the system operation and provide access to equipment, including screwdrivers, wrenches, ladders, flashlights, circuit testing devices, meters, keys, radios, etc.
2. Remove equipment covers (i.e. panelboard trims, motor controls, device plates, and junction box covers) as directed for inspection of internal wiring. Accessible ceilings shall be removed as directed for inspection of equipment installed above ceilings.
3. Energize and de-energize circuits and equipment as directed. Demonstrate operation of equipment and systems as directed by the Representative.
4. The Contractor shall provide authorized representatives of the manufacturers to demonstrate to the Engineer compliance with the specifications of their respective system during or prior to the final inspection at a time designated by the Engineer. Refer to the specific specification section for additional testing requirements. Representatives of the following systems are required for demonstrations:
   a. Engine Driven EPSS

SECTION 16055

SHORT-CIRCUIT/COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.01 SCOPE

A. The contractor shall furnish short-circuit and protective device coordination studies which shall be prepared by the equipment manufacturer.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

1.02 RELATED SECTIONS

1.03 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents

C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition

2. NFPA 70E – Standard for Electrical Safety in the Workplace submittals for review/approval

D. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.04 SUBMITTALS FOR CONSTRUCTION

A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. No more than five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies, where required, shall be provided on CD in PDF format.

B. The report shall include the following sections:

1. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations
2. Descriptions, purpose, basis and scope of the study
3. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings
4. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings
5. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout
6. Incident energy and flash protection boundary calculations
7. Comments and recommendations for system improvements, where needed
8. Executive Summary including source of information and assumptions made

1.05 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies. The Registered Professional Electrical Engineer shall be a full-time employee of the Engineering Services Organization.

PART 2 - PRODUCT

2.01 STUDIES

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer. By using the equipment manufacturer the study allows coordination of proper breakers, fuses, and current transformers. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

2.02 DATA COLLECTION

A. Contractor shall furnish all field data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future utility supplies, motors, and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.

D. Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.03 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.

B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.

C. Provide the following:

1. Calculation methods and assumptions

2. Selected base per unit quantities
3. One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted
4. Source impedance data, including electric utility system and motor fault contribution characteristics
5. Typical calculations
6. Tabulations of calculated quantities
7. Results, conclusions, and recommendations

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility's supply termination point
2. Incoming switchgear
3. Low voltage switchgear
4. Motor control centers
5. Standby generators and automatic transfer switches
6. Branch circuit panelboards
7. Other significant locations throughout the system

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings
2. Adequacy of switchgear, motor control centers, and panelboard bus bracing to withstand short-circuit stresses
3. Adequacy of transformer windings to withstand short-circuit stresses
4. Cable and busway sizes for ability to withstand short-circuit heating
5. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

2.04 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.

B. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.

D. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the curve sheets, where applicable:

1. Electric utility's protective device
2. Medium voltage equipment relays
3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands

4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
5. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters
6. Conductor damage curves
7. Ground fault protective devices, as applicable
8. Pertinent motor starting characteristics and motor damage points
9. Pertinent generator short-circuit decrement curve and generator damage point
10. Other system load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.05 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.

C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

D. The Arc-Flash Hazard Analysis shall include all 480v locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.

E. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

F. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

G. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.

H. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

2.06 REPORT SECTIONS

A. Input Data:

1. Utility three-phase and line-to-ground available contribution with associated X/R ratios
2. Short-circuit reactance of rotating machines with associated X/R ratios
3. Cable type, construction, size, # per phase, length, impedance and conduit type
4. Bus duct type, size, length, and impedance
5. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio
6. Reactor inductance and continuous ampere rating
7. Aerial line type, construction, conductor spacing, size, # per phase, and length

B. Short-Circuit Data:

1. Source fault impedance and generator contributions
2. X to R ratios
3. Asymmetry factors
4. Motor contributions
5. Short circuit kVA
6. Symmetrical and asymmetrical fault currents

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:
   a. Current transformer ratio.
   b. Current setting.
   c. Time setting.
   d. Instantaneous setting.
   e. Specialty non-overcurrent device settings.
   f. Recommendations on improved relaying systems, if applicable.
2. Circuit Breakers:
   a. Adjustable pickups and time delays (long time, short time, ground).
   b. Adjustable time-current characteristic.
   c. Adjustable instantaneous pickup.
   d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations.

1. Arcing fault magnitude
2. Device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.01 FIELD ADJUSTMENT

A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the

engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify Owner in writing of any required major equipment modifications.

D. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

3.02 ARC FLASH WARNING LABELS

A. The vendor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The label shall have an orange header with the wording, "WARNING, ARC FLASH HAZARD", and shall include the following information:

1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy
6. Working distance
7. Engineering report number, revision number and issue date

C. Labels shall be machine printed, with no field markings

D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 480 and applicable 208 volt panelboards and disconnects, one arc flash label shall be provided
2. For each motor control center, one arc flash label shall be provided
3. For each low voltage switchboard, one arc flash label shall be provided
4. For each switchgear, one flash label shall be provided
5. For medium voltage switches one arc flash label shall be provided

E. Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.03 ARC FLASH TRAINING

A. The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces, shall be provided in the equipment manuals.

SECTION 16110

RACEWAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This section covers the complete interior [and exterior] raceway system.

B. Definition: The term conduit, as used in this Specification, shall mean any or all of the raceway types specified.

1.03 QUALITY ASSURANCE

A. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this Specification by reference.
   1. Underwriters' Laboratories, Inc. (UL) Publications:
      No. 1 Flexible Metal Electrical Conduit
      No. 6 Rigid Galvanized Conduit
      No. 6A Rigid Stainless Steel Conduit
      No. 467 Electrical Grounding and Bonding
      No. 651 Rigid Nonmetallic Electrical Conduit
      No. 797 Electrical Metallic Tubing
      No. 1242 Intermediate Metal Conduit
   2. American National Standards Institute (ANSI):
      C-80.1 Rigid Galvanized Conduit.
      C-80.3 Electrical Metallic Tubing.
   3. National Fire Protection Association (NFPA):
      No. 70 National Electrical Code (NEC).
   4. Federal Specifications (Fed Spec):
      a. WW-C-581E: Conduit, Metal, Rigid; And Couplings, Elbow and
      b. Nipple, Electrical Conduit: Zinc Coated.
      c. W-C-1094A: Conduit and Conduit Fittings Plastic, Rigid.

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.
   1. Metallic Conduit Fittings:

a. Appleton
b. Carlon
c. Crouse Hinds
d. Killark
e. O-Z/Gedney
f. RACO
g. Thomas and Betts
h. Calbrite
i. Gibson

2. Support Channel:
a. Kindorf
b. Powers
c. Unistrut

3. Non-Metallic Conduit and Fittings:
a. Carlon
b. Certainteed
c. Thomas and Betts

C. Coordination
1. Coordinate conduit installation with electrical equipment furnished.
2. Coordinate conduit installation with contract documents and other contractors. Adjust installation to eliminate conflicts. Review all shop drawings submitted under this and other sections to insure coordination with all equipment requiring electrical service and to avoid conflict interferences. Coordinate installation sequence with other contractors to avoid conflicts including equipment access and provide the fastest overall installation schedule.

1.04 STORAGE AND HANDLING

A. Refer to the BASIC ELECTRICAL REQUIREMENTS section of the specifications for storage and handling requirements.

B. Non-metallic conduits stored on site prior to installation shall be stored on a surface off of the ground and shall be protected from the direct rays of the sun and from debris.

C. Damaged, oxidized, warped, improperly stored material or material with excessive amounts of foreign debris will be removed from the project and replaced with new materials.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Furnish all materials specified herein.

B. All conduit and fittings shall be listed and bear a label by Underwriters' Laboratories (UL) for use as raceway system for electrical conductors.

C. Raceway is required for all wiring, unless specifically indicated or specified otherwise.

D. Size: The minimum size of conduit shall be 3/4". The size of all conduits shall be in accordance with the NEC, but, not less than indicated on the drawings. 3/8" flexible conduits may be used for connections between outlet box and lighting fixture only.

2.02 EMT CONDUIT FITTINGS

A. Electrical Metallic Tubing (EMT) couplings and connectors shall be steel "concretetight" type. Malleable iron, die cast or pressure cast fittings are not permitted. Fittings 2.0" and smaller shall be gland and ring compression type. Connectors for conduits 2.5" and larger shall be set screw type with two (2) screws each or compression type. Couplings for conduits 2.5" and larger shall be set screw type with four (4) screws each or compression type. All connectors shall be insulated throat type. All set screw connectors encased in walls or floor shall be taped at all joints.

2.03 RIGID AND IMC CONDUIT FITTINGS

A. Fittings for rigid steel and IMC shall be standard threaded couplings, threaded hubs, locknuts, bushings and elbows. All materials shall be steel or malleable iron only. Set screw or non-thread fittings are not permitted. Bushings shall be metallic insulating type consisting of insulating insert molded or locked into the metallic body of the fittings. Erickson-type couplings may be used to complete a conduit run.

2.04 STAINLESS STEEL CONDUIT FITTINGS

A. Fittings for stainless steel shall be standard threaded couplings, threaded hubs, locknuts, bushings and elbows. All materials shall be stainless steel. Set screw or non-thread fittings are not permitted. Bushings shall be metallic insulating type consisting of insulating insert molded or locked into the metallic body of the fittings. Erickson-type couplings may be used to complete a conduit run.

2.05 NON-METALLIC CONDUIT AND FITTINGS

A. Non-metallic conduit shall be Schedule 80 PVC.

B. Non-metallic conduit fittings shall be of the same material as the conduit furnished and be the product of the same manufacturer.

C. Glue for all non-metallic conduit and fittings shall be provided as required by the manufacturer of the conduit being used.

2.06 CONDUIT SUPPORTS

A. For exterior locations provide 304 stainless steel channel, conduit clamps, threaded rod and hardware of equivalent dimensions identified for interior locations. For interior locations all parts and hardware shall be zinc-coated or have equivalent corrosion protection.

B. Conduit straps shall be single hole cast metal type or two hole galvanized metal type.

C. Conduit support channels shall be 1.5" x 1.5" x 14 gauge galvanized (or with equivalent treatment) channel. Channel suspension shall be 3/8" threaded steel rods. Use swivel type connector to attach suspension rods to structure. Spring steel clips are not acceptable. Wire or chain is not acceptable for conduit hangers.

D. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose, sized appropriately for the conduit type and diameter, and have pre-assembled closure bolt and nut and provisions for receiving threaded hanger rod. Support with 1/4" threaded steel rod for individual conduits 1.5" and smaller and 3/8" rod for individual conduits 2.0" and larger.

E. Individual conduit straps on metal studs shall be spring steel and should wrap around entire face of conduit securely biting into both edges and have provisions for screwing into stud. Size appropriately for conduit to be support. Tie wraps are not acceptable.

F. Support multiple conduits from metal studs using pre-assembled bar hanger assembly consisting of hanger bar, retaining clips and conduit straps.

G. Refer to SUPPORTING DEVICES section of these specifications for additional material requirements.

2.07 FLEXIBLE CONDUIT AND FITTINGS

A. Flexible conduit shall be steel metallic type. Where specified herein, indicated on the drawings, or when used in damp or wet locations, as classified by the National Electrical Code, flexible conduit shall be liquid tight.

B. All flexible conduit shall be classified as suitable for system grounding. All flexible (liquid tight) conduits shall be UL listed as sunlight (UV) resistant.

C. Connectors for flexible conduit shall be steel insulated throat type rated as suitable for system ground continuity. Connectors for liquid tight flexible conduit shall be screw-in ground cone type.

D. Flexible conduit use for other than connections to lighting fixtures shall not be less than 3/4" trade size and in no case shall flexible conduit size be less than permitted by the National Electrical Code for the number and size of conductors to be installed herein. 3/8" flexible conduit may be used only for connection to lighting fixtures providing conduit fill requirements of the National Electrical Code are not exceeded.

2.08 MISCELLANEOUS CONDUIT FITTINGS AND ACCESSORIES

A. Vinyl all weather electrical tape for corrosion protection shall be Scotchrap 51 with two coats of Scotchrap pipe primer

B. Expansion and deflection couplings shall be in accordance with UL 467 and UL 514. They shall accommodate 3/4" deflection, expansion, or contraction in any direction and shall allow 30 degree angular deflections. Couplings shall contain an internal flexible metal braid to maintain raceway system ground continuity.

C. Fire and smoke stop materials shall be rock wool fiber, silicone foam, or silicone sealant, UL rated to maintain the fire floor or fire wall partition rating.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General
1. Conceal all conduits, except in unfinished spaces such as equipment rooms or where indicated by symbol on the drawings.
2. Leave all empty conduits with a 200 pound test nylon cord pull line
3. Install as complete raceway runs prior to installation of cables or wires.
4. Flattened, dented, burned, or deformed conduits are not permitted and shall be removed and replaced.
5. Secure rigid conduit i.e., rigid galvanized conduit and intermediate metal conduit, to sheet metal enclosures with two (2) locknuts and insulated bushing. Secure EMT to sheet metal enclosures with insulated throat connectors with lock nut..
6. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on metal studs. Nails are not acceptable.
7. Protect conduits against dirt, plaster, and foreign debris with conduit plugs. Plugs shall remain in place until all masonry is complete. Protect conduit stub-ups during construction from damage; any damaged conduits shall not be used.
8. Seal all conduits originating from outside building from below grade, all conduits entering refrigerated spaces, i.e., freezers and coolers, and all conduits

entering exterior mounted electrical equipment with insulating electrical putty to prevent entrance of moisture. Spray foam is not acceptable.

9. Install conduit with wiring, including homeruns as indicated on the drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Architect by written authorization.
10. Conduits which penetrate roof membranes shall be installed in accordance with manufacturer's recommendations and architectural specifications.
11. Install a complete SCADA Communications system as indicated on the drawings. The minimum conduit size shall be not less than 3/4". All bends in conduit shall be long sweep radius. Install no more than four 90 degree bends between pull or outlet boxes and backboard/cabinets.
12. Use flexible conduit for connection to vibrating equipment and rotating machinery and for connection from junction box to flush mounted lighting fixtures only.
13. Separate raceway systems are to be installed for power systems and for control, signal and communications systems. Do not install control, signal or communications cables in the same raceways as branch circuit or feeder cables, unless indicated otherwise on the drawings.
14. Provide expansion fitting in all conduits where length of run exceeds 200 feet or where conduits pass building expansion joints.

B. Uses Permitted

1. Conduits installed within concrete floor slabs which are in direct contact with grade or other material shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Conduits which penetrate the building roof shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Conduits installed within concrete floor slabs which are above grade shall be galvanized rigid steel (GRS), intermediate metal conduit (IMC), or schedule 40 Heavy Wall PVC. Where transition is made from raceway in slab to any type of raceway out of slab, make transition with rigid galvanized elbow. For corrosion protection, where elbow penetrates surface, apply two(2) coats of Scotchrap pipe primer and two overlapping layers of Scotchrap 51 tape, for 6" above and below concrete surface. Allow primer to cure before applying tape.
2. Stainless steel conduits shall be used in highly corrosive areas where the conduit is subject to damage, specifically in the headworks/bar screen, odor control, grit removal, influent pump station and the SBR tanks.
3. Conduits installed in direct contact with earth shall be schedule 80, heavy wall PVC.
4. Service entrance conduits in direct contact with earth shall be galvanized steel. Other conduit in direct contact with earth shall be schedule 80, heavy wall PVC.
5. All other conduit, unless excluded herein, not permitted in accordance with the National Electrical Code, or otherwise indicated on the drawings, shall be electrical metallic tubing (EMT).

6. Conduit types shall not be mixed indiscriminately with other types in the same run, unless specified herein or required by the NEC.
7. Use flexible conduit for connections to motors, dry type transformers, unit heaters, and flush mounted lighting fixtures.
    a. Flexible conduit used for connection of motors, dry type transformers, unit heaters, shall not exceed 18" in length.
    b. Flexible conduit from outlet box to flush mounted lighting fixture shall not exceed 6-ft. in length.
    c. Maintain ground continuity through flexible conduit with green equipment grounding conductor; do not use flexible conduit for ground continuity.
    d. Liquid tight conduit shall be used to connect equipment in exterior installations.
8. Service entrance and feeder conduits installed exposed or concealed in walls or above ceilings shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC). Service entrance conduits shall be installed "outside" of the building as defined by the NEC. Provide concrete encasement where required.
9. No conduit requiring cutting of cross-webs of concrete masonry units is permitted. Conduit shall be threaded through cells or concrete masonry units lowered around conduit. Neither horizontal joint reinforcement nor bond beam reinforcement shall be cut for conduit installation. Conduits shall not be run horizontally in walls.
10. All conduits installed exposed from the finished floor to a minimum height of 10 ft. above the floor shall be galvanized rigid steel (GRS) or intermediate metallic conduit (IMC).
11. Where hazardous locations, as classified by the National Electrical Code, exist, all conduits and fittings and the installation of these materials shall comply with Article 500 of the National Electrical Code.

C. Below Grade Raceway Installations
1. Direct Burial Conduit
    a. Install top of conduits 24" minimum below finished grade. Maximum depth shall be 36".
    b. Install top of conduits 6" minimum below bottom of building slabs.
    c. Install top of conduits 30" minimum below grade, below roads and any other paved surfaces.
    d. Where transition is made from below grade PVC installation to a metallic conduit system above grade or slab, make transition with rigid galvanized elbow and extend through slab or above grade with galvanized rigid steel conduit. For corrosion protection, where the elbow penetrates surface, apply two(2) coats of Scotchrap pipe primer and two overlapping layers of Scotchrap 51 tape, for 6" above and below concrete surface. Allow primer to cure before applying tape.
    e. For excavation and backfilling, refer to earthwork specification section.
    f. Conduit shall be run following the most direct route between points.

D. Raceway Installations Within Concrete

1. Conduit shall be run following the most direct route between points.
2. Conduit shall not be installed in concrete which is less than 3" thick or where the outside diameter is larger than 1/3 of the slab thickness.
3. Conduits installed in concrete slabs shall be buried in the concrete slab. Wire low conduits to upper side of the bottom reinforcing steel, and upper conduits to the lower side of the top reinforcing steel. Separate parallel runs of conduits within slab by at least 1".
4. Conduits shall not be installed within shear walls unless specifically indicated on the drawings. Conduits shall not be run directly below and parallel with load bearing walls
5. Protect each metallic conduit installed in concrete slab or conduits passing through a concrete slab against corrosion where conduit enters and leaves concrete by applying two(2) coats of Scotchrap pipe primer and two overlapping layers of Scotchrap 51 tape, for 6" above and below concrete surface. Allow primer to cure before applying tape.
6. The maximum projection of conduit stub-up and bushing above slab shall be 3".
7. Protect all conduits entering and leaving concrete floor slabs from physical damage during construction.

E. Concealed (Above Ceilings and in Walls) and Exposed Raceway Installation

1. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.
2. Support branch circuit conduits at intervals not exceeding 10 ft. and within three feet of each outlet, junction box, cabinet or fitting. Attach individual branch circuit conduits to structural steel members with beam conduit clamps and to non-metallic structural members with one hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hangar rod and conduit clamp assembly. Multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.
3. Attach feeder conduits larger than 1" trade diameter to or from structure on intervals not exceeding 12 ft. with conduit beam clamps, one hole conduit straps or trapeze type support in accordance with support systems described for branch circuit conduits.
4. Where conduits must pass through structural members, obtain approval of Engineer with respect to location and size of hole prior to drilling.
5. Conduits rigidly secured to building construction on opposite sides of a building expansion joint shall be provided with an expansion and deflection coupling. In lieu of an expansion coupling, conduits 2-1/2" and smaller may be provided with junction boxes on both sides of the expansion joint connected by 15" of slack flexible conduit with bonding jumper.

3.02 ADJUSTMENT, CLEANING AND PROTECTION

A. Clean: Upon completion, clean all installed materials of paint, dirt, and construction debris. All conduit systems shall be cleaned of water and debris prior to the installation of any conductors.

B. All field cut threads of RGS or IMC conduits shall be painted with four coats of ZRC cold galvanizing compound. Allow compound to fully dry and cure between coats.

SECTION 16120

WIRES AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of furnishing, installation and connections of the building wiring system, 600 volts and below. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. Wiring systems for communication and alarm systems are not included in this section unless specified to be included, by reference, in the respective specification sections for alarm and communication systems.

1.03 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by Reference.
   1. Underwriters' Laboratories, Inc. (UL) Publications:
      a. No. 44: Rubber - Insulated Wire and Cables
      b. No. 83: Thermoplastic - Insulated Wires
      c. No. 493: Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables
      d. No. 486: Wire Connectors and Soldering Lugs
   2. Insulated Cable Engineers Association Standards (ICEA):
      a. S-61-402: Thermoplastic Insulated Wire and Cable
   3. National Electrical Manufacturer's Standards (NEMA):
      a. WC-5: Thermoplastic Insulated Wire and Cable
   4. National Fire Protection Association Publication (NFPA):
      a. No. 70: National Electrical Code (NEC)
   5. Federal Specifications (Fed. Spec.):
      a. J-C-30A(1) Cable and Wire Electrical (Power Fixed Installations)
      b. HH-I-595C: Insulation Type, Electrical, Pressure-Sensitive Adhesive, Plastic

B. Acceptable Manufacturers. Products produced by the following manufacturers which conform to this specification are acceptable.

1. Hydraulically applied conductor terminations:
   a. Square D
   b. Burndy
   c. Ilsco
   d. Scotch (3M)
   e. Thomas and Betts (T&B)
   f. Anderson
2. Mechanically applied (crimp) conductor terminations:
   a. Scotch (3M)
   b. Ideal
   c. Thomas and Betts (T&B)
   d. Burndy
3. Vinyl electrical insulating tape:
   a. Scotch (3M)
   b. Tomic
   c. Permacel
4. Twist-On Wire Connectors:
   a. Scotch (3M)
   b. Ideal
   c. Buchanan
5. Encapsulated insulating kits:
   a. Scotch (3M)
   b. Raychem
   c. Essex Group, Inc.
6. Portable cable fittings:
   a. Crouse Hinds
   b. Appleton
   c. T&B
7. Insulated cable:
   a. Brand-Rex Co.
   b. Cablec Corp.
   c. The Okonite Co.
   d. Pirelli Cable Corp.
   e. Senator Wire and Cable Co.
   f. Southwire Co.
   g. Houston Wire & Cable Co.
   h. Aetna Insulated Wire Co.
   i. American Insulated Wire Corp.

C. Performance: Conductors shall be electrically continuous and free from short circuits or grounds. All open, shorted or grounded conductors and any with damaged insulation shall be removed and replaced with new material free from defects.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Provide all materials under this section of the specifications.

B. All wire and cable shall be UL listed and shall bear a UL label along the conductor length at intervals not exceeding 24 inches.

C. All conductors shall have size, grade of insulation, voltage and manufacturer's name permanently marked on the outer cover at intervals not exceeding 24 inches.

D. Conductor size shall be a minimum of No. 12 AWG. Conductor size shall not be less than indicated on the drawings.

E. Insulation voltage level rating shall be 600 volts.

2.02 PRODUCT/MATERIALS DESCRIPTION

A. Conductors No. 10 AWG and smaller shall be solid copper, 90°C type THHN/THWN or XHHN, unless otherwise indicated on the drawings, required by the National Electrical Code or specified elsewhere in Division 16.

B. Conductors larger than No. 10 AWG shall be stranded copper, 90°C,, type THHN/THWN, XHHW, unless otherwise indicated on the drawings, required by the National Electrical Code, or specified herein.

C. Fixture wire shall be No. 16 AWG silicone rubber insulated, stranded fixture wire, type SFF-2 (150°C), or No. 16 AWG thermoplastic, nylon jacketed stranded fixture wire, type TFFN (90°C). Color code as specified herein shall not be required for fixture wire; however, neutral conductor shall be identified distinctly from phase conductors.

D. Control conductors for use on 120 volt control wiring systems shall be No. 12 AWG stranded type THHN/THWN, unless indicated otherwise on the drawings.

