

**ERIE COUNTY
DEPARTMENT OF ENVIRONMENT & PLANNING
DIVISION OF SEWERAGE MANAGEMENT**



**SPECIFICATIONS
FOR SUBDIVISIONS & SANITARY SEWER
EXTENSIONS WITHIN
ERIE COUNTY SEWER DISTRICTS**

MARCH 2014

ERIE COUNTY
DEPARTMENT OF ENVIRONMENT AND PLANNING (DEP)
DIVISION OF SEWERAGE MANAGEMENT (DSM)

SPECIFICATIONS
FOR
SUBDIVISIONS AND SANITARY SEWER EXTENSIONS

These Specifications for Subdivisions and Sanitary Sewer Extensions apply only to installations constructed in accordance with Section 306 of the Rules and Regulations for Erie County Sewer Districts by persons as defined therein.

These Specifications, in conjunction with the latest revisions of the standard Details issued by the Division of Sewerage Management, supersede all preceding versions issued by Erie County DEP-DSM. All new construction is required to comply with these Specifications.

These Specifications are organized by divisions and sections corresponding to normal design and construction practices. The sections may be general in nature and describe minimum acceptable standards. They are not intended for bidding purposes.

March 2014

**Specifications for
Subdivision and Sanitary Sewer Extensions**

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DIVISION 2

(Site Work)

**Specifications for
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SECTION 02594 - FORCE MAIN SEWERS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install in the locations shown on the Drawings, all force main sewer piping, fittings and incidentals as specified herein.

PART II - PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PLASTIC PIPE

A. Pipe

1. Unless otherwise specified, all PVC pipe for force mains shall conform to the latest AWWA C-900 Specification for polyvinyl chloride pressure pipe.

2. All PVC pipe shall be C-900 having a standard dimension ratio (SDR) of 18, unless otherwise specified, and shall be manufactured in 20 foot laying lengths. The pipe shall have a pressure rating of 150 psi.

3. All supplied PVC pipe shall be side marked with the class type, material code (PVC 1120), dimension ratio number, AWWA pressure class, nominal size and outside diameter base dimension.

4. The materials used in the manufacturing of the PVC Pressure Pipe (PVC 1120) shall be made from Class 12454-A or Class 12454-B Virgin Compounds, as defined in ASTM D-1784, with an established hydrostatic design-basis (HDB) rating of 4000 psi for water at 73.4 F (23 C).

B. Joints

1. Pipe joints shall be the Fluid-Tite IB (Integral Bell) push-on type gasketed joint which shall be an integral and homogeneous part of the pipe barrel. The push-on joints and elastomeric gaskets shall conform to the requirements of ASTM D3139 and F477, respectively.

C. Fittings

1. All required fittings shall be ductile iron conforming to the latest edition of AWWA C110. Fittings shall have mechanical joints and be compatible with the proposed PVC

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SECTION 02594 - 3.01

water pipe.

2. All fittings shall be manufactured in classes suitable for the size of pipe and pressure rating as indicated.

3. All bends, tees, valves and other fittings shall be anchored with thrust blocks, as shown and detailed in the plans. Thrust blocks shall be placed against a solid bearing face of undisturbed material. The concrete shall have a strength of 4000 psi. For thrust blocks placed during connection operations, a quick-setting additive shall be mixed into the concrete prior to placement. Where blocking is placed for downward vertical bends or valves the bends or valves shall be strapped to the blocks as shown on the Plans.

PART III - EXECUTION

3.01 SECTION 02594 - 3.01 PVC PIPE, LOCKING JOINT

A. Prior to assembly, the coupling matching grooves in the male and female ends shall be wiped clean, then lightly coat the "O" ring male end of the pipe with a lubricant.

B. Immediately after the lubricant is applied, the coupling shall be slipped together until the pipe end seats against the stop.

C. The nylon spline is pushed into aligned grooves around the pipe's circumference, securely locking the pipe to the coupling.

3.02 PVC PRESSURE PIPE (FLUID-TITE IB JOINT)

A. Prior to assembly, clean the bell and spigot ends of the coupling to remove all dirt and other foreign materials.

B. Check the rubber gasket in the bell groove in accordance with the manufacturer's instructions.

C. Apply lubricant to exposed gasket surface and to the pipe spigot up to the full insertion mark.

D. Immediately after the lubricant is applied, insert the spigot end until it is flush with the reference mark.

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SECTION 02594 - 3.02

3.03 TRACER TAPE

A. Plastic tracer tape (with wire) 5 mil thick and 3" in width will be required when either Ductile Iron or PVC pipe is utilized. The tracer tape shall be green in color and shall be labeled "Sanitary Sewer". The tape shall be placed 12" below grade and shall be strung along the centerline of the sewer. Splices where needed shall be made in accordance with the manufacturer's recommendation.

B. At completion of the project the Contractor shall test the entire length of the tracer tape using pipe location equipment. The test shall be made only in the presence of the Engineer. Any section of tape which is not continuous or is undetectable shall be removed and relaid.

SECTION 02594 - 4.01

PART IV - TESTING

4.01 PRESSURE

After the sewerage force main has been installed and the joints completed, the pipe shall be subjected to a hydrostatic pressure of 50 percent above the design pressure and/or normal operating pressure, unless otherwise specified.

4.02 DURATION

The duration of the pressure test shall be at least 2 hours.

4.03 PROCEDURE

The pipe shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connections, all necessary apparatus, taps into the pipe, gauges, and measuring devices, shall be furnished by the Contractor and be in good working condition. All work shall be accomplished by the Contractor.

Testing shall be done as soon as the line is completed. All testing shall be witnessed by Sewer District personnel.

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SECTION 02594 - 4.05

4.04 EXPELLING AIR BEFORE TESTING

Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation, and afterwards tightly plugged.

4.05 EXAMINATION UNDER PRESSURE:

All pipes, joints and fittings which are exposed when the test is conducted shall be carefully examined for visible leakage. Those portions of the pipe line covered by backfill shall be walked to observe leakage appearing on the ground surface. Any leaks discovered in the joints shall be corrected. Any cracked or defective pipe, fittings, etc., discovered in consequence of this pressure test shall be removed and replaced with new material as previously specified and the test repeated until satisfactory.

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Section 02594 - 4.06

4.06 ALLOWABLE LEAKAGE:

The duration of leakage test shall be 2 hours unless otherwise specified, and during the test the main should be subjected to the pressure required. Leakage should be defined as the quantity of water that must be supplied into the newly installed pipe, or any valved section thereof, to maintain pressure within 5 psi (12.7 k Pa) of the specified leak test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation shall be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{ND \sqrt{P}}{7400}$$

NOTE: FOR 2 HOUR TEST MULTIPLY RESULT BY 2

Where: L = allowable leakage, gph
 N = number of joints in the length of pipeline tested
 D = nominal diameter of the pipe (inches)
 P = average test pressure during the leakage test, psig

Leakage values determined by the above formula are to be found in the table below:

ALLOWABLE LEAKAGE*

Nominal Pipe Size Inches	Average Test Pressure in Line, psi				
	50	100	150	200	250
4	.19 (.72)	.27 (1.02)	.33 (1.25)	.38 (1.44)	.43 (1.63)
6	.29 (1.10)	.41 (1.55)	.50 (1.89)	.57 (2.16)	.64 (2.42)
8	.38 (1.44)	.54 (2.04)	.66 (2.50)	.76 (2.88)	.85 (3.22)
10	.48 (1.82)	.68 (2.57)	.83 (3.14)	.96 (3.63)	1.07 (4.05)
12	.57 (2.16)	.81 (3.07)	.99 (3.75)	1.15 (4.35)	1.28 (4.84)

*Allowable Leakage Per 1000 feet or 50 Joints, gal/hr (L/Hr)

**Specifications for
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SECTION 02595 - SANITARY SEWERS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, and install in the locations shown on the Drawings, all sanitary sewer piping and fittings as specified herein.

PART II - PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) GRAVITY PIPE

A. Pipe

1. For pipe diameters 4" thru 15", the polyvinyl chloride (PVC) pipe shall be manufactured in accordance with the latest ASTM Specification D-3033 "Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings" or ASTM Specification D-3034 "Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings". For pipe diameters 18" thru 27", the PVC pipe manufacturer shall satisfy the requirements of the latest ASTM Specification F-679, Type I. All pipe shall be SDR-35 or thicker wall and the PVC Compound shall meet the requirements of the latest ASTM Specification D-1784. Pipe in compliance with these standards shall be clearly marked with pipe size (nominal), cell classification, SDR number, PVC Sewer Pipe and ASTM Designation.

2. AWWA C-900 PVC pipe and fittings shall be installed as a gravity sewer pipe at locations shown on the Plans. The C-900 PVC pipe shall meet the technical specifications of Section 2594.

B. Joints

1. The joint shall provide a permanent seal against exfiltration or infiltration. The joining technique shall be with elastomeric gasket.

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SECTION 02595 - 2.01

2. Elastomeric Gasket Joints - The critical sealing dimensions of the bell, spigot and gasket shall be in accordance with the manufacturer's standard dimensions and tolerances. The elastomeric compound shall comply in all respects with the physical requirements specified in ASTM F477-76. The gasket shall provide an adequate compressive force against the sealing surfaces of the bell and spigot so as to effect a positive seal under all combinations of the joint tolerances. The gasket shall be the only element depended upon to make the joint flexible and water tight. The gasket material shall be oil and gasoline resistant.

C. Fittings

1. All PVC wyes, tees and elbows shall be manufactured in classes suitable for the class of pipe with which they will be used.

PART III - EXECUTION

3.01 LAYING PIPE

A. Pipe

1. All sanitary sewer pipe shall be constructed in accordance with Division 2 of these Specifications.

2. All sanitary sewer pipe shall be cleaned, bedded as detailed on the Construction Plans and all work shall be in accordance with the various details shown on the Plans.

3. Pipe used for this project shall be subjected to factory testing. Testing shall be in job lots for a maximum of 6% of pipe quantity or a minimum of 5% of pipe quantity or 2 pieces of each size in each class. Factory tests shall be hydrostatic or air tests up to 24" and hydrostatic tests for over 24", including all other material tests as specified by ASTM.

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SECTION 02595 - 3.01

B. Wye Branches

1. The wye branches shall have approved caps or plugs factory installed on the six (6) inch branches for testing purposes. The wye branches shall be bedded and supported as detailed on the Plans.

C. Tee Branches

Tee branches shall only be allowed on PVC AWWA C-900 pipe. Tee branches shall have approved caps or plugs factory installed on the six (6) inch branches for testing purposes. The tee branches shall be bedded and supported as detailed on the Plans.

D. Riser Pipe

1. All riser pipes shall be constructed according to the details shown on the Plans.

2. Riser pipes installed in areas where house laterals are not required, or not installed yet, shall have the last length of pipe sealed with a cap or plug. Such caps or plugs shall be wired in place so as to withstand pressures during testing. Concrete backing shall be provided as shown on the Plans.

E. Farside Laterals

1. Farside laterals shall be six (6) inch diameter, and conform with DSM Standard Detail No.24-Typical Cross Section of Highway Crossing for House/Commercial Laterals.

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SECTION 02595 - 3.01

F. Records

1. The location of wye branches, tee branches and riser pipes along with laterals shall be measured from the last downstream manhole and in addition, shall be located on a sketch by the use of at least two ties to existing structures. Each record of a wye branch, tee branch, riser pipe or house lateral shall be on a separate sheet and include the depth of cover. This information shall be transferred to the Record Drawings.

G. Concrete Cradle and Encasement

1. Where noted on the Plans, 2000 psi dry mix concrete shall be placed for bedding and pipe protection in conformance with DSM Standard Details No.6 (Typical Concrete Encasement) and No.7 (Concrete Cradle Detail).

3.02 AIR TESTS, INFILTRATION OR
EXFILTRATION AND DEFLECTION REQUIREMENTS

A. Requirements

1. After backfilling and prior to the final acceptance of the project, the Contractor will be required to perform the following three tests on all sewers built under this project:

- a) Air Tests
- b) Infiltration or Exfiltration
- c) Deflection Test (15" dia. and smaller).

2. No more than 1,000 linear feet of installed sewer shall be allowed to remain untested.

3. In view of the fact that house laterals and riser pipes often contribute considerable infiltration, such laterals and risers are to be installed and capped, tied and blocked as the work progresses, prior to the air testing of the lines.

4. The Contractor's testing procedures shall be completed in accordance with OSHA Standards for confined space entry. The Contractor will be required to provide and operate all equipment necessary for full compliance for his operation. Equipment such as gas detectors, safety harnesses, ventilating blowers, respirators etc. shall be provided by the Contractor.

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SECTION 02595 - 3.02

B. Air Tests (Required for All Diameters up to and including 36") 10 State Standards Section, 33.94

1) This test shall be performed no earlier than 14 calendar days after the trenches are backfilled.

2) The procedure for air testing shall be as specified herein. The minimum allowable time for the test pressure to decrease from 3.5 psi to 3.0 psi shall be not less than as called for in the following table:

Minimum Acceptance Times* For Length Shown (min:sec)

Pipe Diameter	Up to 100'	100 - 200'	200 - 300'	300 - 400'
6"	2:50	2:50	2:50	2:51
8"	3:47	3:47	3:48	5:04
12"	5:40	5:42	8:33	11:24
15"	7:05	8:54	13:21	17:48
18"	8:30	12:49	19:14	25:38
21"	9:55	17:27	26:11	34:54
24"	11:24	22:48	34:11	45:35
27"	14:25	28:51	43:16	57:42
30"	17:48	35:37	53:25	71:13
33"	21:33	43:56	64:38	86:10
36"	25:39	51:17	76:55	102:34

* Erie County Sewer District Inspector will extend time to the next full minute during the test.

3. Pipe lines in sizes up to 36 inches in diameter can be air tested from manhole to manhole for distances not to exceed 400 feet.

4. In wet trenches where pumping to lower the water table is impractical, approved 4" diameter, solid PVC drain pipe (with approved cap) shall be placed at each manhole to extend from a point 6 inches below the lowest invert to the top of the ground. Embed the pipe a minimum of 12" into clean #1 stone. Ground water elevations will be measured at each manhole in order to calculate the groundwater pressure acting on the pipe exterior. The initial air test pressure shall be increased as necessary to overcome the calculated groundwater pressure.

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SECTION 02595 - 3.02

5. The testing procedures outlined shall be strictly adhered to.

6. All testing equipment shall be supplied by the Contractor and be in good working condition. Some of the major equipment required for air tests is:

- a) Stop watch graduated in tenths of a second.
- b) Compressor of 50 to 100 psi capacity.
- c) Bulkheads for pipe.
- d) Approximately 100 feet of 3/8" diameter air hose.
- e) Pressure gauge - 0 to 5 psi graduated in 1/16th of a pound increments.
- f) Three 3/8 inch diameter check valves.

C. Infiltration Tests (Applicable Only if Ground Water is Two Feet Above the Top of the Pipe)

1. This test shall be performed no earlier than 14 calendar days after the trenches are backfilled.

2. Infiltration tests for all sewers constructed under this project shall not exceed 100 gallons per inch diameter per mile of sewer, per 24 hours. Each individual run of sewer (from one manhole to the next manhole if greater than 100 feet) shall comply with the allowable rate of infiltration. All equipment for the tests shall be furnished by the Contractor and be in good working condition.

3. The allowable rate of infiltration given in gallons per mile is not to be construed as a commitment on the part of the District to accept an entire line, where overall infiltration is less than the allowable, while one or more runs contribute excessive infiltration.

4. The infiltration test is intended to measure the water tightness of a sewer as related to the infiltration of ground water and is only applicable if the water table level is 2 feet or higher above the top of the pipe for the entire length of the test section.

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SECTION 02595 - 3.02

a) Approved 4" diameter solid PVC drain pipe (with an approved cap) shall be placed at each manhole to extend from a point 6 inches below the lowest invert to the top of the ground. Embed the pipe a minimum of 12" into clean #1 stone. Ground water elevations will be measured at each manhole so that the ground water level can be correlated with the infiltration measurements.

b) Before conducting the tests, the water table should be allowed to stabilize at its normal level and verified that it is 2 feet above the top of the pipe during the test period. The test is usually conducted between adjacent manholes with the upstream end of the sewer bulkheaded in a suitable manner to isolate the test section. All service laterals, stubs and fittings should be properly plugged or capped at the connections to the test pipe section to prevent the entrance of ground water at these locations.

c) A V-notch weir or other suitable measuring device should be installed in the inlet pipe of the downstream manhole. Infiltrating water is then allowed to build up and level off behind the weir until a steady, uniform flow occurs over the weir. Leakage is determined by direct reading from graduations on the weir consecutively for five (5) days and converting the flow quantity to gallons per unit length of pipe per unit of time.

d) An important factor in applying the test criteria is to properly correlate the variable water head over the length of the sewer being tested to the high ground water level. A minimum of 2 feet of water over the pipe is required at the upper manhole before the infiltration test will be allowed.

5. When a sewer run between two consecutive manholes or chambers is found to contribute infiltration at a rate above the allowable, inspection by television or other cameras may be made by the Contractor so that the defective section of sewer can be located and repaired. Each individual run of sewer (from one manhole to the next manhole if greater than 100 feet) shall comply with the allowable rate of infiltration of 100 gallons per inch diameter per mile of sewer per 24 hours.

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SECTION 02595 - 3.02

D. Exfiltration Tests

1. This test shall be performed no earlier than 14 calendar days after the trenches are backfilled.

2. The exfiltration test for all diameter sewers shall be as described below. Although actual infiltration will normally be less than that indicated by the water exfiltration test, the test does provide a positive means of subjecting the completed sewer system to an actual pressure test. Since sanitary sewers are not designed or expected to operate as a pressure system, care must be exercised in conducting the test and correlating the results with the allowable exfiltration limits.

a) The test is usually conducted between adjacent manholes. Prior to the test, all service laterals, stubs and fittings within the test section should be plugged or capped and adequately braced or blocked to withstand the water pressure resulting from the test.

b) If manholes are to be included in the test, the inlet pipe to each manhole should be bulkheaded and the test section filled with water through the upstream manhole. To allow air to escape from the sewer, the flow should be at a steady rate until the water level in the upstream manhole provides an average pressure of 5 psi (11.6' head) at the center point of the test section or the upstream manhole is filled. If necessary, provisions should be made to bleed off entrapped air during the filling of the test section.

c) Once the test section is filled, the water should be allowed to stand for an adequate period of time (one day minimum) to allow for water absorption by the pipe and manhole. After water absorption has stabilized, the water level in the upstream manhole is brought up to the proper test level and this level established by measuring down from the manhole rim or other convenient datum point. After 24 hours, the water elevation should be measured from the same reference point and the loss of water during the test period calculated, or the water can be restored to the level existing at the beginning of the test, and the amount added used to determine the leakage.

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SECTION 02595 - 3.02

d) To exclude both manholes from the test, it is necessary to bulkhead the outlet pipe of the upstream manhole. Provision must be made in the bulkhead for filling the pipe and expelling trapped air.

e) The water level at the upstream manhole shall be computed and varies above the top of the pipe. Since the sewer is installed on a grade, the test section downstream will most likely be subjected to a greater pressure. Therefore, the test pressure head at the upstream manhole should be adjusted such that the maximum pressure on the pipe being tested is no greater than 10 psi, (23 feet of head).

3. When a sewer run between two consecutive manholes or chambers is found to exfiltrate at a rate above the allowable, inspection by television or other cameras may be made by the Contractor during wet weather, so that the defective section of sewer can be located and repaired. Each individual run of sewer (from one manhole to the next manhole) shall comply with the allowable rate of infiltration of 100 gallons per inch diameter per mile of sewer per 24 hours.

E. Deflection Test

1. This test shall be performed no earlier than 30 calendar days after the trenches are backfilled.

2. All flexible (PVC) sewers 8" diameter or larger constructed under this project shall be internally checked with a five percent (5%) deflection "go-no-go pig" or Mandrel to determine if the pipes are deflecting excessively. Any section of pipe unable to pass the deflection test "pig test" shall be removed and replaced at the Contractor's expense.

3. Deflection testing mandrels or pig shall be pulled thru the pipe by hand or hand operated winch. Power winches or drives are not permitted.

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SECTION 02596 - SANITARY SEWER MANHOLES

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, and install in the locations shown on the Drawings, all sanitary sewer manholes as specified herein.

PART II - PRODUCTS

2.01 POURED IN PLACE BASES

A. The concrete base shall be 4000 psi concrete and the fill forming the invert channel shall be 4000 psi concrete as shown on the Plans.

2.02 PRECAST BASES

A. The precast bases shall be monolithic reinforced concrete.

B. The bottom or floor of the monolithic precast base shall have a minimum thickness of 8 inches, and shall project no less than 6 inches beyond the outside walls of the monolithic precast base to form a flange or annular footing intended to resist uplift.

C. The lowest edges of holes or cutouts for line and branch sewers shall be no less than six inches above the inside surface of the floor or footing of the monolithic precast base. The highest edges of holes or cutouts for line and branch sewers shall be no less than 6 inches from joint surfaces as detailed on the Plans. After installation of the line and branch sewers, manhole channels or inverts shall be formed by using 4000 psi fill concrete.

D. At the points where line and branch sewers are connected to the monolithic precast bases or manhole barrels, the annular spaces between the pipes and holes shall be sealed with assemblies consisting of rubber gaskets to form watertight barriers. Such sealing assemblies shall be: watertight manhole boot seal as manufactured by PSX:Direct Drive or approved equal. After installation, metal parts of the above assemblies that are accessible from inside the manholes shall be coated with "Preco-Patch" or approved equal.

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SECTION 02596 - 2.02

E. All precast "Doghouse Style" base sections shall be installed on a minimum 12" thick 4000 psi concrete footer pad. The pre-cast wall section shall be set 3" into the poured concrete base pad. After installation of the branch sewer(s), the existing sewer shall be cut with all interior manhole channels or inverts formed by using 4000 psi fill concrete. The area of the cut out around the existing sewer pipe shall be sealed utilizing a hydrostatic non-shrink grout such as "Preco Patch", "Waterplug" or approved equal.

F. The edges of holes or cutouts in riser or barrel sections for line and branch sewers shall be no less than 6 inches from joint surfaces, as detailed on the Plans.