E. Splices and taps (No. 10 AWG and smaller) - Connectors for solid conductors shall be solderless, screw-on, spring pressure cable type, 600 volt, 105°C. with integral insulation and UL approved for aluminum and copper conductors. Connectors for stranded conductors shall be crimp-on type with integral insulating cover.

F. Splices and taps (No. 8 and larger) - Hydraulically applied crimping sleeve or tap connector sized for the conductors. Insulate the hydraulically applied connector with 90°C., 600 volt insulating cover provided by the connector manufacturer. Insulator materials and installation shall be approved for the specific application, location,

voltage and temperature and shall not have an insulation value less than the conductors being joined.

G. Electrical insulating tape shall be 600 volt, flame retardant, cold and weather resistant, minimally .85 mil thick plastic vinyl material; Scotch No. 88, Tomic No. 85, Permacel No. 295.

PART 3 - EXECUTION

3.01 EXECUTION

A. Install all wiring in raceway system, except where direct burial cable or other conductors are indicated or specified not to be installed in raceway.

B. Connect all conductors. Torque each terminal connection to the manufacturers recommended torque value. A calibrated torqueing tool shall be used to insure proper torque application. Any conductors nicked or ringed while removing insulation shall be replaced.

C. Do not install more conductors in a raceway than indicated on the drawings. A maximum of three branch circuits are to be installed in any one conduit, on 3 phase 4 wire system, unless specifically indicated otherwise on the drawings. No two branch circuits of the same phase are to be installed in the same conduit, unless specifically indicated on the drawings.

D. Conductors shall be tested to be continuous and free of short circuits and grounds.

E. Identification
   1. Conductors within pull boxes shall be grouped and identified with nylon tie straps with circuit identification tag.
   2. Identify each control conductor at its terminal points with wrap around tape wire markers. I.D. to indicate terminal block and point designation, or other appropriate identifying indication.
   3. Refer to ELECTRICAL IDENTIFICATION section of these specifications for additional identification requirements.

F. Color Code Conductors.
   1. Color code all secondary service, feeder and branch circuit conductors. Control and signal system conductors need not be color coded.
   2. Coding shall be as follows:
      a. 208Y/120 volt three phase four wire wye system - Phase A: Black, Phase B: Red, Phase C: Blue, Neutral: White
      b. 480Y/277 volt three phase four wire system - Phase A: Brown, Phase B: Orange, Phase C: Yellow, Neutral: Gray
   3. Grounding conductors shall be green.
   4. Conductors No. 6 and smaller shall have solid color compound insulation or continuous color finish. Conductors No. 4 and larger shall have colored phase

tape. Colored tape shall be installed on conductors in every box, at each terminal point, cabinet, through manhole or other enclosure.

G. Maintain phase rotation established at service equipment throughout entire project.

H. Group and lace with nylon tie straps all conductors within enclosures, i.e. panels, motor controllers motor control center, switchboard, switchgear, terminal cabinets, control cabinets.

I. Make splices in conductors only within junction boxes. Do not splice conductors in pull boxes, panelboards, safety switches, switchboard, switchgear, motor control center, wiring troughs or motor control enclosures.

J. Terminate conductors No. 10 AWG and smaller specified in Division 16 to be stranded, with crimp type lug or stud. Direct termination of stranded conductors without crimp terminator to terminal screws, lugs, or other points is not permitted even if terminal is rated for stranded conductors. Crimp terminal shall be the configuration type suitable for terminal point. Crimp lugs shall be applied in strict accordance with the manufacturer's written requirements.

K. Make connections between fixture junction box and fixture with fixture wire.

L. Control, communications or signal conductors shall be installed in separate raceway systems from branch circuit or feeder raceway, unless indicated otherwise on the drawings.

M. Splices in conductors installed below grade are not permitted.

N. Secure portable cables provided with equipment (floating mixers, submersible pumps) in accordance with the NEC. Install strain relief devices to prevent tension on terminations if cable is pulled. Install cable grips on drops and connect to outlet box or structure. Leave slack cable loop at drop point.

SECTION 16130

BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of outlet boxes, pull boxes, and junction boxes throughout the wiring system including box supports.

B. Definition: Box, as used in this specification, includes all outlet, device, junction, and pull boxes. Feeder shall mean all conductor circuits larger than #8 AWG, including service entrance conductors, and all wiring above 600V.

1.03 QUALITY ASSURANCE

A. Referenced Industry Standards: The following specifications and standards are incorporated into and become a part of this specification by reference.
   1. Underwriters' Laboratories, Inc. (UL) Publications:
      a. No. 50: Electrical Cabinets and Boxes
      b. No. 467: Electrical Grounding and Bonding Equipment
      c. No. 514: Electrical Outlet Boxes and Fittings
   2. National Fire Protection Association (NFPA):
      a. No. 70: National Electrical Code (NEC)

B. Coordination: Review architectural drawings for areas where outlets occur within specific architectural or structural features and install outlets as shown on architectural drawings; or if not shown, accurately center and align boxes within the architectural features or detail.

C. Acceptable Manufacturers:
   1. Exterior junction or pull boxes:
      a. Pencel
      b. Quaztite Type PC
      c. Oldcastle Synertech

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Furnish all materials specified herein.

B. All boxes shall be UL listed and labeled.

C. Boxes shall be galvanized steel sheet metal, unless rustproof cast metal is specified or required by the NEC, or unless otherwise specified or indicated on the drawings.

2.02 OUTLET AND DEVICE BOXES

A. Outlet boxes for surface mounted and pendant mounted lighting fixtures shall be 4" octagon boxes, 1-1/2" deep.

B. Outlet boxes for flush mounted lighting fixtures shall be 4" square boxes 1-1/2" deep, with blank cover, installed adjacent to fixture. Connection to fixture shall be with flexible conduit and fixture wire.

C. Outlet boxes for switches, receptacles and wall mounted junction boxes shall be 4" square boxes, 1-1/2" deep with square edge tile type cover. Where only one conduit enters box, 3-1/2" deep single gang switch box may be used. Outlet boxes for GFI receptacles shall be 2-3/4" deep.

D. Outlet boxes for switches and receptacles in exposed wiring system shall be cast FS boxes with matching device plate. Device plates for exterior installations shall be spring loaded hinged covers. Use FD box for GFI receptacle.

E. Outlet boxes for individual switches, and receptacles flush mounted in exposed concrete block shall be single gang masonry boxes 3-1/2" deep.

F. Outlet boxes for support of surface or pendant mounted incandescent or HID lighting fixtures shall be provided with fixture stud.

G. Where special purpose device specified requires larger outlet box than specified herein, provide outlet box suitable for specific device. These outlet boxes shall be of the same type as specified herein for the installation required.

H. Outlet boxes installed in poured concrete or cast in place shall be concrete-tight type. The box depth shall allow 2" minimum of concrete cover.

2.03 JUNCTION AND PULL BOXES

A. Dimensions of pull boxes and junction boxes shall not be less than those dimensions required by the National Electrical Code for the number, size and position of conductors entering the box. Extension rings shall not be permitted on a box to increase the volume.

B. Pull boxes installed in finished spaces shall be flush mounted cabinets provided with trim, hinged door and flush latch and lock to match panel trim for flush mounted electrical panelboard.

C. Pull boxes required for horizontal feeders containing more than one feeder shall be provided with reinforced flange and removable 12 gauge 1-1/2" x 1-1/2" galvanized channel for support of conductors. Wood supports within pull boxes are not acceptable.

D. Provide box covers for all junction and pull boxes.

2.04 EXTERIOR JUNCTION OR PULL BOXES, FLUSH WITH GRADE

A. Junction or pull box to be mounted flush with grade shall be polymer concrete, open-bottom(self-draining) boxes with bolted cover lids. Box dimensions shall be as indicated on the drawings, sized in accordance with the National Electrical Code minimum requirements. Covers shall be polymer concrete secured to box with stainless steel bolts.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All boxes shall be completely accessible and as required by the NEC. Provide access panels in any non-accessible spaces to allow access to boxes installed. Crawling above ceilings to access boxes is not acceptable.

B. Provide an outlet box for each lighting fixture and for each device. Boxes shall not be smaller than indicated in this section of the specifications and shall be larger if required by Article 314 of the National Electrical Code for the number and size of conductors installed. Where lighting fixtures are installed in continuous rows, only one outlet box shall be required.

C. Outlet boxes for flush mounted lighting fixtures shall be accessible. Where fixture installation is in nonaccessible ceiling, outlet box shall be accessible when fixture is removed.

D. Set outlet boxes for flush mounted devices to within 1/8" of finished wall. Spacers or shims between box and device are not acceptable. Modification of boxes or use of extensioin rings to provide for 1/8” of finished wall is not acceptable.

E. Where low voltage device is to be installed in common outlet boxes with line voltage device, provide metal barrier within outlet box to establish two separate compartments.

F. Where drawings indicate ganged installations of switches controlling 277 volt lighting circuits of opposite phase, separate switches with permanently installed nonmetallic barrier. Where space available for horizontal ganged installation is not adequate, install switches vertically to maintain required clearances between energized terminals.

G. Support every box from structure:
   1. Secure to wood with wood screws.
   2. Secure to hollow masonry with toggle bolts.
   3. Secure to metal with sheet metal screws, machine bolts, or clamps.
   4. Anchors for solid masonry and concrete shall be self drilling expansion shields, insert expansion shields, or lead shields with machine bolts.
   5. Secure outlet boxes to metal studs with spring steel clamp which wraps around entire face of stud and digs into both sides of stud. Clamp shall be screwed into stud.
   6. Where box is suspended below structure, support from structure with threaded steel rod. Secure rod directly to outlet boxes with double nuts. For pull boxes larger than 18" x 18" x 6", construct 1-1/2" x 1-1/2" x 14 gauge metal channel frame. Connect frame to box by bolting and secure frame to threaded rod at each corner.
   7. Hub type cast boxes need not be directly attached to structure if rigid conduit is used and supported in conformance with the NEC.

H. Support outlet boxes for support of surface mounted incandescent lighting fixtures by light weight channel spanning between and attached to main ceiling support member. Attach channel to ceiling support members with galvanized tie wire or nylon tie straps.

I. Do not use outlet boxes for support of fluorescent fixtures; boxes shall be used only as junction boxes.

J. Remove only knockouts as required and plug all unused openings. Use threaded plugs for cast boxes and snap-in metal plugs for sheet metal boxes.

K. Outlet boxes in the same wall shall not be mounted back-to-back. Offset 6" minimum.

L. Install pull boxes only in unfinished spaces or concealed above ceilings, except when indicated on the drawings or approved by the Engineer.

M. Install pull boxes when any of the following conditions apply:
   1. Where indicated on the drawings.
   2. Where conduit run exceeds 200 ft. from box to box or box to terminal.
   3. Where conduit contains more than 4-90 degree bends or the equivalent offsets.
   4. To facilitate conductor installation or to insure that the manufacturer's maximum pulling tension is not exceeded.
   5. As described in the RACEWAYS section of the specifications for crossing expansion joints.

N. Do not splice conductors in pull boxes. Splices are not permitted in pull boxes except when approved in writing by the Engineer or where shown on the drawings. Where splices are permitted, make splices with splicing sleeves attached to conductors with hydraulic crimping tool. Split bolt connectors are not acceptable for splices within pull boxes.

O. Where a pull box is required, one shall be installed for each individual branch circuit conduit or each feeder. It shall contain only the feeder conductors or those conductors in the conduit. A combined pull box for multiple branch conduits or feeders is not permitted, unless approved by the Engineer or indicated on the drawings. Where permitted for multiple circuits within pull box:
   1. Circuit conductors and feeders shall be individually laced with nylon tie straps of the type with enlarged tab to permit identification of each circuit and feeder within pull box. Identify each with respect to load served.
   2. Feeder circuits shall be separated by full height and length sheet metal or polyester resin barrier secured to box by angle brackets.

P. Box covers shall be in place and secured to box.

Q. Identification
   1. Refer to ELECTRICAL IDENTIFICATION section of these specifications for additional requirements.

R. Exterior pull or junction boxes
   1. Exterior pull or junction boxes shall be mounted flush with the grade, unless specified elsewhere or indicated to be aboveground on the drawings.
   2. Flush mounted boxes shall be surrounded on all sides and bottom with 6" minimum of concrete. Top of concrete shall be flush with grade.
   3. Seal conduit entries into box with duct seal to prevent entrance of moisture, after conductors are installed.
   4. Taps and splices, where permitted by these specifications within exterior junction boxes, shall be performed with an encapsulating watertight splice or tap kit which insulates and moisture seals the connection. Kit shall consist of the appropriate size and type mold, encapsulating resin and end sealing tape.

3.02 CLEANING AND ADJUSTMENT

A. After completion, clean all work of dirt, paint and construction debris.

SECTION 16142

ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.

B. Applications of electrical power connections specified in this section include the following:
   1. To resistive heaters.
   2. From electrical source to motor starters.
   3. From motor starters to motors.
   4. To lighting fixtures.
   5. To transformers, and similar current current adjustment features of equipment.
   6. To master units of communication, signal, alarm, clock, public address, sound, and video systems.

C. Electrical connections for equipment, not furnished as integral part of equipment, are specified in Division - 15 and other Division - 16 sections, and are work of this section.
   1. Division 1 - GENERAL REQUIREMENTS
   2. Division 11 - EQUIPMENT
   3. Division 13 - SPECIAL CONSTRUCTION
   4. Division 14 - CONVEYING SYSTEMS
   5. Division 15 - MECHANICAL

D. Motor starters and controllers, not furnished as integral part of equipment, are specified in applicable Division - 16 sections, and are work of this section.

E. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division - 16 sections, and are work of this section.

F. Raceways and wires/cables required for connecting motors and other electrical units of equipment are specified in applicable Division 16 sections, and are work of this section.

G. Electrical identification for wire/cable conductors is specified in Division - 16 section, ELECTRICAL IDENTIFICATION, and is work of this section.

1.03 QUALITY ASSURANCE

A. NEC Compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches. NEC Article 110-14, "ELECTRICAL CONNECTIONS" applies to above.

B. IEEE Compliance: Comply with Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to connections and terminations.

C. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.
   1. ANSI/EIA RS-364-21A: "Insulation Resistance Test"
   2. STD SG-14: "Unplated split-bolt and Vice-Type Electrical Connectors for Copper Conductors".

D. UL Compliance: Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL-listed and labeled.
   1. STD. NO. 486A; Wire Connectors and Soldering Lugs for Use with Copper Conductors.
   2. STD. NO. 486C; Splicing Wire Connectors.
   3. STD. NO. 486D; Insulated Wire Connectors for Use With Underground Conductors.

E. ETL Compliance: Provide electrical connection products and materials which are ETL-listed and labeled.

F. ASTM Compliance: Comply with Standard B539 "Standard Methods for Measuring Contact Resistance of Electrical Connections (Static Contacts)."

G. Federal Specifications:
   1. J-C-30 Electrical Cable and Wire (Power, Fixed Installation).
   2. J-C-145 Electrical Power Cable and Electrical Wire (Weather Resistant).
   3. W-C-596 1 through 212-Series. (Connectors).
   4. W-S-610 Splice Conductor
   5. HH-I-553 Electrical Insulation Tape (Rubber, Natural, and Synthetic).

6. HH-I-595 Electrical Plastic Insulation Tape, Pressure Sensitive Adhesive.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's data on electrical connections for equipment products and materials.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver electrical connection products wrapped in proper factory-fabricated type containers.

B. Store electrical connection products in original cartons and protect from weather, construction traffic and debris.

C. Handle electrical connection products carefully to prevent breakage, denting, and scoring finish.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of product):
1. AMP Incorporated.
2. Appleton Electric Company.
3. Arrow-Hart Div, Crouse-Hinds Company.
4. Bishop Div, General Signal Corporation.
5. Burndy Corporation.
6. General Electric Company.
7. Gould, Inc.
8. Harvey Hubbell Inc.
9. Ideal Industries, Inc.
10. Reliable Electric Company.
11. Square D Company
12. Thomas and Betts Corporation.

2.02 MATERIALS AND COMPONENTS

A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties,

solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

B. Metal Conduit, Tubing and Fittings:
   1. Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways. Provide products complying with Division - 16 BASIC ELECTRICAL MATERIALS and RACEWAYS section, and in accordance with the following listing of metal conduit, tubing and fittings:
      a. Rigid steel conduit.
      b. Rigid metal conduit fittings.
      c. Electrical metallic tubing.
      d. EMT fittings.
      e. Flexible metal conduit.
      f. Flexible metal conduit fittings.
      g. Liquid-tight flexible metal conduit.
      h. Liquid-tight flexible metal conduit fittings.

C. Wires, Cables, and Connectors:
   1. Provide wires, cables, and connectors complying with Division - 16 basic electrical materials and methods section "WIRES AND CABLES".
   2. Wires/Cables: Unless otherwise indicated, provided wires/cables (conductors) for electrical connections which match, including sizes and ratings, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20°C (68°F).
   3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals which are recommended by equipment manufacturer for intended applications.
   4. Electrical Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

PART 3 - EXECUTION

3.01 INSTALLATION OF ELECTRICAL CONNECTIONS:

A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Maintain existing electrical services and feeders to occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove, relocate, or abandon existing wiring as indicated.

E. Cover splices with electrical insulating material equivalent, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

F. Prepare cables and wires by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.

G. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL 486A.

I. Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.

J. Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subject to one or more of the following conditions:
   1. Exterior location.
   2. Moist or humid atmosphere where condensate can be expected to accumulate.
   3. Corrosive atmosphere.
   4. Water spray.
   5. Dripping oil, grease, or water.

K. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Division - 16 section ELECTRICAL IDENTIFICATION. Affix markers on each terminal conductor, as close as possible to the point of connection.

3.02 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

SECTION 16143

WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work included under this section of the specifications consists of the installation of wiring devices, i.e. switches and receptacles and device plates. All materials shall be provided under this section of the specifications.

B. Select devices from lists of acceptable devices contained in this section of the specifications.

C. The catalog numbers listed herein for switches and receptacles are for items with brown finish. Notwithstanding catalog numbers, the switches and receptacles provided on this project shall have Ivory finish unless otherwise indicated. All special purpose receptacles shall be provided in black finish.

1.03 QUALITY ASSURANCE

A. NEMA WD-1 General Purpose Wiring

B. NEMA WD-5 Specific Purpose Wiring Devices

PART 2 - PRODUCTS

2.01 SWITCHES

A. Select switches from the following:
   1. Single pole, 20 amp 277 volt switch: Arrow Hart 1991, Hubbell 1221, Leviton 53521, Pass & Seymour 20AC1.
   2. Threeway, 20 amp 277 volt switch: Arrow Hart 1993, Hubbell 1223, Leviton 53523, Pass & Seymour 20AC3.
   3. Weatherproof, 20 amp 277 volt switch: Arrow Hart 2991-2881G, Hubbell 1281-1750, Pass & Seymour 22515-4515.

4. Weatherproof, 20 amp 277 volt three way switch: Arrow Hart 2993/2881-G, Hubbell 1283-1750, Pass & Seymour 22535-4515.

2.02 RECEPTACLES

A. Select receptacles from those listed herein. Designation in parenthesis is NEMA configuration required.
   1. 15 amp, 125 volt grounded duplex receptacle (5-15R): Arrow Hart 5262, Hubbell 5262, Leviton 5262, Pass & Seymour 5262.
   2. 20 amp, 125 volt grounded duplex receptacle (5-20R): Arrow Hart 5739, Hubbell 5362, Leviton 5362.
   3. Ground Fault Interrupter (GFI) 15 amp, 125 volt duplex receptacle: Leviton 6194, Arrow Hart 1591, Hubbell GF-5262, Pass & Seymour 1591-F.
   4. Ground Fault Interrupter (GFI), 15 amp 125 volt duplex receptacle, through feed type: Arrow Hart 1591-F, Leviton 6399, Pass & Seymour 1591-F, Hubbell GF-5262.
   5. Transient Voltage Surge Suppression (TVSS) receptacles shall comply with ANSI/IEEE C62.41 and UL1449 (3rd Ed.) for categories A and B. Devices shall provide RFI and EMI noise filtration of not less than a 7:1 reduction. Devices shall suppress transients in each of 3 modes: Line-to-neutral, line-to-ground, and neutral-to-ground. Devices shall be provided with an LED for positive indication of failure of protective circuitry or audible alarm. Products complying with this specification manufactured by Arrow Hart, Hubbell, Leviton, or Pass and Seymour are acceptable.

2.03 DEVICE PLATES

A. Device plates shall be one piece single or multi-gang type selected to match the device or combination of devices. Device plates for flush mounted devices shall be Type 302 stainless steel unless indicated otherwise.
   1. Device plates for use with devices flush mounted in exposed masonry construction shall be jumbo type. Device plates for surface mounted devices shall be for use with the type of outlet box in which the device is mounted. All devices installed in areas exposed to the weather and where indicated on the drawings shall be provided with a weatherproof device plate.
   2. Where engraved device plates are indicated on the drawings or specified in Division 16, engraving shall be done by the device plate manufacturer. All lettering shall be 1/8" high and shall be black unless other contrasting color is specified.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. The mounting height of devices are indicated in the legend on the drawings and is intended to mean the bottom of the device above the finished floor unless otherwise indicated on the drawings. Where finished walls are exposed concrete block, brick or tile, the height shall be adjusted to allow outlet box for device to be mounted at a joint.

B. Review Architectural Drawings for any device requiring specific location. Install receptacles above countertops with major axis horizontal above the backsplash.

C. Mount all devices within outlet boxes to allow device plates to be in contact with wall on all sides. Align devices with major axis of device parallel to adjacent predominate building feature, i.e., doorframes or countertops.

D. Install wall switches on the strike side of doors.

SECTION 16170

CIRCUIT AND MOTOR DISCONNECTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This section covers disconnect switches for electrical equipment, 600V and below, and fuses mounted in the disconnect devices.

B. Furnish and install disconnect switches for any of the following conditions:
   1. Where indicated on the drawings.
   2. For all motors located out-of-sight of its motor controller.
   3. For water heaters.
   4. Where required by the National Electrical Code.

1.03 QUALITY ASSURANCE

A. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this Specification by reference.
   1. Underwriters' Laboratories, Inc. (UL) Publications:
      a. No. 98: Enclosed Switches
      b. No. 198.2: High-Interrupting Capacity Fuses, Current Limiting Type
      c. No. 198.4: Class R fuses
   2. National Fire Protection Association (NFPA) Publications:
      a. No. 70: National Electrical Code (NEC)
   3. National Electrical Manufacturers Association (NEMA) Publications:
      a. No. KS 1: Enclosed Switches
   4. Federal Specification (Fed Spec):
      a. No. WS-865-C

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable:
   1. General Electric
   2. Eaton
   3. Square D

C. Coordination: Coordinate installations with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure disconnect switch access and insure that clearance minimums are provided.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

A. Furnish all materials specified herein.

B. All disconnects and fuses shall be UL listed and bear a UL label.

C. Fuses shall be heavy duty, type HD horsepower rated as required for motor load served.

D. Switches shall be 600 volt rated, except for use in system below 240 volt, when they may be 250 volt rated. Switches shall be heavy duty rated. General duty switches are not acceptable.

E. Furnish a solid neutral for each switch being installed in a circuit which includes a neutral conductor.

F. Furnish an equipment grounding conductor lug bonded to the switch enclosure.

G. Disconnect switches shall be non-fusible safety switch, unless fused type is specified or indicated on the drawings, with the number of poles required to disconnect all ungrounded conductors serving equipment.

H. Enclosure shall be NEMA Type One in all interior dry locations and shall be NEMA Type 4X stainless steel in all damp, wet, or exterior locations, unless other type is indicated on the drawings or specified herein.

2.02 PRODUCT/MATERIAL DESCRIPTION

A. Switching mechanism shall be quick-make, quick-break type.

B. Where non-fused disconnect switches are indicated on the drawings or specified for use as disconnects, they shall be the non-fused type.

C. Switches shall have the following features:
   1. Provide line terminal shields in all switches.
   2. Each switch shall have provisions for padlocking in the "OFF" position.
   3. Each switch shall have door interlocks to prevent door from being opened when switch is in closed position. Provide inconspicuous means to defeat interlock mechanism.