2.03 SANITARY MANHOLE BARREL AND CONE

A. All precast manhole cones and barrels shall be constructed in accordance with the latest ASTM Specification C-478 "Precast Reinforced Concrete Manhole Sections", with the following exceptions: The manhole barrel walls shall be five (5) inches thick for a four (4) foot diameter manhole, six (6) inches thick for a five (5) foot diameter manhole, and seven (7) inches thick for a six (6) foot diameter manhole. The upper section of the precast manhole shall be an eccentric cone design having a 24" inside top opening diameter with an 8" (width) top bearing surface.

Where the depth of the manhole is such that an eccentric cone section cannot be used, a flat top section with a 24 inch opening shall be provided. The flat top slabs shall be a minimum of 8" thick and shall be capable of supporting a H-20 loading. Flat top slabs are only allowed on shallow sewers, 5.5 feet or less in depth from rim to invert.

B. The precast bases and manhole barrel sections are required to be vacuum factory tested in job lots per the following schedule. Factory vacuum tests shall be performed on linear footage of manhole barrel job lots as follows:

First test for jobs requiring from 8 feet to 100 feet of manholes.

Second test shall be performed on 101 feet to 300 feet lots.

Third test shall be performed on 301 feet to 600 feet lots.

Fourth test shall be performed on 601 feet to 1,000 feet lots.

Fifth test shall be performed on lots over 1,001 feet.

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SECTION 02596 - 2.03

C. Installation and operation of vacuum equipment and indicating devices shall be in accordance with the manufacturer's recommendations and instructions. A test vacuum of 10 inches of mercury shall be drawn. The time for the vacuum to drop to 9 inches of mercury shall be recorded. Acceptance for 4 foot diameter manholes shall be defined as when the time to drop to 9 inches of mercury meets or exceeds the following:

<u>Manhole Depth</u>	<u>Diameter</u>	<u>Time to Drop 1" Hg</u>
10 feet or less	4'	60 seconds
10 feet to 15 feet	4'	75 seconds
15 feet to 30 feet	4'	90 seconds

For manholes 5' in diameter, add an additional 15 seconds and for manholes 6' in diameter, add an additional 30 seconds to the time requirements for 4' diameter manholes.

If the manhole fails the test, necessary repairs shall be made and the vacuum test repeated until the manhole passes the test.

2.04 JOINTS

A. The manhole barrel and cone joints shall be concrete with a confined "O" ring, neoprene gasket in accordance with the latest ASTM Specification C-443. The manhole supplier will be required to vacuum test the manhole joint in the factory in the job lots as described in 2.03, all in accordance with the latest ASTM Specification C-443 at a test pressure of 13 psi. The joint test may be performed at the same time as the vacuum test which was described previously in this Section. The factory joint test shall be conducted without the joint compound specified below.

B. For "O" ring joints, asphaltic joint compound (60 - 100m) shall be buttered on spigots and bells prior to assembling the manhole sections.

C. After the barrel sections are assembled, the excess joint compound shall be troweled off the inside and outside faces. The inside face of the joint shall then be troweled with "Preco-Patch" or approved equal, the outside with Dewitt No. 10, Duraseal 3101, Pioneer 301, or approved equal.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02596 - 2.05

2.05 ADJUSTING RINGS

A. Grade rings shall not exceed 6 inches in depth. The total number of grade rings shall not exceed 12 inches in height. However, no more than three (3) grade rings will be allowed to be installed. The adjusting ring joints shall be made with an approved cement mortar. The outside of the adjusting rings from casting to cone shall be coated with an approved "Preco-Patch," Rock Mount, "Waterplug," or equal.

2.06 MANHOLE STEPS

A. Manhole steps shall be forged aluminum alloy, as detailed on the Plans, or steel reinforced co-polymer polypropylene, and shall be placed in the forms while the manhole barrel and cone sections are being cast or securely grouted in place after casting.

2.07 MANHOLE FRAMES AND COVER

A. Manhole frames and covers shall be gray iron castings as detailed on the Plans, and have a maximum cover weight of 150 lb +/- 5% for 8" through 18" diameter equally spaced pipe and 200lb +/- 5% for pipe over 18". The cover shall be engraved "E.C.S.D. SANITARY" with 2" high and 1/8" deep letters, and drilled with four(4) 3/4" diameter vent holes as shown on the Plans/Details. Manhole rims shall be set above the adjacent ground level as required. Some manhole covers shall have a locking device as detailed on the Plans and shall be furnished with cam locks as manufactured by McGard Inc., 3875 California Road, Orchard Park, New York 14127, or approved equal.

Manufacturer's drawings of all castings which the Contractor proposes to use shall be submitted to the District for approval prior to the castings being ordered for the work. No commercial "Brand Name" lettering will be allowed on the exposed surface of the cover.

B. Watertight frames and covers shall be gray iron castings as detailed on the Plans. Covers shall be solid with non-penetrating pickholes. Manufacturer's drawings of all castings which the Contractor proposes to use shall be submitted to the District for approval prior to the castings being ordered for the work.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02596 - 2.08

2.08 DROP PIPES

Inside Drop Pipe

1. Inside drop pipes and fittings shall be PVC plastic sewer pipe in compliance with the latest ASTM Specification D-2241 and as detailed on the Plans. Fittings shall be rigid, elastomeric gasket and of the same material as the drop pipe. Suitable unions or adapters shall be provided to connect to other types of piping where necessary. Suitable spacers and anchors shall be provided to adequately attach the drop pipe along the inside of the manhole barrel wall.

2.09 VENT STACKS

A. The vent stack shall consist of 4 inch diameter metal U-type pipe with stainless steel bird screen. If steel pipe is used it shall be galvanized and plastic coated.

PART III - EXECUTION

3.01 INSTALLATION

A. All manholes and drop manholes shall be set on 6" of No. 1 Crushed Stone compacted to proper elevation.

B. Backfill around pipes at manholes shall be carefully tamped.

C. A four(4)- inch diameter solid PVC drain pipe shall be installed at every manhole for measuring the ground water elevation for testing purposes as detailed on the Plans.

SECTION 02596 - 3.02

3.02 TESTING

A. Infiltration and/or exfiltration tests shall be performed for every manhole constructed under this project.

B. Construction shall be such as to keep infiltration within the allowable volume. Any leaks discovered after testing and/or during the two year maintenance period shall be repaired by the Contractor at his expense.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02600 - PAVING AND SURFACING

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all paving and surfacing as shown on the Plans and specified herein, and dispose of all excess material offsite.

1. All existing blacktop paved roads which are removed or damaged during the construction shall be repaired and resurfaced.

2. All permits (Highway, Storm, stream disturbance...,etc.,) necessary from Village, Town, City, County or State shall be obtained and paid for by the Contractor. The terms of any permit issued shall be adhered to as if they were a part of these Specifications. The contractor shall provide the District with copies of all permits prior to the start of construction.

PART II - PRODUCTS

2.01 MATERIALS

A. Bituminous Macadam Pavement and Driveways

1. Unless otherwise specified herein, all bituminous macadam materials and work shall conform to the applicable requirements of the New York State Department of Transportation "Standard Specifications", latest Edition.

B. Crushed Stone Road, Driveways and Parking Areas

1. Road materials shall be approved, well-graded crusher run stone, or well-graded crushed gravel, known commercially as size #2 C/R, conforming to the requirements of the New York State Department of Transportation Specifications Section 304-2.02 (Type 2) for the bottom course and Section 302-2.03 (Option C) for the top course.

2. Finish topping material for roads, driveways and parking areas shall be No. 1A or No. 1 crushed stone or crushed gravel.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02600 - 2.01

C. Concrete Sidewalks

1. Sidewalks shall be constructed of 4000 psi concrete.
2. The foundation course material shall conform to the requirements of the New York State Department of Transportation Specification Section 302-2.03 (Option C).

PART III - EXECUTION

3.01 PREPARATION

A. Sub-grade Preparation

1. After backfilling and grading is completed, the sub-grade shall be shaped and compacted to an even, firm foundation. All unsuitable sub-grade materials, including soft materials, boulders, vegetation and loose stones shall be removed and replaced with well compacted foundation material.

3.02 INSTALLATION

A. Bituminous Macadam Pavement and Driveways - Existing

1. Where existing bituminous pavements or driveways are necessarily required to be cut, the width of pavement required to be removed is shown on the Plans. If the Contractor should remove pavement beyond the limits shown, he shall replace same at his own expense. In all cases, the pavement will be required to be cut back one foot onto undisturbed earth on each side of the excavation.

2. All work affecting paved roads, streets or highways shall be done in a manner satisfactory to the authority having jurisdiction over the particular pavement.

3. The paving materials and methods of placing shall be in accordance with the Specifications of the New York State Department of Transportation for the particular type of bituminous pavement being replaced.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02600 - 3.02

B. Crushed Stone Roadway, Parking Area and Driveway

1. The roadway, parking area, or driveway materials shall be placed and compacted upon the prepared sub-grade to the lines, grades and thickness specified, or as determined by field conditions.

2. Roadways shall be constructed in two courses or lifts. The maximum sub-grade thickness shall be not less than eight (8) inches and the top course thickness not less than four (4) inches. After the courses are thoroughly compacted, No. 1 stone and screenings shall be uniformly spread upon the surface either by hand or by an approved mechanical device, and swept in by means of a gang-dragged broom of an approved type and rolled dry.

C. Concrete Sidewalks

1. Foundation

The concrete sidewalks shall be constructed on a four (4) inch compacted stone or gravel foundation course.

2. Forms

Sidewalk forms are to be set upon the foundation course; the top of the form conforming with the walk grade. Forms shall be steel, 4 inches in height or 6 inches in height when traversing driveways and of such length and shapes as may be required to form the required walks. All inside faces shall be clean and smooth, and shall be oiled before the concrete is placed. Forms shall be held in place with pins, or other devices so that during the construction of the walk a straight and even edge shall be maintained.

3. Joints

Sidewalks shall be built with transverse construction joints 5 feet apart or as directed. Joints shall be cut through the slab. Expansion joints 1/2 inch in width must be cut through the slab to the foundation every 20 feet or fraction thereof and filled with a bituminous expansion joint.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02600 - 3.02

4. Wire Fabric Reinforcement

Wire fabric (6x6x10 ga.) shall be used in the 6 inch thick sidewalks traversing driveways. The wire fabric shall be placed at the mid-depth point of the slab supported on wire chairs and lapped as required.

5. Placing and Finishing Concrete

After the foundation course has been satisfactorily prepared and after the approved forms are in place to grade, and the same has been checked and approved, the Contractor shall proceed to place the concrete. Concrete of 4000 psi shall be placed to the full depth of the form, carefully spaded or vibrated, and placed to form a uniform and dense mixture, and leveled off with a template to a smooth surface level with the top of the forms. The surface shall be finished with a float and troweled by skilled workmen. After the surface has been leveled and finished and before the concrete takes its final set, the surface shall be evenly stroked with a broom to give a slightly rough and uniform finish. All outside edges, and the division marks or joints between blocks, shall all be carefully finished with an edging tool with 1/4 inch radius.

6. Curing

After concrete is placed and finished, it shall be protected by applying an approved colorless curing compound. This compound shall be applied by pressure spraying at a rate of not less than 1/30 of a gallon per square yard. In lieu of the spraying compound, a covering may be used which meets with the approval of the Engineer.

7. Protecting Work

When the concrete work is finished, the Contractor for at least three days shall protect the concrete from the weather, trespassers, or other injurious elements, and until the concrete has received a final set. The forms shall remain in place during this curing period. Work placed during cold weather shall be covered.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02600 - 3.02

D. Concrete Driveways

1. Foundation

The concrete driveways shall be constructed on a six (6) inch compacted stone or compacted gravel foundation course.

2. Forms

Driveway forms are to be set upon the foundation course; the top of the form conforming with the driveway grade. Forms shall be steel, 6 inches in height and of such lengths and shapes as may be required to form the required driveways. All inside faces shall be clean and smooth, and shall be oiled before the concrete is placed. Forms shall be held in place with pins, or other devices so that during the construction of the driveway a straight and even edge shall be maintained.

3. Joints

Driveways shall be built with transverse construction joints 10 feet apart or as directed. Joints shall be cut through the slab. Expansion joints 1/2 inch in width must be cut through the slab to the foundation every 20 feet or fraction thereof and filled with a bituminous expansion joint.

4. Wire Fabric Reinforcement

Same as specified for Section 02600-3.02 C-4.

5. Placing and Finishing Concrete

Same as specified for Section 02600-3.02 C-5.

6. Curing

Same as specified for Section 02600-3.02 C-6.

7. Protecting Work

Same as specified for Section 02600-3.02 C-7.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02712 - VINYL COATED FENCES AND GATES

PART I - GENERAL

1.01 SCOPE OF WORK

A. Extent of chain link fences and gates is shown on Drawings.

1.02 QUALITY ASSURANCE

A. Provide chain link fences and gates as complete units controlled by a single source including necessary erection accessories, fittings, and fastenings.

PART II - PRODUCTS

2.01 STEEL FENCING

A. Fabric: No. 9 ga. (0.148") finished size steel wires, 2" mesh, with top selvages knuckled for fabric 60" high and under, and both top and bottom selvages twisted and barbed for fabric over 60" high.

Perimeter Fencing: 6'-0" high

Fabric finish, aluminized, ASTM A 491, Class II, with not less than 0.40 oz. aluminum per sq. ft. of surface.

B. Framework: Galvanized steel, ASTM A 123, with not less than 1.8 oz. zinc per sq. ft. of surface.

C. Hardware and Accessories: Galvanized, ASTM A 153, with zinc weights per Table I.

2.02 FRAMING AND ACCESSORIES

A. End, Corner and Pull Posts: Minimum sizes and weights as follows:

Up to 6' fabric height, 2.375" OD steel pipe, 3.65 lbs. per lin. ft., or 3.5" x 3.5" roll-formed sections, 4.85 lbs. per lin. ft.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02712 - 2.02

B. Line Posts: Space 10' o.c. maximum, unless otherwise indicated, of following minimum sizes and weights:

Up to 6' fabric height, 1.90" OD steel pipe, 2.70 lbs. per lin. ft. or 1.875" x 1.625" C-sections, 2.28 lbs. per lin. ft.

C. Gate Posts: Furnish posts for supporting single gate leaf, or one leaf of a double gate installation, for nominal gate widths as follows:

<u>Leaf Width</u>	<u>Gate Post</u>	<u>Lbs./lin. ft.</u>
Up to 6'	3.5" x 3.5" roll-formed section or 2.875" OD pipe	4.85 5.79
Over 6' to 13'	4.000" OD pipe	9.11
Over 13' to 18'	6.625" OD pipe	18.97
Over 18'	8.625" OD pipe	28.55

D. Top Rail: Manufacturer's longest lengths with approximately 6" long expansion type couplings for each joint. Provide means for attaching top rail securely to each gate corner, pull and end post. Top rail shall be of the following size and weight:

1.66" OD pipe, 2.27 lbs. per ft. or 1.625" x 1.25" roll-formed sections, 1.35 lbs. per ft.

E. Tension Wire: 7 gage, coated coil spring wire, metal and finish to match fabric. Tension wire to be located at bottom of fabric.

F. Post Brace Assembly: Manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use same material as top rail for brace, and truss to line posts with 0.375" diameter rod and adjustable tightener.

G. Post Tops: Weathertight closure cap (for tubular posts), one cap for each post. Furnish caps with openings to permit passage of top rail.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02712 - 2.02

H. Barbed Wire Supporting Arms: Manufacturer's standard barbed wire supporting arms with provision for anchorage to posts and attaching 3 rows of barbed wire to each arm. Metal and finish to match framework. Supporting arms may be attached to posts or be integral with post top weather cap and must be capable of withstanding 250 lbs. downward pull at outermost end. Provide the following type:

Single 45 degree arm at each post designed for attachment of 3 rows of barbed wire.

I. Barbed Wire: 2 strand, 12-1/2 ga. wire with 14 ga. 4-point barbs spaced not more than 5" o.c.; metal and finish to match fabric.

J. Stretcher Bars: One piece equal to full height of fabric, with minimum cross-section of 3/16" x 3/4". Provide one stretcher bar for each gate and end post, and 2 for each corner and pull post, except where fabric is integrally woven into post.

K. Stretcher Bar Bands: Space not over 15" o.c., to secure stretcher bars to end, corner, pull, and gate posts.

L. Gates: Fabricate swing gate perimeter frames of 1.90" OD pipe. Metal and finish to match framework. Provide horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories. Space so that frame members are not more than 8' apart.

Assemble gate frames by welding or with special fittings and rivets for rigid connections. Use same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretchers to gate frame at not more than 15" o.c. Attach hardware to provide security against removal or breakage. Install diagonal cross-bracing consisting of 3/8" diameter adjustable length truss rods on gates to ensure frame rigidity without sag or twist, if required.

Where barbed wire is indicated above gates, extend end members of gate frames up 1'-0" and prepare to receive 3 strands of wire. Provide necessary clips for securing wire to extensions.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02712 - 2.02

M. Gate Hardware: Furnish the following hardware and accessories for each gate:

Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180 degree gate opening.

Latch: Forked type or plunger-bar type to permit operating from either side of gate, with padlock eye as integral part of latch.

Keeper: Provide keeper for vehicle and railroad gates, which automatically engages gate leaf and holds it in open position until manually released.

Double Gates: Provide gate stops for double gates, consisting of mushroom type or flush plate with anchors. Set in concrete, to engage the center drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch, using one padlock for locking both gate leaves.

N. Wire Ties: For tying fabric to line posts, use wire ties spaced 12" o.c. For tying fabric to rails and braces, use wire ties spaced 24" o.c. For tying fabric to tension wire, use hog rings spaced 24" o.c.

O. Concrete: Concrete shall be as specified in Division 3 of the Erie County Division of Sewerage Management Standard Specifications.

PART III - EXECUTION

3.01 General Installation

Do not begin installation and erection before final grading is completed, unless otherwise permitted.

3.02 Excavation

Holes for posts shall be drilled in firm, undisturbed or compacted soil, and shall be a minimum of 6" larger than the O.D. of the pipe.

Unless otherwise indicated, excavate hole depths approximately 3" lower than post bottom, with bottom of posts set not less than 42" below finish grade surface.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02712 - 3.03

3.03 Setting Posts

Center and align posts in holes 3" above bottom of excavation.

Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.

3.04 Top Rails

Run rail continuously through post caps, bending radius for curved runs. Provide expansion couplings as recommended by fencing manufacturer.

3.05 Brace Assemblies

Install braces so posts are plumb when diagonal rod is under proper tension.

3.06 Tension Wire

Install tension wires before stretching fabric and tie to each post with not less than 6 ga. galvanized wire. Fasten fabric to tension wire using 11 ga. galvanized steel hog rings spaced 24" o.c.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02750 - UNPAVED AREAS WITHIN PUMPING STATION SITES

PART I - GENERAL

1.01 Scope of Work

A. Description of Work

1. The contractor shall furnish all labor, materials, tools, equipment, services and incidentals necessary to prepare the subgrade for installation of woven landscape fabric and 4 inch deep overlay of stone.

PART II - PRODUCTS

2.01 Materials

A. Landscape Fabric

The woven landscape fabric shall be Exxon landscape fabric or equal and shall provide 95 lbs. grab tensile strength (ASTM D-1682), UV stability of 90% strength retained after 500 hours carbon arc testing (FED TM 191), permeability greater than 0.01 cm. sec (ASTM D4491-85) and sufficient sunlight blocking characteristics to effectively retard weed growth.

B. Stone

1. The stone required shall be of the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 1/2"	100
1"	90-100
1/2"	15-45
1/4"	0-10
No 200	0-1.0

Decorative stone may be used.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

PART III - EXECUTION

3.01 Installation

A. Landscape Fabric

1. The landscape fabric shall be placed according to manufacturers instructions on all unpaved areas in the pumping station site to the limits as shown on the Plans.

B. Stone

1. Stone shall be placed over the landscape fabric to a depth of 4 inches. The surface shall be left smooth and even.

SECTION 02800 - RESTORATION

PART I - GENERAL

Where subdivision or sanitary sewer extension plans extend offsite either on private lands, on easement, or in the public right-of-way, restoration requirements shall be as specified in the Erie County Division of Sewerage Management Construction Specifications, easement conditions of the private land owner and permit conditions of the entity having jurisdiction over the public right-of-way.

SECTION 02982 - SIMULTANEOUSLY BORING AND JACKING

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, tools, equipment and incidentals required to install steel encasing pipe under State, County or Town highways, railroads, high pressure gas mains, and/or beneath existing trees, as specified herein or in the governing permits, by simultaneously boring and jacking, or tunneling.

B. All required permits shall be obtained by the contractor and the terms of said permits shall be adhered to.

PART II - PRODUCTS

2.01 MATERIALS

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02982 - SIMULTANEOUSLY BORING AND JACKING

A. The casing pipe shall be weldable steel pipe meeting ASTM A-139, Grade B requirements, with an outside diameter and a minimum wall thickness as noted on the Road Crossing by Jacking and Boring Method Detail, and as shown on the Plans. The carrier pipe shall be of same material as the sanitary sewer pipe adjacent to the casing.

PART III - EXECUTION

3.01 INSTALLATION

A. The steel casing pipe shall be installed at the design slope of the carrier pipe by simultaneously boring and jacking. The casing pipe joints are to be butt welded following the structural welding code (AWS D1.1). The carrier pipe shall be installed inside the casing pipe, adequately supported on grade as required and as detailed on the Plans.

B. The void between the casing pipe and carrier pipe shall be filled with dry pea gravel meeting the New York State Department of Transportation No. 1A gradation, and the ends of the casing pipe sealed with brick and masonry bulkheads. Flowable fill is not permitted.

C. The temporary sheeting, shoring and bracing required for the jacking pit shall be approved by the Agency having jurisdiction.

D. Maximum allowable vertical error for the casing pipe shall be 0.2 of a foot above or below the design grade. The maximum allowable error on the horizontal alignment of the casing pipe shall not exceed 4" off the designed centerline of alignment. Any errors in grade and/or alignment which exceeds the noted allowable shall be suitably corrected.

E. The work shall include dewatering by pumps, well points, drains or other acceptable means. Unstable or wet runny soils shall be stabilized by dewatering, chemical grout or other acceptable means.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 02990 - ABANDONMENT OF MANHOLES, CHAMBERS AND PIPES

PART I - GENERAL

1.01 Scope of Work

A. Furnish all labor, materials, tools, equipment and other incidentals required for the abandonment of pipes, manholes and chambers at the locations shown on the Plans and as specified herein.

B. All required permits shall be obtained by the contractor and the terms of said permits shall be adhered to as if they were a part of the Specifications.

C. The contractor's method of construction shall consider all sheeting, shoring and ventilation required by OSHA for a safe working environment.

D. A written description of the method of construction shall be submitted for approval prior to proceeding. A copy of this information must also be submitted to the governing right-of-way agency having jurisdiction for review and approval.

PART II - PRODUCTS

2.01 Materials

A. For pipes to be abandoned

1. Fill all pipes with a slurry which shall consist of a mixture of water and fine aggregate meeting the requirements of Section 703-01 of the New York State Department of Transportation Specifications (Latest edition). The slurry mix shall have a consistency and uniformity compatible with the method of placements.

OR

2. A dry course aggregate meeting the requirements of Section 703 of the New York State Department of Transportation Specifications (Latest edition). The maximum aggregate size shall not exceed Type 1A gradation.

B. For manholes and chambers to be abandoned

1. Install select granular run of crusher stone meeting the requirements of Section 304-2.02, Type 4 of the NYS Department of Transportation Specifications (Latest edition).

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SECTION 02990 - PART III - EXECUTION

3.01 Installation

The abandoned sewer pipes shall be completely filled with a fine/coarse aggregate. The contractor shall utilize either the "air blown method" which utilizes a dry aggregate or the "hydraulic slurry method" which consists of a water and fine aggregate mixture pumped into the pipe. The ends of the pipe sections shall be bulkheaded utilizing sand bags sealed by a concrete cap (2000 psi).

Once the pipe sections are completely filled and bulkheaded, the contractor shall proceed with the abandonment of the manholes/chambers. The contractor will be required to do the following:

1. Remove the frame and cover. The contractor shall deliver the frame and cover to the Erie County Sewer District Offices.

2. Drill four (4) holes, 1-1/2" to 2" in diameter, through the base of the manhole/chamber.

3. Remove or demolish the top wall sections of the structure. All structure walls within four feet of existing grade shall be removed. The contractor will be required to dispose of said material in accordance with State/Federal Regulations.

4. Backfill the manhole/chamber to existing grade utilizing the select granular backfill material as specified in Section 02990-2.01 B-1. The backfill material shall be compacted in lifts. The contractor's method a compaction shall be such so as to achieve not less than 95% of Standard Proctor Maximum Density.

DIVISION

8

(Site Work)

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 08130 - STAINLESS STEEL FRAMES AND DOORS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install frames and doors including all accessories as shown on the Plans and as specified herein.

1.02 SUBMITTALS

A. Shop Drawings

1. Shop drawings for doors shall indicate the location of each door, elevation of each type of door, details of construction, method of assembling sections, location and extent of hardware reinforcement, hardware locations and thickness of metal. Drawings for frames shall show construction and thickness of metal, provisions for receiving hardware, method of reinforcing, type and location of anchors.

PART II - PRODUCTS

2.01 MATERIALS

A. Stainless Steel Door and Frame

1. Materials for stainless steel work shall be Type 316 stainless steel sheet 0.078 thickness. All exposed stainless steel shall receive a #4 finish after all fabrication has been completed, and then totally protected with waterproof adhesive backed paper before being shipped.

2. Stainless steel frames shall be formed to sizes and profiles as indicated on the Drawings, and designed to fit provided openings for respective installations. Jambs, head and other members of frames shall be assembled with continuously welded joints, with exposed weld surfaces ground flush and dressed smooth.

3. Reinforcement for hardware shall be stainless steel, of proper size and thickness, designed to develop the full strength required for the support of respective hardware items as specified herein.

4. All frames noted to be labeled shall be constructed according to the Underwriters Laboratories requirements, and delivered with the labels permanently attached.

5. Bucks shall be mortised and reinforced to

**Specifications for
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SECTION 08130 - 2.01

receive hardware as required. Reinforcement shall be welded in place and tapped for machine screws at factory. Stainless steel strike boxes shall be welded to jambs to receive lock bolts. Reinforcement shall be offset so that the faces of the butts or keepers are flush with the face of rebate. Reinforcement for butts shall be 1/4" stainless steel plate. Except as otherwise hereinafter specified, the reinforcement shall extend not less than 6" above and below the centerline of each hinge. Reinforcement for exterior doorframes and for frames requiring 1-1/2 hour fire resistive ratings and over shall have the reinforcement for butts run the full length of the jambs.

PART III - EXECUTION

3.01 INSTALLATION

A. Doors, frames and hardware shall be individually packaged for protection during transit and field storage.

B. Doors, frames and hardware shall be installed and adjusted by skilled work persons experienced in this type of work in strict accordance with the recommendations of the manufacturer.

C. Hardware and operating equipment shall be carefully adjusted and the opening and closing movements shall be uniformly smooth.

D. After erection of doors, frames and hardware, precautionary methods shall be employed to adequately protect exposed surfaces of the installed items from damage due to installation of other work or from lime, acid, cement, or other harmful compounds.

E. Doors and frames shall be free of any dents or scratches after installation. Any door or frame marred shall be removed and replaced with a new door.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 08510 - WINDOWS

PART I - GENERAL

1.01 DESCRIPTION

A. Furnish all labor and materials to complete the fabrication of windows as shown on the Plans and as specified herein. All windows covered by this specification shall be fabricated and installed and shall include, but not limited to, the following:

1. Steel weatherstrip projected sash.
2. All sash anchors, mullions, covers and trim.
3. Factory applied Hope's Ultra-coat finish.
4. Insect screens for all operating sashes.
5. Installation

1.02 QUALITY ASSURANCE

A. Manufacturer shall have not less than five years experience in the manufacture of steel windows.

B. Erector shall have not less than five years experience in the installation of steel windows.

C. Allowable tolerances: size dimensions \pm 1/16 inch.

D. Source quality control.

1. Air infiltration test

a. ASTM E283

b. Maximum air infiltration one-half CFM/Ft of crack length.

2. Water penetration test

a. ASTM E331

b. No water penetration for 15 minutes when window is subjected to a rate of flow of 5 gal/hr/sq ft with differential pressure across window unit of 6.24 PSF.

**Specifications for
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SECTION 08510 - 1.02

3. Upon request the window manufacturer shall provide a test report from a qualified independent testing laboratory regularly engaged in testing windows to verify that his products conform to these test requirements.

1.03 SUBMITTALS

A. Samples

1. Typical sash corner
2. Color sample of finish
3. Hardware

B. Shop drawings and manufacturer's literature

1. Submit shop drawings showing sash and installation details including anchorage, fastening and sealing methods.
2. Dimensioned elevations showing window opening and sash sizes.
3. Color charts for standard Ultra-coat finishes and sealants.

1.04 GUARANTEE

Guarantee all materials and workmanship furnished and installed to be free from defects for a period of 24 months from the date of final acceptance or from date of substantial occupancy, whichever may be earlier. Repair or replace any materials or workmanship found to be defective under conditions of normal use during this period.

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PART II - PRODUCT

2.01 MATERIALS

A. Heavy intermediate weatherstrip windows shall be manufactured from solid hot rolled shapes.

1. Sections made from new billet steel with flanges rolled integral at the mill.

2. Glazing rebates shall provide an unobstructed glazing surface 3/4" in height.

3. Combined weight of frame and ventilator sections shall be a minimum of 4 pounds per lineal foot and frame depth from front to back 1 7/16 inches.

4. The ventilator sections shall have an integral dove tail groove located on the inside bedding contact for the reception of weather-stripping.

B. Glazing beads shall be extruded aluminum alloy 6063-T5 with a minimum thickness of .060 inches.

C. Weather-stripping shall be extruded vinyl.

D. Hardware

1. Use 60-2 bronze fasteners for P.O. vents.

2. Use 65-2 bronze fasteners for P.I. vents.

3. When ventilators are out of reach for hand operation:

a. Use 64-2 bronze fasteners for P.O. vents.

b. Use 456 bronze spring catch for P.I. vents

4. Fasteners shall be attached with brass screws.

5. Projected ventilators shall be hung on heavy duty steel side arms and brass friction shoes.

E. Screens

1. Frames shall be of formed electro-galvanized steel sections having a minimum thickness of 0.032 inches.

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2. Mesh shall be 18 x 14 mesh bronze wire cloth having a nominal diameter of not less than 0.0113 inches.

F. Paint

1. Pre-treatment - Bonderite 37
2. Primer - special epoxy
3. Finish coat - acrylic enamel

2.02 FABRICATION

A. Fabricate steel windows in accordance with approved shop drawings.

B. Prior to fabrications, all hot rolled steel sections shall be cleaned by shop blasting.

C. Corners of frames and ventilators shall be mitered and copied, then solidly welded. Tee shaped muntins shall be tenoned and riveted. Exposed and contact surfaces shall be finished smooth flush with the adjacent surfaces.

D. Operable Hardware

1. Projected ventilators shall be balanced on heavy steel side arms securely pivoted to the vent and frame at each jamb. Friction shall be maintained by means of two brass shows sliding in the channel of the frame section controlled by compression springs enclosed in tubular housings.

2. Provide two fasteners per vent where sash width exceeds 4'8".

3. Projected ventilator fasteners shall be shipped loose for field installation

E. Weatherstrip

1. Continuous vinyl weather-stripping, especially designed for the purpose shall be applied to dove tail grooves in the interior contact surface of the ventilator section.

2. Surface applied weather-stripping is not acceptable

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F. Screens

1. Screen frames shall be electro-galvanized steel, rewireable and filled with 18 x 14 mesh bronze wire cloth.
2. Screen fastenings shall permit easy attachment and removal from the exterior.
3. Provide flat screens for project in vents and wicket screens for project-out.
4. Finish screen frame to match sash color.

G. Glazing

1. All ventilators and fixed lights shall be designed for inside (or outside) glazing.
2. Provide continuous glazing beads, screw attached or hook on, to suit the glass as specified.

H. Factory Finishing

1. After fabrication, steel windows, mullions, covers and trim shall be zinc-phosphate treated with Bonderite 37 in a continuous five stage process.
2. This shall be followed by one coat of DuPont's special epoxy primer, oven baked at 325 degrees for 35 minutes.
3. Following the prime coat all windows shall be given a spray coat of acrylic enamel applied by an automated electro-static process and oven baked at 370 degrees for 15 minutes.
4. Color shall be as selected by the architect from the manufacturer's standard colors.

SECTION 08510 - 3.01

PART III - EXECUTION

3.01 INSPECTION

- A. Window openings shall conform with details, dimensions and tolerances shown on the shop drawings.
- B. Conditions which may adversely affect the window installation must be corrected before installation commences

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SECTION 08510 - 3.02

3.02 INSTALLATION

A. Install windows in openings in strict accordance with shop drawings.

1. Set units plumb, level and true to line, without warp or rack of frames or vents.

2. Anchor units securely to surrounding construction with fasteners

3. The exterior joints between the sash, trim and mullions shall be properly sealed watertight with an approved sealant and neatly pointed.

B. Attach ventilator hardware and adjust ventilators to operate smoothly, free from twist and be weathertight when closed.

C. Repair any abraded areas of the factory finish.

3.03 CLEANING

A. Window installer shall leave window surfaces clean after installation and ready to receive glazing.

SECTION 08700 - FINISH HARDWARE

PART I - GENERAL

1.01 SCOPE OF WORK

A. Description of Work

1. Provide all materials, equipment and services required to furnish all hardware necessary to complete the building as shown on the Plans and specified herein.

2. Finish hardware shall consist of:

a. All finish hardware necessary to complete the work in sufficient quantities to meet the project requirements even though every such item is not specifically mentioned, including the correct number of screws of proper size, materials, and finish for each piece of hardware and all parts necessary to put all hardware in operating condition.

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b. Master keyed cylinders used for the main entrance door.

SECTION 08700 - 1.02

1.02 QUALITY ASSURANCES

A. The finish hardware supplier must be regularly engaged in contract hardware work, be staffed to execute the work expeditiously and must have in his employ a certified Architectural Hardware Consultant to set up the final hardware schedule.

1.03 SUBMITTALS

A. Shop Drawings and Schedules

1. Hardware Schedule

The supplier shall submit to the District a complete schedule of all finish hardware as part of the required work of this Section.

2. The schedule shall be prepared by the finish hardware supplier after careful examination of all drawings, details, specifications and addenda to determine the composition of his schedule. The supplier shall include with this submission a bound copy of the catalog cuts for each item to be furnished. These cuts to include descriptive information and technical data so that the gauge of metal, type, function, finish, design and quality may be readily determined.

3. The supplier's schedule shall include the location of each hardware item on the project, the name of the manufacturer and the manufacturer's catalog number; the template number and all additional information necessary to completely identify the item to be furnished. The hardware schedule shall also include a complete keying schedule.

4. Prior to installation, the manufacturers recommended installation methods shall be delivered to all installing personnel.

1.04 Product Handling

A. Each item of hardware shall be substantially packaged and clearly marked to indicate its location in the building as shown in the accepted hardware schedule.

B. Each hardware piece shall be packed separately in

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the manufacturer's original package, complete with screws, keying, instructions and templates, marked to correspond with the approved hardware schedule.

PART II - PRODUCTS

2.01 MATERIALS

A. The hardware items to be products exactly as specified or equivalent products of approved manufacturers noted in this Specification.

2.02 HINGES

A. Hinges to be button tip, five knuckle with stainless steel pins and concealed bearings.

B. Acceptable manufacturers are Hager Hinge, Lawrence Bros., Stanley Hardware and McKinney, or equal.

2.03 MORTISE LOCKSETS AND LATCHSETS

A. Mortise locksets, latchsets and trim to conform with ANSI A156.2, Series 1000, Grade 1 specifications.

B. Lock cases of steel with a standardized size of functions available in one size case.

C. Locksets completely reversible with 3/4" throw latchbolt for non-deadbolt functions and one inch throw deadbolt and minimum 5/8" latchbolt for deadbolt functions.

D. Acceptable manufacturers are Sargent Services 8000 or 9000, or approved equal

E. Lock trim forged of wrought brass or bronze meeting ANSI A156.2 Grade 1 Specifications

F. Acceptable manufacturers are Sargent OB, or approved equal.

G. Locksets requiring "knurled outside knob" may have abrasive coating meeting ANSI specifications in lieu of actual knurling.

H. Locksets with standard ANSI strikes of template construction.

2.04 DOOR CLOSERS

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A. Closers with key valves, adjustable back-check and Phillips head hex bolts.

B. Special arms, brackets, shims and spacers provided to suit conditions.

SECTION 08700 - 2.04

C. Acceptable manufacturers are Corbin, Dorma, Norton, Russwin, Sargent, Yale or LCN.

2.05 WALL AND FLOOR STOPS

A. Hardware supplier to coordinate the sill clearance of the door manufacturer with bumper size to provide appropriate Type.

B. Acceptable manufacturers are Baldwin, Glynn Johnson, Rockwood or Ives.

2.06 THRESHOLDS

A. Thresholds shall have expansion shield anchors unless otherwise required.

B. Acceptable manufacturers are Pemko, Reese, Durable Products or National Guards.

SECTION 08700 - 2.07

2.07 WEATHERSTRIPPING AND DOOR BOTTOMS

A. National Guard is the preferred manufacturer for door bottoms. Other acceptable weather-stripping manufacturers are Reese, Durable Products or Stanley Products.

2.08 FINISHES

A. Hardware shall have brushed chrome, US26D finish.

B. Door closers to have aluminum sprayed lacquer finish equal to LCN No. 1 (FHMA 689) unless otherwise stated.

2.09 FASTENERS

A. Exposed fasteners shall have philips heads and be finished to match the items fastened.

B. Install hex bolts for door closers, exit devices and overhead holders and thru bolts with grommet.

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2.10 FIRE AND CODE LABELS

A. Where hardware is to be installed in or on labeled fire doors and frames, hardware is to conform with Underwriters Laboratories requirements for time-rating or other performance requirements indicated. Hardware conforming to the UL requirements to be properly stamped or labeled.

B. Finish hardware shall comply with the requirements of the laws, codes, ordinances and regulations of the governmental authorities having jurisdiction where such requirements exceed the requirements of the specification.

2.11 KEYING

A. Cylinders master keyed to Sargent-Keso key system, as directed by the District.

B. Final change keys and master keys delivered to the District.

C. Keys with visual key control. Key bow stamped with the proper key set symbol.

D. Provide temporary cylinders during construction.

E. Provide the following cut keys: Master keys - five (5) each; Change keys - minimum of five (5) and maximum of twenty (20) per key set.

2.12 TEMPLATES

A. Furnish templates to the manufacturers of doors and frames as required for proper reinforcement and preparation of their work.

B. When required, the hardware supplier will furnish the physical hardware to the door and frames manufacturer for application.

2.13 HARDWARE SCHEDULE

The Hardware Supplier is cautioned to coordinate the Hardware Schedule with the General Contractor since options on door materials and thickness exist in other parts of the specifications.

PART III - EXECUTION

3.01 INSTALLATION

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A. Mounting heights stated below are center line heights in inches up from the floor. Where heights are not listed, mount in accord with recommendations of D.H.I.

- | | |
|---------------------------|--------------------|
| 1. Bottom hinge | 10-13 |
| 2. Top hinge | 6-8 down from head |
| 3. Intermediate hinge | Equally spaced |
| 4. Door knob, wall bumper | 38 to 42 |

SECTION 08700 - 3.02

- | | |
|--------------------------|----------|
| 5. Panic device crossbar | 37 to 41 |
| 6. Cylinder deadlock | 60 |
| 7. Holder | 76 |

B. Install each hardware item according to the manufacturers instructions. Fit hardware accurately and properly. Remove exposed parts until after painter's finishing is completed, then reinstall. Fit faces of mortised parts snug and flush. Make sure operating parts move freely and smoothly without binding, sticking or excessive clearance.

C. Door closers installed to allow the maximum degree of openings without the door or hardware causing interference or damage to the door or trim.

D. The thresholds shall be installed in one continuous piece for the full width of opening, set in a full bed of mastic and fastened with countersunk anchors.

3.02 FIELD QUALITY CONTROL

A. A final check of all hardware items and the installation shall be made by the District prior to final acceptance of the building.

B. Where hardware is found to be defective in materials or installation, that hardware shall be replaced with new.

1. The following will be considered as defective materials:

- unauthorized substitutions
- items of incorrect hand or function
- items delivered with:
 - missing parts
 - broken parts
 - damaged parts
 - defaced parts

2. The following will be considered as defective installation:

- items broken after delivery

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- items damaged after delivery
- items defaced after delivery
- items incomplete
- items misaligned
- items incorrectly located

SECTION 08700 - 3.03

3.03 ADJUSTING AND CLEANING

A. After work has been otherwise completed, examine all hardware items for complete and proper installation. Lubricate bearing surfaces of moving parts. Adjust latching and holding devices to proper function.

B. Adjust door control devices to proper speed and power.

C. Clean all exposed surfaces and check for surface damage

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SECTION 08800 - GLASS AND GLAZING

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals necessary to install all glass as shown on the Plans and specified herein.

1.02 RESERVED

1.03 DESCRIPTION OF WORK

A. The extent of glass and glazing work is shown on the Plans.

B. Sizes of glass indicated on the Drawings are approximate. Size for glass shall be taken from the actual frames.

C. Manufacturer's labels showing strength and quality will be required on all glass. Labels shall remain on glass until after inspection.

D. The Contractor shall examine the Specifications for the various trades and thoroughly familiarize himself/herself with all of their provisions regarding glass and glazing.

PART II - PRODUCTS

2.01 MATERIALS

A. All exterior doors and exterior windows shall have maintenance free exterior, bullet resistant laminated glass glazing (Clear Lexgard Laminators mp 750 or sp 1250 as manufactured by General Electric, Co. or equal).

B. Setting Blocks: Neoprene, 70 to 90 Shore A durometer hardness.

C. Preformed Glazing Tape: Non-sagging, non-oxidizing, non-staining, self-adhesive butyl rubber.

D. Spacers: Neoprene blocks, adhesive blocked one face, 40 to 50 Shore A durometer hardness.

E. Joint Cleaner, Primer and Sealer: As recommended by the manufacturer of the primary glazing material for each specific use.

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SECTION 08800 - 3.01

PART III - EXECUTION

3.01 INSTALLATION

A. Glazing materials shall be delivered in unopened containers, fully identified with trade name, color, size, hardness, type, class and grade. Each material shall be stored in accordance with manufacturer's instructions.

B. Glass shall be delivered and stored in accordance with the manufacturer's recommendations, protected from weather, staining, damage and loss. At all times during storage and handling of glass, provide cushions at edge to prevent impact damage and protect faces from scratches and abrasion.

C. Glazing shall be done after doors and windows have been installed.

D. Glass shall be pressed into the rabbet without springing or forcing, and centered into the rabbet. Glass in units provided with stops shall be set with stops along all edges, and a proper bed of compounds shall be provided between the glass and stops. Excess compound shall be stripped off from both sides of the glass at an angle. Glazing channels shall not project above the sight line.

E. Glass shall be set tightly and shall be free from rattle.

F. All exterior glass shall be installed watertight and air-tight, capable of withstanding temperature changes, wind, loading and operation impact.

G. Clean and remove labels from all glass and clean glazing compound from frames around glass installed under this section upon completion of work. All defective or broken glass and glass broken because of faulty setting shall be replaced.

H. All glass shall be protected from accidental damage with tapes or streamers attached to the sash or frame. No tape or streamer shall contact the glass.

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SECTION 15172 - PRESSURE GAUGES

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, and install, complete and ready for operation, the pressure gauges as shown on the Plans and as specified or implied herein.

1.02 DESCRIPTION OF SYSTEM

A. The term "pressure gauges" shall, in general, mean positive pressure, vacuum, or positive pressure and vacuum compound gauges.

1.03 SUBMITTALS

A. The engineer must submit shop drawings for each type gauge shown on the Plans.

1.04 TOOLS AND TESTING EQUIPMENT

A. The following tools and equipment shall be furnished:

1. One (1) vacuum gauge test kit, to consist of but not be limited to hand operated vacuum pump, vacuum test gauge with a range 0-28 in. Hg an accurate to; within 0.25 percent; test stand; two gauge wrenches; one gauge handjack; one gauge hand set; connection nipples; and lockable steel storage case.

2. One (1) positive pressure gauge test kit to consist of but not limited to hand operated test pump, test gauge with a range of 0-160 psi and accurate to within handjack set; pipe fitting adaptor; spare 0-rings; and lockable steel storage case.