4. Provide permanent nameplate indicating switch rating in voltage, amperes and horsepower.
5. Arch chute for each pole.

D. Disconnect switches for three phase motors rated two horsepower and above shall be three pole nonfusible type rated as indicated on the drawings. Disconnect switches for three phase motors rated below two horsepower shall be three pole manual motor starter switches without overload protection. Disconnect for single phase motors shall be single or two pole horsepower rated switches without overload protection.

E. Fusible switches through 600 amp shall be provided with rejection clips to accept RK1 or RK5 class fuses only. Fusible switches larger than 600 amp shall be suitable for class L fuses. Furnish and install a complete set of fuses in each disconnect sized as indicated on the drawings. Fuses serving predominantly motor or transformer loads shall be dual-element, time delay type, otherwise non-time delay fast acting type is required. Fuses shall be current limiting with 200,000 AIC.

F. Disconnect switches for motors controlled by variable frequency drives shall be equipped with a normally open auxillary contact. The auxillary contact shall be wired into the control voltage stop/start circuit on the drive. The auxillary contact shall be early break, so that the start stop circuit drops out before the disconnect power circuit opens, and late make so that the disconnect power circuit closes before the start circuit on the drive is closed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Locate disconnect switches to maintain line of sight and to provide working clearance and full accessibility as required by the National Electrical Code.

B. Unless indicated otherwise on the drawings, locate disconnects adjacent to equipment served.

C. Lace and group conductors installed in disconnect with nylon tie straps. Only one conductor shall be installed under terminals. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond 1/8" from terminal lug.

D. Mounting and Support
1. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5" minimum diameter round washer shall be used between head of screw or bolt and enclosure.
2. Mounting

a. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.
b. Attach enclosure directly to masonry, concrete, or wood surfaces.
c. Mount enclosure on metal channel (strut), which is connected to structure with fastening device specified, for installations on steel structure, sheet metal equipment enclosure, or sheet rock walls.
d. Where enclosure is not indicated on a wall or structure, construct a metal channel (strut) free standing frame secured to floor, pad, or other appropriate building structure. Refer to the detail on the drawing for frame installation and construction information.
e. Mount switch with handle between 36" and 60" above floor or grade, unless otherwise indicated on the drawings.

E. Do not splice conductors in enclosure. Where required, install junction box or wireway adjacent to disconnect and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the WIRES AND CABLES section of the specifications and do not exceed.

F. Conductors not terminating in disconnect shall not extend through or enter disconnect enclosure.

G. Install push-in knock-out closure plugs in any unused knock-out openings.

H. Identification
1. Disconnect switches shall be identified.
2. Refer to the ELECTRICAL IDENTIFICATION section of the specifications for identification requirements.

3.02 CLEANING AND ADJUSTMENT

A. After completion, clean the interior and exterior of dirt, paint and construction debris.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

SECTION 16190

SUPPORTING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Extent of supports, anchors, sleeves and seals is indicated by drawings and schedules and/or specified in other Division - 16 sections.

B. Types of supports, anchors, sleeves and seals specified in this section include the following:
   1. Clevis hangers.
   2. Riser clamps.
   3. C-clamps.
   4. I-beam clamps.
   5. One-hole conduit straps.
   6. Two-hole conduit straps.
   7. Round steel rods.
   8. Expansion anchors.
   9. Toggle bolts.
   10. Wall and floor seals.

C. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment are specified as part of that equipment assembly in other Division - 16 sections.

D. For exterior locations, provide stainless seel supports, anchors and straps.

E. Provide seismic support for electrical equipment as required by IBC and Authority Having Jurisdiction.

1.03 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of electrical supporting devices.

B. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.

C. UL Compliance: Provide electrical components which are UL-listed and labeled.

D. FS Compliance: Comply with Federal Specification FF-S-760 pertaining to retaining straps for conduit, pipe and cable.

PART 2 - PRODUCTS

2.01 MANUFACTURED SUPPORTING DEVICES

A. General: Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Installer's option.

B. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:

1. Clevis Hangers: For supporting 2" rigid metal conduit; galvanized steel; with 1/2" diameter hole for round steel rod; approximately 54 lbs. per 100 units.
2. Riser Clamps: For supporting 5" rigid metal conduit; black steel; with 2 bolts and nuts, and 4" ears; approximately 510 lbs. per 100 units.
3. Reducing Couplings: Steel rod reducing coupling, 1/2" x 5/8"; black steel; approximately 16 lbs. per 100 units.
4. C-Clamps: Black malleable iron; 1/2" rod size; approximately 70 lbs. per 100 units.
5. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approximately 52 lbs. per 100 units.
6. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 lbs. per 100 units.
7. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
8. Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 lbs. per 100 units.
9. Round Steel Rod: Black steel; 1/2" diameter; approximately 67 lbs. per 100 feet.
10. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 lbs. per 100 units.
11. Provide stainless steel supporting devices for exterior locations and where specified.

C. Anchors: Provide anchors of types, sizes and materials indicated, with the following construction features:
   1. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 lbs. per 100 units.
   2. Expansion sleeve anchors by Hilti or Phillips Redhead: 1/2"; approximately 38 lbs. per 100 units.
   3. Manufacturers: Subject to compliance with requirements, provide anchors of one of the following:
      a. Ackerman Johnson Fastening Systems Inc.
      b. Hilti
      c. Ideal Industries, Inc.
      d. Joslyn Mfg and Supply Company
      e. McGraw Edison Company
      f. Phillips Redhead
      g. Rawlplug Company Inc.

D. Sleeves and Seals: Provide sleeves and seals, of types, sizes and materials indicated, with the following construction features:
   1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

E. U-Channel Strut Systems:
   1. Provide U-channel strut system for supporting electrical equipment, 12-gage hot-dip galvanized steel, of types and sizes indicated; construct with 9/16" diameter holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel.
      a. Fixture hangers.
      b. Channel hangers.
      c. End caps.
      d. Beam clamps.
      e. Wiring studs.
      f. Thinwall conduit clamps.
      g. Rigid conduit clamps.
      h. Conduit hangers.
      i. U-bolts.
   2. Manufacturers: Subject to compliance with requirements, provide channel systems of one of the following:
      a. Allied Tube and Conduit Corporation.
      b. B-Line Systems, Inc.
      c. Elcen Metal Products Company.
      d. Greenfield Mfg Company, Inc.
      e. Midland-Ross Corporation.
      f. OZ/Gedney Div; General Signal Corporation.
      g. Power-Strut Div; Van Huffel Tube Corporation.

h. Unistrut Div; GTE Products Corporation.

3. Provide stainless steel channel for exterior locations and where specified.

2.02 FABRICATED SUPPORTING DEVICES

A. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal: 3" and smaller, 20-gage; 4" to 6", 16-gage; over 6", 14" gage.
2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
3. Iron Pipe: Fabricate from cast-iron or ductile-iron pipe.
4. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

B. Sleeve Seals: Provide modular mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports in compliance with NEC requirements.

D. Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.

E. Remove burrs from ends of pipe sleeves.

SECTION 16195

ELECTRICAL IDENTIFICAITON

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Extent of electrical identification work is as outlined by this specification.

B. Types of electrical identification work specified in this section include the following:
   1. Buried conduit warnings.
   2. Electrical power, control and communication conductors.
   3. Operational instructions and warnings.
   4. Danger signs.
   5. Equipment/system identification signs.

C. Refer to Division 1 General Requirements section IDENTIFICATION SYSTEMS, for equipment and system nameplates, and performance data; not work of this section.

1.03 QUALITY ASSURANCE

A. NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.

B. UL Compliance: Comply with applicable requirements of UL Std 969, "Marking and Labeling Systems", pertaining to electrical identification systems.

C. ANSI Compliance: Comply with applicable requirements of ANSI Std A13.1, "Scheme for the Identification of Piping Systems".

D. NEMA Compliance: Comply with applicable requirements of NEMA Std No's WC-1 and WC-2 pertaining to identification of power and control conductors.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical identification materials and products.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide electrical identification products of one of the following (for each type marker):
   1. Almetek
   2. Brady, W.H. Company
   3. Calpico Inc.
   4. Cole-Flex Corporation
   5. Direct Safety Company
   6. George-Ingraham Corporation
   7. Griffolyn Company
   8. Ideal Industries, Inc.
   9. LEM Products, Inc.
   10. Markal Company
   11. National Band and Tag Company
   12. Panduit Corporation
   13. Seton Name Plate Company
   14. Tesa Corporation

2.02 ELECTRICAL IDENTIFICATION MATERIALS

A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

B. Color-Coded Plastic Tape:
   1. Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2" wide.
      a. Colors: Unless otherwise indicated or required by governing regulations, provide orange tape.

C. Underground-Type Plastic Line Marker:
   1. Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick.

Provide detectable type tape with printing which most accurately indicates type of service of buried cable.

D. Cable/Conductor Identification Bands:
   1. Provide manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers of wrap-around type, either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification.

E. Plasticized Tags:
   1. Manufacturer's standard pre-printed or partially pre-printed accident-prevention and operational tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording, e.g., DANGER, CAUTION, DO NOT OPERATE.

F. Self-Adhesive Plastic Signs:
   1. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.
   2. Colors: Unless otherwise indicated, or required by governing regulations, provide white signs with black lettering.

G. Baked Enamel Danger Signs:
   1. General: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gage steel; of standard red, black and white graphics; 14" x 10" size except where 10" x 7" is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.

H. Engraved Plastic-Laminate Signs:
   1. Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
   2. Thickness: 1/8", except as otherwise indicated.
   3. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.03 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled.

Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

A. General Installation Requirements:
   1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NEC and OSHA.
   2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
   3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Conduit Identification:
   1. Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by color-coded method, apply color-coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated, use white as coded color for conduit.

C. Box Identification:
   1. After completion, using an indelible wide tip marker, indicate on the cover of each junction and pull box the designation of the circuits contained therein, i.e., A-1, 3, 5. Use a black marker for normal power circuits and a red marker for emergency circuits.

D. Underground Conduit Identification:
   1. During back-filling/top-soiling of each exterior underground electrical, signal or communication conduit, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.
   2. Install line marker for every buried conduit.

E. Cable/Conductor Identification:
   1. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification

for project's electrical work. Refer to WIRES AND CABLES section of these specifications for color coding requirements.

F. Operational Identification and Warnings:
   1. Wherever required by OSHA or directed by the Owner, to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities equipment by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

G. Danger Signs:
   1. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work or the Owner as constituting similar dangers for persons in or about project.
      a. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.
      b. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

H. Equipment/System Identification:
   1. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/-control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering, on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
      a. Panelboards, electrical cabinets and enclosures.
      b. Access panel/doors to electrical facilities.
      c. Major electrical switchgear.
      d. Motor control centers.
      e. Power transfer equipment.
      f. Transformers.
      g. Power generating units.
      h. Automatic transfer switch.
   2. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and

maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate. Identification of flush mounted cabinets and panelboards shall be on the inside of the device.

3. Panelboards, individually mounted circuit breakers, and each feeder breaker in the distribution panels or motor control centers and each cubicle of the motor control center shall be identified with an engraved plastic laminate sign. Plastic nameplates shall be multicolored laminated plastic with faceplate and core as scheduled. Lettering shall be engraved minimum 1/4" high letters.
   a. 480/277 volt normal power equipment shall be identified with white faceplate with black core.
   b. 480/277 volt emergency power equipment shall be identified with white faceplate with red core.
   c. 208/120 volt normal power equipment shall be identified with black faceplate with white core.
   d. 208/120 volt essential power equipment shall be identified with red faceplate with white core.
   e. Equipment identification is to indicate the following:
      1) Equipment ID abbreviation.
      2) Voltage, phase, wires and frequency.
      3) Emergency or other system.
      4) Power source origination. Example:
         a) Panel E3HA
         b) 480/277V, 3 phase, 4 wire
         c) Emergency System
         d) Fed by SWBD-7
   f. Submit complete schedule with the shop drawings listing all nameplates and information contained thereon.

SECTION 16210

ENGINE DRIVEN EMERGENCY POWER SUPPLY SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of one owner furnished generator, the relocation of an existing generator, the purchase and installation of paralleling switchgear, controls and an automatic transfer switch with isolation bypass; to provide a complete engine driven emergency power supply system. All materials and devices which are an integral part of this system shall be provided under this section of the specifications.

B. Definition: The Emergency Power Supply System (EPSS) shall consist of one or more engine driven generator sets, each of which contains an engine directly coupled to an electric generator, together with the necessary switchgear, controls, accessories, transfer devices and fuel supply to provide electric power for the duration of any failure of the normal power supply.
   1. Automatic Transfer Switch (ATS): An automatic transfer switch is self-acting equipment for transferring one or more load conductor connections from one power source to another.

C. Contact John Carper, Cummins Power South, (912) 721-3028.

1.03 QUALITY ASSURANCE

A. The following specifications and standards are incorporated into and become a part of this specification by reference.
   1. National Fire Protection Association (NFPA):
      a. NFPA-37 Combustion Engines
      b. NFPA-70 National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701 and 702,
      c. NFPA-110 Emergency and Stand-By Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.
   2. Electrical Generating Systems Association (EGSA) Standards:

a. EGSA CEP2 Codes for Emergency Power by States and Major Cities
b. EGSA GTD3 Glossary of Standard Industry Terminology and Definitions
c. EGSA ECB1 Performance Standard for Engine Cranking Batteries
d. EGSA TSS1 Performance Standard for Transfer Switches for use with Engine Generator Sets
e. EGSA BCES1 Performance Standard for Battery Chargers
f. EGSA ICAE1 Performance Standard for Electric Generator Set Instrument Control and Auxiliary Equipment

3. Institute of Electrical and Electronics Engineers (IEEE) Standards:
   a. IEEE 446 IEEE Recommended Practices for Emergency and Standby Power Systems for commercial and industrial applications.
   b. IEEE 472 Voltage Surge Withstand Capabilities
4. National Electric Manufacturers Association (NEMA) Standards:
   a. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
   b. ICS1-109 Test and Test Procedures for Automatic Transfer Switches
   c. ICS 10-2005 Part 1 A.C. Automatic Transfer Switch
5. Underwriters Laboratories Inc. (UL) Publications:
   a. UL 1008 Automatic and Non-Automatic Transfer Switches
   b. UL508. The entire control system of the generator set shall be UL 508 listed and labeled.
   c. UL142 – Sub-base Tanks
   d. UL 1236 – Battery Chargers
   e. UL2200 – The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.
6. American National Standards Institute (ANSI):
   a. C37.90a Voltage Surge Withstand Capability
7. The control system for the generator set shall comply with the following requirements.
   a. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
   b. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements Part 2: Industrial
   c. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
   d. FCC Part 15, Subpart B.
   e. IEC8528 part 4. Control Systems for Generator Sets
   f. IEC Std 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions.
8. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation and service, in accordance with ISO 9001.

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable:
   1. Engine Driven Generator Sets:
      a. Cummins/Onan: No Substitutions
   2. Automatic Transfer Switches:
      a. Cummins/Onan: No Substitutions
   3. Sub-Base Fuel Tanks:
      a. Pryco
      b. Simplex
      c. JRS
      d. Globel
   4. Paralleling Switchgear & Controller
      a. Cummins Power Systems: no substitutions.
   5. Provide aluminum work/service platform for the generator, it shall extend down both sides of the generator and across the end opposite the radiator exhaust. The platform shall have a structural aluminum frame, aluminum grating and aluminum hand rails. It shall be 4' wide throughout and the elevation shall be equal to the top of the fuel tank. Provide aluminum steps at the center aisle (between the generators) toward the service road, provide handrails on the steps. Provide a concrete foundation for the work platform and steps.

C. Equipment Dimensions:
   1. Dimensions indicated on the drawings are maximum allowable and shall not be exceeded. Where equipment of acceptable manufacturers listed exceeds the maximum dimensions, products of such manufacturers shall not be acceptable.

D. Coordination:
   1. Review shop drawings submitted under this and other sections, as well as other divisions, to insure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications, and electrical equipment to insure access and clearance minimums are provided..

1.04 SUBMITTALS

A. Refer to the SHOP DRAWINGS, PRODUCT DATA AND SAMPLES Section for required procedures.

B. Manufacturer's Product Data:
   1. Submit material specifications and installations data for products specified under Part 2 - Products to include:
      a. Engine driven generator sets
      b. Sub-base fuel tanks

c. Transfer switches

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings. Submittals containing less than the information listed below will be rejected.

1. Shop drawings for the engine driven generator sets shall contain not less than the information listed as follows:
   a. Certification that the engine driven generator set(s) furnished will serve electrical loads indicated including motor starting loads with type(s) of starting indicated.
   b. Stand-by rating of engine driven generator set(s) including voltage and phase.
   c. Frequency and voltage regulation with maximum voltage dip and time of recovery to stable operation.
   d. Output voltage adjustment range in percentage of rated plant voltage.
   e. Alternator type and method of connection to prime mover.
   f. Components contained in alternator instrument panel.
   g. Rating of engine at operating speed, engine cycle and number of cylinders.
   h. Type of engine lubrication system and verification of components specified.
   i. Type of engine governor.
   j. Components contained in engine instrument panel.
   k. Fuel consumption at ¼, ½, ¾ and full load.
   l. Starting batteries including ampere hour rating.
   m. Verification that all accessories specified is to be provided. This includes cold weather starting aid with rating and voltage indicated, exhaust system with muffler type indicated, and outdoor housing (where applicable) with verification of space available within housing for batteries.
   n. Line and machinery constants of the generator furnished.
   o. Terminal board connection diagram where reconnectable generators are specified.
   p. Circuit breaker type, rating, A.I.C. rating and cable capacity of lugs.
   q. Paralleling Switchgear
2. Shop drawings for the transfer switch shall contain not less than the information listed as follows:
   a. List of accessories contained in the control panel.
   b. Withstand rating in RMS symmetrical amperes.
   c. Dimensions and access requirements.

D. Quality and Service:

1. All materials and parts of the EPSS shall be new and unused. Each component shall be of current manufacture from a firm regularly engaged in the production of such equipment. Units and components offered under these specifications shall be covered by the manufacturer's parts and labor warranty

for a minimum of five (5) years from date of Owner acceptance of the project on a new machine, a copy of which shall be included in the shop drawings submittal.

2. Submittals will be accepted only on engine driven generator sets and transfer switches which can be properly maintained and serviced without requiring the Owner to stock spare parts or wait longer than twenty-four hours for service. Submittals shall include the nearest location of permanent parts outlet from which parts may be obtained and written assurance that trained service personnel will be available on twenty-four hour's notice. Units with service centers more than 75 miles from project site will not be accepted.

E. Record Drawings

1. Include in each set three sets of operating, maintenance, and parts manuals covering all components for the EPSS. Provide instructions to the Owner in operation and maintenance of his equipment, both in written form and with on-site personnel for a minimum of six hours.

PART 2 - PRODUCTS

2.01 ENGINE DRIVEN EMERGENCY POWER SUPPLY (EPS)

A. Engine

1. The engine driven emergency power supply (EPS) shall be an internal combustion diesel driven prime mover. The generator set shall have the following characteristics:
   a. 1500 KW Capacity (two in parallel)
   b. 1875 KVA Capacity (two in parallel)
   c. 480/277 Volts
   d. 60 Hertz
   e. 0.8 Power Factor
   f. 3 Phase
   g. 4 Wire
2. Maximum one-step load at 0.8 P.F. is 255.1 KW (step 1). The load to be served by this generator set consists of 566.9 KVA non-inductive load plus 1205 total motor horsepower. The motors shall be started as shown in the following table:

Sequence	Horse Power/KW/KVA	Code Letter	Starting Method
a. Initial Load			
Panel HPE	96.2 KVA	NA	NA
Panel HA	239.9 KVA	NA	NA
Panel B	3.8 KVA	NA	NA
Control Bldg	122.0 KVA	NA	NA
Belt Press Bldg	105.0 KVA	NA	NA
b. Influent Pump No. 1	140 HP	B	VFD
c. Influent Pump No. 2	140 HP	B	VFD

d. Digester Blower No. 1	125 HP	B	VFD
SBR Mixer No. 1	60 HP	B	RVSS
e. SBR Blower No. 1	125 HP	B	VFD
SBR Mixer No. 2	60 HP	B	RVSS
f. SBR Blower No. 2	125 HP	B	VFD
Digester Sludge Pump	40 HP	B	RVSS
g. SBR Blower No. 3	125 HP	B	VFD
h. SBR Blower No. 4	125 HP	B	VFD
i. Digester Mixer No. 1	100 HP	B	RVSS
j. Future Reuse Pump	50 HP	B	VFD
SBR Sludge Pump 1-2	10 HP X 2	B	RVSS

3. Provide load shed controls in plant SCADA system to match loading shown. In event of one generator out of service, SCADA system shall monitor load to not overload system.
4. The rated net horsepower of the engine at the generator synchronous speed, with all accessories, shall not be less than that required to produce the KW specified in paragraph 1 above. The horsepower rating shall take into account generator efficiency and all accessory losses such as fans, battery charger, etc. The generator set shall be capable of producing the specified KW (without overload) for the duration of the power outage, under the following ambient conditions:
   a. Altitude: 10 feet above mean sea level.
   b. Air temperature at engine intake: 104 degrees F.
   c. Humidity Range: 40 - 95%.
5. Included with the shop drawing submittal shall be the manufacturer's estimate of supply fuel and oil consumption for each engine. Each engine shall have an oil filter with replaceable elements, a lube oil cooler, and an oil reservoir.
6. The engine shall be equipped with a suitable governor (engine speed control) to maintain frequency within limit specified below by controlling engine and generator speed. Manufacturer shall indicate in submittal data whether mechanical, hydraulic, electrical, or hybrid governors are provided.
   a. Type: Isochronous
   b. Stability: + ¼% maximum steady state frequency variation at any constant load from no load to full load.
   c. Regulation: 5% maximum frequency deviation between no-load steady state and full load steady state.
7. The engine shall be electric start, provided with a solenoid energized motor with either positive engagement or clutch drive to the engine.
8. The engine starting batteries shall be sealed lead-acid recombination type. Batteries shall be rack mounted inside the weatherproof plant housing to minimize the distance from the batteries to the starter. Provide battery straps and battery heater.

9. A float type battery charger, compatible with the batteries selected, shall be furnished at the engine which shall maintain the starting batteries at full charge.
10. It shall have an equalize rate and a float rate charging system. An ammeter and voltmeter shall indicate the charge rate and the circuit shall be protected by either fuses or circuit breakers. The charger or charging circuit shall be so designed that it will not be damaged during the engine cranking cycle, for example, by a current limiting charger or a crank disconnect relay. It shall also be capable of recharging a discharged battery in 12 hours while carrying normal loads. The charger shall be equipped with alarm relays as required for remote annunciation equipment.
11. The engine shall be liquid cooled. The type of liquid cooling system shall be unit mounted radiator - consideration shall be given for air temperature rise across the engine in addition to ambient. Minimum capacity shall be rated for 104°F. minimum engine ambient temperature plus air temperature rise across the engine.
    a. Provide two electric heaters, thermostatically controlled, in the engine coolant system as a cold weather starting aid. Heater shall be for operation on 120 volt single phase A.C. for 2500 watt units and below and on 208/240 volt single phase A.C. for all other units and shall be permanently connected to a circuit from the building electrical system. Heater shall maintain 70°F. to 90°F. Provide isolation valves or quick connect couplings for jacket water heaters.
12. Air Supply/Exhaust System
    a. Cleaner: An air cleaner and silencer shall be furnished, located and mounted as recommended by the engine manufacturer.
    b. Exhaust: An exhaust system of suitable size, configuration, and material in accordance with engine manufacturer's recommendations shall connect the exhaust outlet of the engine to a silencer. The type of silencer shall meet the requirements of engine manufacturers and shall be industrial. The silencer shall be located inside outdoor enclosure.
    c. The exhaust system including silencer shall be of such size that back pressure on the system will not exceed the back pressure permitted by the engine manufacturer's recommendation. A flexible connection shall be mounted at the engine exhaust outlet and the discharge end shall be protected against entry of precipitation. For piping rising up through the roof, provide condensation drip leg with valve at pipe elbow. Piping and silencer within reach of personnel or with 8'-0" of finished floor or grade shall be protected by screening and shall be insulated with two inches of calcium silicate insulation with aluminum jacket. All exhaust piping shall be gas tight.
13. The engine instrument panel shall be mounted at the engine and shall contain the following:
    a. Oil pressure gauge to indicate lubricating oil pressure.
    b. Temperature gauge to indicate cooling medium temperature.

c. Hour meter to indicate total actual running time.
d. Battery charging meter to indicate satisfactory performance of battery charging means.
e. Other instruments as recommended by the manufacturer for proper maintenance.
f. Manual stop/start controls: All instruments, controls, and indicating lights shall be properly identified. All wires shall be individually identified and must agree with the wiring diagram provided. All wiring shall be harnessed or flexibly enclosed. Terminals on all terminal blocks shall be individually identified.