PART II - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. General

1. All of the equipment specified herein is intended to be standard pressure gauging equipment. All parts shall be designed and proportioned to have liberal strength and to be suitable for the specified applications. Gauges shall be liquid filled, diaphragm isolated and pulsation dampened.

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B. Pressure Gauges

1. Each pressure gauge shall have a minimum 4" dial and be sealed in a weatherproof liquid filled phenolic case and shall be equipped with a threaded type locking ring, phosphor bronze Bourdon tube, stainless steel rotary geared movement, adjustable pointer, glass or acrylic plastic crystal, and 1/2" NPT male connection. Each gauge shall be accurate to within one percent of scale range. Each dial shall have black lettering and scales on a white background.

2. Unless otherwise stated in the pump specification, each pressure gauge for use on the discharge side of pumps shall have a range of zero (0) to twice the anticipated working line pressure or a maximum pressure equal to the shut off head of the pump feeding the system in which the pressure is being monitored. These gauges shall be graduated in 1 psi increments (figured at every 10 psi) or feet of head. Unless otherwise stated in the pump specification, each pressure gauge for use on the suction side (if applicable) of pumps, shall be a compound gauge with a range of 30 inches of mercury vacuum to 15 psi positive pressure and graduated in 2 inch mercury vacuum and 1 psi increments respectively and figured at every 10 inches mercury vacuum and 10 psi respectively.

C. Diaphragm Seals

1. Each diaphragm seal shall consist of a wafer-thin diaphragm of the material specified backed with a stainless steel plate and a stainless steel stud connection with double "O-ring". Each diaphragm seal shall be filled with silicone, and shall be suitable for the vacuum and pressure ranges of the corresponding pressure gauge. Each diaphragm seal used in conjunction with the gauge specified shall have a combined accuracy of 1-1/2% of scale range maximum, not including temperature effects. Each diaphragm seal shall have a plugged (removable) flushing connection for the bottom housing.

D. Pulsation Dampener

1. Each pressure gauge must be accompanied by a pulsation dampener, consisting of an insert designed to restrict the movement of the pressure sensing fluid so as to virtually eliminate pulses in the gauge pointer.

E. Gauge Mounting Assembly

1. The gauge mounting assembly shall consist of one (1) stainless steel angle plate (3"x3"x1/4"), six (6) inches in length and one (1) 4" nominal (for a 2x4) stainless steel square U-Bolt with extra stainless steel nuts.

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The U-Bolt and angle plate assembly shall be installed as shown on "Gauge Detail (Page 15-3)."

PART III - EXECUTION

3.01 INSTALLATION

A. Each pressure gauge shall be installed in the location shown or noted in the Drawings and in accordance with the manufacturer's instructions. The Contractor shall furnish all necessary fittings required to adapt the specified gauges to the particular installation.

B. Pressure gauges in cast iron or ductile iron pipe shall be installed with pipe fittings or by direct pipe taps using municipal water service connection type corporation stops. Pressure gauges in all other types of pipe shall be installed with pipe fittings only.

C. Connections are to include two (2) ball valves for shut off when replacing.

3.02 TESTING

A. Each pressure gauge shall be tested in conjunction with pipe and pump tests. Defective gauges shall be repaired or replace with new gauges of the same type quality.

DIVISION 15

(Site Work)

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SECTION 15330 - SEWAGE GRINDER ASSEMBLY (COMMINUTOR)

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, and install, test and place in satisfactory operation one (1) sewage grinder assembly (comminutor) in the underground chamber at the proposed pumping station site shown on the Plans and as specified herein.

1.02 SYSTEM DESCRIPTION AND PERFORMANCE

A. The sewage grinder assembly (comminutor) is intended for continuously cutting coarse solids normally contained in raw sewage and reducing them to a size which will not interfere with subsequent pumping and treatment operations.

PART II - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. SEWAGE GRINDER ASSEMBLY (COMMINUTOR)

1. The sewage grinder as a minimum shall be a channel unit Model 30000 series "Muffin Monster" as manufactured by Disposable Waste Systems, Inc. Santa Anna, California, or approved equal. The unit shall be remotely driven by a 5 HP Hydraulic Power Pack to be located in the Control Building. A NEMA 4X Solid State Motor Controller shall be provided for automatic reversal in case of jamming.

2. High pressure hydraulic hose shall be provided within the Control Building and chamber as detailed on the Plans. The hoses shall have quick-disconnect type fittings for attachment to the grinder unit, hydraulic drive unit, and underground hydraulic piping. Suitable restraints shall be provided in the chamber to support the hydraulic hose and prevent kinking and/or damage to hydraulic fittings. Underground hydraulic piping from the chamber to the Control Building shall be installed in conduits and tested for leaks at full rated pressure, and shall be coated with bituminous paint prior to completion.

B. SEWAGE GRINDER

1. The sewage grinder shall be gear driven and shaft coupled of the two shaft design, with a minimum output torque of 11000 in/lbs. One shaft shall turn at 2/3 the speed of the other. Shafts shall be construction from 4140 steel hexagon stock. The two shafts shall counter rotate and be equipped with spacers and intermeshing cutters. Cutters and spacers shall be cast from 4130 steel, surface ground for uniformity and through

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hardened to 43.48 Rockwell "C".

2. Cutters shall be of the 7 tooth design with two leading cutting edges on each tooth so as to cut in each direction without removing the cutters from the grinder.

3. The sewage grinder shall be so designed that when one cutting edge on the tooth of the cutter becomes worn, the entire grinder can be rotated 180° in channel; and by reversing the two hydraulic lines to the torque motor, the opposite cutting edge of the cutter tooth can be utilized. Cutters shall be placed on the shafts in a 1:1 ratio to the spacers and shall be in a helical formation. The inside diameter of the spacer shall be hexagon shaped.

4. The sewage grinder shall be constructed of corrosion resistant material and must be compatible so as to resist corrosion due to cavitation or galvanic action. Housing of the sewage grinder shall be cast of Class 20/30 Grey Iron.

5. Side rails shall be of the open end design and bolt laterally to the end housing.

6. The sewage grinder shall be installed in a straight rectangular channel and shall not require bolting directly to the channel. In channel grinder shall be supplied with channel mounting frames so designed to hold the grinder in position without bolts. Anchor bolts for the channel frame work shall be supplied.

The design of the channel shown on the plans fits on type of sewage grinder. If another acceptable make is used which requires alterations to the channel design, then such changes shall be made by the contractor.

7. The sewage grinder shall be capable of operating continuously, processing wet or dry, in air or completely submerged in water or sewage. Seals shall be comprised of replaceable wear sleeve cartridge fixedly mounted to the housing bore which carries internally the fixed race of an anti-friction bearing and a tungsten carbide static seal race. The wear sleeve cartridge defines with a labyrinth pre seal bushing hexagonally fixed to the shaft, the basic elements of a labyrinth pre seal and additionally, resiliently couples through a seal wedge, a tungsten carbide rotating seal race couples whose end face is both fluid pressure and resiliently biased against the end face of the annular static seal race. Seals shall require no external water source.

8. The high speed shaft of the grinder shall be directly coupled to a hydraulic torque motor by means of a 2 piece interlocking coupling and a gasket spool piece. The

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torque motor shall utilize the hydraulic pressure developed by the power unit to provide the rotational torque required by the cutters.

9. All appurtenances including shafts, couplings, bearings, bearing supports, bar screen, foundation bolts, and instruction books shall be furnished by the manufacturers of the comminutor.

10. One extra set of oscillating (revolving) and stationary cutters shall be supplied as spare parts.

C. THE HYDRAULIC POWER UNIT

The hydraulic power unit shall consist of the following:

1. A 14" x 14" x 14" epoxy coated, 10 gallon capacity reservoir.
2. A positive displacement pump driven by a high efficiency (TEFC) or (Explosion Proof), C face, vertically mounted 5 HP motor.
3. A combination oil level and oil temperature gauge
4. A 10 micron, return line filter
5. A 40 micron suction filter
6. A 120 volt 4 way solenoid valve
7. A pressure switch preset at 2,850 psi
8. A relief valve preset at 3,000 psi
9. An oil temperature limit switch set at 145°F
10. An oil level switch
11. A 2-1/2", 0-3000 psi oil filled gauge
12. A filler breather

The hydraulic power will be mounted in the Control Building as shown on the plans.

D. THE HYDRAULIC SYSTEM

The entire hydraulic system shall be designed for 3,000 psi minimum pressure. At idle load conditions operating pressure should be in the 200 to 400 psi range. Continuous operating pressure above 2,000 psi will not be acceptable. Consult factory for alternative recommendations. As solids are encountered, pressure is automatically increased on a demand basis to provide the required torque necessary to continue rotation of the cutter.

Should the demand require pressure in excess of 2,850 psi, a pressure switch is activated and a 4 way valve is shifted, instantly reversing the rotation of the cutters for about 1/2 to 1 revolution or about 1/2 second. At the end of this time the valve is again shifted and the cutters will return to the forward direction.

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If the obstruction has been cleared the unit will continue to operate in the forward direction. If the obstruction has not cleared the reversing sequence will repeat until the torque requirement is reduced or until it has had to repeat the reversing cycle 9 times within a 30 second time span. If 9 reversals have occurred within 30 seconds the electrical controller will shut down the hydraulic unit and activate an alarm.

Hydraulic connections between the torque motor and the power pack shall consist of (2) 1/2" flexible hoses rated for 3,500 psi each 20' long.

On completion of installation the hydraulic power unit shall be filled with high quality fluid with a viscosity of approximately 150 to 250 SSU at 100°F with good chemical stability and anti-foaming properties. the grades of hydraulic fluid shall be in accordance with the recommendations of the manufacturer.

E. MOTOR CONTROLLER - MODEL HB 100

1. The motor controller shall utilize a solid state logic design. Line transient protection shall be provided to 1,000 volts. A transformer will supply all low and intermediate control voltages. All transformer legs shall be fuse protected. The controller shall provide thermal motor overload protection, low oil level and high oil temperature cutoff circuitry.

Standard controller enclosure: NEMA 12 v

The controller shall provide the following functions:

- a. Operate in a normal "on" "off" mode.
- b. Sense an overload signal from the pressure switch, momentarily energizing the directional valve reversing the torque motor for approximately 1/2 second, it will then de-energize the valve allowing it to return to the forward position.
- c. If eight (8) overloads occur, the same schedule shall apply as for one overload.
- d. If a ninth (9) overload occurs within a 30 second time span the controller will reverse direction and shut down the power unit, energizing a light and alarm relay rated 120 VAC, 10 amp resistive load.

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2. Motor Controller - Model HB 100R, or approved equal.

The Motor Controller shall be equipped with a "local", "Off", "Remote" switch. In the off position, the hydraulic power pack will not run. In the local position the panel controls are used. In the remote position the unit starts when two (2) terminals are closed and stops when they are opened.

3. Electrical Requirements

3 phase, 50-60 Hz

F. SEWAGE GRINDER (COMMINUTOR) CHAMBER

1. The square chamber shall be constructed to the dimensions shown on the plans of precast reinforced concrete with a base and concrete cover. The design shall prevent floatation.

Exterior surface of the chamber shall be coated with Koppers Super Service Black, or approved equal.

2. The chamber access shall be aluminum hinged double leaf, watertight diamond plate anodized doors with locking drain and safety devices to withstand a live load of 300 lbs/sq. ft. Hinges shall be flush type with bronze pins. Each cover shall be equipped with a locking device keyed alike to District requirements.

3. The chamber shall have a hot dipped galvanized 42" ladder up safety post with special alloy spring, Bilco Model 2 or approved equal.

4. The chamber shall have a fiberglass reinforced plastic ladder. OSHA qualified safety yellow, C.R.M.C. Co., Farmingdale, New Jersey or approved equal.

5. The chamber shall be ventilated as described in Section 15839.

PART III - EXECUTION

3.01 FIELD SUPERVISION

A. Provide a manufacturer's qualified representative to supervisor installation and instruct the Owner's personnel in the maintenance of the unit, for at least three (3) days.

3.02 FIELD TESTS

A. The field tests conducted by a representative of the sewage grinder manufacturer shall demonstrate that the unit has

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not been damaged during transport; that it has been properly installed and aligned; that it is running without any excessive noise, vibration, overloading or overheating and capable of comminuting the coarse suspended solids in the raw sewage, without surcharging in excess of the limits shown on the Plans.

B. A field test shall be conducted by the contractor and/or pump manufacturer to demonstrate that pump alternator and controls have been properly connected and that the system operates as intended. The pumping station including all equipment shall be tested completely before being accepted by the Owner for a period of three continuous days trouble free.

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3.03 SPARE PARTS

A. The following spare parts shall be provided for the sewage grinder:

1. Eight (8) oil filters
2. Reversing pressure switch
3. Programmable logic controller
4. One extra set of oscillating (revolving) and stationary cutters.

3.04 GUARANTEE

The grinder manufacturer shall warrant the sewage grinder hydraulic drive unit and controller to be free of any defects in construction or materials for a period of two (2) years from the date of acceptance, or for the period of warranty normally furnished by the equipment manufacturer if longer than two years. Any defects not due to ordinary wear or usage or care shall be corrected by the Contractor at his expense.

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SECTION 15351 - SUBMERSIBLE SEWAGE PUMPING STATION

PART I - GENERAL

1.01 DESCRIPTION OF SYSTEM

A. Furnish and install the complete submersible sewage pumping station system at the location shown on the Plans and specified herein.

B. Pumping equipment shall include submersible sewage pumps and motors with discharge connection elbows, guide bar brackets, lifting chain, electric power cable, pump mounting plates (with bottom rail supports, upper rail supports, stainless steel guide rails), aluminum access hatch, aluminum access ladder, wiring channel, liquid level sensors, spare parts, pump controls and appurtenances, belted vent set, vent pipe, auxiliary pumping pipe, jib crane and hoist, all installed on or in a fabricated concrete basin, and all other work required for a complete installation. Structure and dimensions to be as shown on the Plans.

C. Submersible sewage pumps shall be furnished for the pumping station, which shall be capable of passing 3" diameter spherical solids, and shall be non-overloading at all points on their performance curves. All pumps shall be the product of a single manufacturer to provide for interchangeability and standardization of spare parts. Also, one completely assembled spare pump shall be provided.

PART II - PRODUCTS

2.01 PERFORMANCE RATING

A. Acceptable Manufacturers

1. Gorman-Rupp Company of Mansfield, Ohio
2. Flygt Corporation of Norwalk, CT
3. Or approved equal

B. Certification

1. Submit the following Shop Drawings and data prior to manufacture:

- a. Application Data Sheet
- b. Pump dimensional drawing
- c. Pump head/capacity curve
- d. Pump motor input KW/capacity curve
- e. Five year/10,000 hour pump and motor warranty
- f. Division 1 certification
- g. Electrical control drawings with list of material

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- h. List of spare parts
- i. List of special tools

- 2. Submit the following Data after manufacture:
 - a. Report of factory testing
 - b. O&M Manual in electronic format (PDF on CD) and two (2) bound hard copies. Include the certified pump curves.
 - c. Technical manual.

2.02 SUBMERSIBLE SEWAGE PUMPS

A. General

1. Pumps shall be specifically designed to handle raw, unscreened sewage. The discharge connection elbow shall be permanently secured to the wet well floor by stainless steel anchor bolts; pumps 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 pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. The entire weight of the pumping unit shall be guided by no less than two stainless steel guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact. No portion of the pump shall bear directly on the floor of the sump.

B. Pump Construction

1. Major pump components shall be gray cast iron, Class 30, with smooth surfaces. Where watertight sealing is required, O-rings made of nitrile rubber shall be used. All exposed nuts and bolts shall be of stainless steel 304 construction. All exposed pump surfaces shall be protected by an approved sewage resistant coating. A replaceable wear ring system shall provide sealing between the volute and impeller. Impellers shall be of the single-vane, double shrouded, non-clog design.

2. Each pump shall be provided with a tandem mechanical rotating seal system, running in an oil chamber, with provision for determining the condition of the lower seal unit without disassembly of the pump. The lower seal unit shall contain one stationary and one positively driven rotating tungsten-carbide ring and sealing shall be assisted by liquid pressure. The upper seal unit shall contain one stationary tungsten-carbide ring and one positively driven rotating carbon ring. Each seal unit shall be held in contact by its own spring system.

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The mechanical seal must be warranted for a minimum of four (4) years from date of shipment. Should the seal fail within the first year, the manufacturer is obligated, upon notification, to furnish and install a new seal, no charge, to owner, F.O.B., factory. The cost of replacement seals thereafter will be on a pro rata basis as follows:

<u>Failure Within</u>	<u>Percentage of New Seal Price</u>
2 Years	25%
3 Years	50%
4 Years	75%

Certified pump curves are to be submitted as part of the station operation and maintenance manual.

C. Motor Construction

1. The pump motors shall be capable of supplying the maximum rated horsepower at the conditions and within the ranges specified, without overloading or exceeding Maximum Power, Input KW as specified in Subsection 30.

2. Pump motors shall be squirrel-cage, induction, shell-type design, housed in an air-filling, watertight chamber, NEMA Design B type. They shall have Class F insulation suitable for operating to temperatures of 155°C. Motors shall have an adequate cooling system with integral thermal radiators in smaller sizes and water jackets in larger sizes, which shall also include three thermal sensors imbedded in the stator coils to protect against overheating. The heat sensing units shall trip starter if motor overheats.

3. The seal chamber shall be fitted with electrode probe and signal box shall be supplied to indicate water in the seal chamber.

4. The pump motor electrical cable shall be type SPC of special design for submersible pump applications with P122-MHSA approval permanently embossed on the cable. Cable length shall allow installation and removal of pumps while still terminated at the above ground junction box.

5. Cable entry design shall insure a watertight seal, without specific torque requirements. It shall be comprised of a single cylindrical elastomer grommet flanked by washers, all having a close tolerance fit against the outside of the cable. The cable shall be compressed by the entry inside diameter, with a strain relief function separate from the

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sealing function. The cable entry junction chamber shall be isolated from the motor by a sealed terminal board to prevent foreign material from entering through the pump top.

2.03 PUMP CHAMBER

A. Sump Basin

1. The reinforced concrete wet well shall have an inside diameter and an inside height as shown on the Plans. Reinforced concrete basin walls and bottom shall be designed for the appropriate earth and water pressure and the top shall be of reinforced concrete of the strength designated on the Plans. Bottom of basin shall be reinforced concrete, sufficient to prevent floatation. The aluminum access hatch shall be cast in concrete. Wet well shall be coated inside and outside with an approved bitumastic coating. Pump mounting plates shall be bolted to the concrete base. Mounting plate shall be raised on pads to prevent corrosion under the plate. Discharge piping from pumps shall be mounted in wet well and shall be extended through wet well walls to the valve chamber.

B. Piping

1. Piping in the wet well shall be 4" size or greater and shall pass through the wet well wall sleeves. A sleeve shall be used in the wet well wall where each pipe passes through for gasket or packing with sealing cement to provide a waterproof and gastight joint. Inlet into wet well shall be mechanical link seal connection. The pump guide rails shall be Type 304 stainless steel pipe. Intermediate 316 stainless steel guide rail supports shall be used.

C. Access Hatch

1. The access hatch shall be a double-leaf aluminum hinged type, 37" x 60" or larger, diamond pattern, as manufactured by the Bilco Co. Doors shall be equipped with forged brass hinges, stainless steel pins, spring operators, and an automatic hold open arm. A snap lock with removable handle shall be provided. Each cover shall be equipped with a locking device keyed alike to District requirements.

D. Pump Mounting Bases

1. A separate mounting plate shall be furnished for each pump. These plates shall include adjustable guide rail supports.

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E. Discharge Elbow

The pump discharge elbow shall be furnished in gray cast iron, Class No. 30. The vertical or discharge leg shall be provided with a 4" (or 6") 125 lb. cast iron pipe flange for mating to discharge piping. The horizontal or inlet leg shall be provided with a flat machined face for forming an effective seal with the lip seal on pump. Elbow shall be provided with an integral base for anchoring and support of piping and pump to the wet well floor.

The discharge elbow shall be provided with a 304 stainless steel pivot pin for engagement of discharge flange hooks on pump.

F. Guide Rails

The guide rail package shall include two lengths of stainless steel pipe with pilots per Engineering drawing. Guide rail pipes shall be 2", schedule 40, stainless steel (304). Bottom pilots shall be Class 30 cast iron with flake glass/polyester or coal-tar epoxy coating. Upper pilots shall be non-sparking bronze.

G. Pump Guides

The guides attached to the pump which position pump between the guide rails, shall be completely encapsulated by fluidized bed coating with a hard nylon plastic or coal-tar epoxy coating. The guides are to be attached to the pump volute with 316 stainless steel hex head cap screws. A 1/4" diameter stainless steel braided wire lift cable shall be permanently attached to the pump. Hangers for lifting cable and pump cable shall be fabricated from 3/8" flat stock of 316 stainless steel. Cables shall be supported by stainless steel, split mesh rod closing "Kellums" grips.

H. Hardware

All bolts, machine screws, nuts, washers, and lockwashers for complete assembly of access cover, guide rails and discharge elbow shall be furnished by manufacturer in 316 stainless steel.

I. Submersible Level Transmitter

1. A Blue Ribbon Corporation Model BC001 Birdcage Series submersible level transmitter or equal is to be installed in the wetwell. The transmitter shall include the following features:

- a) A non-clogging 3-1/2 diameter sensor face.

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b) All 316 stainless steel construction to resist corrosion.

c) 1/2" NPT male electrical conduit connection for rigid installation support.

2. A BCP 3000 Surge Protector or equal shall also be installed such that a life-time surge warranty replacement program shall be in effect for the submersible level transmitter.

3. Both the transmitter and the surge protector shall be installed according to the manufacturer's recommendations.

J. Run Lights

Include in the motor control center a pilot light for each pump motor which shall illuminate when the motor is running. Additional lights are to indicate high wet well, low wet well, individual pump seal failures, individual motor overloads, individual motor overtemp and air system failure. All pilot lights in panel to be replaceable Light Emitting Diode (L.E.D.) type.

K. Elapsed Time Meters

Separate elapsed time meters shall be mounted in the motor control center and wired to each motor starter to indicate total running time of each pump motor in hours and tenths of hours. Elapsed time meter shall be 6-digit non-resettable.

L. Motor Overload Reset Pushbutton

An overload reset pushbutton shall be mounted through the door of the motor control center and permit resetting of the motor overload relays without opening the control panel door.