B. Generator
1. The generator shall be an engine-driven single or two bearings type, synchronous, brushless, and conforming to applicable standards. It shall be connected to the engine flywheel by means of a flexible type coupling for single bearing generators and elastic coupling for two bearing generators.
2. The generator shall be rated for 40°C ambient. Class of insulation shall be NEMA Class F. The voltage regulation shall be plus or minus 2% from no load to full load with plus or minus 5% speed change and a 15°C. rise in ambient. The generator voltage dip from no load to full load shall not exceed 22%.
3. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.
4. Provide 120 volt condensation heater in windings.

C. Voltage Regulation
1. The generator shall be equipped with a volts-per-hertz type voltage regulator to maintain voltage within limits specified below:
a. Stability: ½ % maximum voltage variation at any constant load from no load to full load.
b. Regulation: 4 % maximum voltage deviation between no load steady state and full load steady state.
c. Transient: 30 % voltage dip or overshoot on one-step application or removal of 0.8 power factor full load.

D. Generator Full Main Line Adjustable Circuit Breaker
1. A main line adjustable electronic circuit breaker with ground fault shall be supplied to protect the generator and controls from overloads and/or short circuits in the load. It shall be rated as indicated on the drawings. Breakers shall comply with UL 489 and NEMA AB-3. Breaker shall be rated at 2500 Amps with adjustable settings set at 1600 Amps.

E. Start and Stop Controls

1. Automatic starting and stopping controls shall be furnished to start the engine automatically when the normal electrical power fails or falls below specific limits and to stop the engine automatically after the normal power supply resumes. The signal for starting or stopping the engine shall be sensed through an auxiliary contact in the existing automatic transfer switch. The controls shall be capable of operating at 50% of normal DC system supplied voltage.
2. The cranking cycle shall be initiated by manual start, loss of normal power at the existing transfer switch, clock exerciser, or the manually operated test switch at existing ATS.
3. Crank control and the time delay relays shall provide a minimum of 4 crank attempts of at least 7 seconds each, separated by appropriate rest periods. A sensing device shall automatically disconnect the starting circuit when the engine has started. If the engine has not started at the completion of the starting program, the overcrank signal shall indicate. The engine starting controls shall be locked out and no further starting attempts shall take place until the overcranking device has been manually reset.
4. A selector switch shall be incorporated in the automatic engine start and stop controls. It shall include an "off" position that prevents manual or automatic starting of the engine; a "manual" position that permits the engine to be started manually by the pushbutton on the control cabinet and run unloaded; an "automatic" position that readies the system for automatic start or stop on demand or the automatic load transfer switches or of the programmed exerciser.
5. A remote manual stop station similar to a break-glass station shall be provided at the new generator and existing transfer switch and shall be tied into the engine controls to stop the engine when activated. Provide laminated plastic label with 1/4" minimum engraved letters to read "EMERGENCY GENERATOR SHUTDOWN". Background to be red and core to be white.

F. Instrumentation
1. Remote and local engine control and safety panels shall be provided, containing the following:
   a. Automatic remote start capability.
   b. "Manual-Off-Auto" switch.
   c. Controls to shut down and lock out the prime mover under the following conditions: failure to start after specified cranking time, overspeed, low lubricating oil pressure, high engine temperature and operation of remote manual stop station.

   d. Battery powered individual alarm indication to annunciate visually at the control and safety panel the occurrence of any condition itemized below; contacts or circuits for a common audible alarm signaling locally and remotely the occurrence of any itemized conditions listed below. Test switch shall be provided to test the operation of all lamps. Remote panel may be silenced in similar fashion to fire alarm control panel.

1) Indicator Function, Level 1 (At Battery Voltage):

	Control Panel Mounted Visual Indication	Shutdown of EPS	Remote Audible
a) Overcrank	X	X	X
b) Low Water Temp. < 70°F (21°C)	X		X
c) High Engine Temp. Pre-alarm	X		X
d) High Engine Temp.	X	X	X
e) Low Lube Oil Pressure Pre-alarm	X		X
f) Low Lube Oil Pressure	X	X	X
g) Overspeed	X	X	X
h) Low Fuel Main Tank	X		X
i) EPS Supplying Load	X		X
j) Control Switch Not In Auto Pos.	X		X
k) Battery Charger Malfunctioning	X		X
l) Low Voltage in Battery	X		X
m) Lamp Test	X		
n) Contacts for Local & Remote			
o) Common Alarm	X		X
p) Audible Alarm Silencing Switch			X
q) Remote Emergency Stop	X	X	X
r) Ground Fault Indication (400KW and greater)	X		X
s) Fuel in containment	X		X

2) Controls to shutdown the prime mover upon removal of initiating signal or manual emergency shutdown.
3) A.C. voltmeter with selector switch off position and positions for phase to phase and phase to neutral.
4) A.C. ammeter with selector switch with positions for each phase.
5) Frequency meter -- digital electronic type.
6) Voltage adjusting to allow plus or minus 5% voltage adjustment.
7) Manual reset circuit breaker.

8) Manual stop/start control.
9) Elapsed time meter.
10) Panel lights.
11) Indicator lights for signals from engine instrument panel.
12) Light to indicate switch has been left in the "off" position.
13) Light to indicate remote start.
14) Provide surface remote annunciator where shown on the drawings.

2. All instruments, controls, and indicating lights shall be properly identified. All wires shall be individually identified and must agree with the wiring diagram provided. All wiring shall be harnessed or flexibly enclosed. Terminals on all terminal blocks shall be individually identified. All instrumentation must be isolated from engine generator set vibration.

G. Enclosures and Connections:

1. All electrical enclosures, i.e., terminal cabinets, wire ways, circuit breaker enclosures, etc., shall be of adequate size to provide minimum bending radius as required by the NEC and measured from the terminals directly to the opposite wall of the enclosure, for the size conductor actually terminated within or passing through the enclosure.
2. All factory provided enclosures shall have gasket and finish appropriate for the environment in which the unit is to be mounted. All wiring, wiring harness, etc., shall be protected from the elements, such as direct sunlight, moisture, etc. or shall be UL listed for direct exposure to the applicable elements. Include written documentation of the above with the shop drawing submittal.

H. Provide flexible fuel connections at supply at return piping. Flexible hoses shall be steel reinforced type. Provide solenoid valve in series with gate valve in supply line. Solenoid valve shall be powered from generator batteries and shall be open only when generator is running.

I. Provide a 80 amp, 2 pole, 208 volt main breaker, single phase, three wire panel board mounted in generator enclosure attached to generator frame. Panel board shall include equipment ground bar and circuit breakers required for generator control circuits and weather starting aids etc. Quantity of breakers shall be determined by generator manufacturer with 25% spare breakers included. Service voltage – 208/120 volts, 1-phase 3-wire.

2.02 TRANSFER SWITCH(ES)

A. Transfer switch(es) shall be rated at not less than as indicated on the drawings at rated voltage. Transfer switch(es) shall be rated and marked for total system load.

B. Transfer switch(es) serving 480V three phase four wire loads shall be four poles with a switched neutral. Neutral contacts must be on the same shaft as the associated main contacts and have the same continuous current rating and withstand current rating. Neutral contacts shall break last and make first.

C. Transfer switch(es) shall be automatic, open-transition type.

D. Transfer switch(es) shall be floor mounted in a NEMA one enclosure. Enclosure shall have hinged door with three point latching and factory installed key locking enclosure.

E. Installation shall be for front and rear accessibility for all components as well as load, normal and emergency power terminals up to and including 4000 amp switch size. Where transfer switch power connections are made to busway or switchboard bus connections shall be made with bus; otherwise connections shall be with 90°C insulated cables. Transfer switch shall be installed in separate compartment, isolated from other electrical equipment by metal barriers. Control panel containing transfer switch control components shall be on compartment door. All control wiring between control panel and transfer switch shall be installed and tested for compliance with operational requirements prior to shipment. The interconnecting wiring harness shall include a disconnect plug to disconnect all wires including both sources of control power for routine maintenance.

F. Operation shall be inherently double-throw whereby all contacts move simultaneously. Electrical spacing shall be equal to or exceed those listed on Table 15.1 of UL-1008. Only those main contact structures specifically designed for transfer switch service shall be acceptable. An overload or short circuit shall not cause the switch to go to a neutral position. A manual operating handle shall be provided. All main contacts shall be silver alloy type protected by arc quenchers and, for switches rated 600 amps and larger, by arching contacts. Operating transfer time shall be 1/10 second or less on switches rated 600 amps and above.

G. All switch and contacts, coils, springs and control elements shall be removable from the front of the transfer switch without removal of the switch panel from the enclosure and without disconnecting power conductors or drive linkages. Control and sensing relays shall be continuous duty industrial type with minimum contact rating of ten amps.

H. Transfer switch shall be rated to withstand in RMS symmetrical amperes not less than the available symmetrical RMS amperes when protected by the circuit protective device on the line side of the transfer switch. Withstand rating of switch shall be based on switch contacts not welding under fault conditions. Provide switch with current limiting fuses to increase current withstand rating when switch is not rated for fault duty.

I. The control panel for each automatic transfer switch shall contain the following accessories:
   1. Adjustable 0.5 to 6 second time delay on starting of EPS to override momentary power dips and interruptions of the normal services. Time delay shall be factory set at 1 second.
   2. Time delay on transfer to emergency adjustable from 0 to 60 seconds, factory set at 0 seconds.

3. Test switch on enclosure door to simulate failure of the normal power source. ATS shall transfer load to the EPS.
4. Push button to bypass time delay on re-transfer to normal.
5. Close differential voltage sensing shall be provided on all phases of the normal power supply. The pickup voltage shall be adjustable from 85% to 100% of nominal and the dropout voltage shall be adjustable from 75% to 98% of the pickup value. The transfer to emergency will be initiated upon reduction of normal source to 85% of nominal voltage and re-transfer to normal shall occur when normal source restores to 95% of nominal.
6. Independent single phase voltage and frequency sensing of the emergency source. The pickup voltage shall be adjustable from 85% to 100% of nominal. Transfer to emergency upon normal source failure when emergency source voltage is 90% or more of nominal and frequency is 95% or more of nominal.
7. A time delay on re-transfer to normal source. The time delay shall be automatically bypassed if the emergency source fails and normal source is available. The time delay shall be field adjustable from 0 to 25 minutes and factory set at 15 minutes.
8. An unloaded running time delay for emergency generator cool-down, factory set at 5 minutes.
9. Pilot light for indicating switch in normal position (includes fuses and auxiliary contact).
10. Pilot light for indicating switch in emergency position (includes fuses and auxiliary contact).
11. An exerciser for exercising standby power plant on a weekly basis shall be provided in the transfer switch. Exerciser shall be set to exercise standby plant for one half hour per week under load. Time of plant exercise shall be set in field. Exerciser timer shall have reserve power back-up, either by battery or spring-wound clock, to ride through power outages to the switch.
12. Provide adjustable timed intermediate position in both directions.
13. Auxiliary contact (gold plated) which closes when normal source fails. (Closed after override delay of 0.5 to 6 seconds).
14. Auxiliary contact (gold plated) which opens when normal source fails. (Opens after override delay of 0.5 to 6 seconds).
15. Auxiliary contacts on same shaft as main contacts (closed on normal).
16. Auxiliary contacts on same shaft as main contacts (closed on emergency).
17. Provide pre-transfer and post-transfer contacts for connection to in-plant SCADA system.

J. Bypass Isolation Switch
1. The bypass isolation switch(es) shall have the same specification requirements as the automatic transfer switch portion of this specification except as described below:
    a. The automatic transfer and bypass-isolation switch shall be provided to manually permit convenient electrical bypass and isolation of the automatic transfer switch. Bypass of the load to either the normal or emergency power source with complete isolation of the ATS shall be

possible regardless of the status of the ATS. The bypass-isolation switch shall permit proper operation by one person through the movement of a maximum of two handles at a common dead front panel. The entire system shall consist of two elements: The automatic transfer switch and the bypass-isolation switch furnished completely factory interconnected and tested.

b. The operating speed of the bypass switch contacts shall be the same as the automatic transfer switch and independent of the speed of operation of the bypass handle.

c. The automatic transfer and bypass-isolation switch shall be the product of one manufacturer and be completely factory interconnected and tested so that only the service and load connections to the bypass-isolation switch are required for field installation. All interconnections between the transfer switch, bypass switch and isolation switch shall be by silver-plated copper bus bar. A visual position indicator shall be provided to indicate bypass-isolation switch positions, and availability of normal and emergency sources. A prominent and detailed instruction plate shall be furnished for convenient operation.

d. The automatic transfer and bypass-isolation switch shall provide manual bypass of the load and isolation of all service and load terminals of the automatic transfer switch to permit periodic testing, maintenance, and service of the automatic transfer switch.

e. The bypass-isolation switch shall be capable of bypassing the load to either source. Provisions shall be made to assure continuity of auxiliary circuits necessary for the proper operation of the system.

f. The isolation handle shall provide for automatic operation, testing or removal of the automatic transfer switch. The test position shall permit electrical testing of the automatic transfer switch without disturbing the load. The open position shall completely isolate the transfer switch from both lines and load without actual removal of the line or load conductors, and allow its removal for inspection, adjustment and maintenance. The transfer switch shall be arranged for drawout operation to facilitate its removal. Also, while in the Test of Open positions, the bypass switch shall function as a manual transfer switch to allow load transfer to either source of power regardless of the position or condition of the transfer switch, including the condition when the automatic transfer switch is removed, and without reconnecting the load terminals of the automatic transfer switch.

2.03 FUEL SUPPLY

A. A double wall fuel storage tank with sufficient fuel capacity to allow the EPS to operate continuously at full rated load for 24 hours (2500 gal. min) shall be located in the skids below the generator set, and shall be complete with all piping and fittings connected. No galvanized material shall be used in the tank or fueling system. The tanks shall be vented to atmosphere. A fuel level gauge shall be

located as indicated on the drawings. The system shall be supplied to deliver an adequate amount of fuel to the engine from the storage tank. Pipe sizes shall be no smaller than the minimum recommended by the engine manufacturer to avoid fuel flow restriction. The engine supply and return line shall be equipped with a length of flexible fuel lines, unions, and gate valves. No copper lines are acceptable.

B. Provide a set of normally open contacts in fuel level indicating "LOW FUEL" in fuel tank. Interconnect with remote low fuel alarm specified earlier in this section.

C. Provide leak detection monitoring system with a set of normally open contacts in secondary compartment of double wall tank space to indicate presence of fuel.

D. Provide audible/visual alarm so that if tank is above 90% full, alarm sounds. Provide silence switch and engraved sign reading "DISCONTINUE FILLING IF ALARM SOUNDS."

PART 3 - EXECUTION

3.01 EPS INSTALLATION

A. The plant shall be anchored to a concrete base whose overall dimensions shall exceed the outside dimensions of the plant base by 12" in each direction. Base depth shall be 12".
   1. Concrete base shall be isolated from adjacent concrete paving.
   2. Concrete base shall be extended to support maintenance platform.

B. The plant shall be on a welded steel base with vibration isolators. Isolators designed specifically for this application, mounted on rubber plates to block high frequency vibrations shall be provided. Isolators shall be designed for the seismic zone requirements in the area where the generator is installed.

C. Provide a laminated sign at the building service entrance equipment indicating type and location of on-site emergency power sources.

D. For exterior installations, the EPS shall be provided in outdoor, weatherproof housing with removable panels for access to equipment. Color shall be factory standard "sandstone". The starting batteries shall be rack mounted within the housing. Provide manufacturer's standard maintenance switched lighting system within housing. Enclosure shall be aluminum rated for 150 mph winds.

E. Provide non-sound attenuating enclosure.

F. Extend 120 volt and/or 208 volt emergency power circuits for fuel pump and cold weather starting aids from the generator mounted panel board.

G. Provide service lights within weatherproof housing plus 2 emergency battery packs with 2 lights per generator.

3.02 EXISTING TRANSFER SWITCH INSTALLATION

A. Locate transfer switch(es) to provide working clearance and full accessibility as required by the National Electrical Code.

B. Lace and group conductors installed in transfer switch with nylon tie straps. Only one conductor shall be installed under terminals. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eights inch from terminal lug. Conductors shall be installed such that no stresses are transferred to terminal lugs.

C. Mounting and Support
   1. Mounting
      a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. Transfer switches 400 amps and larger shall be secured by a minimum of eight (8) devices. A 1.5 inch minimum diameter round washer shall be used between head or screw or bolt and enclosure.
      b. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.
      c. Do not splice conductors in enclosure. Where required, install junction box or wireway adjacent to transfer switch and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the WIRES AND CABLES section of the specifications and do not exceed.
      d. Conductors not terminating in transfer switch shall not extend through or enter transfer switch enclosure.
      e. Install push-in knock-out closure plugs in any unused knock-out openings.
      f. Free standing transfer switch(es) shall be installed on a four inch high concrete pad, with horizontal base dimension exceeding base dimension of switch by three inches.
      g. Cleaning and Adjustment
         1) After completion, clean the interior and exterior of dirt, paint and construction debris.
         2) Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

3.03 TESTING

A. Submit verification letter to engineer indicating successful completion of sequence of operations testing and certification that all functions are operational. Letter to request load testing approval and schedule of proposed test. Prior to load test, written approval must be provided by engineer. Representatives of the generator shall be present. The local authority having jurisdiction shall be given advance notification of the time of the final test in order that he may witness the tests.

B. A failure of any test or any component during a test will require a complete retest program at no additional cost to the Owner.

C. Provide all lubricants, and other consumables for testing. Contractor to provide 1,000 gallons of fuel per generator.

D. An on-site acceptance test shall be conducted as a final approval test for all Emergency Power Supply Systems.
   1. The test shall be conducted after completion of the installation with all EPSS accessory and support equipment in place and operating.
   2. Test Results. The EPSS shall perform within the limits specified in the standard NFPA-110, level I.
   3. The on-site installation test shall be conducted as required by the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

3.04 O&M MANUALS

A. At least three sets of an instruction manual(s) for all major components of the EPS shall be supplied by the Manufacturer(s) of the EPS and shall contain:
   1. A detailed explanation of the operation of the system.
   2. Instruction for routine maintenance.
   3. Detailed instructions for repair of the EPS and other major components of the EPS.
   4. Pictorial parts list and part numbers.
   5. Pictorial and schematic electrical drawings of wiring systems, including operation and safety devices, control panels, instrumentation and annunciators.

3.05 IDENTIFICATION

A. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

SECTION 16426

SWITCHBOARDS – FRONT ACCESSIBLE
GROUP MOUNTED FEEDER DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the Specifications consists of the installation of all switchboards designated on the drawings to have group mounted feeder devices with front access only construction for use on systems 600 volts and below. All materials and devices which are an integral part of the switchboard shall be provided under this section of the specifications.

B. Definition: Switchboards are floor mounted assemblies of one or more enclosed vertical section containing circuit breakers, switches, meters, fuses, and terminals essential to operation of electrical equipment. A dead front switchboard has no exposed live parts on front.

1.03 QUALITY ASSURANCE

A. The following specifications and standards are incorporated into and become a part of this Specification by reference.
   1. National Electrical Manufacturers Association (NEMA) Standards:
      a. PB-2: Dead Front Distribution Switchboards
      b. PB-2.1: General Instruction for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards rated 600 volts or less.
      c. SG-3: Low Voltage Power Circuit Breakers.
   2. Underwriters Laboratories, Inc. (UL):
      a. UL-489: Molded Case Circuit Breakers and Circuit Breaker Enclosures
      b. UL-891: Deadfront Electrical Switchboards
      c. UL-977: Fused Power Circuit Devices
   3. Institute of Electrical and Electronics Engineers (IEEE):
      a. STD-241: IEEE Recommended Practices for Electric Power Systems in Commercial Buildings
   4. National Fire Protection Association (NFPA):
      a. NFPA-70: The National Electrical Code

5. American National Standards Institute (ANSI):
    a. C37.13: Low-Voltage AC Power Circuit Breakers used in Enclosures
    b. C37.16: Related Requirements and Application Recommendations for Low-Voltage Power Circuit Breakers and AC Power Protectors, Preferred Ratings

B. Equipment Dimensions
    1. Dimensions indicated on the drawings are maximum allowable and shall not be exceeded. Where switchboards of acceptable manufacturers listed exceed the maximum dimensions, products of such manufacturers shall not be acceptable.

C. Coordination
    1. Review shop drawings submitted under this and other sections, as well as other divisions, to ensure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure access and so that clearance minimums are provided.

1.04 SUBMITTALS

A. Refer to the BASIC ELECTRICAL REQUIREMENTS section for submittal requirements.

B. Product Data: Switchboards including, but not limited to, voltages, number of phases, frequencies, and short-circuit and continuous current ratings. Provide application data for main and branch circuit-breakers, sections, main buses, and basic insulation levels.

C. Shop Drawings: Layout drawings of switchboards showing accurately scaled basic equipment sections including auxiliary compartments, section components, and combination sections.

D. Wiring Diagrams: For switchboards showing connections to electrical power feeders and distribution branches. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed.

E. Closeout Submittals: As follows:
    1. Record Drawings: Include in each set:

F.
    a. Complete set of switchboard manufacturers' product data and shop drawings indicating all post bid revisions and field changes.
    b. Schedule of each overcurrent protection device indicating unit ampere rating and rating.
    c. Copy of the ground-fault system performance test as required by Article 230-95(c) of the NEC.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Deliver switchboards and components properly packaged and mounted on pallets, or skids to facilitate handling of heavy items. Utilize factory-fabricated type containers or wrappings for switchboards and components which protect equipment from damage. Install gravity measuring meters in containers which indicate whether container has been bumped or dropped. Return G-meters to manufacturer for re-use upon delivery of switchboards. Inspect equipment to ensure that no damage has occurred during shipment.

B. Store switchboard equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle switchboard equipment carefully to prevent physical damage to equipment and components. Remove packaging, including the opening of crates and containers, avoiding the use of excessive hammering and jarring which would damage the electrical equipment contained therein. Do not install damaged equipment; remove from site and replace damaged equipment with new.

1.06 SEQUENCING AND SCHEDULING

A. Schedule delivery of switchboard equipment which permits ready building ingress for large equipment components to their designated installation spaces. Coordinate delivery of equipment with the installation of other building components.

B. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 3.

C. Coordinate with other electrical work including raceways, electrical boxes and fittings, and cabling/wiring work, as necessary to interface installation of switchboards with other work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton
   2. General Electric
   3. Square D

2.02 GENERAL

A. AC Dead-Front Distribution Switchboards: Provide factory-assembled, dead-front, metal-enclosed, self-supporting secondary power switchboards, of types, sizes, electrical ratings and characteristics indicated; consisting of vertical panel units, and containing circuit-breakers of quantities, ratings and types indicated. Provide copper main bus and connections to circuit-breaker branches of sufficient capacity to limit rated continuous current operating temperature rise of no greater than 65°C above average ambient temperature of 25°C; with main bus and tap connections silver-surfaced and bolted tightly according to manufacturer's torquing requirements for maximum conductivity. Brace bus for short-circuit stresses up to maximum interrupting capacity. Provide accessibility of line and load terminations from front of switchboard. Equip units with built-in lifting eyes and yokes; and provide vertical individual panel units, suitable for bolting together at project site. Construct switchboard units for the following environment:
   1. Installation: Indoors, NEMA Type 1.