M. Pump Sequence Selector Switch

A 3-position toggle switch shall be provided which shall override the automatic alternator and provide manual selection of either pump No. 1 or No. 2 as the lead pump.

N. Installation and Operating Instructions

Installation of pumping unit and appurtenances shall be done in accordance with written instructions provided by the manufacturer.

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O. Experience and Workmanship

The pumping unit shall be the product of a manufacturer with a minimum of twenty (20) years experience in the design and manufacture of centrifugal pumps handling sewage. Workmanship and materials throughout shall be of highest quality.

P. Pump and Motor Testing

1. The pump manufacturer shall perform the following inspections and tests on each pump before shipment from the factory.

a. Impeller, motor rating and electrical connections shall first be checked for compliance with specifications.

b. A motor and cable insulation test for moisture content or insulation defects shall be made.

c. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

d. The pump shall be run for 30 minutes submerged and the amperage and voltage recorded during the test.

e. One hour after operation test (d), and while still submerged the insulation test (b) is to be performed again.

f. A written report certifying the foregoing steps shall be supplied with each pump at the time of shipment.

g. Immediately prior to shipment, each pump cable end shall be fitted with a shrink fit rubber boot or plastic dipped to protect the pump from water seepage that could occur on-site before the electrical installation is completed.

2. Each pump shall be factory tested to provide certification that head, capacity and input power requirements are met. Test data shall be utilized to prepare specific curves; curves shall include the pump serial number. Certification shall be by a registered professional engineer.

Q. Pump Controls

1. Appropriate electrical power is to be furnished to the site. Three phase power is required. Three phase systems derived from single phase power sources are not allowed.

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The control circuitry shall be designed to operate on 115 +/-10% volt, 60 Hertz, single phase current, and control a minimum of two (2) pumps. The control panel shall consist of a circuit breaker and magnetic starter for each pump motor actuated by a liquid level control system with all components mounted in one common enclosure. The control assembly shall provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall provide means to automatically alternate the position to the "lead" and "lag" pumps after each pumping cycle.

The complete control assembly shall be wall mounted in a suitable one electrical enclosure which is large enough to readily permit installation of any or all standard options without rearrangement of existing components.

The control shall be equipped with high temperature shutdown for each motor and shall utilize the temperature switches embedded in the motor windings. In a high motor temperature condition, the switch shall open, de-energize and lockout the motor starter. The high motor temperature shutdown device shall be manually reset.

The control panel shall be equipped with a moisture detector control for each pump which senses moisture in the oil cavity should the lower seal fail. Sensor probes located in the oil cavity will detect the influx of moisture and light an indicator marked "seal failure pump # _____". Should this condition occur, the light shall remain on until the problem is corrected and the control circuit has been manually reset. When a seal failure occurs, a normally open, dry contact will close to signal the telemetry system that a seal failure has occurred in that pump.

Indicator lights shall be heavy duty, oil and dust tight, and have replaceable light-emitting diode (LED) bulbs. All indicator lights, control switches (both electric and pneumatic) will be labeled with engraved laminated plastic labels secured by screws to control panels. All control components shall be permanently marked to match As Built Schematics.

A voltage sensing relay to monitor all incoming legs to ground shall be supplied. The relay shall sense low power or power failure on any leg. An interlock control circuit to prevent motor damage and a normally open dry contact output to telemetry shall indicate power failure. The relay is to be model SLA by Diversified, or equal.

Supply an incoming power terminal block with lightning/surge protection. All power leads, incoming power and alarm outputs shall be terminated in the control panel. A

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separate terminal strip for power, power output and alarm output shall be provided. All terminal points are to be marked.

2. Additional Controls:
 - a. Test switches for each level sensor.
 - b. Intrinsically Safe Barrier Relays required for Class 1, Division 1.
 - c. Alternating relay to alternate the Lead/Lag pumps on each successive cycle of operation. Starters shall have auxiliary contacts to operate both pumps on override.
 - d. Pump running light mounted on cabinet door.
 - e. High level alarm circuitry. Lights mounted on outside of building in weatherproof glove and on panel.
 - f. Pump cable ground fault protection, with operational test capability.
 - g. Annunciator shall be Panalarm Series 10 Model, 12 Twinpoint, or equal. Cabinet shall be 12 circuit site with 9 being used and 3 spaces. Relays shall be modular, hermetically sealed plug-in watt lamps in parallel for each alarm point. Nameplate shall be engraved as shown on the Plans. Provide alarm horn and silence pushbutton. Sequence of operation is: trouble contact closure sounds horn and light remains steady; trouble cleared circuit returns to normal. Annunciators shall be wired to a set of terminals for future telemetering use that will indicate a closed circuit on any of the nine circuits.

R. Level Sensors

The level control systems shall start and stop the pump motors in response to changes in wet well level.

The level control system shall be the submersible level sensor.

2.04 VALVE CHAMBER

Valve chambers shall be reinforced concrete with a base and concrete cover. The design shall prevent floatation. The aluminum hinged access cover shall provide a minimum of 37 inches by 60 inches clear opening or larger. Each cover shall be

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equipped with a locking device keyed alike to District requirements A fixed, aluminum or fiberglass ladder shall be provided. A cast iron drain line with a cast iron trap and check valve is required to drain the sloped floor to the wet well.

Valve stand pipe with an appropriate size Evertite male adapter is required.

PART III - EXECUTION

3.01 INSTALLATION

A. Electrical

1. Power will be 480/120 volts, 60 Hertz, three phase, 4 wire, (230/120 volts in acceptable and requires DSM prior approval).

2. Furnish and install underground service to the pump station control cabinet.

B. Spare Parts

1. The Contractor shall supply the following spare parts:

- a. One set of wearing rings for each pump.
- b. One set of special tools required for maintenance of the pumps.
- c. One complete set of shaft seals for each type and size of pump.
- d. Two spare liquid level sensors.
- e. One complete pump and motor.

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3.02 PERFORMANCE

A. Sequence of Operation

The level control system shall continuously monitor the wet well level. The system shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the system shall stop this pump. Additionally a low level redundant cut off with alarm indicator on the control panel with normally open dry contact output for telemetry, alarm to reset automatically with rising wet well level shall be supplied. Also, a high level alarm with indicator on the control panel with normally open dry contact for telemetry output and alarm to reset automatically with decreasing wet well level shall

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be supplied. These actions shall constitute one pumping cycle.

Should the wet well level rise to the "lag pump start level", the system shall start the second pump so that both pumps are operating to pump down the well. Pumps shall stop at their respective "stop" levels. The levels shall be adjustable as described below.

B. Automatic Pump Alternation

The level control system shall utilize the alternator relay 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.

3.03 FIELD QUALITY CONTROL

A. Supervision

1. Provide a qualified manufacturer's service engineer for a minimum of five days to supervise installation, start-up, testing and adjustments, and to instruct the District's personnel in operation of the equipment.

3.04 TEST PROCEDURE FOR (COLLECTOR) PUMPING STATIONS

The following test procedure is applicable to pumping stations designed to serve up to 500 homes. A successful test is only one step in completing a subdivision or development and does not constitute formal acceptance.

The pumping station test procedure consists of a minimum of three (3) days of continuous operation using water and a pump around connection to simulate actual running conditions including alternating pumps.

Normally the pump test procedure starts after the pump station is complete. Where the pump station is not complete, additional monitoring may be required. All equipment called for in this procedure must be present and operable.

Before the pumping station test procedure begins, the upstream sewer line and the wet well must be clean and free of all mud, debris or other foreign material. During the test, the pump station must be locked and the site secure from unauthorized entry. The following procedure will be followed.

1. The Developer or his representative is to notify the District prior to preparing for the test.

2. Insert a test ball with drain and valve into the

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influent pipe of the station. Shut off this valve draining into the wet well.

3. Install temporary piping to return flows to the first manhole upstream of the pump station. Attach the temporary discharge piping to the station by-pass in the valve chamber and run it back to the first upstream manhole. Secure the discharge piping/hose in the manhole to prevent damage. It is strongly suggested that a riser, constructed of rigid piping, be attached to the by-pass connection along with a rigid pipe discharge manifold for the manhole discharge. This is to prevent kinking of a soft discharge hose that would result in an interruption of the test. This temporary piping must be installed so as not to be a hazard to the public.

4. Shut off the force main with the force main outlet valve in the valve chamber.

5. If the radio telemetry system is not operational, provide a recording amp meter for each pump. Other recording devices to record the operation of pumps during the test are subject to prior approval of the District.

6. Turn pumps to "OFF". Record pump hours.

7. Fill wet well with water until high wet well level is passed. Turn on one pump to empty the wet well, and fill hose and influent sewer.

8. Open valve on influent line into wet well to simulate normal dry flow into the station.

9. With outlet valves closed, manually operate each pump for five minutes against shut off head and record pressure gauge reading.

10. Open bypass valve in valve chamber.

11. Turn all pumps to "AUTO". Adjust inlet sewer valve and check to assure proper pump cycling. Add water to wet well if necessary to achieve proper pump cycling. (Excess water may be pumped to the sewer through the force main, if necessary.)

12. Inspect the station daily to verify proper test operation. Daily check should be done in approximate 24 hour increments. A record will be kept indicating time, date, pump hours and pressure reading of pump discharge (each pump). District Personnel will have access to verify data and operation at anytime during test duration.

13. Minimum pump operation period will be three (3) days

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- uninterrupted. Failure of the test at anytime will result in the entire test duration to be repeated. A longer test period may be required. The decision for a longer test duration will be at the sole discretion of the Division of Sewerage Management.

14. At the end of the continuous test, shut off the pumps, close the inlet valve and bypass valve and open the force main valve to allow wet well pump down.

15. Fill the force main with water from the wet well. Add water if necessary.

16. With District personnel present, manually start the first pump and record the time it takes to pump the wet well down approximately one foot (read the elevations to the nearest 1/8 inch and the time to the nearest second). Simultaneously record the discharge pressure gauge.

17. Repeat step 16 for the second pump after opening the wet well inlet valve.

18. Once the test is completed and verified by the District personnel, the Contractor may remove all test apparatus. Remaining water used during the test may be discharged through the force main.

19. Include the test results in the operation and maintenance manual.

NOTE: ACCEPTANCE OF THE STATION TEST IS NOT A FORMAL ACCEPTANCE OF THE PUMPING STATION. ALL REQUIREMENTS ISSUED BY THE DIVISION OF SEWERAGE MANAGEMENT MUST BE FINALIZED BEFORE FORMAL ACCEPTANCE.

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SECTION 15401 - PLUMBING SYSTEMS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, tools, material, equipment and incidentals to install a complete, in place, tested and operational plumbing system as shown on the Plans and specified herein.

1.02 DESCRIPTION OF SYSTEM

A. The Plans and Specifications describe certain features of the equipment, but do not cover all design and construction details. It shall be the responsibility of the Plumbing Contractor to furnish and install the equipment complete, tested and ready for operation in accordance with the applicable codes.

B. All miscellaneous items of the plumbing system and other items which are required for proper installation and operation shall be included under this section.

PART II - PRODUCTS

2.01 MATERIALS

A. Pipe, Fittings and Accessories

1. Materials for all indoor piping, fittings, accessories and connections for plumbing work shall conform to the following Specifications.

2. Piping

a. Interior soil, drainage and vent piping shall be standard weight bell and spigot cast iron (ductile iron) conforming to ANSI Specification A-21.6 (A-21.51). Joints shall be okum and pure lead. Schedule 80 PVC may be substituted for cast iron.

3. Fittings

a. Interior soil, drainage and vent pipe fittings shall be standard weight bell and spigot cast iron (ductile iron) conforming to ANSI Specification A 21.10 (B 16.1). Joints shall be okum and pure lead. Schedule 80 PVC may be substituted for use with PVC piping.

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4. Accessories

a. Seals - Seals shall be equivalent to "Link-Seal", as manufactured by Thunderline Corporation, Wayne, Michigan, or equal. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the sleeve, with zinc phosphate plated carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe, with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide a strictly watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved.

b. Hangers and Supports - Pipe hangers and supports shall be Grinnel, Zurn Industries, or equal. Hangers shall be constructed as required for proper pipe support.

PART III - EXECUTION

3.01 INSTALLATION

A. Plumbing Systems

1. All miscellaneous items of piping, fittings and valves and other items which are required for proper installation and operation of the plumbing systems shall be included under this section. The Plumbing Contractor shall make final connections to all equipment furnished and installed under other sections of the Specifications requiring water, including plumbing service connections.

2. Installation of plumbing work shall be complete in every respect insuring a system which will operate satisfactorily and noiselessly. All work shall be performed by skilled workmen; work performed by unskilled help will not be accepted. Unless otherwise indicated, all material and equipment shall be installed in strict accordance with the manufacturer's recommendations.

3. Dielectric unions shall be used wherever pipes of dis-similar metals are to be connected.

4. All cutting, fitting, repairing and finishing of masonry, concrete, metal and carpentry work that may be required for the plumbing work shall be by craftspersons skilled in this respective trades.

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5. Excavation and back fill work required for plumbing shall be performed by the Plumbing Contractor in accordance with Division 2 of these specifications.

B. Fuel Oil Piping

1. Gasoline and Fuel oil piping shall be installed in accordance with the latest edition of the Fire Code of the local county or municipality.

3.02 FIELD QUALITY CONTROL

A. Soil, Waste, Drainage and Vent Piping

1. All soil, waste, drainage and vent piping shall be tested at the completion of the installation of each stack or section of piping by filling the system with water to the highest point and checking joints and fittings for leaks. All leaks shall be eliminated before proceeding with work or concealing the piping.

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SECTION 15606 - FUEL OIL TANKS AND TRANSFER EQUIPMENT

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, tools, equipment, materials and incidentals necessary to install an above ground fuel oil storage tank of the specified capacity at the location shown, and as detailed on, the Plans, complete with related piping and gauging systems, all fuel oil piping including connections to the day tank if required and flexible connections from day tank to diesel generator unit, as shown on the Plans and in accordance with the requirements of the National Board of Fire Underwriters.

B. The Contractor shall provide sufficient amounts of #2 fuel oil for testing of generator set and fill the fuel oil tank to capacity prior to acceptance by the District.

PART II - PRODUCTS

2.01 FABRICATION

A. Fuel Oil Tanks

1. The fuel oil tanks shall be specifically designed for the above ground storage of No. 2 fuel oil. Underground fuel tanks are not accepted by Erie County Sewer Districts. The tank shall be of the appropriate gallonage.

2. The tank installation shall conform to the NFPA 30 specifications and shall meet the requirements of all local and state building codes. The tank shall bear the U.L. label for above ground installation.

2.02 ACCESSORIES

A. Fittings - Threaded - NPT

1. All threaded fittings on U.L. labeled tanks shall be of a material of construction consistent with the requirements of the U.L. label. All fittings to be supplied with cast iron plugs.

B. Lifting Lugs

Provide lifting lug(s) on all tanks. Lugs shall be capable of withstanding weight of tank with a safety factor of 3.

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C. Fill Line and Fittings

1. Building Mounted

The fill line shall be provided with a lockable, waterproof cap.

2. Ground Level

The fill line shall be provided with a lockable weatherproof cap. The fill line shall terminate 4" above grade. Two concrete filled bollards shall be installed to protect the fill line.

D. Free Vent

1. The free vent shall be offset as shown on the Plans. The offset line shall be pitched down to the tank with no sags or pockets. The free vent shall be provided with a vented cap at the outlet on weather end and shall be Model No. 249 Upflow Vent (Pressure and Vacuum) as manufactured by A.Y. McDonald Mfg., or approved equal.

E. Tank Gauging System

1. The level of fuel in the storage tank shall be measured by a magnetic reed switch transmitter and solid state, indicator-receiver combination. The tank mounted transmitter shall have a stainless steel tube stem, with 4 inch diameter Buna-N float of suitable buoyancy for liquid being measured. Overlapping reed switches shall be mounted inside the stem. The float shall contain a permanent magnet, which activates sequences of reed switches as it travels along the stem.

2. A watertight junction box shall be provided above the stem flange similar to a Crouse Hinds Type GUAL-16 for transmitter connections.

3. The receiver shall have an indicating dial calibrated in gallons, and accurate to 2% of span. The receiver shall be provided with an alarm contact for "low fuel level" (contact closure).

4. The tank shall contain a dip stick, including a 2" drop pipe and cap.

F. Transfer Pump(s)

1. The fuel oil shall be pumped from the storage tank to the generator or day tank by a positive displacement

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rotary gear, rotary screw type, or sliding vane type pump, specifically designed for pumping No. 2 fuel oil. Two (2) base mounted pumps shall be provided.

2. Each pump shall have a capacity of 5 gpm when discharging against a total head of 25 psi. The pump shall be installed complete with motor, base, couplings, relief valve, and bypass piping if internal relief valve is not furnished. The pump motor shall be not less than 1/3 HP. The pump shall be equal to those as manufactured by Blackmer, Viking, Worthington, DeLaval (IMO), or equal. TEFC suitable for use of 3 phase, 208 volt power, or single phase, 120 volt motor approved by Underwriters Laboratory for pumping No. 2 fuel oil.

3. Spare parts such as one (1) extra set of vanes, for each vane pump, or one (1) gear set for each gear pump, whichever is approved, shall be suitably boxed and delivered to the District.

4. Control of the transfer pump(s) shall be by float switch in the day tank or other control system supplied by the generator manufacturer. An automatic alternator shall be provided with pump controls. Complete assembly is to have Underwriters Laboratory approval for use with No. 2 fuel oil.

G. Fittings

1. An angle check valve, double poppet design, and flat machined seats and discs of high grade bronze shall be provided for each fuel transfer pump suction line.

2. Line strainers shall be provided in transfer pump suction lines as shown on the Plans. The line strainers shall be of the TOP-CLEAN OUT style with semi-restrained yoke, 1/16" diameter perforated brass screen, and cast iron body, yoke and cap.

PART III - EXECUTION

3.01 INSTALLATION

A. Tank

The tank shall be installed in accordance with the best practice recommended by the manufacturer; and shall be set in the location shown the approved plans.

**Specifications for
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SECTION 15606 - 2.02

B. Piping and Fittings

1. Piping for fuel oil and compressed air shall be 40-A-120 steel (iron) pipe with black banded malleable iron fittings.

2. Connections to the tank shall be made with elbows and nipples, on both suction and return lines.

3. All underground piping shall be cleaned to bare metal and a bituminous coal tar primer applied to all exterior surfaces. Two coats of coal tar saturated asbestos felt pipeline covering, and an exterior wrapping of 89 pound weight kraft paper shall also be applied.

4. Fusible link shut off valves shall be installed in accordance with local codes or National Board of Fire Underwriters.

5. Fuel oil strainers shall be furnished and installed in the fuel oil suction pipelines.

6. Swing type check valves, oil shut-off gate valves, flexible couplings and pressure relief valves shall be required.

**Specifications for
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SECTION 15818 - ELECTRIC UNIT HEATERS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, tools, materials, equipment and incidentals required to install complete, in place, tested, electric unit heater system as shown on the Plans and specified herein.

B. One (1) unit heater shall be installed in each room of the building as shown on the Plans.

1.02 QUALITY ASSURANCE

A. Heaters shall be installed according to the manufacturer's recommendations and applicable local and national codes and shall be U.L. listed.

PART II - PRODUCTS

2.01 HORIZONTAL ELECTRIC UNIT HEATERS

A. Heating coil shall consist of a nickel-chromium resistance wire surrounded by a dielectric and sheathed in steel finned tubes. Heating elements shall be protected by an internal (U.H. casing) automatic resetting overheat control (including all sensors, switches and relays).

B. Motors shall be of the totally enclosed, continuous fan-duty, sleeve bearing type equipped with built-in thermal overload protection. Each unit shall be equipped with a combination fan guard/motor support, resiliently mounted at 4 points, to absorb any motor vibration. The fan motor shall be wired within the unit heater to the electric heating coil power supply, thus eliminating need for external motor starters or a separate fan motor circuit to unit.

C. Adjustable louvers shall be furnished to direct discharge air up or down as desired.

D. Fans shall be broad bladed aluminum direct connected to fan motor, dynamically balanced and designed specifically for unit heater application.

E. The casing shall be steel, rust and corrosion resistant treated inside and out, and the outside painted with factory baked enamel finish.

F. Each heater shall be provided with threaded fasteners to receive mounting rods for permanent ceiling installation.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 15818 - 2.01

G. Each heater shall have built-in contactors and control and power circuit transformers (where required) to provide a single power source connection.

H. Electrical components shall be safely enclosed in a separate junction box.

I. A wiring diagram and grounding log shall be included in each junction box.

2.02 THERMOSTATS

A. Provide line voltage or low voltage thermostats, suitable for use with the unit supplied and for wall mounting, and having sufficient current rating for the unit controlled. Utilize thermostats adjustable from 45 - 75 degrees.

B. If low voltage thermostat is supplied, the transformer and relays shall be mounted within the metal cabinetry of the unit heater, and supplied with the unit.

PART III - EXECUTION

3.01 INSTALLATION

A. Thermostats shall be surface-mounted on interior partitions about 5 feet above the floor, unless otherwise indicated on the Plans.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 15839 - CENTRIFUGAL UTILITY VENTILATING FAN

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, tools, materials, equipment and incidentals required to install one (1) floor mounted, belted, utility ventilating set, as shown on the Plans and specified herein.

1.02 DESCRIPTION OF SYSTEM

A. The fan shall provide ventilation air for the comminutor chamber. New ductwork is to be installed as shown.

PART II - PRODUCTS

2.01 GENERAL PURPOSE VENTILATION FAN

A. The motor compartment shall be open on both sides for adequate motor ventilation, access to fan wiring and adjustments. The motor platform shall have ample movement for adjustment of belt tension. A positive screw-type adjustment shall be provided for adjustment.

B. The fan housing shall be fabricated from heavy gage steel. The scroll and housing sides shall be a minimum of 16 gage. The construction shall feature all welded seams.

C. The fan shall have a backward, inclined, air-foil type bladed wheel. The wheel shall be an all welded, aluminum construction.

The fan shall have an AMCA "B" rating for spark-proof construction.

D. The horsepower, rpm and electrical service requirements are shown below in the schedule. The drive shall be by adjustable V-belts.

E. The unit shall be provided with a snow hood fabricated of minimum 16 gauge steel.

F. The unit shall be suitably protected against corrosion, and painted with a zinc chromate primer and two (2) coats of finish machinery enamel prior to shipping.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 15839 - 3.01

PART III - EXECUTION

3.01 INSTALLATION

A. Electrical connections shall be performed by a licensed electrician according to N.E.C., latest edition.

3.02 SCHEDULE

<u>Item</u>	<u>Location</u>	<u>Capacity (CFM)</u>	<u>Motor HP Min.</u>	<u>RPM</u>	<u>Electrical Service</u>	<u>Remarks</u>
Fresh Air Supply	Comminutor Chamber	1,000	1/6	1800	110/1/60	1.Manual control near unit

2.Ductwork

required

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 15840 - DUCTWORK (ALUMINUM)

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all tools, labor, materials, equipment and incidentals to install a complete duct system for the air handling system(s) for the comminutor chamber as shown on the Plans and specified herein.

PART II - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Aluminum Ductwork

1. All duct work for air intake or distribution shall be fabricated and installed in accordance with the manual "Low (High) Velocity Duct Construction Standards" (formerly "Duct Manual and Sheet Metal Construction"), latest edition and appropriate section, prepared by the Sheet Metal and Air Conditioning Contractors National Association, Inc. The manual shall set the minimum requirements for the installation unless otherwise noted.

2. All ducts and ductwork shall be of 18 gauge aluminum constructed in a workmanlike manner with a smooth inner surface. Reinforcement shall be provided where required, and adequate hangers and supports shall be installed to properly support the ducts. The ducts shall be located as shown on the Plans. Access doors are to be provided where indicated on the Plans and as required.

3. All ducts more than 18 inches in width shall have standing seams or reinforcements.

B. Duct, Flexible, Non-Acoustical, Non-Insulated

1. Flexible, non-acoustical, non-insulated duct shall have external spring wire helix for a smooth, seamless interior.

2. The core fabric shall be glass fiber reinforced, copolymer impregnated, tough, fire retardant fabric.

3. Duct shall be suitable for temperatures of 0°F to 250° F.

4. Duct shall conform to Codes UL-181 Class 1 air duct, NFPA 90A and 90B.

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 15840 - 3.01

PART III - EXECUTION

3.01 INSTALLATION

A. Unless otherwise shown, all angular turns shall be made with elbows, with a minimum radius 8 inches. All changes in direction are to be made with bends, curves and turning vanes. Branch ducts shall make a curved connection with the main duct.

B. Fire dampers shall be provided and installed where required by Fire Insurance or other jurisdictional authority, and shall be accessible for inspection and maintenance.

C. Flexible connections shall be installed between central air handling equipment and inlet and outlet ducts. The outlet ends of all air supply ducts and the inlet ends of all air exhaust ducts shall be as specified hereinafter.

D. Wherever aluminum is built into concrete or other masonry or comes in contact with steel or other metals, the contact surface shall be painted with a bituminous coating or otherwise treated for adequate protection against the corrosive effect of the masonry or metal.

E. Floor and wall openings for ducts shall not exceed dimensions required for proper duct installation. Ducts passing through walls or slabs shall be neatly finished.

3.02 SCHEDULE

<u>Duct Location</u>	<u>Type</u>	<u>Remarks</u>
Comminutor Chamber	10"x6" Aluminum	Non-Insulated

**Specifications for
Subdivisions and Sanitary Sewer Extensions**

SECTION 15879 - MOTOR OPERATED WALL LOUVERS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, tools, equipment and incidentals required and install complete, in place and ready for operation, motor operated wall louvers as shown on the Plans and as specified herein.

1.02 PROTECTION OF MATERIALS, WORK AND GROUNDS

A. Protect and preserve all materials, supplies and equipment of every description and all work and finishes performed or installed.

B. Protect all existing equipment and property of any kind from damages during his operations. Damages shall be repaired and/or replaced promptly.

PART II - PRODUCTS

2.01 GENERAL

A. Furnish and install motor operated wall louvers, intake and exhaust types, suitable for use in the generator building, and capable of adequate air velocity through the louver area, to accommodate the generator unit.

2.02 MATERIALS AND EQUIPMENT

A. Frames, Blades and Hinges

1. Louver frames, blades and hinges for operating louvers shall be extruded aluminum sections of 6063-T52 alloy and shall be of minimum 0.81 inch thickness (12 gage). All blades shall be of the stormproof design, with reinforcing bosses. All louver blades shall be center pivoted with 1/2 inch diameter Zamac alloy pinions operating in self-lubricating nylon bearings.

All louvers shall be operated by concealed drive arms at each jamb and assembled with aluminum shoulder rivets. Louver blades and sills shall be equipped with vinyl gaskets for the full blade width. Vinyl gaskets shall also be riveted to the ends of the operating louver blades to minimize infiltration when closed.

2. All louvered openings shall be equipped with factory installed intercrimp bird screening. The screen shall have a 1/2 inch mesh, 0.80 inch wire secured in an extruded aluminum frame.

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SECTION 15879 - 2.02

B. Motors

1. All operating louvers shall be equipped with factory mounted and wired electric motors. Motors shall be designed for spring open/pull closed operation. Motors shall be equipped with required limit switches and shall be suitable for 120 volt, single phase, 60 Hertz operation. Motors shall be of sufficient size to operate the units without an overload as recommended by the manufacturer. Explosion-proof motors shall be in accordance with the National Electric Code requirements for a Class 1, Division 1, gas-hazardous area.

C. General

1. All louvers shall be free of scratches and blemishes and shall be finished in a two-coat system with baked-on primer and a fluoro-carbon polymeric finish coat in a color matching the building exterior color. The final coat shall be a full strength fluoro-carbon coating. Two (2) 3"x6" samples of the selected standard color shall be furnished on 0.032" thick aluminum sheets for approval prior to any factory finishing. All aluminum shall be thoroughly cleaned, etched, and given a chromate conversion coating pretreatment before the application of an epoxy baked-on prime coat. The subsequent top finish color coating shall be not less than 0.8 mils thick. All finishing procedures shall be one continuous operation and shall take place in the plant of the manufacturer. There shall be no checking, crazing, or peeling and the coating shall show a chalk no greater than No. 7 in accordance with ASTM No. D659-44. A minimum of fading from the original color sample, no greater than 7 units as measured by an IDL color eye, shall occur within a period of 20 years from the date of shipment.

2. The manufacturer shall provide a written 20 year guarantee against failure of the Kynar/Fluoropon finish at contract completion.

3. The design of the louvers will be such that they can be removed thereby leaving a clear opening in the building wall large enough for removal/installation of the generator.

PART III - EXECUTION

3.01 OPERATIONS

A. The controls for operating louvers supplying air and exhaust for the generator shall be connected so as to fully open the dampers when the generator is activated. A parallel connected room thermostat shall be installed to open the louvers when temperature rises above selected temperature.

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SECTION 15879 - 3.02

3.02 SCHEDULE

<u>Location</u>	<u>Size WxH</u>	<u>No. Req'd</u>	<u>Type</u>	<u>Control</u>
Generator	To meet Gen Set Manufacturer Recommended Size	2	Operating	Connect to generator circuitry

Specifications for

Subdivisions and Sanitary Sewer Extensions

SECTION 15880 - AIR RELEASE VALVE AND MANHOLE

PART I - GENERAL

1.01 Scope of Work

A. Furnish all labor, materials, equipment and incidentals required, and install, complete and ready for operation, the air release valves and manhole assemblies shown on the Plans and as specified or implied herein.

PART II - PRODUCTS

2.01 Materials and Equipment

A. General

1. All of the equipment specified herein is intended to be standard air release equipment. All valves shall be of adequate size and be suitable for the specified applications.

2. An adequate number of valves shall be installed at the required locations for proper venting of the line.

B. Air Release Valves

1. Air release valves shall be furnished with a flush-out attachment whereby the valve mechanism can be flushed with a water hose when required.

2. Air release valves shall be of the Kinetic valve design.

3. Air release valves shall be designed for operation at a working pressure of not less than twice the design pressure.

4. Air release valves shall be provided with a 2" shut-off valve and a 1" blow-off valve at the bottom. The working pressure and venting capacity shall be specified by the design engineer.

C. Air Release Valve Manhole

1. Manhole shall be a minimum of 48" high x 60" inside diameter precast reinforced concrete base with "O" ring gasket and precast reinforced concrete roof slab.

2. Contractor may either order manhole bases with factory installed inlet holes and approved watertight barriers or core drill openings in the field. If the openings are core

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SECTION 15880 - 2.01

drilled in the field, the diameter shall be 2" larger than the outside diameter of the pipe and the approved watertight barriers shall be installed.

3. Manhole shall have a 4" drain hole in center of base.

4. Pipe inlet and outlet openings shall be covered with a non-shrink grout on outside of manhole and as shown on DSM's Standard Detail No. 49 - Sewer Air Release Valve and Manhole.

5. Manhole base shall be set on 12" min. Class 1 No. 1 stone.

6. Manhole shall have a heavy duty frame cover with machined bearing surfaces, and the cover shall be inscribed E.C.S.D Sanitary, as shown on DSM's Standard Detail No. 13 - Standard Frame and Cover.

Adjust frame to grade with precast concrete extension rings. The individual extension ring shall not exceed 6" in thickness. The total number placed shall not exceed 12" in height.

7. Manhole shall have standard steps of forged aluminum alloy or steel reinforced copolymer polypropylene, as shown on DSM's Standard Detail No. 17 - Standard Manhole Step.

PART III - EXECUTION

3.01 INSTALLATION

A. Each air release valve and manhole shall be installed in the location shown on the Plans and in accordance with the manufacturer's instructions.

B. Air release valve shall be installed vertically in the manhole and a minimum of 12" from the wall. The valve shall be securely fastened to the manhole wall with a stainless steel bracket. Shut-off and blow-off valves shall be oriented to allow the greatest accessibility.

C. Connection of air-release valve to force main to be located at the high point of the pipe. A concrete thrust block and hairpin tie shall be installed under the connection.

D. A tee with blind flange facing up shall be installed on the force main inside the manhole.

E. A schedule 80 one-half inch tap with ball valve shall be installed on the top of the force main for future installation of a pressure gauge by others.

DIVISION

16

(Site Work)

**Specifications for
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SECTION 16010 - GENERAL PROVISIONS

PART I - GENERAL

1.01 SCOPE OF WORK

A. This section is coordinated with, and complementary to, the requirements of Division 15 Mechanical and other applicable sections of these Specifications.

B. Where items of the General Conditions or of the Special Conditions are repeated in this section of the Specifications, it is intended to call particular attention to or qualify them; it is not intended that any other parts of the General Conditions or Special Conditions shall be assumed to be omitted if not repeated herein.

C. Complete details of the procedure for filing a bid for this Contract are contained in the Information for Bidders and the General Contract Conditions.

D. Heating and Ventilating equipment will be furnished and installed under Division 15. All wiring and electrical controls shall be installed under this Division.

E. Certain pieces of control equipment (pressure switches, limit switches, solenoid valves, etc.) will be furnished unassembled. The Contractor shall do all work necessary to make this equipment operative. The Contractor shall wire all control and alarm equipment.

F. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required and the Contractor shall, at no extra cost, supply all material and do all work which may be reasonably implied as being incidental to the work of this Section.

1.02 VISIT TO SITE

A. Before submitting a bid the Contractor shall visit the project location and determine all existing conditions that will affect the installation of his material and equipment.

1.03 HAZARDOUS AREAS

A. All equipment used in areas designed as hazardous shall be designed for Class I, Division I, Groups C & D

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SECTION 16010 - PART I

atmospheres. All installation shall be in strict accordance with the National Electrical Code for Class I, Division I, Groups C & D atmospheres.

1.04 INSPECTION AND FEES

A. All material and installation shall be in accordance with the National Electrical Code.

B. All work must be inspected by the New York State Fire Underwriters and an original certificate acknowledging compliance with the Codes must be provided to the Owner.

C. The Contractor shall pay all fees required for permits and inspections.

1.05 TESTS

A. The Contractor shall test all systems and repair or replace all defective work. The Contractor shall make all necessary adjustments to the systems and shall instruct the Owner's personnel in the proper operations of the systems.

1.06 EXCAVATION AND BACKFILLING

A. Excavation and backfilling for underground electrical work is specified in Division 2.

1.07 SLEEVES AND FORMS FOR OPENINGS

A. The Contractor shall provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. The Contractor shall locate all necessary slots for his work and these shall be formed before concrete is poured.

1.08 CUTTING AND PATCHING

A. All cutting and patching shall be done in a thoroughly workman-like manner.

1.09 INTERPRETATION OF DRAWINGS

A. All three-phase circuits shall be run in separate conduits unless otherwise shown on the Drawings. Single phase circuits may be trunked in conduits sized as per NEC Table 3A - RHW, RHH (without outer covering), and THW.

B. Any work installed contrary to, or without approval by the Engineer, shall be subject to change as directed by the Engineer.

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SECTION 16010 - PART I

Cost of excavating and backfill for electrical work is to be included in the electrical contract.

C. The locations of equipment, fixtures, outlets, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. The Contractor shall obtain in the field all information relevant to the placing of electrical work and in case of any interference with other work, shall proceed as directed by the Engineer and shall furnish all labor and materials necessary to complete the work in an approved manner.

D. Surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

E. Circuit diagrams shown are diagrammatic and functional only and are not intended to show exact circuit layouts, number of fittings, or other installation details. The Contractor shall furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed by the Contractor wherever needed to conform to the specific requirements of the equipment.

F. Conduits beyond first pushbutton or control device and conduits containing lighting circuits beyond panelboards are not scheduled. The number of conductors shown is not necessarily the correct number required. As many conductors as are required in each case shall be installed. Grounding conductors are not scheduled.

G. The ratings of motors and other electrically operated devices together with the size shown for their branch circuit conductors and conduits are approximate only and are indicative of the probable power requirements insofar as they can be determined in advance of the purchase of equipment. The ratings shown for motor branch circuit protective devices are the maximum ratings permitted. Lower ratings may be used where approved as being proper for the dynamic characteristics of the motor and its connected load.

H. Unless otherwise specified, all conduits, wires and cables and the support systems for the conduits and cables that are required to make the electrical connections to equipment shall be furnished and installed by the Electrical Contractor. All connections to equipment shall be made as shown, specified and directed and in accordance with the approved shop and setting drawings.

1.10 SIZE OF EQUIPMENT

A. The Contractor shall investigate each space in the

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SECTION 16010 - PART I

building through which equipment must pass to reach its final location. If necessary, the manufacturer shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.

1.11 SHOP DRAWINGS

A. As specified under General Conditions, shop drawings shall be submitted for review of all materials, equipment, apparatus, and other items as required by the Engineer.

B. Shop drawings shall be submitted for the following equipment:

1. Main Circuit Breaker
2. Distribution Panel
3. Lighting Fixtures
4. Standby Generator Equipment
5. Transfer Switch
6. Motor Starters, Instrumentation, and Controls

C. The manufacturer's name and product designation or catalog numbers shall be submitted for the following material:

1. Conduit
2. Receptacles
3. Boxes and fittings
4. Wire

D. All shop drawings shall be checked by the Contractor for accuracy and contract requirements before submittal to the Engineer. Shop drawings shall bear the signature of the Contractor and date checked and shall be accompanied by a statement that the shop drawings have been examined for conformity to Specifications and Drawings. This statement shall also list all discrepancies with the Specifications and Drawings. Shop drawings not so checked and noted by the Contractor shall be returned to him/her without review.

E. The Engineer's check shall be only for conformance with the design concept of the project and compliance with the Specifications and Contract Drawings. The Engineer's review shall in no way relieve the Contractor from the responsibility of, or the necessity of, furnishing materials and workmanship required by the Contract Drawings and Specifications which may not be indicated on the shop drawings.

F. Record drawings are required, as described in the General Contract Conditions. These shall include "as-built" drawings of equipment, and plans showing location and sizes of all branch

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SECTION 16010 - PART I

circuit and feeder conduit runs, with number and sizes of all wires.

G. The Contractor shall be responsible for all dimensions to be confirmed and correlated at the job site and for coordination of his work with the work of all other trades.

H. No material shall be ordered or shop work started until the Engineer's approval of shop drawings has been given.

1.12 MANUFACTURER'S SERVICES

A. The Contractor shall provide manufacturer's services for testing and start-up of the instrumentation and control equipment.

1.13 MATERIALS

A. The materials used in all systems shall be new, unused and as hereinafter specified. All materials, where not specified, shall be of the very best of their respective kinds. Samples of materials or manufacturer's specifications shall be submitted for approval as required by the Engineer.

B. Materials and equipment used shall be U.L. approved wherever such approved materials and equipment are available.

C. Electrical equipment shall, at all times during construction, be adequately protected against mechanical injury or damage by water. Installation of the electrical equipment shall commence after the roof is completed on any building such as a pump station facility. If any apparatus has been damaged, such damage shall be repaired by the Contractor at his own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer.

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SECTION 16020 - WORK INCLUDED

PART I - GENERAL

1.01 SCOPE OF WORK

A. The scope of the work consists of the furnishing and installing of complete electrical systems - exterior and interior including miscellaneous systems. The Electrical Contractor shall provide all supervision, labor, materials, equipment, machinery, and any and all other items necessary to complete the systems. The Electrical Contractor shall note that all items of equipment are specified in the singular; however, the Contractor shall provide and install the number of items of equipment as indicated on the Drawings and as required for complete systems.

B. It is the intention of the Specifications and Drawings to call for finished work, tested, and ready for operation.

C. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be furnished, delivered and installed by the Contractor without additional expense to the Owner.

D. Minor details not usually shown or specified, but necessary for proper installation and operation, shall be included in the Contractor's estimate, the same as if herein specified or shown.

The work for this Contract shall include furnishing and installing the following items:

1. Power supplies to equipment being installed.
2. Underground conduits for electric, telephone, and signal cables
3. Conduits, fittings, wire, etc.
4. Miscellaneous controls.
5. Motor control equipment.

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6. Panelboard(s)
7. Standby generator system.
8. Lighting system.
9. Electrical connections to heating and ventilating equipment.
10. Automatic load transfer switch.
11. Conduit, wire and control equipment for equipment furnished under other divisions of these Specifications.

E. Certain pieces of control equipment (pressure switches, limit switches, solenoid valves, etc.) will be furnished unassembled. The Contractor shall do all work necessary to make this equipment operative. The Contractor shall wire all control and alarm equipment.

F. Heating equipment will be furnished and installed under Division 15. All wiring and electrical controls shall be installed under this Division.

G. Some motor control equipment will be furnished by the successful pump manufacturer or supplier. Certain pieces of control equipment will be furnished unassembled. All wiring and electrical controls (including installation and adjustment of control equipment, etc.) shall be installed under this Division.

H. It is the intent of these Specifications that the electrical system shall be suitable in every way for the service required and the Contractor shall, at no extra cost, supply all material and do all work which may be reasonably implied as being incidental to the work of this Section.

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SECTION 16110 - RACEWAYS AND FITTINGS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install complete raceway systems as shown on the Drawings and as hereinafter specified.

B. Except where otherwise shown on the Drawings, all wiring shall be in rigid steel heavy wall conduit. EMT conduit can be used for concealed wiring in suspended ceilings and walls of offices, toilet rooms, etc., where approved by the Engineer.

C. All conduits of a given type shall be the product of one manufacturer.

D. Except where otherwise shown on the Drawings, polyvinyl jacketed conduit shall be used in hazardous or corrosive areas and all exposed conduit run outdoors. Underground conduits shall be PVC coated if not concrete encased as described in Section 16411.

1.02 SUBMITTALS

A. Samples of proposed conduit submitted as a substitution shall be submitted for approval. Each sample shall have the size, type and intended use contained on a label attached.

1.03 MINIMUM SIZES

A. Except where otherwise approved, no conduit shall be smaller than 3/4" trade size.

PART II - PRODUCTS

2.01 RIGID CONDUIT

A. Steel conduit shall be hot-dipped galvanized with zinc coated threads as manufactured by the Allied Tube & Conduit Corp., Wheatland Tube Co., or equal. Conduit shall comply with the Underwriter's Laboratories Standard UL-6, Federal Specification WWC-581-D, and with ANSI Standard C80-1.

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SECTION 16110 - PART II

B. Polyvinyl jacketed conduit shall be galvanized rigid steel conduit conforming to Federal Specification WWC-581-D, ANSI Standard C80-1 and UL Standard #6 with a bonded 40 mil PVC jacket; PlastiBond or KorKap as manufactured by Robroy Industries, or equal.

2.02 ELECTRICAL METAL TUBING

A. E.M.T. Conduit shall be formed and welded low carbon steel tubing. The welded seam shall be free of any splits or burrs. The conduit shall be inside coated for corrosion protection and to facilitate ease of wire pulling. Exterior surface to be electrolytic galvanized and zinc chromate final coated. E.M.T. Conduit to be as manufactured by Jones & Laughlin Steel Corp., Allied Tube & Conduit Co., or equal.

2.03 FLEXIBLE CONDUIT COUPLINGS AND FITTINGS

A. Liquidtight, flexible metal conduit shall be Sealtite, Type UA, manufactured by the Anaconda Metal Hose Div., Liquatite by Electri-Flex Co., or equal.

B. Fittings used with flexible conduit shall be of the screw-in type as manufactured by the Thomas and Betts Co., Pittsburgh Standard Conduit Co., or equal.

C. Flexible couplings shall be Crouse-Hinds Co., Type EC, Killark Type ECF, or equal.

2.04 BOXES AND FITTINGS

A. Pressed steel boxes shall be hot-dipped galvanized as manufactured by the Raco Manufacturing Co., Steel City Co., or equal.

B. Cast iron boxes and fittings shall be galvanized with cast galvanized covers and corrosion-proof screws as manufactured by the Crouse-Hinds Co., Appleton Co., or equal.

C. All boxes and fittings used with PVC jacketed conduit shall be coated with not less than a 40 mil bonded PVC jacketed.

D. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., General Electric Co., or equal.

E. Conduit wall seals shall be type WSK as manufactured by O. Z./ Gedney, Link-Seal as manufactured by Thunderline Corp., or equal.

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F. Expansion fittings shall be type DX as manufactured by the O. Z./ Gedney , Type XJ by Crouse-Hinds Co., or equal. Expansion fittings used with PVC jacketed conduit systems shall be supplied by the manufacturer of the jacketed conduit supplied.

G. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co., Killark, or equal.