B. Provide accessory and instrumentation small wiring, necessary fuse blocks and terminal blocks within the switchboard. Control components, such as control transformers, fuse blocks, relays, etc., shall be suitably marked for identification where mounted on the switchboard corresponding to appropriate designations on manufacturer's wiring diagrams. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.03 BUSSING

A. All bus bars shall be silver-plated copper with bolted connections at joints. The bus bars shall be of sufficient size to limit the temperature rise to 65°C rise based on UL tests, and rated to withstand mechanical forces exerted during short circuit conditions when directly connected to a power source having an available fault current as shown on the drawings. Provide full capacity neutral where a neutral is indicated on the drawings.

B. A ground bus rated a minimum of 25% of main bus ampacity shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard. An incoming ground lug shall be furnished. Other ground lugs for feeder circuits shall also be supplied as shown in the schedules on the drawings.

C. All hardware used on conductors shall be high-tensile strength and plated. All terminals shall be of the anti-turn solderless type suitable for CU or A1 cable of sizes indicated for 75°C cable.

2.04 CONSTRUCTION

A. Switchboards shown mounted against a wall shall be front accessible. All sections of the switchboard shall be 20" deep except service sections containing large ampacity main disconnects which may be deeper as required. All sections of the switchboard shall align so that the back of the complete structure may be placed flush against a wall.

B. Construction shall allow maintenance of incoming line terminations, main device connections and all main bus bolted connections to be performed without rear access. The feeder or branch devices shall be removable from the front and shall be panel mounted with the necessary device line and load connections front accessible. Provide lugs on all devices for cable sizes shown on drawings.

2.05 OVERCURRENT DEVICES - GENERAL

A. Group mounted feeder protective devices shall be molded case breaker type with frame and trip rating as shown on the drawings and have additional characteristics as specified.

B. Devices shall be manually operated (MO).

2.06 MOLDED CASE BREAKERS

A. Protective devices as shown shall be molded case circuit breakers providing complete circuit overcurrent protection by having inverse time and instantaneous tripping characteristics, and where applicable, be current limiting.
   1. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes.
   2. Circuit breaker interrupting capacities shall be as indicated on the drawings or as specified hereinafter. Where applicable, circuit breakers shall be listed for series application.

B. Breakers 150 ampere and below shall be thermal-magnetic trip with inverse time current characteristics. Breakers with 250 and 400 ampere frame shall be solid-state trip, as applicable.

C. Breakers with 600 amperes frame and above shall be solid-state trip complete with built-in current transformers, solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings. Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.
   1. Trip units shall have adjustable short time setting with a fixed instantaneous override for circuit protection.

2. Breakers shall have built-in test points for testing long delay, instantaneous and ground fault functions of the breaker by means of a 120 volt operated test kit. Provide one test kit capable of testing all breakers 600 ampere and above.
3. Where indicated on the drawings, provide built-in ground fault protection with adjustable pick-up rating not exceeding 1200 amperes; ground fault time delay shall be adjustable 0.1 to 0.5 seconds. Provide neutral ground fault current transformer for four wire systems.

2.07 NAMEPLATES

A. Engraved nameplates shall be furnished for all main and feeder circuits including control fuses and also for all indicating lights and instruments. Nameplates shall give item designation and circuit number as well as frame size and appropriate trip rating. Furnish Master nameplate giving switchboard designation, voltage ampere rating, short circuit rating, manufacturer's name, general order number and item number. Refer to ELECTRICAL IDENTIFICATION section of this specification.

2.08 FINISH

A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 and use the manufacturer's standard process.

2.09 CONTROL POWER TRANSFORMERS

A. Control power transformers with primary and secondary protection shall be provided as indicated on the drawings or where required to operate ground fault systems, adequately sized for required burdens.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine areas and conditions under which switchboards and components are to be installed, and notify General Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION OF SWITCHBOARDS:

A. Install switchboards as indicated, in accordance with manufacturer's written instructions, and with recognized industry practices; complying with applicable requirements of NEC, NEMA's Stds Pub/No. PB 2.1, and NECA's "Standard of Installation".

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486 A and B, and the National Electrical Code.

3.03 FIELD QUALITY CONTROL

A. Refer to ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

B. Contractor shall verify in the field that all factory-made connections and terminations are torqued to manufacturer's recommended tolerances.

3.04 ADJUSTING AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.05 GROUNDING

A. Provide equipment grounding connections for switchboards as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

3.06 FIELD QUALITY CONTROL

A. Subsequent to wire and cable hook-ups, energize switchboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

SECTION 16427

SWITCHBOARDS – FRONT AND REAR
ACCESSIBLE GROUP MOUNTED FEEDER DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the Specifications consists of the installation of all switchboards [designated on the drawings to have group mounted feeder devices with front and rear access] for use on systems 600 volts and below. All materials and devices which are as integral part of the switchboard shall be provided under this section of the specifications.

B. Definition: Switchboards are floor mounted assemblies of one or more enclosed vertical sections containing circuit breakers, switches, meters, fuses, and terminals essential to operation of electrical equipment. A dead front switchboard has no exposed live parts on front.

1.03 QUALITY ASSURANCE

A. The following specifications and standards are incorporated into and become a part of this Specification by reference.
   1. National Electrical Manufacturers Association (NEMA) Standards:
      a. PB-2: Dead Front Distribution Switchboards
      b. PB-2.1: General Instruction for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards rated 600 volts or less.
      c. SG-3: Low Voltage Power Circuit Breakers.
   2. Underwriters Laboratories, Inc. (UL):
      a. UL-489: Molded Case Circuit Breakers and Circuit Breaker Enclosures
      b. UL-891: Deadfront Electrical Switchboards
      c. UL-977: Fused Power Circuit Devices
   3. Institute of Electrical and Electronics Engineers (IEEE):
      a. STD-241: IEEE Recommended Practices for Electric Power Systems in Commercial Buildings

4. National Fire Protection Association (NFPA):
    a. NFPA-70: The National Electrical Code
5. American National Standards Institute (ANSI):
    a. C37.13: Low-Voltage AC Power Circuit Breakers used in Enclosures
    b. C37.16: Related Requirements and Application Recommendations for Low-Voltage Power Circuit Breakers and AC Power Protectors, Preferred Ratings

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable:
1. General Electric
2. Square D
3. Eaton

C. Equipment Dimensions
1. Dimensions indicated on the drawings are maximum allowable and shall not be exceeded. Where switchboards of acceptable manufacturers listed exceed the maximum dimensions, products of such manufacturers shall not be acceptable.

D. Coordination
1. Review shop drawings submitted under this and other sections, as well as other divisions, to ensure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure access and so that clearance minimums are provided.

1.04 SUBMITTALS

A. Refer to the BASIC ELECTRICAL REQUIREMENTS section for submittal requirements.

B. Product Data: Submit manufacturer's data on switchboards including, but not limited to, voltages, number of phases, frequencies, and short-circuit and continuous current ratings. Provide application data for main and branch circuit-breakers, sections, main buses, and basic insulation levels.

C. Shop Drawings: Submit factory prepared layout drawings of switchboards showing accurately scaled basic equipment sections including auxiliary compartments, section components, and combination sections.

D. Wiring Diagrams: Submit wiring diagrams for switchboards showing connections to electrical power feeders and distribution branches. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed.

E. Record Drawings: Include in each set:

1. A complete set of switchboard manufacturers product data and shop drawings indicating all post bid revisions and field changes.
2. A schedule of each overcurrent protection device indicating unit ampere rating and trip rating.
3. A copy of the ground-fault system performance test as required by Article 230-95(c) of the NEC.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Deliver switchboards and components properly packaged and mounted on pallets, or skids to facilitate handling of heavy items. Utilize factory-fabricated type containers or wrappings for switchboards and components which protect equipment from damage. Install gravity measuring meters in containers which indicates whether container has been bumped or dropped. Return G-meters to manufacturer for re-use upon delivery of switchboards. Inspect equipment to ensure that no damage has occurred during shipment.

B. Store switchboard equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle switchboard equipment carefully to prevent physical damage to equipment and components. Remove packaging, including the opening of crates and containers, avoiding the use of excessive hammering and jarring which would damage the electrical equipment contained therein. Do not install damaged equipment; remove from site and replace damaged equipment with new.

1.06 SEQUENCING AND SCHEDULING

A. Schedule delivery of switchboard equipment which permits ready building ingress for large equipment components to their designated installation spaces. Coordinate delivery of equipment with the installation of other building components.

B. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 3.

C. Coordinate with other electrical work including raceways, electrical boxes and fittings, and cabling/wiring work, as necessary to interface installation of switchboards with other work.

PART 2 - PRODUCTS

2.01 GENERAL

A. AC Dead-Front Distribution Switchboards: Provide factory-assembled, dead-front, metal-enclosed, self-supporting secondary power switchboards, of types, sizes, electrical ratings and characteristics indicated; consisting of vertical panel units, and containing circuit-breakers of quantities, ratings and types indicated. Provide copper main bus and connections to switching devices and circuit-breaker branches of sufficient capacity to limit rated continuous current operating temperature rise of no greater than 65°C above average ambient temperature of 25°C; with main bus and tap connections silver-surfaced and bolted tightly according to manufacturer's torquing requirements for maximum conductivity. Brace bus for short-circuit stresses up to maximum interrupting capacity. Provide accessibililty of line and load terminations from rear of switchboard. Equip units with built-in lifting eyes and yokes; and provide vertical individual panel units, suitable for bolting together at project site. Construct switchboard units for the following environment:
   1. Installation: Indoors, NEMA Type 1.
   2. Installation: Indoors, NEMA Type 2.
   3. Installation: Outdoors, NEMA Type 3R.

B. Provide accessory and instrumentation small wiring, necessary fuse blocks and terminal blocks within the switchboard. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips.

2.02 BUSSING

A. All bus bars shall be silver-plated copper with bolted connections at joints. The bus bars shall be of sufficient size to limit the temperature rise to 65°C rise based on UL tests, and rated to withstand mechanical forces exerted during short circuit conditions when directly connected to a power source having an available fault current as shown on the drawings. Provide full capacity neutral where a neutral is indicated on the drawings.

B. A ground bus rated a minimum of 25% of main bus ampacity shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard. An incoming ground lug shall be furnished. Other ground lugs for feeder circuits shall also be supplied as shown in the schedules on the drawings.

C. All hardware used on conductors shall be high-tensile strength and plated. All terminals shall be of the anti-turn solderless type suitable for CU or AL cable of sizes indicated for 75°C cable.

2.03 CONSTRUCTION

A. Switchboards where shown shall be front and rear accessible. All vertical sections shall align front and rear with uniform depth as shown on the drawings. Switchboard shall be constructed for placement away from walls with required NEC clearances.

B. All internal devices, except the main disconnect and individually mounted feeder devices, shall be removable from the front and shall be panel mounted with the necessary line and load connections front accessible. The main device and individually mounted feeder devices and their connections shall be rear accessible. All bus connections not accessible from the front shall be accessible from the rear.

2.04 METERING

A. Where indicated on the drawings, provide a separate customer metering compartment with front hinged door and include the following:
   1. Current transformers.
   2. Potential transformers including primary and secondary fuses with disconnecting means for metering as shown on the drawings.
   3. Indicating ammeter with ammeter switch, indicating voltmeter with voltmeter switch.
   4. Kilowatt hour meter with demand register in flex test case.

2.05 OVERCURRENT DEVICES - GENERAL

A. Main protective devices shall be fixed mounted molded case breaker with interrupting rating, frame and trip ratings as shown on the drawings.

B. Group mounted feeder protective devices shall be molded case circuit breaker type with frame and trip rating as shown on the drawings and have additional characteristics as specified.

C. Devices shall be manually operated (MO).

2.06 MOLDED CASE BREAKERS

A. Protective devices as shown shall be molded case circuit breakers providing complete circuit overcurrent protection by having inverse time and instantaneous tripping characteristics, and where applicable, be current limiting.
   1. Circuit breakers shall be be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of arc chutes.

2. Circuit breaker interrupting capacities shall be as indicated on the drawings or as specified hereinafter. Where applicable, circuit breakers shall be listed for series application.

B. Breakers 150 ampere and below shall be thermal-magnetic trip with inverse time current characteristics. Breakers with 250 and 400 ampere frame shall be thermal-magnetic or solid-state trip, as applicable.

C. Breakers with 600 amperes frame and above shall be solid-state trip complete with built-in current transformers, solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings. Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.
   1. Trip units shall have adjustable short time setting with a fixed instantaneous override for circuit protection.
   2. Breakers shall have built-in test points for testing long delay, instantaneous and ground fault functions of the breaker by means of a 120 volt operated test kit. Provide one test kit capable of testing all breakers 600 amperes and above.
   3. Where indicated on the drawings, provide built-in ground fault protection with adjustable pick-up rating not exceeding 1200 amperes; ground fault time delay shall be adjustable 0.1 to 0.5 seconds. Provide neutral ground fault current transformer for four wire systems.

D. Breakers 2000A through 4000A frame where indicated on the drawings shall be UL listed and labeled for 100% application per NEC.

E. Where indicated on the drawings, provide zero sequence ground fault protection system with necessary sensor, monitor, test panel, shunt trip and control power source for use with breakers indicated.

2.07 NAMEPLATES

A. Engraved nameplates shall be furnished for all mains and feeder circuits with designation and circuit number as indicated on the drawings. Furnish Master Nameplate giving voltage, ampere rating, short circuit rating, manufacturer's name, general order number and item number.

2.08 FINISH

A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 and use the manufacturer's standard process.

2.09 CONTROL POWER TRANSFORMERS

A. Control power transformers with primary and secondary protection shall be provided as indicated on the drawings or where required to operate ground fault systems, adequately sized for required burdens.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine areas and conditions under which switchboards and components are to be installed, and notify General Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION OF SWITCHBOARDS:

A. Install switchboards as indicated, in accordance with manufacturer's written instructions, and with recognized industry practices; complying with applicable requirements of NEC, NEMA's Stds Pub/No. PB 2.1, and NECA's "Standard of Installation".

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486 A and B, and the National Electrical Code.

3.03 FIELD QUALITY CONTROL

A. Refer to ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

B. Contractor shall verify in the field that all factory-made connections and terminations are torqued to manufacturer's recommended tolerances.

3.04 ADJUSTING AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.05 GROUNDING

A. Provide equipment grounding connections for switchboards as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

3.06 DEMONSTRATION

A. Subsequent to wire and cable hook-ups, energize switchboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

SECTION 16450

SECONDARY GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of furnishing, installation and connections of the building secondary grounding systems. Exterior branch circuit wiring and feeder conductors extended beyond the building are included. The building electrical system shall be a 3 phase, 4 wire grounded wye system supplemented with equipment grounding system. Equipment grounding system shall be established with equipment grounding conductors; the use of metallic raceways for equipment grounding is not acceptable.

1.03 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by Reference.
   1. Underwriters' Laboratories, Inc. (UL) Publications:
      a. No. 44: Rubber - Insulated Wire and Cables
      b. No. 83: Thermoplastic - Insulated Wires
      c. No. 467: Electrical Grounding and Bonding Equipment
      d. No. 493: Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables
      e. No. 486: Wire Connectors and Soldering Lugs
   2. National Electrical Manufacturer's Standards (NEMA):
      a. WC-5: Thermoplastic Insulated Wire and Cable
      b. WC-7: Cross-Linked-Thermosetting Polyethylene Insulated Wire and Cable
   3. National Fire Protection Association Publication (NFPA):
      a. No. 70: National Electrical Code (NEC)

B. Acceptable Manufacturers. Products produced by the following manufacturer which conform to this specification are acceptable.
   1. Hydraulically applied conductor terminations:
      a. Square D
      b. Burndy
      c. Ilsco
      d. Scotch (3M)
      e. Thomas and Betts (T & B)
      f. Anderson
   2. Mechanically applied (crimp) conductor terminations:
      a. Scotch (3M)
      b. Ideal
      c. Thomas and Betts (T & B)
      d. Burndy
   3. Exothermic connections:
      a. Cadweld

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Provide all materials under this section of the specifications. All materials shall be new.

B. All materials shall be UL listed and bear a UL label.

C. Refer to the specific specification section for the description and requirements of materials mentioned herein for installation.

2.02 GROUNDING CONDUCTORS

A. Grounding electrode conductor shall be bare or green insulated copper conductor sized as indicated on the drawings.

B. Equipment grounding conductors shall be green insulated type THHN, THWN, or XHHN conductors sized as indicated on the drawings. Where size is not indicated on the drawings, conductor size shall be determined from the National Electrical Code table on sizes of equipment grounding conductors.

C. Bonding jumpers shall be flexible copper bonding jumpers sized in accordance with the National Electrical Code tables for grounding electrode conductors.

2.03 TRANSFORMERS, MOTOR CONTROLLERS, AND DISCONNECT SWITCHES

A. Provide a conductor termination grounding lug bonded to the enclosure of each equipment item.

2.04 DEVICES

A. Each receptacle and switch device shall be furnished with a grounding screw connected to the metallic device frame.

2.05 GROUND RODS

A. Ground rods shall be 3/4" x 10'-0" copper clad steel.

B. Sectional ground rods shall be hot dip galvanized 5/8" x 10' sections with an internal stainless steel splined coupling pin.

2.06 OTHER MATERIALS

A. Ground bus shall be solid copper, 1/4" thick x 2" x 24", tapped and drilled for conductor termination lug connections.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ground all non-current carrying parts of the electrical system, i.e., wireways, equipment enclosures and frames, junction and outlet boxes, machine frames and other conductive items in close proximity with electrical circuits, to provide a low impedance path for potential grounded faults.

B. Service entrance and separately derived electrical systems, grounding electrode system.

1. The neutral conductor of the electrical service serving the premises wiring system shall be grounded to the ground bus bar in the service equipment which shall be grounded to the cold water system, the ground rod system, and other grounding electrodes specified herein or indicated on the drawings. Grounding electrode conductors shall be installed in rigid, non-metallic conduit to point of ground connection, unless subject to physical damage in which case they shall be installed in galvanized rigid steel. Where metallic conduit is permitted, bond conduit at both ends to grounding electrode conductor with a UL bonding bushing.

2. Make connection to main water line entering the building. Make connections ahead of any valve or fittings whose removal may interrupt ground continuity. Install a bonding jumper of the same size as the grounding conductor around the water meter.
3. Bond together the following systems to form the grounding electrode system. All system connections shall be made as close as possible to the service entrance equipment and each connected at the service entrance equipment ground bus. Do not connect electrode systems together except at ground bus.
    a. Cold water piping system
    b. Ground rod system
    c. Structural steel metal building frame
    d. Main rebar in a foundation footing, for a concrete structure
4. Ground the neutral of all dry type transformers to building steel which shall serve as the grounding electrode for the separately derived system. In reinforced concrete structures building steel shall be considered to be reinforcing steel of vertical columns. Make connection to building steel with an exothermic weld in a location in unfinished space where the connection will not be subject to physical abuse.
5. Ground the neutral and frame of the emergency generator to the ground rod system, which shall serve as the grounding electrode for the separately derived system.
6. Grounding electrode connections to structural steel, reinforcing bars, ground rods, or where indicated on the drawings shall be with chemical exothermic weld connection devices recommended for the particular connection type. Connections to piping shall be with UL listed mechanical ground clamps.
7. Where more than one service serves a building or interconnected buildings, connect each service equipment ground bus together with a #4/0 copper conductor in PVC conduit.
8. Bonding shall be in accordance with the National Electrical Code.
9. Install ground rods where indicated on the drawings with the top of the ground rods 12" below finished grade.

C. Equipment Grounding Conductor
1. Grounding conductors for branch circuits are not shown on the drawings; however, grounding conductors shall be provided in all branch circuit raceways and cables. Grounding conductors shall be the same AWG size as branch circuit conductors.
2. Grounding conductors for feeders are typically indicated on the drawings and the raceway is sized to accommodate grounding conductor shown. Where grounding conductor size is not indicated on the drawings, conductor shall be in accordance with the equipment grounding conductor table of the National Electrical Code.
3. A grounding conductor shall be installed in all flexible conduit installations. For branch circuits, grounding conductor shall be sized to match branch circuit conductors.

4. The equipment grounding conductor shall be attached to equipment with bolt or sheet metal screw used for no other purpose. Where grounding conductor is stranded, attachment shall be made with lug attached to grounding conductor with crimping tool.
5. Ground all motors by drilling and tapping the bottom of the motor junction box and attaching the equipment grounding conductor to the box with a round head bolt used for no other purpose. Conductor attachment shall be through the use of a lug attached to conductor with crimping tool.
6. Equipment grounding conductors shall terminate on panelboard, switchboard, or motor control center grounding bus only. Do not terminate on neutral bus. Provide a single terminals lug for each conductor. Conductor shall terminate in the same section as the phase conductors originate. Do not terminate neutral conductors on the ground bus.

D. Other Grounding Requirements
1. Each telephone backboard shall be provided with a No. 6 grounding conductor. When backboard is located in vicinity of electrical service equipment, the "point of grounding" of this conductor shall be the main cold water service with connections made ahead of any valves or joints. Remote backboards shall use building steel as "point of grounding". Terminate conductor by stapling to backboard.
2. At each building expansion joint flexible copper bonding jumpers shall be attached to building structure by exothermic weld process. Install bonding jumpers in concealed locations that will not subject connections or jumpers to physical abuse. Install 100' on centers across expansion joints.
3. Lighting fixtures shall be grounded with a green insulated ground wire secured to the fixture with a UL listed bond lug, screw, or clip specifically made for such use.

3.02 TESTING

A. Upon completion of the ground rod installation, the Contractor shall test the installation in accordance with the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification. Grounding resistance reading shall be taken before connection is made to the building cold water piping system. Ground resistance readings shall not be taken within forty-eight hours of rainfall. Results of ground resistance readings shall be forwarded, in writing, immediately to the Engineer.

SECTION 16460

TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of the furnishing, connection and installation of dry type transformers.

B. Definition: Dry type transformers, as described herein, applies to those with primary and secondary voltage connections of 600 volts and less. Autotransformers are not acceptable, except where indicated for buck boost or zig-zag connections.

1.03 QUALITY ASSURANCE

A. Referenced Industry Standards: The following specifications and standards are incorporated into and become a part of this specification by reference.
   1. Underwriter's Laboratories, Inc. (UL) Publications:
      a. No. 506 Transformers (1000 KVA, 3 phase and below; 167 KVA, 1 phase and below)
   2. National Fire Protection Association (NFPA):
      a. No. 70 National Electrical Code (NEC)
   3. National Electrical Manufacturers Association (NEMA):
      a. No. ST-20 Dry-type transformers for general applications
   4. American National Standards Institute (ANSI):
      a. No. C57.12.80 Terminology for Power and Distribution Transformers
      b. No. C57.12.90 Guide for Short Circuit Testing of Distribution and Power Transformers
      c. No. C57.94 Recommended Practice for Installation, Application, Operation and Maintenance of Dry-Type General Purpose Distribution and Power Transformers

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.
   1. Eaton
   2. General Electric

3. Square D

C. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure transformer access and clearance minimums are provided, and adequate ventilation is permitted.

1.04 SUBMITTALS

A. Refer to the BASIC ELECTRICAL REQUIREMENTS section for submittal requirements.

B. Manufacturers Product Data:
1. Submit material specifications and installation data for products specified under PART 2 - PRODUCTS. Product data shall indicate sound and temperature rating, overload capacity and efficiency at 25%, 50% and 100% load, available taps, voltage, impedance, nameplate data, wiring diagrams, physical dimensions and net weight. Product data shall also contain certification that transformers are constructed and tested in accordance with standards specified herein.

C. Record Drawings. Include in each set:
1. A complete set of manufacturers product data indicating all post bid revisions and field changes.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Furnish all materials specified herein and indicated on the drawings.

B. All transformers shall be UL listed and bear a UL label.

C. Transformers shall be self-cooled, rated for continuous operation at rated KVA, 24 hours per day, 365 days per year with normal life expectancy (IEEE Standard No. 65). KVA ratings shall be as indicated on the drawings.

2.02 GENERAL PURPOSE DRY TYPE TRANSFORMERS

A. Insulation System
1. Single phase 25 - 167 KVA and three phase 30 - 1500 KVA: Transformers shall be rated for average temperature rise by resistance of 220°C in 40°C. maximum ambient, 30°C average ambient. Transformer insulation system shall be UL rated as 220°C. system.

2. Three phase 3 - 15 KVA: Transformers shall be rated for average temperature rise by resistance of 115°C. Insulation system shall be 180°C.
3. Single phase up through 250 VA: Transformers shall be rated for 55°C. rise by resistance. Insulation system shall be 105°C.
4. Single phase 500 - 3000 VA: Transformers shall be rated for 115°C. temperature rise by resistance. Insulation system shall be 180°C.

B. Sound rating shall not exceed NEMA and ANSI standards for KVA rating. Internal vibration dampening shall be provided as a standard feature of all transformers.

C. Single phase transformers rated up to 15 KVA shall have two, 5 percent full capacity taps below normal rated primary voltage. All other single phase and all three phase transformers shall be provided with six 2-1/2% full capacity taps, two above and four below normal voltage unless only four 2-1/2% taps, two above and two below normal voltage, are standard.

D. Construction and Enclosures
1. Transformers 30 - 1500 KVA: Transformer enclosures shall be open, ventilated, drip-proof with removable front and rear cover panels. Transformers shall be suitable for floor mounting, unless wall mounting is indicated on the drawings.
2. Transformers up through 25 KVA: Transformers shall be totally enclosed, non-ventilated with a resin encapsulated core and coil and drip-proof housing. Removable panel section shall permit access to wiring compartment.

E. Dry type transformers shall provide 3 phase 4 wire 208Y/120 volt service to designated panelboards or other equipment. Primary rating shall be 480 volts.

F. Nominal transformer impedance shall be 4.5 percent minimum, unless otherwise indicated on the drawings.

G. Dry type transformer K-factors shall be as indicated on the drawings and as outlined in ANSI C57.110 "Recommended Practice for Establishing Transformer Capability when Supplying Nonsinusoidal Load Currents."

H. Core assemblies and the center ground connection point of the coil secondaries shall be grounded to their enclosures by adequate, flexible ground straps. Provide grounding lug at the strap to enclosure bonding location for connection of three conductors; the primary and secondary equipment grounding conductors and the grounding electrode conductor.

I. Provide weather shield on transformers indicated on drawings and for all exterior installations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Dry transformers larger than 15 KVA shall be floor mounted, unless wall or suspension mounting is indicated on the drawings. Transformers 15 KVA and smaller shall be wall mounted. Installation shall provide not less than twelve inch clearance from walls or equipment. Floor mounted transformers shall be mounted on neoprene, waffle type vibration pads 5/8" thick. Where transformers are indicated on the drawings, or specified herein to be mounted on suspended channels of angles or wall mounted, transformers shall be bolted to structure with 5/8" thick vibration pad between transformer base and structural surface. Loosen shipping bolts to free up internal vibration mounts on core and coil assembly.

B. Primary and secondary connections to dry type transformers shall be made with flexible conduit.

C. The secondary windings of each dry type transformer shall be grounded in accordance with the National Electrical Code requirements for separately derived electrical systems. Extend a grounding electrode conductor from the transformer grounding lug to the nearest building structural steel or main column rebar. Connect the primary and secondary feeder equipment grounding conductors to the grounding lug. Refer to the secondary grounding section of these specifications for additional requirements.

D. Install secondary overcurrent protective device within 10 feet of conductor length. Where none is indicated on plans, provide enclosed circuit breaker within 10 feet rated at 125 percent of the transformer full load ampacity but not greater than the secondary conductor ampacity.

E. Do not install equipment over transformer, unless indicated on the drawings.

F. Locate transformers to provide working clearance and full accessibility as required by the National Electrical Code.

3.02 CLEANING AND ADJUSTMENT

A. Prior to final inspection, under maximum available load, measure secondary voltage and adjust tap setting to deliver nominal rated voltage within the percentage limits of one tap setting. Record the voltages of each transformer and submit in accordance with the requirements specified in the basic electrical requirements section.

B. After completion, clean the interior and exterior of dirt, paint and construction debris.

C. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

3.03 IDENTIFICATION

A. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

3.04 FIELD QUALITY CONTROL

A. Refer to the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

SECTION 16470

PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of the furnishing, installation and connection of lighting and appliance panelboards and distribution type panelboards.

B. Panelboards designated as HDA, HDB, DA, DB, etc., or indicated on the drawings shall be distribution type panelboards. Those designated as HA, HB, A, B, etc., are lighting and appliance type panelboards.

C. Definitions: The term panelboard, as used in this specification or on the drawings, shall mean the complete assembly including the enclosure, bus work, trim hardware and circuit breaker or fused devices. The words panel and panelboard are used synonymously in these contract documents.

1.03 QUALITY ASSURANCE

A. Industry Referenced Standards. The following specifications and standards are incorporated into and become a part of this Specification by Reference.
   1. Underwriters' Laboratories, Inc. (UL) Publications:
      a. No. 50: Cabinets and Boxes, Electrical
      b. No. 67: Panelboards
      c. No. 489: Molded Case Circuit Breakers and Circuit Breaker Enclosure
   2. Federal Specifications (Fed Spec):
      a. WC-375: Circuit Breakers
   3. National Electrical Manufacturer's Association (NEMA) Publications:
      a. No. PB-1: Panelboards
      b. No. AB-3: Molded Case Circuit Breakers
   4. National Fire Protection Association (NFPA):
      a. No. 70: National Electrical Code (NEC)

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.
   1. General Electric
   2. Eaton
   3. Square D

C. Coordination: Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure panel access and insure that clearance minimums are provided.

1.04 SUBMITTALS

A. Refer to BASIC ELECTRICAL REQUIREMENTS for submittal requirements.

B. Manufacturers Product Data:
   1. Submit material specifications and installation data for products specified under Part 2 - Products to include:
      a. Circuit breakers
      b. Panelboards

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings.
   1. Include electrical characteristics and ratings for each panelboard with dimensions, mounting, bus material, voltage, ampere rating, mains, poles and wire connection, and any accessories. Indicate method of ground bus attachment to enclosure.
   2. Include front elevation bussing diagram indicating each bussing circuit breaker position.
   3. Provide a schedule indicating circuit breaker type, trip and size, poles, frame type, and interrupting capacity.
   4. Nameplate identification designation schedule.

D. Record Drawings. Include in each set:
   1. A complete set of panelboard manufacturers product data and shop drawings indicating all post bid revisions and field changes.
   2. A copy of each panelboard directory incorporating all post bid revisions and field changes.

PART 2 - PRODUCTS

2.01 GENERAL MATERIALS REQUIREMENTS

A. Furnish all materials specified herein.

B. All panels and circuit breakers shall be UL listed and bear a UL label.

C. Panels shall be of the dead front safety type.

D. Provide panels complete with factory assembled circuit breakers connected to the bus bars in the positions shown on the panel schedules or bus diagrams as indicated on the drawings.

E. Number all panelboard circuits in the following sequence:
   1. Circuits No. 1 and 2, Phase A; Circuits No. 3 and 4, Phase B; Circuits No. 5 and 6, Phase C. Connect two pole breakers to phase indicated on the drawings.

2.02 BUSSING AND INTERIORS

A. All bus bars shall be copper. Main lugs and main breakers shall be UL approved for copper or aluminum conductors and shall be of a size range for the conductors indicated on the drawings. Each panel shall contain an equipment grounding bus. Each lighting and appliance panelboard shall contain a full size insulated neutral bus. Where a distribution type panelboard is indicated on the drawings to have a neutral bus, the bus shall be insulated and full size, unless otherwise indicated on the drawings.

B. The neutral and ground busses shall have a sufficient number of lugs to singularly terminate each individual conductor requiring a connection.

C. The ground bus shall be factory brazed, riveted or installed on studs welded to the panel enclosure or panel frame. The ground bus shall not be attached to the panel interior.

D. Where designated on panel schedule as "space", include all necessary bussing, device support and connections. Provide blank cover for each space.

E. Where specified or indicated on the drawings, provide sub-feed lugs adjacent to the mains and increase box heights to provide additional cable bending and termination space. Lugs to be the same size and capacity as mains and rated for aluminum or copper conductor terminations.

2.03 ENCLOSURES

A. Panelboard width shall not be less than 20", nor more than 22" unless specific width is indicated on the drawings. Panelboard depth shall not exceed 5-3/4".

B. Distribution panelboard width shall not be less than 31" and the depth shall not exceed 14".

C. Review panelboard schedules and system one line diagram and provide panelboard gutters and bending space at terminals to conform to the National Electrical Code.

D. Provide concealed captive clamping devices, concealed hinges and lock for all flush mounted panels. Key all panels throughout project alike.

E. All surface mounted panels shall be provided with door-in-door hinged cover trims. Trims shall be secured by piano hinges to enclosure and secured closed by two trim clamps.

F. Where two section panels are required, both sections shall have fully rated bus and separate cabinets connected by conduit nipples. Interconnect sections with copper conductors with ampacity equal to rating of main bus. Route phase and neutral conductors together between panels. Provide separate trims and card holder with each section.

G. Provide a directory card, metal holder, and transparent cover permanently mounted on inside of doors.

H. Where indicated on the drawings or required for the environmental conditions, provide a NEMA 4X stainless steel enclosure. Mount a thermostatically controlled 120V electric space heater in the enclosure. Connect to a 480V to 120V control power transformer with fused primary and secondary windings. Drill and tap bus and connect primary leads.

2.04 CIRCUIT BREAKERS

A. Interrupting rating of all circuit breakers in panelboards operating on 208Y/120 volt system shall have UL rating of not less than 10,000 RMS symmetrical amps at system voltage. Panelboards for use on 480Y/277 volt system shall contain circuit breakers with UL interrupting rating of not less than 14,000 RMS symmetrical amps at system voltage. Provide circuit breakers with higher interrupting capacity when indicated on the drawings.

B. Circuit breakers shall be provided with trip rating, poles and minimum interrupting rating as indicated on the drawings or specified herein.

C. Multi-pole breakers shall be common trip and common reset; tie handle connection between single pole breakers is not acceptable.

D. Branch circuit breakers in lighting and appliance panels shall be quick-make, quick-break, thermal magnetic type bolted to the bus. Circuit breakers in distribution type panelboards shall be bolted to the bus except, Square D I-line style plug in devices are acceptable.

E. Molded case circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for 100 ampere frame or less. Magnetic trip shall be adjustable for breakers with 600 ampere frames and higher. Factory setting shall be HI, unless otherwise noted.

F. Provide the following special devices and accessories when indicated on the drawings, specified herein, or required by the NEC.
   1. Ground fault interrupting circuit breaker (GFI).
   2. Provide handle lock-off device to prevent manually turning off device without removal. Install on all circuit breakers indicated on the panel schedule.
   3. Provide shunt trip device for electrically tripping circuit breakers indicated on the drawings. Shunt trip to be for operation on a 120V or 277V source and have integral coil clearing contacts to de-energize coil after operation. Connect shunt trip to circuit indicated on the drawings.

2.05 SEPARATELY ENCLOSED MOLDED CASE CIRCUIT BREAKERS

A. Where separately enclosed molded case circuit breakers are shown on the drawings, provide circuit breakers in accordance with the applicable requirements of those specified for panelboards.

2.06 CURRENT LIMITING CIRCUIT BREAKERS

A. Feeder protective devices as shown shall be molded case circuit breakers built and tested and UL labeled per UL 489.

B. Breakers up to 100 ampere frame size shall be thermal magnetic trip with inverse time current characteristics. Breakers 400 amp and 250 ampere frame size shall be electronic trip complete with built in current transformers, solid-state trip unit and shunt trip. Breakers shall have changeable trip rating plugs with trip ratings as indicated on the drawings. Rating plugs shall be interlocked so they are not interchangeable between frames and interlocked such that the breaker cannot be latched with rating plug removed. Breakers shall have built-in test points for testing long delay and instantaneous and ground fault (where shown) functions of the breaker by means of 120 volt operated test kit.

C. All current limiting circuit breakers shall be rated as indicated on the drawings interrupting capacity symmetrical. Current limiting circuit breakers shall protect all molded case breakers down stream as shown on the drawings. No deviations from this provision shall be acceptable. Manufacturers shall submit test data proving the protection, from both peak currents and I^2T energy, of down stream devices.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount panelboards with top circuit not more than 6'-6" above finished floor.

B. Lace and group conductors installed in panels with nylon tie straps. Only one conductor shall be installed under terminal of individual circuit breakers. Form and train conductors in panel enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eights inch from terminal lug.

C. Do not splice conductors in panels. Where required, install junction box adjacent to panel and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the conductors and cables section of the specifications and do not exceed.

D. Mounting and Support
   1. Mounting
      a. Enclosure shall be secured to structure by a minimum of four (4) fastening devices. A 1.5" minimum diameter round washer shall be used between head of screw or bolt and enclosure.
      b. Enclosures shall be mounted where indicated on the drawings or specified herein. Support from the structure with fastening device specified.
      c. Attach enclosure directly to masonry, concrete, or wood surfaces.
      d. Mount enclosure on metal channel (strut), which is connected to structure with fastening device specified, for installations on steel structure or sheet rock walls.

E. Conductors not terminating in panelboard shall not extend through or enter panel enclosure.

F. Maintain conductor phase color code requirement described in the wires and cables section of the specifications.

G. Provide in each panelboard with a typewritten circuit directory mounted under clear plastic in a metal directory frame on interior of panel door. Directory shall reflect any field changes or additions.

H. Install push-in knock-out closure plugs in any unused knock-out openings.

I. Identification
   1. Panelboards and individually mounted circuit breakers shall be identified.
   2. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.
   3. Submit complete schedule with the shop drawings listing all nameplates and information contained thereon.

3.02 CLEANING AND ADJUSTMENT

A. After completion, clean the interior and exterior of dirt, paint and construction debris.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

C. Adjust and align panelboard interior and trim in accordance with manufacturers recommendations, and to eliminate gaps between the two.

3.03 FIELD QUALITY CONTROL

A. Refer to the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

B. Contractor shall verify in the field that all factory-made connections and terminations are torqued to manufacturer's recommended tolerances.

SECTION 16481

MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.02 SUMMARY

A. The work required under this section of the Specifications consists of the installation of all Motor Control Centers for use on systems 600 volts and below. All materials and devices which are an integral part of the Motor Control Center shall be provided under this section of the specifications.

B. Definition: Motor Control Centers are floor mounted assemblies of one or more enclosed vertical sections having a common horizontal power bus and primarily containing combination Motor Control Units. Units are mounted one above the other in the vertical sections, with power supplied to the individual units by vertical power busses. The words motor control units, starters, and motor controllers are used synonomously in these contract documents.

1.03 QUALITY ASSURANCE

A. The following specifications and standards are incorporated into and become a part of this Specification by reference.
   1. National Electrical Manufacturers Association (NEMA) Standards:
      a. ICS-1: General Standards for Industrial Control and Systems
      b. ICS-2: Industrial Control Devices, Controllers and Assemblies
      c. ICS-3: Industrial Systems
      d. ICS-4: Terminal Blocks for Industrial Control Equipment and Systems
      e. ICS-6: Enclosures for Industrial Controls and Systems
   2. Underwriters Laboratories, Inc. (UL) Publications:
      a. UL 198.4: Class R Fuses
      b. UL 508: Industrial Control Equipment
      c. UL 845: Standard for Motor Control Centers
   3. National Fire Protection Association (NFPA)
      a. NFPA 70: National Electrical Code
   4. American National Standards Institute (ANSI):
      a. C97.1: Low Voltage Cartridge Fuses, 600 Volts or Less

B. Acceptable Manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.
   1. Motor control centers and controllers:
      a. Square D
      b. General Electric
      c. Eaton
   2. Fuses:
      a. Gould-Shawmut
      b. Bussman
      c. Littlefuse

C. Equipment Dimensions
   1. Dimensions indicated on the drawings are maximum allowable and shall not be exceeded. Where motor control centers of acceptable manufacturers listed exceed the maximum dimensions, products of such manufacturers shall not be acceptable.

D. Coordination
   1. Review shop drawings submitted under this and other sections, as well as other divisions, to ensure coordination between work required among different trades. Coordinate the installation sequence with other contractors to avoid conflicts and to provide the fastest overall installation schedule. Coordinate installation with architectural and structural features, equipment installed under other sections of the specifications and electrical equipment to insure access and so that clearance minimums are provided.

1.04 SUBMITTALS

A. Refer to basic electrical requirements section for submittal requirements.

B. Manufacturer's Product Data:
   1. Submit material specifications and installation data for products specified under Part 2 - Products to include:
      a. Motor controllers
      b. Motor control centers
      c. Fuses

C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract drawings.
   1. Include electrical characteristics and ratings for each motor control center with dimensions, mounting, bus material, voltage, bracing, ampere rating, mains, poles and wire connection, and any accessories.
   2. Include bussing diagram indicating each bussing motor control unit, circuit breaker, or fused switch position.
   3. Provide a schedule indicating motor control unit type, or trip and size, poles, frame type, fuse size and type, and interrupting capacity.

4. Identification designation schedule.

D. Record Drawings - Include in each set:
1. A complete set of motor control center manufacturers product data and shop drawings indicating all post bid revisions and field changes.
2. A schedule of each motor's actual full load nameplate rating and NEMA design with the selected overload heater catalog number and current range.

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish all materials specified herein.

B. Motor control center, motor control units, circuit breakers, and fused devices shall be UL listed and bear the UL label.

C. The type of enclosure shall be in accordance with NEMA standards for Type 1, gasketed construction. All enclosing sheet steel, wireways and unit doors shall be gasketed.

D. The motor control center shall be suitable for operation on a 480 3-phase, 3-wire 60 Hz system.

E. Motor control center wiring shall be NEMA Class I type B.

2.02 STRUCTURE ARRANGEMENT

A. Motor Control Center shall consist of free-standing, standardized vertical sections; each section shall have the following nominal dimensions: 90" H. x 20" W. x 20D. Maximum overall dimensions, not to be exceeded, shall be as indicated on the drawings.

B. Each section shall contain continuous horizontal and vertical wireways. The horizontal wireway shall be located at the top and bottom of the section. Vertical wireways shall be provided adjacent to each unit. All wireways shall have provisions for cable support, shall be isolated from the bus bars and shall be accessible through hinged doors held closed by captive screws.

C. Adequate space for conduit and conductors entering the top or bottom, in accordance with the National Electrical Code, shall be provided without structural interference. Conductors shall be safely accessible without disrupting service.

D. Individual sections shall be assembled to form a totally enclosed deadfront, front accessible motor control center, as indicated on the drawings.

E. Motor control center design shall permit the future installation of matching vertical sections without the need for transition sections.

2.03 BUS ARRANGEMENT

A. Each vertical section shall contain a continuous three-phase bus, rated as shown on the drawings. Vertical busses shall be connected to the main horizontal bus.

B. A continuous, three-phase, main horizontal bus, rated as shown on the drawings, shall be provided for the distribution of power to the vertical busses. The main bus shall be located in the upper part of the structure.

C. All non-current-carrying parts of the control center shall be grounded through the use of a continuous horizontal ground bus connected to vertical ground busses in each section. Ground bus rating shall not be less than 25% of main bus rating. Bus design shall include feature that for any plug-on unit the ground bus stab shall make contact with the ground bus before the power bus contact is made.

D. All busses shall be tin-plated copper, rated for a 50 degrees C. temperature rise above a 40 degrees C ambient. The minimum bus bracing, in RMS - symmetrical-amperes, shall be as shown on the drawings. Busbars shall be isolated and insulated with polyester boards front and back.

E. A front accessible main lug compartment shall be provided for incoming line termination. Lugs shall be suitable for terminating the size and quantity of conductors as indicated. The compartment shall be located in the unit space shown on the drawings and shall have a hinged door held closed by captive screws. Door shall have provisions for a padlock.

2.04 UNIT CONSTRUCTION

A. Combination magnetic starters shall be installed in removable units constructed in basic heights of 12" or multiples thereof. Each unit shall be isolated from others on structure. Connection to vertical bus for NEMA size five across the line starters and smaller shall be made with draw out stab type connection. Each plug-in type unit shall have a provision for positive horizontal and vertical alignment. Provisions shall also be included for positive ground connections through plug-in facilities. Each magnetic starter shall contain a solid state overload relay for each phase, three in all. Each unit shall contain separable control terminal blocks and separable power terminal blocks to permit removal of unit without disturbing control wiring.

B. Magnetic starters shall be the combination type with molded case circuit breakers. UL listed interrupting rating of molded case circuit breakers shall not be less than indicated on the drawings at system voltage.

C. Solid-State Overload Relay

1. Where indicated on the drawings, provide a definite-purpose, microprocessor-based Overload Relay (OLR) in each starter and/or where indicated on the drawings for protection, control and monitoring of the motors. The OLR shall meet UL 1053, CUL and CSA standards
2. The relay shall not require external current transformers for applications up to 150 amperes for motors rated less than 600 Vac. Where larger motors are involved, external current transformers shall be used. The relay shall include terminals for remote trip and remote reset.
3. The OLR shall have the following motor control functions:
    a. Fault relay, Form C, NO/NC contact with a rating code of B300 per UL 508.
    b. Ground fault relay, Form A, NO contact with a rating code of B300 per UL 508.
    c. External remote reset terminal
    d. Trip status indicator
4. The OLR shall be capable of accommodating external current transformers with ranges from 150:5, 300:5, and 600:5 amperes. Provide three (3) current transformers sized per manufacturer's recommendations based on motor full-load amperes and service factor.
5. The OLR shall draw its power from the line-voltage input for the motor. The OLR shall be suitable for either 50 Hz or 60 Hz
6. The OLR shall have selectable trip classes 5-30.
7. The OLR shall be equipped with an operator-interface (OI)/ display interface panel. The OI shall have a seven-segment display for programming, monitoring, and alarming functions.
8. The OLR shall annunciate the following conditions:
    a. Motor Protection consisting of:
        1) Thermal overload
        2) Jam protection
        3) Current unbalance
        4) Current phase loss
        5) Ground fault
        6) Phase reversal
        7) Load protection consisting of :
            a) Under-current
            b) Low power (kW)
            c) High power (kW)
        8) Line Protection consisting of:
            a) Over-voltage
            b) Under-voltage
            c) Voltage unbalance
            d) Voltage phase unbalance
9. The OLR shall have the following monitoring capabilities:
    a. Current—Average and Phase RMS
    b. Voltage—Average and Phase RMS

c. Power—Motor kW
d. Power Factor
e. Frequency
f. Thermal capacity
g. Run hours
h. Ground fault current
i. Current unbalance %
j. Voltage unbalance %

10. The OLR shall be equipped with Ethernet/IP Communications from remote monitoring and load shed control from SCADA. Reduced voltage starters shall be combination, closed transition, solid state type. Reduced voltage starters shall be provided with shorting contactors.

D. Two speed magnetic starters shall be for two winding two speed motors. Starters shall be combination type with dual sets of overload relays, hand-off-automatic switch and fast-slow-stop selector switch and "hi-low" pilot lamps. Starters shall contain a time-delay relay, adjustable from 0 to 30 seconds factory set at 20 seconds, which will interrupt power to the motor for the duration of the time settings.

E. VARIABLE FREQUENCY DRIVES (VFD)

1. References
   a. The VFD controller shall meet or exceed the requirements within the following standards for VFDs.
      1) NFPA 70
      2) UL 508C
      3) NEMA ICS 3.1
      4) NEMA 250
      5) IEEE 519

IEEE 519 Reference Table

NOTE: Vendor to provide harmonic analysis study as part of submittal process to ensure provided equipment is in compliance with this standard.