2.05 CONDUIT MOUNTING EQUIPMENT

A. Hangers, rods, backplates, beam clamps, etc., shall be hot-dipped galvanized iron or steel. They shall be as manufactured by the Appleton Electric Co., Crouse-Hinds, or equal.

PART III - EXECUTION

3.01 INSTALLATION

A. No conduit smaller than 3/4 inch electrical trade size shall be used, nor shall any have more than three 90 degree bends in any one run. Pull boxes shall be provided as required or directed.

B. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

C. The ends of all conduits shall be tightly plugged to exclude dust and moisture while the buildings are under construction.

D. All conduits and fittings on exposed work shall be secured by means of metal clips and back plates.

E. Conduit supports shall be spaced at intervals of 8 feet or less, as required to obtain rigid construction.

F. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates to raise conduits from the surface. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8 inch diameter.

G. Conduit hangers shall be attached to structural steel by means of beam or channel clamps. Where attached to concrete surfaces, concrete inserts of the spot type shall be provided.

H. All conduits on exposed work shall be run at right angles to, and parallel with, the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in

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parallel conduit runs shall be concentric. All conduits shall run perfectly straight and true.

I. Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings.

J. Conduit terminating in gasketed enclosures shall be terminated with conduit hubs and insulated bushings.

K. Conduit wall seals shall be used for all conduits penetrating walls below grade or other locations shown on the Drawings.

L. Liquidtight flexible metal conduit shall be used for all motor terminations and other equipment where vibration is present.

M. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.

N. Expansion and deflection fittings shall be used where conduits cross building expansion joints and where exterior conduit is subject to the possibility of frost heaving.

O. Pressed steel boxes shall be used for concealed work. Exposed boxes and fittings shall be cast metal.

P. Each conduit leaving a motor control center or instrument control panel shall be marked to indicate its circuit number with either plastic conduit markers or stamped metal tags tied to conduits. A similar marker or tag shall be placed on each side of pull or junction boxes and at termination of run.

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SECTION 16120 - WIRES AND CABLES

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all wire, cable and appurtenances as shown on the Drawings and as hereinafter specified.

1.02 SUBMITTALS

A. Samples of proposed wire, if not one of the makes specified below, shall be submitted for approval. Each sample shall have the size, type of insulation and voltage stenciled on the jacket.

1.03 APPLICATIONS

A. Wire for lighting and single phase motor circuits shall be Type THW.

B. Wire for 3-phase circuits shall be type THW or THWN. High voltage wire (above 600 volt) shall be specified for specific application.

C. Power and lighting circuits run in underground duct lines shall be Type USE.

D. Single conductor wire for control, indication and metering shall be type THWN No. 14 AWG, stranded.

E. Multi-conductor control cable shall be No. 14 AWG, stranded.

1.04 MINIMUM SIZES

A. Except for control and signal leads, and instrumentation, no wire smaller than No. 12 AWG shall be used.

PART II - PRODUCTS

2.01 MATERIALS

A. Wires and cables shall be of annealed, 98 pct conductivity, soft drawn copper.

B. All conductors No. 8 AWG and larger sizes shall be stranded.

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SECTION 16120 - 2.02

2.02 600 VOLT WIRE

A. Type THW shall be as manufactured by the General Electric Co., Vulkene, Type SI-58175; Simplex Wire and Cable Co. product No. 4200 or equal.

B. Type XHHW shall be product No. 4201 as manufactured by the Simplex Wire and Cable Co., SI-58053 by General Electric Co, or equal.

C. Type THWN shall be as manufactured by the Simplex Wire and Cable Co., SI-58101 by General Electric Co., or equal.

D. Type USE shall be cross-linked polyethylene; as manufactured by the General Electric Co., Vulkene, Type SI-58073; Simplex Wire and Cable Co. Product No. 4200, or equal.

E. Instrumentation wire shall be twisted pair, polyethylene insulated, aluminum tape shielded, polyvinyl chloride jacketed, #18 AWG stranded, General Electric Co. Type SI-58763, Belden #8760, or equal.

F. Multi-conductor control cable shall be stranded, cross-linked polyethylene insulated polyvinyl chloride jacketed; General Electric Co. Vulkene, Type SI-58743, or equal.

PART III - EXECUTION

3.01 INSTALLATION

A. All conductors shall be carefully handled to avoid kinks or damage to insulation.

B. Lubrications shall be used to facilitate wire pulling. Lubricants shall be U.L. approved for use with the insulation specified.

C. All power and control wires shall be identified at each termination point and in all pull boxes or junction boxes for easy check out of system. Label each wire termination with the appropriate wire number or terminal number of the opposite end.

Labels shall be self-sticking vinyl or plastic impregnated cloth, resistant to moisture, as manufactured by Brady Co., Ideal Co., or equal.

D. Wires in motor control centers, motor control cabinets, instrument control cabinets, etc., shall be neatly grouped and bundled with plastic tie wraps as made by T & B Co. "TY-RAP," Panduit "Sta-strap," or equal.

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SECTION 16120 - 3.02

3.02 TESTS

A. All 600-volt wire insulation shall be tested after installation. Tests shall be made at not less than 500-V.

SECTION 16131 - PULL AND JUNCTION BOXES

PART I - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to install pull, floor and junction boxes where shown on the Plans and specified.

1.02 RELATED WORK

- A. Refer to Section 16110 for Raceways and Fittings.
- B. Refer to Section 16120 for Wire and Cables.
- C. Refer to Section 15351 for Pump Controls and Annunciator.

1.03 MANUFACTURERS

A. Hoffman, Crouse-Hinds, Killark, Appleton, Steel City, or equal.

PART II - DESCRIPTION

2.01 FLOOR BOXES

A. Boxes for floor installation shall be of the cast-metal, threaded-conduit-entrance, waterproof type with means for adjusting cover plate to finished floor level.

B. Cover plates on floor boxes shall be heavy brass, with permanent ring or flange and rubber gasket.

2.02 JUNCTION AND PULL BOXES

A. Boxes required to terminate, tap-off or redirect multiple conduit runs shall be appropriately designed junction boxes. Boxes shall be cast type or fabricated from sheet steel with galvanized finish unless in area where other type protective coatings are specified.

B. Boxes installed in exterior settings shall be stainless steel, type 316, NEMA 4X with gasketed door(s), stainless steel

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hardware including pad-lockable multi-point latches, backplates, interior doors, and continuous stainless steel hinges.

C. Pull boxes shall be installed where necessary in the raceway system to facilitate conductor installation. In general, conduit runs of more than 100 feet, or with more than three right angle bends, shall have a pull box installed at a convenient location. All such pull boxes shall be indicated on the Contractor's shop drawings.

D. Boxes shall have full-access screw covers mounted with corrosion-resistant machine screws. Covers shall be for surface or flush installation as noted or required.

E. Where indicated on the Plans, boxes shall be equipped with steel barriers to separate power, control, instrument, and intrinsically safe circuits.

F. Where feeder splices are to be made, boxes shall be large enough to provide ample work space.

2.03 CABLE SUPPORT BOXES

A. Vertical cable-support boxes shall be fabricated sheet steel type, galvanized, installed where indicated on the riser diagrams.

B. Boxes shall have removable screw cover fastened by corrosion-resistant machine screws.

C. Boxes shall be large enough to accommodate the feeder conduits indicated and shall have ample space to install cable supports in the conduits.

2.04 STANDARDS

A. Attention is directed to the provisions in the General Conditions of the Contract which state the full name of organizations publishing standard specifications and/or providing inspection services, which organizations are named in the following specifications by abbreviations.

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B. Where materials and methods are indicated in the following specifications as being in conformance with a standard specification, it shall refer in all cases to the latest edition of the specification and shall include all interim revisions. Listing of a standard specification without further reference indicates that the particular material or method shall conform to such listed specification.

PART III - EXECUTION

3.01 INSTALLATION

A. Box size shall be as required by the National Electric Code for the number of conduits and conductors entering and leaving it. Where intermediate cable supports are necessary because of box dimensions, provide insulated, removable cross-brackets to support the conductors.

B. Boxes shall be supported independently of conduits entering them. Brackets, rod hangers, bolts or other suitable supporting methods may be used.

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SECTION 16134 - PANELBOARDS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all panelboards as hereinafter specified and as shown on the Drawings.

PART II - PRODUCTS

2.01 RATING

A. Panelboard ratings shall be as shown on the Drawings. All panelboards shall be rated for the intended voltage.

2.02 STANDARDS

A. Panelboards shall be in accordance with the Underwriter Laboratories, Inc., "Standard for Panelboards" and "Standard for Cabinets and Boxes " and shall be so labeled where procedures exist. Panelboards shall also comply with NEMA Standard for Panelboards and the National Electrical Code.

2.03 CONSTRUCTION

A. Interiors

1. All interiors shall be completely factory assembled with circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type and all shall be suitable for copper or aluminum wire of the sizes indicated.

2. Interiors shall be so designed that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors and shall be so designed that circuits may be changed without machining, drilling or tapping.

3. Branch circuits shall be arranged using double row construction except when narrow column panels are indicated. Branch circuits shall be numbered by the manufacturer.

4. A nameplate shall be provided listing panel type, number of circuit breakers and ratings.

B. Buses

1. Bus bars for the mains shall be of copper. Full sized neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the

**Specifications for
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SECTION 16134 - 2.03

branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction. Cross connectors shall be copper.

2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection.

3. Spaces for future circuit breakers shall be bussed for the maximum device that can be fitted into them.

C. Boxes

1. Boxes shall be made from galvanized code gauge steel having multiple knockouts unless otherwise noted. Surface mounted boxes shall be painted to match the trim. Boxes shall be of sufficient size to provide a minimum gutter space of 4 inches on all sides.

2. At least 4 interior mounting studs shall be provided.

3. Enclosure type shall be NEMA 1 except as shown on the Drawings.

D. Trim

1. Hinged doors covering all circuit breaker handles shall be included in all panel trims.

2. Doors shall have semi-flush type cylinder lock and catch, except that doors over 48 inches in height shall have a vault handle and 3-point latch, complete with lock, arranged to fasten door at top, bottom and center. Door hinges shall be concealed. Two keys shall be supplied for each lock. All locks shall be keyed alike; directory frame and card having a transparent cover shall be furnished on each door.

3. The trims shall be fabricated from code gauge sheet steel.

4. All exterior and interior steel surfaces of panelboard shall be properly cleaned and finished with gray ANSI-61 paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.

5. Trims for flush panels shall overlap the box by at least 3/4 in. all around. Surface trims shall have the same width and height as the box. Trims shall be fastened with quarter turn clamps.

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E. Circuit Breakers

1. Panelboards shall be equipped with circuit breakers with frame size and trip settings as shown on the Drawings.
2. Circuit breakers shall be molded case, bolt-in type.
3. Circuit breakers used in 120-208-240 V panelboards shall have an interrupting capacity of not less than 10000 - amperes, RMS symmetrical.
4. Single pole circuit breakers used in 277/480 V panelboards shall have an interrupting capacity of not less than 14000 - amperes, RMS symmetrical.
5. Three pole breakers used in 277/480 V and 480 V panelboards shall have an interrupting capacity of not less than 14000 - amperes, RMS symmetrical.

F. Contactors

1. Where shown on the Drawings, contactors shall be furnished in panelboards. Contactors shall be mechanically held, tungsten rated, with ampere and voltage rating as shown on the Drawings. Contactors shall be Automatic Switch Co. Square D, or equal.

G. Lugs

1. Main lugs and sub-feed lugs shall be furnished where shown on the Drawings.

PART III - EXECUTION

3.01 INSTALLATION

- A. Boxes for surface mounted panelboards shall be mounted so there is at least 1/2 in. air gap between the box and the wall.

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SECTION 16135 - MISCELLANEOUS EQUIPMENT

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all miscellaneous equipment as hereinafter specified and as shown on the Drawings.

PART II - PRODUCTS

2.01 MATERIALS

A. Control Stations

1. Control stations shall be heavy-duty type, with full size operators - NEMA type, 30 mm.

2. Indicating lights or illuminated switches shall use replaceable LED lamps.

3. NEMA Type 4 and 7 enclosures shall be cast iron, cast aluminum, or where specified, stainless steel and shall be equipped with a padlock device for locking out the stop button. Enclosure types shall be as shown on the Drawings. Control stations shall be Class 9001 as manufactured by the Square D Co., Allen Bradley Bulletin 800H, or equal.

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SECTION 16150 - MOTORS

PART I - GENERAL

1.01 DESCRIPTION OF SYSTEM

A. Motors are generally specified with the driven equipment. The Contractor is advised to consult all Specification Divisions and Sections to determine their electrical rating, wiring requirements and responsibility for motor controls and starting equipment.

B. All electric motors furnished for installation on this Contract shall comply with the following General Specifications, the Project Specifications which precede this General Specification and the Contract Drawings.

C. This General Specification Section 16150 covers the specifications of electric motors generally utilized on power driven equipment. The Project Specifications which precede this General Specification and the Contract Drawings include specifications for any special motor types required and indicates the motor characteristics required on each application on this Contract.

PART II - PRODUCTS

2.01 GENERAL

A. Motors shall conform to the latest applicable NEMA, AIEE and ASA Standards. The motor ratings and types shall be as specified herein, except as modified by the Equipment Specifications. All motors shall receive routine tests in accordance with AIEE test procedures.

B. Output torque and speed characteristics of each motor shall be suitable to operate the driven equipment under the full range of equipment operating load conditions without exceeding the nameplate current rating, and/or temperature rise.

C. To insure proper coordination between motor drives and motor starting and protective devices, no motor shall be installed with less than 80% power factor at guaranteed full load speed.

D. Special equipment requiring a motor drive with unusual characteristics shall be equipped with a definite

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SECTION 16150 - PART II

purpose motor to meet the necessary requirements. All motors for special equipment shall first be approved by the Engineer for each individual application.

E. Motor bearings shall be of the anti-friction type. Thrust bearings in vertical motors shall be adequate for the loading encountered.

F. Motor conduit boxes shall be oversized and shall be located so as to be readily accessible.

2.02 RATINGS

A. Motor ratings shall be based on continuous operation in an ambient temperature of 40 degrees C. at sea level (3,300 feet or less). The maximum temperature rise for open and drip-proof type motors shall not exceed that allowed for the type of insulation used, service factor considered, and for totally enclosed type motors shall not exceed that allowed for the type of insulation used.

2.03 TYPES

A. Motors of 1/2 HP and larger shall be squirrel cage induction type designed for 3 phase, 60 Hertz, 230/460 volt operation unless otherwise specified. Motors smaller than 1/2 HP shall be of the capacitor type designed for single phase, 60 Hertz, 115 volt operation unless otherwise specified. Motors indicated on the Contract Drawings and/or specified in the Specifications as 208 volt or 480 volt shall be specially wound for voltage indicated and/or specified. Dual rated motors (i.e. 208/230 volts) are not acceptable for operation on 208 volts.

B. Torque and locked rotor current characteristics for three phase motors shall be NEMA Design "B". The locked rotor KVA/HP input at full voltage for 20 HP motors and larger shall not exceed that permitted for Code Letter "F", except for specialized equipment requiring a motor drive with special definite characteristics with the Engineer's approval.

C. All motors shall be of the open "drip-proof" type except in hazardous locations and otherwise specified under the Specifications and/or the Contract Drawings.

D. Explosion-proof type motors shall be furnished for hazardous areas as defined in the National Electrical Code. They shall be totally enclosed, fan cooled and bear the Underwriters Laboratories Label indicating compliance with the requirements for the specific application.

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SECTION 16150 - PART II

2.04 MOTOR DATA REQUIRED FOR APPROVAL

- A. Manufacturer
- B. Motor frame and type
- C. Insulation class
- D. Ambient temperature rating
- E. Maximum operating temperature
- F. Nameplate rated horsepower, voltage, phase, frequency and RPM
- G. NEMA design (starting torque)
- H. NEMA code letter (starting current)
- I. Guaranteed locked rotor current
- J. Guaranteed full load current
- K. Guaranteed full load efficiency
- L. Guaranteed full load, 3/4 load and 1/2 load power factor at rated full load, 3/4 load and 1/2 load RPM
- M. Outline drawings, dimensions, etc.
- N. Accessories, if any required

2.05 STANDARDS

A. Attention is directed to the provisions in the General Conditions of the Contract which states the full name of organizations publishing standard specifications and/or providing inspection services, which organizations are named in the following specifications by abbreviations.

B. Where materials and methods are indicated in the following specifications as being in conformance with a standard specification, it shall refer in all cases to the latest edition of the specification and shall include all interim revisions. Listing of a standard specification without further reference indicates that the particular material or method shall conform to such listed

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specification.

PART III - EXECUTION

3.01 INSTALLATION

A. Motors

1. The Contractor shall install a total, functional, tested and ready-to-operate system for any motor or otherwise electrically actuated system that is described within the Specifications, irrespective of source of delivery and mechanical installations. This shall include installation of all auxiliary and ancillary devices, switches, starters, contactors, sensing systems, alarms, controls, indicating, measuring, and instrumentation devices that may be associated with the basic system.

2. The Contractor shall furnish and install the required wire and conduit, boxes, fittings, etc. necessary to the proper operation and code conformance of each such system. Special attention is called out to systems requiring weather-tight water-tight and explosion-proof treatment.

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SECTION 16160 - MOTOR STARTERS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all motor starters as hereinafter specified and as shown on the Drawings.

PART II - PRODUCTS

2.01 MANUAL MOTOR STARTERS

A. Manual motor starters shall be furnished and installed for single-phase motors. Manual starters shall be non-reversing, reversing or two speed type as shown on the Drawings. Built-in control stations shall be furnished where shown on the Drawings.

B. Enclosure type shall be NEMA 1 except as shown on the Drawings.

C. NEMA Type 4 and 7 enclosures shall be cast iron or stainless steel.

D. Manual motor starters shall be as manufactured by the Square D Co., Cutler-Hammer, or equal.

2.02 MAGNETIC MOTOR STARTERS

A. Motor starters shall be 2 or 3 pole, 1 or 3-phase as required, 60 Hertz, 600 volt, magnetically operated, full voltage non-reversing except as shown on the Drawings. NEMA sizes shall be as required for the horsepower shown on the Drawings.

B. Two speed starters shall be for single or two winding motors as shown on the Drawings.

C. Each motor starter shall have a 120 volt operating coil, and control power transformer, when required. Three phase starters shall have an electronic overload relay. Auxiliary contacts shall be provided as shown on the Drawings or required.

D. Overload relays shall be adjustable and manually reset.

E. Control power transformers when required shall be sized for additional load as needed. Transformer primary shall be controlled by a separate control circuit breaker. Transformer secondaries shall be equipped with time-delay fuses. All control power circuits to be fused.

F. Built-in control stations and indicating lights shall be

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furnished where shown on the Drawings.

G. Enclosure type shall be NEMA 1 except as shown on the Drawings.

H. NEMA Type 4 and 7 enclosures shall be cast iron or stainless steel.

I. Magnetic motor starter shall be as manufactured by the Square D Co., Cutler-Hammer, or equal.

2.03 COMBINATION MAGNETIC MOTOR STARTERS

A. Motor starters shall be 2 or 3 pole, 1 or 3-phase as required, 60 Hertz, 600 volt, magnetically operated, full voltage non-reversing except as shown on the Drawings. NEMA sizes shall be as required for the horsepower shown on the Drawings.

B. Two speed starters shall be for single or two winding motors as shown on the Drawings.

C. Each motor starter shall have a 120 volt operating coil, and control power transformer, when required. Three phase starters shall have an electronic overload relay. Auxiliary contacts shall be provided as shown on the Drawings or required.

D. Overload relays shall be adjustable and manually reset.

E. Control power transformers, when required, shall be sized for additional load as needed. Transformer primary shall be controlled by a separate control circuit breaker. Transformer secondaries shall be equipped with time-delay fuses. All control power circuits to be fused.

F. Built-in control stations and indicating lights furnished where shown on the Drawings.

G. Enclosure type shall be NEMA 1 except as shown on the Drawings.

H. NEMA type 4 and 7 enclosures shall be cast iron or stainless steel.

I. Disconnect switches shall be unfused, quick-make, quick-break with operating mechanism mounted in a fixed portion of the enclosure. Door mounted mechanisms will not be acceptable.

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SECTION 16160 - 2.03

J. Circuit breakers shall have operating mechanisms mounted in the fixed portion of the enclosure. Door mounted mechanisms will not be acceptable.

K. Combination magnetic motor starters shall be as manufactured by the Square D Co., Cutler-Hammer, or equal.

PART III - EXECUTION

3.01 INSTALLATION

A. Motor starters shall be installed and connected as shown on the Drawings and specified for a complete and operating system.

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SECTION 16170 - DISCONNECTS

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install all circuit disconnects as hereinafter specified and as shown on the Drawings.

PART II - PRODUCTS

2.01 MATERIALS

A. Disconnect Switches

1. Disconnect switches shall be heavy-duty, quick-make, quick-break, visible blades, 600 volt, 3 pole with full cover interlock.

2. Enclosure type shall be NEMA 1 except as shown on the Drawings.

3. Switches shall be as manufactured by the Square D Co., Cutler-Hammer, or equal.

PART III - EXECUTION

3.01 INSTALLATION

A. Disconnects shall be installed in circuit locations as shown on the Drawings, as specified and as required by the National Electrical Code.

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SECTION 16220 - STANDBY GENERATOR UNIT

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, appurtenances and incidentals required, and install complete, ready for operation and field test one (1) _____ eKW, ____kVA, 1800 RPM, three phase diesel engine driven standby generator unit for operation at ___ volts, 60 Hertz, including radiator fan and all parasitic loads as shown on the plans and as hereinafter specified. Natural gas powered standby generator units may be substituted with Division of Sewerage Management approval.

B. The unit shall have a standby power rating of not less than the above specified eKW at 0.8% Power Factor with 3 phase, 60 Hz, at above specified voltage, 4 wire alternating current generator, complete with excitation system, controls, steel sub-base, vibration isolators, exhaust system with insulation wrap, flexible shroud from radiator to wall if radiator is not wall mounted, duct (radiator) mounted or exterior load bank, sub base _____ gallon skid mounted diesel fuel tank, and all essential and desirable appurtenances.

C. The unit shall be arranged for automatic starting and stopping and load transfer upon failure of the normal source of power.

D. These Specifications are intended to give a general description of what is required, but do not purport to cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, shop testing, delivery, complete installation, and field testing of all materials, equipment and appurtenances for the complete units as herein specified, whether specifically mentioned in these Specifications or not.