Harmonic Current Distortion Limits (I_h and TDD) in % of I_L (≤ 69kV)

I_{SC}/I_L Ratio	I_h <11	11≤ I_h <17	17≤ I_h <23	23≤ I_h <35	TDD
<20	4.0	2.0	1.5	0.6	5.0
20-50	7.0	3.5	2.5	1.0	8.0
50-100	10.0	4.5	4.0	1.5	12.0
100-1000	12.0	5.5	5.0	2.0	15.0
>1000	15.0	7.0	6.0	2.5	20.0

The voltage distortion guidelines for IEEE-1992 (at 480V) remain the same as IEEE 519-1981:

3% - Special systems (i.e. hospitals or universities)

5% - General systems

10% - Dedicated systems (AFD's only)
NOTE: The point of analysis shall be the secondary side of the utility transformer. (480V)

2. Design Requirements
   a. Provide VFD controllers in accordance with the detailed specifications and plans.
3. Submittals
   a. Shop drawings are required with the following:
      1) Fault ratings.
      2) Unit descriptions, including amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, pilot devices, etc.
      3) Schematic wiring diagrams.
4. Warranty
   a. The VFD manufacturer shall provide a Parts and Labor warranty for the VFDs that extends 24 months from the date of start-up or 18 months from the date of Project Acceptance, whichever expires first.
5. Manufacturers
   a. Square D Altivar 61
   b. Eaton SVX9000
   c. Danfoss VLT Aqua
   d. GE AF-650
6. Ratings
   a. Voltage: Unless shown differently on the plans, the VFD shall be rated for a 480V (+/- 10%), 3-phase system.
   b. For VFD controllers greater than 5HP, the displacement power factor shall range between 1.0 and 0.95 lagging, over the entire speed range.
   c. Efficiency: Minimum of 97% at full load and speed.
   d. Environmental Ratings:
      1) Operating ambient temperature range (NEMA 4X): 0° C to 40° C.
      2) Relative humidity range: 5% to 95% non condensing.
   e. Output Power Ratings:
      1) The output voltage shall be adjustable from 0 to rated motor voltage.
      2) The output frequency range shall be adjustable from 0 to 320 Hz.
      3) The inverter section shall produce a pulse-width-modulated (PWM) waveform using latest generation insulated gate bipolar transistors (IGBTs).
   f. Sizing:
      1) Unless otherwise noted on the plans, all loads are normal-duty loads.
      2) The VFD manufacturer shall size each VFD based on the following normal-duty requirements:

i. VFD continuous output amps rating shall be higher than the Full Load Amps (FLA) of the motor that it is to control.
ii. VFD 1-minute overload output amps rating shall be a minimum of 110% higher than the FLA of the motor that it is to control.
iii. VFD 3-second overload output amps rating shall be a minimum of 150% higher than the FLA of the motor that it is to control.

7. Enclosure
   a. The VFD shall be mounted within the motor control center.
8. VFD Controller Features
   a. Overload Protection
      1) The drive shall provide internal Class 10 motor overload protection investigated by UL to comply with N.E.C. Article 430.
      2) Overload protection shall be speed sensitive and adjustable.
   b. Terminal Blocks
      1) Separate terminal blocks shall be provided for control and power wiring.
   c. Flying Start
      1) The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick up" the motor at the rotating speed.
9. VFD System Options
   a. Harmonic Mitigation
   b. High System Harmonic Influence VFD Controllers shall be provided with 3% line reactors and passive filters (IEEE 519 – 1992 compliant):
      1) Other harmonic mitigation designs, including Active Filters and Active Front Ends, are not allowed.
   c. Hand-Off-Auto Selector Switch
      1) Provide a "Hand/Off/Auto" selector switch for start-stop control.
      2) Provide pilot lights for indication of the "Hand" and "Auto" modes.
      3) The devices shall be NEMA Type 4/4X/12 (minimum 22.5mm diameter), mounted on the drive system enclosure door.
   d. Pilot Lights
      1) Provide pilot lights, mounted on the enclosure door, for indication of Control Power On, Run, and Drive Fault (others if indicated on the plan drawings).
      2) The devices shall be NEMA Type 4/4X/12 (minimum 22.5mm diameter), mounted on the drive system enclosure door.
   e. Speed Potentiometer
      1) Provide a NEMA Type 1/4/12 single turn speed pot mounted on the drive system enclosure door.

f. Communications
    1) Provide Ethernet/IP communications for remote control from SCADA.

10. Manufacturer's Services
    a. The VFD Manufacturer shall provide start-up services for the VFDs. The start-up services shall be performed by a trained Field Service Engineer who is an employee of the VFD manufacturer and a degreed engineer. All costs (travel, expenses, potential stand-by time) shall be included in the start-up services. The VFD manufacturer shall be responsible for coordinating with the Equipment Supplier and Installer to avoid/minimize stand-by time. Per VFD, a minimum of 4 hours on-site service shall apply for VFDs rated 77A or below. Per VFD, a minimum of 6 hours on-site service shall apply for VFDs rated above 77A.
    b. At a minimum, the start-up service shall include:
        1) Pre-Power Check
            i. Megger motor resistances: phase-to-phase and phase-to-ground.
            ii. Verify system grounding per manufacturer's specifications.
            iii. Verify power and ground signals.
            iv. Check connections.
            v. Check environment.
        2) Power-Up and Commissioning
            vi. Measure incoming power: phase-to-phase and phase-to-ground.
            vii. Measure DC bus voltage.
            viii. Measure AC current: unloaded and loaded.
            ix. Measure output voltage: phase-to-phase and phase-to-ground.
        3) Record all measurements.
        4) Tune for system operation.
        5) Provide final parameter listing.

11. Training
    a. The VFD manufacturer shall provide (1) 6-hour on-site training course for up to 6 students on the basic operation, maintenance, and troubleshooting of the VFDs and reduced voltage solid state starters utilized on the project. If VFDs are supplied in a combination of Specification Sections by different Equipment Suppliers, then only one VFD training session is required. This training will be conducted on (1) trip. Coordination shall be the responsibility of the Equipment Suppliers. All costs (travel and expenses) shall be included.
    b. At a minimum, the training shall include:
        1) Review of the final plans identifying major components.
        2) Review starting/stopping procedures and options for the various controllers/starters.

3) Review operation of the Human Interface Modules (if applicable for programming and monitoring of the system(s).
4) Review the maintenance requirements of the system(s).
5) Review safety concerns of the system(s).
6) Hands-On Labs (max two students per VFD demo).
7) Review of Support Sources and contacts

F. Individual starter doors and individual overcurrent device doors shall be interlocked to prevent door from being opened until switch is in "OFF" position. However, a "cheater screw" or other inconspicuous means shall be provided to permit access to energized starter, by authorized personnel. An interlock contact shall be provided within the starter to open control circuit to magnetic starter when device handle is in the open position. A door activated interlock switch is not acceptable.

G. Each magnetic starter shall be provided with HOA switch, as indicated on the drawings. Where no device is indicated on the drawings, provide an HOA switch for any motors automatically controlled or an ON-OFF switch for those specified to be manually controlled. Provide each magnetic starter with a "RUN" and an "OVERLOAD" pilot lamp. Control devices shall be of oil tight construction and shall be mounted on a removable panel on the unit door. Identify each control device with a metal tag or plastic laminated label.

H. Thermal overload protection shall be adjustable and manually reset solid state type, settings shall be coordinated in accordance with full load rating of motors actually furnished. Relay switching mechanism shall be single pole, double throw with normally open position connected to operate a door mounted, oil tight blue pilot lamp to indicate starter has tripped on overload. A thermal overload schedule applicable to control centers shall be provided on inside of door of each magnetic starter.

I. Control voltage for magnetic starters shall be 120 volts obtained from a individual control power transformers in each magnetic starter. Each control power transformer shall be fused.

J. Provide contacts in magnetic starters to provide interlocking control sequence of operation specified under other Divisions. Provide one normally open and one normally closed spare auxiliary contact in each starter.

K. Starter sizes are based on design conditions using horsepower ratings of motors indicated on drawings. If motors actually furnished have horsepower ratings other than those indicated, motor starters and feeders shall be adjusted in accordance with the rated horsepower at no additional cost to the Owner.

L. Provide, where indicated, molded case circuit breakers for feeder protection. All circuit breakers shall have UL interrupting rating of not less indicated on the drawings, at system voltage.

2.05 AUXILIARY EQUIPMENT

A. Identification:
   1. The motor control center, each magnetic starter, each feeder protective device, and each auxiliary equipment item shall be provided with an engraved plastic nameplate approximately 1" x 3" permanently attached to the unit exterior door with self-tapping screws. Refer to ELECTRICAL IDENTIFICATION section.
   2. Refer to the basic electrical requirements section of these specifications for nameplate requirements.
   3. Submit complete schedule with the shop drawings listing all nameplates and information thereon.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install motor control center on 3" high concrete pad, the horizontal dimensions of which shall exceed the base dimensions of the motor control center by 3" on all sides.

B. Control and power circuits shall terminate in respective section in which starter is located.

C. Lace and group conductors installed in motor control center with nylon tie straps. Only one conductor shall be installed under each terminal. Form and train conductors in enclosure neatly parallel and at right angles to sides of box. Uninsulated conductor shall not extend beyond one-eighth inch from terminal lug.

D. Do not splice conductors in motor control center. Where required, installed junction box adjacent to enclosure and splice or tap conductors in box. Refer to number of conductors in a conduit limitation defined in the wires and cables section section of the specifications and do not exceed.

E. Conductors not terminating in motor control center section or unit shall not extend through or enter the section or unit.

F. Maintain conductor phase color code requirement described in the wires and cables section of the specifications.

3.02 CLEANING AND ADJUSTMENT

A. After completion, clean the interior and exterior of dirt, paint and construction debris.

B. Touch up paint all scratched or marred surfaces with factory furnished touch up paint of the same color as the factory applied paint.

C. Select and install overload heaters based on the full load current of the motor actually installed. All heaters in a starter shall be of the same size.

3.03 IDENTIFICATION

A. Refer to the ELECTRICAL IDENTIFICATION section of these specifications for identification requirements.

3.04 FIELD QUALITY CONTROL

A. Refer to the ELECTRICAL EQUIPMENT ACCEPTANCE TESTING section of this specification.

B. Contractor shall verify in the field that all factory-made connections and terminations are torqued to manufacturer's recommended tolerances.

SECTION 16501

LAMPS

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of lamps in all interior and exterior lighting fixtures. All materials shall be provided under this section of the specifications.

1.03 QUALITY ASSURANCE

A. All lamps provided under this section shall be UL listed and labeled.

B. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this specification by reference.
   1. IES LIGHTING HANDBOOK - REFERENCE & APPLICATION VOLUME, 9^{th} Ed.
   2. LM 9 ELECTRICAL AND PHOTOMETRIC MEASUREMENT OF FLUORESCENT LAMPS
   3. LM 15 COLORIMETRY OF LIGHTING SOURCES
   4. LM 20 ELECTRICAL AND PHOTOMETRIC TESTING OF REFLECTOR TYPE LAMPS
   5. LM 40 LIFE PERFORMANCE TESTING OF FLUORESCENT LAMPS
   6. LM 45 ELECTRICAL AND PHOTOMETRIC MEASUREMENT OF GENERAL SERVICE INCANDESCENT FILAMENT LAMPS.
   7. LM 47 LIFE PERFORMANCE TESTING OF HID LAMPS
   8. LM 54 GUIDE TO LAMP SEASONING

C. Acceptable manufacturers: Products of the following manufacturers, which comply with these specifications, are acceptable.
   1. General Electric
   2. North American Philips
   3. Osram-Sylvania
   4. Ushio

1.04 SHOP DRAWINGS

A. Submit shop drawings for each type of lamp specified. Refer to Division 1 GENERAL REQUIREMENTS.

B. Drawings shall indicate lamp type and complete details. A complete listing of fixture type, and complete lamp catalog number shall be supplied with the shop drawings.

C. Manufacturer's catalog cuts will be acceptable for review if the cut represents the lamp type exactly as specified without any modifications.

D. Provide written verification from the lamp and ballast manufacturer for each energy saving lamp and ballast combination that this particular pairing will provide full rated lamp output and restart without flicker or delay. Submittals without this verification will be rejected.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

A. All materials shall be new, free from defects and shall be listed by, or bear the Underwriters Label.

B. Lamp wattages for each fixture type are specified in the fixture schedule. Unless a manufacturer is specified, in the lamp schedule, lamps as manufactured by those manufacturers listed above are acceptable. Coordinate lamp ANSI ordering code and/or product code with the exaxt fixture used for each fixture type.

2.02 FLUORESCENT LAMPS

A. Unless otherwise specified lamps shall be Extra long life(52000 hr), extra low mercury (1.7mg), 3500˚K 2950Lm, 85CRI, F32T8.

B. Energy saving lamps shall be used only with ballast types that provide full rated light lumens.

C. Fluorescent lamps shall be used with high frequency electronic ballasts only.

2.03 HID LAMPS

A. Metal-Halide lamps with a color shift after 100 hours of operation shall be replaced with no additional cost to the Owner.

B. Unless otherwise specified, all Metal-Halide lamps shall be phosphor coated.

C. All metal halide lamps used in open fixtures where people may be exposed to ultraviolet radiation shall be the type which will automatically extinguish when the outer envelope is broken or punctured. This feature shall be provided regardless of the lamp ordering code listed in the fixture schedule.

D. Coordinate lamp burning position of HID lamps with fixture orientation and mounting. Provide lamp burning position compatible with application.

E. All high pressure sodium lamps shall be clear, unless otherwise specified.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All lamps shall be installed in the fixtures for which they are specified. Any lamps which fail up to and including the day the project is accepted by the Owner as substantially complete shall be replaced with an identical new lamp from the same lamp manufacturer.

SECTION 16502

BALLASTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of ballasts in all interior and exterior lighting fixtures. All materials shall be provided under this section of the specifications.

1.03 QUALITY ASSURANCE

A. All ballasts provided under this section shall be UL listed and labeled or bear the CBM label.

PART 2 - PRODUCTS

2.01 FLUORESCENT BALLASTS

A. Linear fluorescent ballasts shall be electronic, high frequency type, with a frequency of 20 khz or higher. Total harmonic distortions shall be 20% or less with the specified lamp and shall operate at a power factory of 98% or greater. The crest factor shall be less than 1.7 in accordance with the lamp manufacturer's recommendations and ANSI C82.11. The audible sound rating shall be Class A or better.

B. Ballasts used for exterior applications shall be rated at -20°F, where the ballast is exposed to the weather it shall be in a weather proof container.

C. Fluorescent ballasts shall be individually fused with GLR slow blow fuses.

2.02 HIGH INTENSITY DISCHARGE BALLASTS

A. Ballast for high intensity discharge fixtures shall be self contained high power factor, regulating type, with voltage regulation of + or - 10%, (+7.5%, -10% for 400 watt or 1000 watt high pressure sodium) and crest factor of not more than 1.8 Ballast shall be as indicated in fixture schedule. Primary starting current shall not exceed operating current. Ballast in luminaires installed out of doors shall have ambient temperature rating of -20°F. Ballast for high intensity discharge fixtures, installed indoors, shall be encapsulated core and coil type with vibration dampening mounting. HID ballasts shall be KTK fused.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Ballasts shall be installed within lighting fixtures by the fixture manufacturer prior to delivery to jobsite. All installation shall be in accordance with applicable standards.

SECTION 16503

LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of all lighting poles and standards for both the interior and exterior of the project. All materials shall be provided under this section of the specifications.

1.03 QUALITY ASSURANCE

A. All lighting poles and standards shall be manufactured according to the recommended standards as provided by the American Society for Testing Materials.

B. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this specification by reference.
   1. American Society for Testing Materials (ASTM).
   2. American Association of State Highway Transportation Officers (AASHTO).

C. Acceptable Manufacturers: Products of the following manufacturers which comply with these specifications are acceptable.
   1. Poles and Standards
      a. Union Metal Corporation
      b. Valmount
      c. Millerbernd

1.04 SHOP DRAWINGS

A. Submit shop drawings for each type of fixture specified. Refer to Division 1 - General Requirements.

B. Drawings shall indicate fixture type and complete details. A complete listing of fixture type, manufacturer and complete catalog number shall be supplied with the shop drawings.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

A. All materials shall be new, free from defects and shall be listed by, or bear the underwriters label where subject to such approval.

B. All poles and standards shall be supplied with base covers and/or nut covers.

C. Concrete bases and pedestals are not a portion of this specification. Refer to the Concrete sections of this specifications.

2.02 POLES AND STANDARDS - STEEL

A. Lighting poles and standards shall be manufactured from steel having the following minimum yield strengths:
   1. Pole Shaft: 55,000 psi
   2. Base Plate: 36,000 psi
   3. Anchor Bolts: 55,000 psi
   4. Pipe Tenons: 35,000 psi

B. Where lighting poles are specified with a prime or paint finish, the interior of the pole shall be completely finished with a rust-inhibiting finish.

C. Where Galvanized finish is specified, poles shall be hot dipped in accordance with ASTM-A153.

D. All anchor bolts and nuts shall be galvanized in accordance with ASTM-A153.

E. Where poles are specified with a finish coat of paint, the finish coat shall be a minimum of 2 mils thick. Each pole shall be individually wrapped with a Kraft type paper prior to shipment to the job site.

F. Where poles are vertically seamed and welded the weld shall be ground smooth so as not to be readily visible.

G. Steel poles designed for direct burial shall be coated with a bituminous paint below the ground line.

2.03 POLES AND STANDARDS - ALUMINUM

A. Lighting poles and standards shall be manufactured from aluminum having the following strengths:
   1. Pole Shaft: 6063-T6
   2. Base Plate: 356-T6
   3. Pipe Tenons: 6063-T6

4. Anchor Bolts: 55,000 psi

B. Where lighting poles are specified with a painted finish the pole shall be coated with zinc chromate primer or acid etched prior to painting.

C. Where poles are specified with a finish coat of paint, the finish coat shall be a minimum of 2 mils thick. Each pole shall be individually wrapped with a Kraft type paper prior to shipment to the job site.

D. Base plates, handhole covers and all welds shall be coated with zinc chromate primer prior to painting.

E. Aluminum poles designed for direct burial shall be coated with a bituminous paint below the ground line.

F. All anchor bolts and nuts shall be galvanized in accordance with ASTM-A153.

2.04 POLES AND STANDARDS - HIGHMAST

A. Lighting poles and standards shall be manufactured from steel having the following minimum yield strengths:
   1. Pole Shaft 65,000 psi
   2. Base Plate 60,000 psi
   3. Anchor Bolts 105,000 psi

B. Where lighting poles are specified with a prime or paint finish, the interior of the pole shall be completely finished with a rust-inhibiting finish.

C. Where galvanized finish is specified, poles shall be hot dipped in accordance with ASTM-A153.

D. All anchor bolts and nuts shall be galvanized in accordance with ASTM-A153.

E. Where poles are specified with a finish coat of paint, the finish coat shall be a minimum of 2 mils thick. Each pole shall be individually wrapped with a Kraft type paper prior to shipment to the job site.

F. Where poles are vertically seamed and welded the weld shall be ground smooth so as not to be readily visible.

G. Telescoping joints shall have a minimum overlap of one and one half times the diameter of the pole less 2 inches.

H. Handhole openings will be reinforced with a doubler plate around the handhole opening.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Lighting poles and standards shall be installed per the manufacturers recommended mounting methods and the provisions of the drawings as noted.

B. Where lighting poles are installed with anchor bolts, the area between the pedestal and the base plate shall be grouted and smoothed after the pole has been leveled.

C. The design and specification of concrete anchor bases and pedestals is not a portion of this specification, drawings of anchor bases or pedestals are for conduit detail only.

D. When poles are supplied with a finish coat of paint the supplier shall provide one pint of touch up paint with the poles.

E. When the handhole in the base of the pole is not of sufficient size to allow the splicing of branch circuiting as indicated on the drawings in accordance with NEC fill requirements, then a weather-proof junction box shall be installed flush with finished grade adjacent to the pole. Extend only the conductors required for the adjacent pole from the junction box to the handhole in the pole base. The junction box shall be provided in accordance with the BOXES section of these specifications.

SECTION 16510

INTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of all lighting fixtures within the building. Lighting fixtures attached to the exterior of the building are included in the EXTERIOR LIGHTING FIXTURES section of this specification.

1.03 QUALITY ASSURANCE

A. All lighting fixtures shall be UL listed and labeled or manufactured from UL components.

B. Referenced Industry Standards: The following specifications and standards are incorporated into and become a part of this specification by reference.
   1. IES LIGHTING HANDBOOK – REFERENCE AND APPLICATION VOLUME, 9th Ed.
   2. LM 41 PHOTOMETRIC TESTING OF INDOOR FLUORESCENT LUMINARIES
   3. LM 46 PHOTOMETRIC TESTING OF INDOOR LUMINARIES USING HID LAMPS

1.04 SHOP DRAWINGS

A. Submit shop drawings for each type of fixture specified. Refer to Division 1 GENERAL REQUIREMENTS.

B. Drawings shall indicate fixture type and complete details. A complete listing of fixture type, manufacturer and complete catalog number shall be supplied with the shop drawings.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

A. All materials shall be new, free from defects and shall be listed by or bear the Underwriters' Label where subject to such approval.

B. All fixtures installed in damp areas as classified by Article 100 of the National Electric Code shall be UL listed and labeled as suitable for damp locations. All fixtures installed in wet areas as classified by the National Electric Code shall be UL listed and labeled as suitable for wet locations.

C. Reference BALLASTS section of this specification.

2.02 FIXTURES - FLUORESCENT

A. Fluorescent fixtures shall not be manufactured with less than code gauge steel.

B. Hinged doors shall be gasketed on all sides to prevent light leaks.

C. Where fixtures are specified with a plastic prismatic lens the lens shall be manufactured of UV stabilized virgin acrylic. The lens shall be not less than 0.125 nominal thickness +.005 - .010.

D. Where prismatic wrap fixtures are specified the lens shall have a DR type additive.

2.03 FIXTURES - HID

A. Recessed HID fixtures shall be the prewired type with junction box and flexible conduit with fixture wire mounted on the fixture frame by the manufacturer, unless otherwise specified.

B. HID fixtures installed in nonaccessible ceilings shall provide bottom access to the junction box, regardless of the catalog number on the drawings.

C. HID fixtures with Metal-Halide lamps shall have a protective glass lens and shall be rated by the manufacturer to withstand an arc-tube rupture. Provide arc-tube rupture testing data in shop drawing submittals.

D. Ceiling trims for square or rectangular recessed fixtures shall have mitered corners, continuously welded and smoothed before finish is applied. No lapping of metal strip will be permitted.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Lighting fixtures shall be installed per the manufacturers recommended mounting methods and the provisions of the drawings as noted.

B. It is the contractors responsibility to review the architectural plans and specifications to verify the mounting compatibility of the lighting fixtures with the ceiling type before fixtures are released for ordering and manufacture. Catalog numbers on the drawings which do not require plaster frames, for instance, do not relieve the Contractor of the responsibility for providing accessories required for each ceiling type.

C. Safety chains or clips shall be installed on all suspended or grid ceiling type fixtures. Clips or screws shall fasten to the main ceiling runner only; do not connect to secondary runner. Metal channel which spans and connects to the main ceiling runners shall be used in lieu of secondary runners.

D. Fixtures shall be installed so that no labels will be visible under normal operating conditions of the fixture.

E. All installed fixtures shall be cleaned and free of fingerprints prior to final acceptance.

3.02 FLUORESCENT FIXTURES

A. Fluorescent fixtures flush mounted in exposed Tee suspended acoustical tile ceilings shall be of the lay-in type which shall rest on and be supported by the main runners of the ceiling support systems. Each fixture installation shall be attached to the main runners at each end with clips intended for that purpose.

B. Fluorescent fixtures mounted in concealed suspension system type suspended acoustical tile ceilings, or in plaster, stucco or sheet rock ceilings shall be supported by adjustable brackets, integral with the fixture, resting on support channels of the ceiling suspensions system. Brackets shall be adjustable from inside the fixture and shall be constructed to insure compliance with Article 410-16c of the National Electrical Code.

C. Surface mounted fluorescent fixtures shall be supported by light weight channel (16 ga. 3/4" x 5") attached by nylon tie straps to two members of the ceiling suspension system. Two support channels are required for each four foot fixtures. Surface mounted fluorescent fixtures with ballasts rated at 800 ma. shall be mounted with 2" spacers between the fixture and the ceiling. Surface mounted fluorescent fixtures with ballasts rated at 1500 ma. shall be mounted with 6" spacers between the fixture

and the ceiling. Surface mounted fixtures mounted on low density acoustical tile ceilings shall be specifically rated for low density acoustical tile mounting.

D. Where fluorescent fixtures are specified to be pendant mounted type, pendants, hanger rods or conduits used for mounting shall be attached to ceiling mounted junction box or pendant, rod or conduit attachment with light weight channel attached by nylon tie straps to two members of ceiling suspension system.

3.03 HID FIXTURES

A. Interior High Intensity Discharge Fixtures shall be supported in the manner specified for fluorescent fixtures.

SECTION 16511

EXTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of all exterior and landscape lighting fixtures. Lighting fixtures attached to the exterior of the building are included in this section of the specifications. All materials shall be provided under this section of the specifications.

1.03 QUALITY ASSURANCE

A. All lighting fixtures shall be UL listed and labeled or manufactured from UL components.

B. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this specification by reference.
   1. IES LIGHTING HANDBOOK - REFERENCE & APPLICATION VOLUME, 9^{th} Ed.

1.04 SHOP DRAWINGS

A. Submit shop drawings for each type of fixture specified. Refer to Division 1 GENERAL REQUIREMENTS.

B. Drawings shall indicate fixture type and complete details. A complete listing of fixture type, manufacturer and complete catalog number shall be supplied with the shop drawings.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

A. All materials shall be new, free from defects and shall be listed by, or bear the Underwriters Label where subject to such approval.

B. All fixtures installed in damp areas as classified by article 100 of the National Electric Code shall be UL listed and labeled as suitable for damp locations. All fixtures installed in wet areas as classified by the National Electric Code shall be UL listed and labeled as suitable for wet locations.

2.02 FIXTURES - FLUORESCENT

A. Fluorescent fixtures used for exterior use shall be UL wet labeled.

B. Fluorescent fixtures for exterior use shall have 0°F ballasts.

C. Surface mounted fluorescent fixtures shall be mounted on junction boxes rated for below grade mounting. Above grade junction boxes will not be allowed.

2.03 FIXTURES - HID

A. HID fixtures for exterior use shall have -20° ballasts.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Lighting fixtures shall be installed per the manufacturers recommended mounting methods and the provisions of the drawings as noted.

B. Fixtures shall be installed so that no labels will be visible under normal operating conditions of the fixture.

C. All installed fixtures shall be cleaned and free of fingerprints prior to final acceptance.

D. Lighting fixtures mounted on lighting poles or standards shall not exceed the maximum rated weight or EPA wind loading for that pole or standard.

SECTION 16535

EMERGENCY LIGHTING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. The work required under this section of the specifications consists of the installation of all emergency lighting fixtures within the building. All materials shall be provided under this section of the specifications.

1.03 QUALITY ASSURANCE

A. All lighting fixtures and battery packs shall be UL listed and labeled.

B. Referenced Industry Standard: The following specifications and standards are incorporated into and become a part of this specification by reference.
   1. IES LIGHTING HANDBOOK - REFERENCE & APPLICATION VOLUME, 9^{th} Ed.
   2. UL 924 Jan. 2009

C. Acceptable Manufacturers: Products of the following manufacturers which comply with these specifications are acceptable.
   1. Bodine
   2. Lightalarms
   3. Beghelli
   4. Sure-Lite
   5. Emergi-Lite
   6. Cloride
   7. Exide
   8. ELS
   9. High-Lites

1.04 SHOP DRAWINGS

A. Submit shop drawings for each type of fixture specified. Refer to Division 1 GENERAL REQUIREMENTS.

B. Drawings shall indicate fixture type and complete details. A complete listing of fixture type, manufacturer and complete catalog number shall be supplied with the shop drawings.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

A. All materials shall be new, free from defects and shall be listed by, or bear the Underwriters Label where subject to such approval.

B. All fixtures installed in damp areas as classified by Article 100 of the National Electrical Code shall be UL listed and labeled as suitable for damp locations. All fixtures installed in wet areas as classified by the National Electrical Code shall be UL listed and labeled as suitable for wet locations.

2.02 EMERGENCY INCANDESCENT FIXTURES

A. Battery operated emergency incandescent fixture cases shall not be manufactured with less than 18 gauge steel.

B. Battery operated emergency incandescent fixtures shall have pure lead or lead calcium batteries and shall provide 85% nominal light output for a period of 90 minutes.

C. Wall mounted type battery operated fixtures shall be fed from a junction box and not be of the cord and plug type. A light emitting diode shall be positioned on the fixture to provide a visual indication that the emergency power system is operable. The output of the diode shall be a bright red glow. A test button shall be provided adjacent to the visual signal, to simulate a power failure. Where indicated on the drawings a remote wall switch with the plate engraved "Emergency Lighting System Test Switch" shall be provided for each room.

2.03 EMERGENCY EXIT SIGNS

A. Exit signs shall be in compliance with UL 924 dated January 13, 2009.

B. Battery operated exit fixtures shall be fed from a junction box and not be of the cord and plug type. A light emitting diode shall be positioned on the fixture to provide a visual indication that the emergency power system is operable. The output of the diode shall be a bright red glow. A test button shall be provided adjacent to the visual signal, to simulate a power failure. Where the test button is not readily accessible, a remote wall switch with the plate engraved "Emergency Lighting System Test Switch" shall be provided for each room.

C. Battery operated exit fixtures shall have nickel-cadmium batteries.

D. Provide fixture with a self-diagnostic module.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Emergency lighting fixtures shall be installed per the manufacturers recommended mounting methods and the provisions of the drawings as noted.

B. It is the contractors responsibility to review the architectural plans and specifications to verify the mounting compatibility of the lighting fixtures with the ceiling type before fixtures are released for ordering and manufacture.

C. Safety chains or clips shall be installed on all suspended or grid ceiling type fixtures.

D. Fixtures shall be installed so that no labels will be visible under normal operating conditions of the fixture.

E. All installed fixtures shall be cleaned and free of fingerprints prior to final acceptance.

F. All battery operated emergency fixtures shall be individually operated and tested prior to being turned over the Owner.

SECTION 16960

ELECTRICAL EQUIPMENT ACCEPTANCE TESTING

PART 1 - GENERAL

3.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

3.02 SUMMARY

A. The work required under this section of the specifications consist of the start-up testing and inspection of the electrical equipment designated within. All labor and testing equipment which is required shall be provided under this section of the specifications.

3.03 GENERAL

A. The Contractor shall perform the tests, or employ a testing company, as outlined below to insure system acceptance of the electrical equipment as specified in this section.

B. When the tests and inspections have been completed, a label shall be attached to all devices tested. The label shall provide the name of the testing company, the date the tests were completed, and the initials of the technician who performed the tests.

C. The tests shall insure that the equipment is operational and functioning within industry standards and manufacturer's tolerances. Forward all test reports to the engineer at least two weeks prior to the project final inspection for review. Reports shall be bound as required by Division 1 of this specification.

3.04 QUALITY ASSURANCE

A. The testing and inspection shall comply with all applicable sections of the following codes and standards:
    a. American National Standards Institute - ANSI
    b. American Society for Testing and Materials - ASTM
    c. Association of Edison Illuminating Companies - AEIC
    d. Institute of Electrical and Electronics Engineers - IEEE
    e. Insulated Power Cable Engineers Association - IPCEA

f. International Electrical Testing Association - NETA Acceptance Testing Specifications
g. National Electrical Code - NEC
h. National Electrical Manufacturers Association - NEMA
i. National Fire Protection Association - NFPA
j. State and Local Codes and Ordinances

B. The inspection and testing shall comply with the project plans and specifications as well as with the manufacturer's drawings, instruction manuals, and other applicable data for the apparatus tested.

3.05 DIVISION OF RESPONSIBILITY

A. The contractor shall perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.

B. The contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.

C. The contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

D. The contractor is responsible for obtaining and approving a short-circuit analysis and coordination study prepared by the switchgear manufacturer.

E. The contractor shall notify the Engineer prior to commencement of any testing.

F. Any system, material or workmanship which is found defective on the basis of acceptance tests shall be reported to the Engineer.

G. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

3.06 SAFETY AND PRECAUTIONS

A. Safety practices shall comply with applicable state and local safety orders as well as with the Occupational Safety and Health Act of 1970 (OSHA). Compliance with the National Fire Protection Association standard NFPA 70E and the Accident Prevention Manual for Industrial Operations of the National Safety Council shall be observed.

B. Tests shall only be performed on apparatus which is de-energized. The testing company's lead test engineer for the project shall be a designated safety representative and shall supervise testing observations and safety requirements. Work shall not proceed until he has determined that it is safe to do so.

C. Power circuits shall have conductors shorted to ground by a hotline grounded device approved for the purpose. Warning signs and protective barriers shall be provided as necessary to conduct the tests safely.

3.07 REPORTS

A. The test report shall include the following sections:
   1. Scope of testing
   2. Equipment tested
   3. Description of test
   4. Test results
   5. Conclusions and recommendations
   6. Appendix, including test forms

B. Each piece of equipment shall be recorded on a data sheet listing the condition of the equipment as found and as left. Included shall be recommendations for any necessary repair and/or replacement parts. The data sheets shall indicate the name of the engineer who tested the equipment and the date of the test completion. All test reports shall bear the seal of an electrical engineer registered in the project state.

C. Record copies of the completed test report shall be submitted no more than 30 days after completion of the testing and inspection.

3.08 TEST EQUIPMENT

A. All test equipment shall be in good mechanical and electrical condition. All field instruments shall have been calibrated within six months of the testing date, and dated calibration labels shall be visible on the testing equipment. Submit calibration certification in the final report.

PART 2 - PRODUCTS

3.01 MATERIALS

A. All materials are specified under other sections of this specification. All testing equipment required shall be provided under this section of the specifications.

PART 3 - EXECUTION

3.01 EQUIPMENT TO BE TESTED

A. The following equipment shall be tested in accordance with the scopes of work which follow.
   1. Dry Type Transformers
   2. Low Voltage Switchgear and Switchboards
   3. Low Voltage Power Circuit Breakers and InsulatedCase Circuit Breakers
   4. Molded Case Circuit Breakers
   5. Motor Control Centers and Motor Controllers
   6. Automatic Transfer Switches
   7. Emergency Power Supply-Engine Driven
   8. Lighting Control System
   9. Grounding System
   10. Cables, Low Voltage, 600 Volts Maximum
   11. Ground Fault Systems
   12. Surge Arrestors

3.02 DRY TYPE TRANSFORMERS

A. Visual and Mechanical Inspection
   1. With case covers removed, inspect transformer core and coil assembly and enclosure interior. Cloth wipe and/or brush major insulating surfaces.
   2. Check primary, secondary, and ground connections.
   3. Check tap connections and tap changer.
   4. Inspect all bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.
   5. Inspect insulators, spacers, and windings.
   6. Inspect for adequate electrical clearance.
   7. Check base or support insulators, including vibration isolation supports.
   8. Check accessory devices for condition and proper operation.
   9. Verify that the transformers have been provided with adequate spacing for ventilation.

B. Electrical Tests
   1. Insulation Resistance Test: Megger transformer windings high to low and ground, low to high and ground, and high and low to ground.
   2. Where auxiliary cooling has been provided, verify proper operation of such equipment.
   3. Include measured secondary voltage (line-to-line and line-to-ground) for each transformer in the test report. Verify that the taps on all transformers with primary voltages above 600 volts are set to deliver voltage indicated in the Contract Documents with the system in full operation. Secondary voltage readings, at each transformer, phase to phase neutral, and phase load readings

shall be recorded and tap positions of transformer taps noted. This test shall be conducted with a calibrated voltmeter.

4. Each ground rod installation shall be tested after all connections to ground rods are made before grounding conductor connection is made to the transformer. Ground rod installations shall be tested by "fall of potential" measuring method using ground resistance test meter and two auxiliary electrodes driven into the earth, interconnected through the meter with the ground rod installation being tested.
5. Placement of auxiliary electrodes shall be in accordance with operating instructions of test meter, but in no case shall auxiliary current electrodes be placed within 70' of the grounding system being tested. Test data shall indicate placement of auxiliary electrodes with respect to systems being tested, date readings were taken and lowest resistance recorded.

3.03 LOW VOLTAGE SWITCHGEAR AND SWITCHBOARDS

A. Visual and Mechanical Inspection
1. Verify that the contractor has cleaned enclosure interiors of accumulated dust, dirt, oil films, and other foreign materials.
2. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.
3. Check for proper travel and alignment of any drawout or plug-in circuit breakers.
4. Check breaker connections to bus.
5. Inspect bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.
6. Inspect for missing or loose hardware or accessories.
7. Inspect ground bus connections.
8. Operate key and door interlock devices to assure proper operation.

B. Electrical Tests
1. Insulation Resistance Test: Megger main secondary bus and feeder circuits phase-to-phase and phase-to-ground.
2. Energize any space heater circuits to insure proper operations.

C. Check phase rotation with a Biddle phase rotation meter.

D. Instruments and Meter Tests
1. Inspect panel mounted instruments and meters. Clean and check for calibration accuracy. Make minor adjustments as necessary.

3.04 LOW VOLTAGE POWER CIRCUIT BREAKERS AND INSULATED CASE CIRCUIT BREAKERS

A. Visual and Mechanical Inspection

1. Remove each draw-out type circuit breaker.
2. Inspect arc chutes of power circuit breakers.
3. Inspect circuit breaker for defects or damage.
4. Inspect and check contacts. Check alignment, over-travel, and pressure. Adjust if necessary.
5. Inspect finger clusters on line and load stabs of draw-out circuit breakers.
6. Check for proper mechanical operation. Lubricate where necessary.
7. Check auxiliary devices for proper operation.
8. Check breaker racking device (if applicable) for alignment and friction-free operation. Lubricate if necessary.

B. Electrical Tests
1. Insulation Resistance Test: Megger main poles of breaker pole-to-pole, from each pole to ground, and across the open contacts of each pole.
2. Contact Resistance Test: Ductor across main pole contacts with breaker closed and latched to check for good, low resistance contact.
3. Test overcurrent trip device by primary injection and calibrate to settings provided by the manufacturer'ss engineer. Static overcurrent trip devices shall be tested per the manufacturer's instructions. Test each pole of the breaker individually. Data shall be compared with manufacturer's published data.
   a. Test for minimum pick-up current.
   b. Apply 300% of pick-up current and measure time necessary to trip breaker (long time delay).
   c. Where short time delay characteristics are provided, test short time pick-up and delay.
   d. Test instantaneous trip by passing current sufficiently high to trip breaker instantaneously.
   e. Where ground fault protection is provided, test ground fault pick-up and delay.
   f. Check reset characteristics of trip unit.
4. Electrically test any auxiliary devices such as shunt trips, undervoltage trips, alarm contacts, and auxiliary contacts.

3.05 MOLDED CASE CIRCUIT BREAKERS

A. Visual and Mechanical Inspection
1. Inspect cover and case, and check for broken or loose terminals.
2. Operate breaker to check operation.

B. Electrical Tests (400 ampere frame and larger)
1. Insulation Resistance Test: Megger main poles of breaker pole-to-pole, from each pole to ground, and across the open contacts of each pole.
2. Contact Resistance Test: Ductor across main pole contacts with breaker closed and latched to check for good, low resistance contact.
3. Test overcurrent trip device and calibrate to settings provided by the manufacturer's engineer. Where primary injection testing is specified, test

each pole of the breaker individually. Data shall be compared with manufacturer's published data.

a. All trip units shall be tested by primary injection.
b. Static overcurrent trip devices shall be tested per manufacturer's instructions.
c. Test for minimum pick-up current.
d. Apply 300% of pick-up current and measure time necessary to trip breaker (long time delay).
e. Where short time delay characteristics are provided, test short time pick-up and delay.
f. Test instantaneous trip by passing current sufficiently high to trip breaker instantaneously.
g. Where ground fault protection is provided, test ground fault pick-up and delay.
h. Check reset characteristics of trip unit.

4. Electrically test any auxiliary devices such as shunt trips, undervoltage trips, alarm switches, and auxiliary switches.

3.06 MOTOR CONTROL CENTERS AND MOTOR CONTROLLERS

A. Visual and Mechanical Inspection

1. Verify that the contractor has cleaned structure interiors and starter cells of accumulated dust, dirt, oil films, and other foreign material.
2. Inspect bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.
3. Check mechanical operation of starters for freedom from binding.
4. Check motor circuit protector setting and overload relay heater size against contractor furnished list of motor nameplate full load current values.

B. Electrical Tests

1. Verify operation of each starter.
2. Test each overload relay by current injection through relay heaters. Record heater catalog numbers for each starter and submit list for maintenance. List shall contain circuit number, description of equipment and motor full load amps.
3. Contact Resistance Test. Ductor across main pole contacts of each breaker or switch with device closed and latched to check for good, low resistance contact.
4. Test overcurrent trip device of each circuit breaker trip device by current injection.

3.07 AUTOMATIC TRANSFER SWITCHES

A. Visual and Mechanical Inspection

1. Verify that contractor has cleaned enclosure interiors and all components of accumulated of dust, dirt, oil films, and other foreign material.
2. Inspect all electrical and mechanical components for condition and any evidence of defect or failure.
3. Perform inspection checks on individual components as recommended by the manufacturer.
4. Inspect connections for looseness. The electrical contractor shall torque wrench tighten or remake any questionable connections.
5. Inspect for missing or loose hardware or accessories.
6. Check for proper mechanical operation and lubricate, as necessary.
7. Check transfer mechanism for alignment and friction-free operation. Lubricate, as necessary.
8. Check all connecting wiring for condition.

B. Electrical Tests
1. Use test switch, when available, to check the electrical operation of the transfer switch.
2. When a test switch is not available, a failure of the normal source power will be simulated by disconnecting a voltage sensing lead.
3. Test and adjust all sensing relays, and other devices specifically associated with the transfer switch.
4. Contact Resistance Test: Ductor across main pole contacts of power switching circuit breakers, switches or contactor contacts with device closed and latched to check for good, low resistance contact.

3.08 EMERGENCY POWER SUPPLY-ENGINE DRIVEN

A. Visual and Mechanical Inspection
1. Verify that contractor has cleaned enclosure interiors of accumulated dust, dirt, oil films, and other foreign material.
2. Inspect all electrical and mechanical components for condition and any evidence of defects or failure.
3. Check output circuit breaker(s) bus connection.
4. Inspect bolted connections. The electrical contractor shall torque wrench tighten or remake any questionable connections.
5. Inspect for missing or loose hardware or accessories.
6. Inspect grounding system connections.
7. Operate key and door interlock devices to assure proper operation.
8. Inspect all associated systems and circuits for proper operation, including but not limited to the fuel supply system, jacket heater, battery charger, engine mounted control panel, remote monitoring and control panel, emergency cut-off, battery lighting system, exhaust system, radiator system, and ventilator system.
9. Inspect anchoring and vibration isolation systems.

B. Electrical Tests.

1. Insulation resistance test: Megger main poles of output circuit breaker(s) pole-to-pole, from each pole to ground, and across the open contacts of each pole.
2. Contact Resistance Test: Ductor across main pole contacts of output circuit breaker(s) with breaker closed and latched to check for good, low resistance contact.
3. Follow completely the load testing procedures of the latest issue of NFPA-110 for EPS systems, including prior notification of the local inspection authority having jurisdiction. Include all measured data and conditions in the final report. All non-compliance items shall be corrected by the contractor and retested until full compliance with NFPA-110 Level 1 is achieved.
4. Demonstrate load shed operation for both parallel generator and single generator operation.

3.09 LIGHTING CONTROL SYSTEM

A. Visual and Mechanical Inspection
1. Inspect each device for physical damage.
2. Check for proper labeling of conductors
3. Inspect all system lamps and LED's for proper operation. Replace all non-operational equipment.
4. Check all cabinet doors, latches, and hinges for proper operation. Adjust, lubricate, and/or repair as required.

B. Electrical Tests
1. Verify the absence of unwanted voltages between circuit conductors and ground that would constitute a hazard or prevent proper system operation.
2. Meggar test all conductors (other than those intentionally grounded) for isolation from ground.
3. Test all conductors (other than those intentionally connected together) for conductor-to-conductor isolation using as insulation testing device.
4. The control unit shall be tested to verify it is in the proper operating condition as detailed in the manufacturer's manual.
5. Each control circuit shall be tested to confirm proper operation of the circuit. Monitor the system with all building equipment energized, such as variable speed controllers, to verify the absence of control inhibiting electrical noise.

3.10 GROUNDING SYSTEM

A. Visual and Mechanical Inspection
1. Inspect wiring system outlet and junction boxes for proper grounding. Green grounding conductor shall be connected to outlet and junction boxes. Inspect a minimum of 5% of project boxes.

2. Verify connections of grounds for the secondary of separately derived grounding systems, i.e. at dry type transformers. Note type of connection, i.e. mechanical or exothermic.
3. Verify proper connection to all components of building service entrance grounding system. Note all system components which are interconnected and type of connection either mechanical or exothermic. Note depth of driven ground rods.

B. Electrical Tests (Small Systems)
1. Perform ground-impedance measurements utilizing the fall-of-potential method per ANSI/IEEE Standard 81 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System". Instrumentation utilized shall be specifically designed for ground impedance testing. Provide sufficient spacing so that plotted curves flatten in the 62% area of the distance between the item under test and the current electrode.

C. Electrical Tests (Large Systems)
1. When sufficient spacing of electrodes described above is impractical, perform ground-impedance measurements utilizing either the intersecting curves method or the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81.)

D. Equipment Grounds
1. Utilize two-point method of IEEE Std. 81. Measure between equipment ground being tested and known low-impedance grounding electrode or system.

E. Test Values
1. The main ground electrode system impedance-to-ground should be no greater than five (5) ohms for commercial or industrial systems and one (1) ohm of less for generating stations, transmission stations, and large industrial systems. Equipment grounds, depending on size and length of grounding conductor, should be only fractionally higher than system ground.

3.11 CABLES - LOW-VOLTAGE - 600V MAXIMUM

A. Visual and Mechanical Inspection
1. Inspect cables for physical damage and proper connection in accordance with single-line diagram.
2. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.
3. Check cable color coding with applicable engineer's specifications and National Electrical Code standards.

B. Electrical Tests

1. Perform insulation-resistance test on each feeder on the riser diagram with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
2. Perform continuity test to insure proper cable connection.

C. Test Values
1. Evaluate results by comparison with cables of same length and type. Investigate any values less than 50 megohms.

3.12 GROUND-FAULT SYSTEMS (NEC 230-95)

A. Visual and Mechanical Inspection
1. Inspect for physical damage and compliance with drawings and specifications.
2. Inspect neutral main bonding connection to assure:
   a. Zero-sequence sensing system is grounded.
   b. Ground-strap sensing systems are grounded through sensing device.
   c. Ground connection is made ahead of neutral disconnect link on zero-sequence sensing systems.
   d. Grounded conductor (neutral) is solidly grounded.
3. Inspect control power transformer to ensure adequate capacity for system.
4. Manually operate monitor panels (if present) for:
   a. Trip test
   b. No trip test
   c. Nonautomatic reset
5. Record proper operation and test sequence.
6. Set pickup and time-delay settings in accordance with the settings provided by the owner/user's electrical engineer.

B. Electrical Tests
1. Measure system neutral insulation to ensure no shunt ground paths exist. Remove neutral-ground disconnect link. Measure neutral insulation resistance and replace link.
2. Determine the relay pickup current by current injection at the sensor and operate the circuit interrupting device.
3. Test the relay timing by injecting three hundred percent (300%) of pickup current, or as specified by manufacturer.
4. Test the system operation at fifty-seven percent (57%) rated control voltage, if applicable.
5. Test zone interlock systems by simultaneous sensor current injection and monitoring zone blocking function.
6. On multiple source, tie breaker, etc., systems, devise a simulation scheme that fully proves correct operation.

C. Test Parameters
1. System neutral insulation shall be a minimum of one hundred (100) ohms, preferably one (1) megohm or greater.

2. Relay timing shall be in accordance with manufacturer's published time-current characteristic curves but in no case longer than one (1) second for fault currents equal to or greater than 3,000 amperes.
3. Relay pickup value shall be within +/- 10% of setting and in no case greater than 1200A.

3.13 SURGE ARRESTORS

A. Low-Voltage Surge Protection Devices
   1. Visual and Mechanical Inspection
      a. Inspect for physical damage and compare nameplate data with drawings and specifications.
      b. Inspect for proper mounting and adequate clearances.
      c. Check tightness of connections by using calibrated torque wrench. Refer to manufacturer's instructions for proper torque levels.
      d. Check ground lead on each device for individual attachment to ground bus or ground electrode.