E. For all units there shall be furnished and installed all necessary and desirable accessory equipment and appurtenances whether specifically mentioned in the Specifications or not, and as required for an installation incorporating the highest standards for the type of service including field testing of the entire installation and instructing the regular operating personnel in the care, operation and maintenance of all equipment.

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SECTION 16220 - PART I

1.02 RELATED WORK

- A. Electrical is specified under Division 16.
- B. Automatic Load Transfer Switch is specified under Division 16.
- C. Piping and valves are specified under respective sections of Division 15.
- D. Generator Load Bank is specified under Division 16.
- E. Louver Assembly specified under Division 15.

1.03 SUBMITTALS

- A. Submit to the Engineer for approval six (6) complete sets of shop drawings, schematics and wiring diagrams which shall show in detail the generator unit and installation of the same to the work of other sections including foundation drawing showing location and size of foundation bolts.
- B. The contractor's submittal shall also include all information stipulated in Part III, Article 3.05 of the Specification. The information shall be submitted with the installation drawings.
- C. Furnish four (4) copies of the manufacturer's certified shop test record of the complete engine driven generator unit. Final test record shall show the generator set performance as required by Part III, Article 3.03 of this Specification.
- D. Refer to GCC-34 for Operation and Maintenance Manuals.

1.04 UNIT PERFORMANCE

- A. The unit shall be capable of maintaining rated frequency from no load to full load (isochronous operation). The voltage regulation shall be as defined under Part II, Article 2.01-A and recovery to steady state operation shall be within two seconds.
- B. Stable or steady state operation is defined as operation with terminal voltage remaining constant within plus or minus 0.5 percent of rated voltage.

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SECTION - 16220 - PART I

1.05 QUALIFICATIONS

A. The entire engine-generator set shall be the product of a single manufacturer, to create one source of supply and responsibility.

B. The complete generator set shall be fully fabricated, tested and shipped by a single manufacturer who has been regularly engaged in the production of such equipment for the past twenty-five years. The electric generating system described herein, including all components shall be factory built, factory tested, and shipped by this single manufacturer, so there is one source of supply and responsibility for warranty.

C. The unit manufacturer shall provide support services to the contractor during the construction contract. An accredited factory trained technician shall supervise and offer assistance to the contractor during the installation and testing of the equipment and accessories. Upon completion of final testing and acceptance of the equipment, a qualified representative of the manufacturer shall be present to train personnel designated by the Owner in the proper maintenance and operation of this equipment. A minimum of eight (8) hours shall be allowed for this training. Further, the qualified manufacturer shall have a local representative who can provide factory trained service personnel, replacement parts, and technical assistance.

D. Safety Standard: The electric generating system must meet all current NPFA 110 requirements including design specifications, prototype tests, one-step full-load pickup, and installation acceptance.

E. The engine-generator set shall be the standard product, as modified by these specifications, of a manufacturer regularly engaged in the production of this type of equipment. The unit to be furnished shall be a standard production model of proven ability and shall be designed, constructed, and installed in accordance with best practices and methods.

F. The unit must be of such physical dimensions as to make a good installation in the opinion of the Engineer, in the space provided and/or as indicated on the Drawings.

G. Shall submit to the Engineer a certified factory load test report showing satisfactory operation at the full load rating specified herein for a minimum two-hour continuous period.

H. All controls shall be the standard of the manufacturer, who is engaged in the manufacture of generators and has them available for sale on the open market. Control parts shall be identified by part

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number of this manufacturer and shall have second source listing where applicable. Control systems that are supplied by a sub-vendor or sub-contractor of the vendor and not incorporated within the documentation drawings of the generator manufacturer are not acceptable.

1.06 TESTING

A. The intent of this specification is to provide equipment of proven reliability and compatibility. Three separate series of tests shall be performed: Factory Prototype Model Tests, Factory Production Model Tests, and Field Tests. (See Section 3.04)

1. Factory Prototype Model Tests: The electric generating system consisting of prime mover, generator, governor, coupling and all controls must have been tested as complete unit on representative engineering prototype model as required by the current NPFA 110 requirements. The tests, being potentially damaging to the equipment tested, must not be performed on equipment to be sold, but on separate prototype models as specified by NFPA 110, and their accomplishment certified by means of documentation of the tests accompanying submittal data. These tests shall have included:

- a. Maximum power level (maximum KW).
- b. Maximum motor starting capacity (maximum KVA) and voltage dip recovery within seven (7) cycles of applied load.
- c. Structural soundness (Short-Circuit and Endurance Tests).
- d. Torsiograph Analysis: The manufacturer of the engine-generator set shall verify that the engine-generator combination, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype unit. The empirical data must include spectrum analysis of the torsional transducer output within the critical speed range of the engine-generator set. Results of this analysis shall be made available to the specified on request. Calculations based on engine and generator separately are not acceptable.
- e. Engine-generator cooling air requirements.
- f. Transient response and steady-state speed control and voltage regulation.
- g. Generator temperature rise per NEMA MG1.

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h. Harmonic analysis and voltage waveform deviation per MIL-STD-705B, Method 601.4.

i. Three phase short-circuit test for mechanical and electrical strength. With system operating at rated volts, amps, power factor, and speed, the generator terminals must be short circuited ten times on all three phases for a duration of thirty seconds. Engine-generator set must build up and perform normally without manual interventions of any kind such as resetting of circuit breakers or other tripping devices when the short circuit is removed.

j. Failure mode test for voltage regulator. With engine-generator set operating at no load, rated speed and voltage, the AC sensing circuit to the regulator must be disconnected for a period of at least one hour. The engine-generator set must be fully operative after the test, and without evidence of any kind of damage.

k. Endurance testing is required to detect and correct potential electrical and mechanical problems associated with typical operation.

l. Paralleling Test: For paralleling applications the manufacturer shall have performed and certified that the engine-generator set can withstand 180° out-of-phase paralleling from full rated voltage and speed without sustaining any mechanical or electrical damage.

2. Factory Production Model Tests: Before shipment of the equipment, the engine-generator sets shall be tested under rated load and power factor for performance and proper functioning of control and interfacing circuits. Testing at unity power factor only (resistance banks only) is not acceptable, since KW output is affected by the higher generator efficiency at unity power factor, and the KVAR for motor starting and regulation loads varies with power factor. Tests shall include:

a. Single step load pickup per the current NFPA 110 Standard.

b. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.

c. Fuel consumption (no load, 1/4, 1/2, 3/4, and Full load).

d. Generator temperature rise by resistance method.

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The Engineer and/or representative of the Owner shall have the option of witnessing these tests. A summary of these test results shall be submitted.

1.07 WARRANTY

A. The complete standby electric power system, including the 1800 rpm engine-generator set and transfer switch equipped with set exerciser, and running time meter, shall be warranted for a period of two (2) years from the date of final acceptance of the unit by the Owner after the unit has satisfactorily passed the on-site performance testing. The warranty shall be all inclusive of all labor, parts, travel costs, etc. for the repair. Multiple warranties for individual components (engine, generator, controls, etc.) will not be acceptable.

Satisfactory warranty documents must be provided prior to the installation of the equipment. This warranty shall be a written document certified by the company. In the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

1.08 SUBSTITUTE EQUIPMENT

A. Equipment as described herein is that as manufactured by Caterpillar, Inc. of Peoria, Illinois, and all equipment furnished shall be equal in every way to that specified herein, including quality, operation, and function. The equipment spacing, mounts, electrical wiring, ventilation equipments, fuel and exhaust components must have all been sized and designed around the Caterpillar equipment.

If alternate equipment is substituted, the Contractor shall be responsible for all changes to the proposed and/or existing facilities and additional construction/engineering costs made necessary for installation of equipment other than Caterpillar. The substitute equipment shall cause no additional cost to the Owner or his Engineer, and the Contractor shall verify all work with the equipment manufacturer. A complete set of shop drawings, diagrams, and details shall be prepared specifically showing how the substitute equipment fits with the project specifications/layouts. Standard and typical drawings will not be acceptable.

B. Data for substitute equipment shall include complete information for the following:

1. A prepared plan drawing to verify that substitute equipment will fit into space allocated, and allow for its removal and service.

2. Allowance for proper cooling and combustion air.

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3. Verification that all interconnecting wiring and piping is accounted for. Provide complete set of interconnecting wiring and piping diagrams.
4. Provide a copy of the prototype testing results.
5. Complete load study and load profile to show that engine-generator set will not be overloaded during any phase of operation, including motor starting and steady-state load conditions.
6. Specification information, factory literature, catalog sheets, etc., to show compliance with specifications.
7. A tabulation which outlines the changes to the contract caused by the use of proposed substitute equipment and the equated expense or credit caused by it.
8. Complete list of deviations from these specifications.
9. Short circuit study of the load circuits to verify that selective coordination and thermal and magnetic stresses on components will be equal to that specified.
10. List of projects using similar equipment for the last five (5) years.

PART II - PRODUCTS

2.01 GENERAL

A. The engine-generator set shall be a factory assembled unit, specially designed and equipped for operation with No. 2 diesel fuel, and shall be a Caterpillar, Inc. or equal. The engine and generator shall be direct connected with a semiflexible steel coupling, shall be free from injurious torsional or other vibration, and shall be vibro mounted with a heavy steel subbase. The diesel engine shall be of the vertical, in line or V-type construction, four stroke cycle, full diesel, mechanical injection, arranged for direct connection to an alternating current generator. The unit shall operate at the rotating speed of not more than 1800 rpm.

The AC engine-generator set shall be rated by the manufacturer for standby operation at _____ ekW, _____ kVA at 0.8 PF, 60 Hz, 1800 RPM for use with a _____ Volts AC, 3 Phase, 4-wire system. Ratings must be substantiated with manufacturer's standard published curves. Special ratings for a particular application are not acceptable.

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B. The generator set manufacturer shall verify the diesel engine as capable of driving the generator with all accessories in place and operating, at the generator set kW rating after derating for the range of temperatures expected in service and the altitude of the installation.

C. Voltage regulation shall be +/- 0.5 percent of rated voltage for any constant load between no load and rated load.

D. Frequency regulation shall be isochronous from steady state no load to steady state rated load.

E. Random Voltage Variation; the cyclic variations in RMS voltage shall not exceed plus or minus 0.5 percent of rated for constant loads from no load to rated load, with constant ambient and operating temperature.

F. Random Frequency Variation; speed variations for constant loads from no load to rated load shall not exceed plus or minus 0.25 percent of rated speed, with constant ambient and operating temperature.

G. Total Harmonic Distortion; the sum of AC voltage waveform harmonics, from no load to full linear load, shall not exceed 5% of rated voltage (L-N, L-L, L-L-L) and no single harmonic shall exceed 3% of rated voltage.

H. Telephone Influence Factor; TIF shall be less than 50 per NEMA MG1-22.43.

I. The diesel engine-generator set shall be capable of picking up 100% of nameplate kW, less applicable derating factors, in one step with the engine-generator set at operating temperature, in accordance with NFPA Standard 110.

J. Motor starting kVA shall be a minimum of _____, based upon a sustained RMS voltage drop of no more than 20% of no load voltage with the specified load kVA at near zero power factor applied to the engine-generator set.

K. The unit shall be installed for automatic starting and stopping, and automatic transfer of load, but not including the automatic load transfer switch which is furnished under another section. The load shall be transferred to the diesel unit when it has attained rated frequency and voltage. The engine shall be capable of starting solely from the heat of compression and operation with No. 2 diesel fuel.

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2.02 AC Generator, Regulator and Exciter Unit

A. The AC generator, exciter and voltage regulator shall be designed and manufactured by the engine-generator set manufacturer as a complete generator system.

B. The AC generator shall be; synchronous, four pole, revolving field, drip proof construction, single prelubricated sealed bearing, self ventilated in accordance with NEMA MG 1, and directly connected to the engine with flexible drive disc(s). The armature shall have skewed laminations of insulated electrical grade steel, two-thirds pitch windings. The rotor shall have amortisseur (damper) windings, layer wound mechanically wedged winding construction. The rotor shall be dynamically balanced and be capable of surviving the effects of 125% over speed for two (2) minutes according to NEMA MG1-33. The permissible residual imbalance permitted in the rotor, measured at maximum service speed (nominal +25% over speed), must not exceed the limits as described in ISO 1940/1 - G2.5 The exciter shall be brushless, three phase, and a surge suppressor (for 200 KW to 1500 KW units) connected in parallel with the field winding. Field discharge resistors shall not be acceptable. Systems using three-wire solid-state devices (such as SCRs or transistors) mounted on the rotor shaft shall not be acceptable.

C. Twelve AC output leads shall be brought out to field connection bus bars accessible through removable plates on either side of a sheet metal output box.

D. All insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed _____ degrees Centigrade to provide additional allowance for internal hot spots. The main generator and exciter insulation systems must be suitably impregnated for operation in severe environments for resistance to sand, salt, and sea spray.

E. A permanent magnet generator (PMG) shall derive excitation current from a pilot exciter mounted on the rotor shaft and shall provide power to the automatic voltage regulator for immunity from voltage distortion caused by non-linear SCR controlled loads on the generator. The PMG shall sustain 300% of rated current for ten seconds during a fault condition.

F. The automatic voltage regulator shall be temperature compensated, solid-state design and include overvoltage and overexcitation protection functions. The voltage regulator shall be equipped with three-phase RMS sensing. The regulator shall control buildup of AC generator voltage to provide a linear rise and limit

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overshoot. Overvoltage protection shall sense the AC generator output voltage and in the event of regulator failure or loss of reference, shut down regulator output on a sustained overvoltage of one (1) second duration. Overexcitation protection shall sense regulator output and shut down regulator output if overloads exceed ten (10) seconds duration. Both overvoltage and overexcitation protection shutdowns shall be latched, requiring the AC generator to be stopped for reset.

G. The regulator shall include an under frequency rolloff torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of 58-59 Hz. The torque-matching characteristic shall include differential rate of frequency change compensation to use maximum available engine torque and provide optimal transient load response. Regulators which use a fixed volts per hertz characteristic are not acceptable.

H. Alternator shall be equipped with a 120 VAC, single phase space heater to minimize condensation. Mounting shall be simplified for maintenance. The heater shall automatically disconnect upon engine start up.

2.03 Engine-Generator Set Control:

A. The control shall have automatic remote start/stop capability. A panel mounted switch shall stop the engine in the STOP position, start and run the engine in the RUN position, and allow the engine to start and run by closing a remote contact, and stop by opening the remote contact when in the AUTO position.

B. The control shall include a cycle cranking function. The cranking cycle, nonadjustable, shall consist of an automatic crank period of approximately 15 seconds duration followed by a rest period of approximately 15 seconds duration. Cranking shall cease upon engine starting and running. Two means of cranking termination shall be provided, one as a backup to the other. Failure to start after three cranking cycles (75 seconds) shall shut down and lockout shall be provided, one as a backup to the other. Failure to start after three cranking cycles (75 seconds) shall shut down and lockout the engine, and visually indicate an overcrank shutdown on the panel. Batteries provided for the starting system shall be flooded lead acid of a capacity recommended by the engine manufacturer.

C. The control shall shut down and lockout the engine upon: failing to start after the specified time (overcrank), overspeed/underspeed, low lubricating oil pressure, high engine coolant temperature, low coolant level, operation of a remote manual stop station or additional specified protective actions.

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D. Provide a generator mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include digital AC metering (0.5% true RMS accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cool down timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components mounted in control panel shall also be environmentally enclosed and sealed to protect against failure from moisture or dirt. Components shall be housed in a NEMA 1/IP22 enclosure. Control panel shall be UL listed in accordance with Section 508A.

E. Control panel shall be constructed of a minimum 12 gauge steel, fully welded with gasketed and hinged door. No enclosure utilizing screws to piece together an enclosure shall be allowed due to the susceptibility of water penetration.

F. Provide a low coolant level shutdown, which shall be indicated on the control panel. Provide required sets of normally open dry contacts to indicate the generator is running. Contacts shall be connected to the Alarm Annunciator, Louver motors, and generator room heating control.

G. The NEMA 1 enclosed control panel shall be mounted off the engine-generator set and mounted directly to the structural steel base isolated from vibrations induced by the engine-generator set. Control wiring shall be encased in protective loom and terminate at the control panel with quick connecting military style connectors for a water proof and rodent proof entrance.

H. The control panel shall feature the following requirements:

1. 32-bit programmable microprocessor
2. Graphical display with positive image, transfective LCD, adjustable white backlight/contrast. Three character lines and twenty-one characters per line minimum with a minimum display height of 28mm x 100 mm.
3. Monitoring and functionality from -40°F to 158°F.
4. Simultaneous viewing of all L-L voltages, all L-N voltages, or all AC line currents.
5. User friendly, program directs Owner to logical parameter groups for quick keypad access.
6. Nonvolatile memory for all software and set points.
7. True RMS sensing (+1%) for all AC voltage, current and power parameters.
8. Three security levels for Owner operator privileges.

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9. Real time clock for time-stamp of diagnostics and events in control logs. Included are service maintenance reminders based on engine operating hours or calendar days.
10. J1939 data link for add-on devices.
11. Service tool for programming and diagnostics.
12. Two LED status indicators (one red, one amber). Engine control keys and status indicators (Run/Stop/Auto). Lamp test, Alarm acknowledgement, and Display navigation keys
13. Lockdown emergency stop pushbutton.
14. Voltage adjust and Speed adjust capability.

I. The Control Panel shall provide the minimum digital readouts:

1. Engine oil pressure.
2. Coolant temperature.
3. Engine RPM.
4. System DC voltage.
5. Engine run hours.
6. Crank attempt counter.
7. Start counter.
8. Generator AC volts - Three phase line-to-line and line-to-neutral.
9. Generator AC amperage - Per phase and average.
10. Generator frequency.
11. KW and KVA - Per phase and total.
12. KVAR - Per phase and total.
13. Power factor - Per phase and overall.
14. Real time clock.
15. Service interval counter.
16. KW and KVAR hours total.

J. The Control Panel shall provide the following protective actions:

1. Overcrank (failure to start).
2. Low oil pressure shutdown.
3. High coolant temperature shutdown.
4. Approaching low oil pressure shutdown.
5. Approaching high coolant temperature shutdown.
6. Low coolant temperature alarm.
7. Not in Auto mode.
8. High/Low battery voltage.
9. Battery charger failure.
10. Underspeed/Overspeed.
11. Loss of engine speed protection.
12. Under/Over Voltage.
13. Under/Over frequency.
14. Overcurrent.

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K. The Control Panel shall provide the following capabilities for communications:

1. Panel mounted audible alarm.
2. Twenty event fault log that indicates name, engine hours, and time stamp at first and last occurrence, including number of occurrences.
3. Common, dry contact, alarm.
4. Generator set running (dry contact)
5. Remote annunciator interface.
6. Discrete input/output module.
7. Modbus communications - RS485 connection.
8. Remote start/stop signal input
9. Six programmable spare digital input signals.

L. Provide a remote annunciator to allow indication of all points listed on the alarm schedule and incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the audible horn. Locate remote annunciator as indicated on the Plans.

2.04 Engine

A. The diesel engine shall be manufactured by Caterpillar, Inc. or approved equal and shall be designed specifically for generator set duty. The engine shall be 4 cycle, water cooled, diesel fueled, with forged steel crankshaft and connecting rods. The cylinder block shall be cast iron and have two valves per cylinder (4 valves per cylinder for 200 KW to 1500 KW units). Design shall be no less than _____ cylinders with a minimum displacement of _____ cubic inches, turbocharged and after-cooled where required by the generator set manufacturer. Two cycle engines are not acceptable.

B. The generator set shall be EPA Tier 3 Certified and in compliance with New York Emission regulations at the time of installation/commissioning. Actual engine emission values must be in compliance with EPA Tier 3 emissions standards per ISO 8178 - D2 Emissions Cycle at specified ekW/bHP rating. Utilization of the "Transition Program for Equipment Manufacturers", also known as "Flex Credits" to achieve Tier 3 certification is unacceptable.

C. The engine generator set shall include the following engine accessories:

1. An electric starter(s) capable of three complete cranking cycles without overheating, before overcrank shutdown (75 seconds).

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2. Positive displacement, gear type, full pressure, lubrication oil pump and water cooled lube oil cooler. Pistons shall be spray cooled. Full flow lubrication oil filters with replaceable spin-on canister elements, oil pressure gauge, oil drain, and dipstick oil level indicator.

3. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Replaceable dry element air cleaner. Fuel priming pump. Flexible fuel lines, supply and return.

4. Engine mounted battery charging alternator, 55 ampere minimum, and solid-state voltage regulator.

5. The engine-generator set shall be mounted on a heavy duty steel base to maintain proper alignment between components. The engine-generator frame set shall incorporate a battery tray with battery hold down clamps within the base rails. Provisions for stub up of electrical and fuel connections shall be within the footprint of the generator set base rails.

6. Spring type vibration isolators for mounting the unit shall be provided. The actual quantity and type is as recommended by the generator set manufacturer or as shown on the drawings.

7. Generator main circuit breaker, mounted and wired, UL listed, molded case, shunt-trip, thermal magnetic type - with solid state trip unit, _____ amps trip, 3-pole, _____ volt, rated at 100% with NEMA 1/IP22 rating. The breaker shall be connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box isolated from generator vibrations. Mechanical lugs, sized for the breaker feeders shall be supplied on the load side of the Main Breaker.

8. Engine mounted, thermostatically controlled, coolant heater. The heater shall be rated _____ watt, _____ volt, single phase, 50/60 Hz. The Contractor shall provide a separate branch circuit to the heater. Valves shall be supplied on each fluid circuit to isolate the heaters to facilitate replacement when required.

2.05 Electric Governor

A. The electronic governor consisting of a magnetic pickup speed sensor, adjustable electronic control, and an electric actuator mounted integrally with the fuel pump, shall provide automatic engine-generator set frequency regulation adjustable from isochronous to 5% droop. The governor shall be suitable for paralleling future generator sets with the addition of load sharing controls. Governors using external throttle linkages shall not be acceptable.

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2.06 Engine Cooling System

A. The engine shall be cooled by a skid-mounted closed loop radiator system including belt-driven pusher fan, coolant pump and thermostat temperature control. The cooling system shall be rated for full rated load operation in 122 degrees F (50 degrees C) ambient conditions. Allowable radiator fan back pressure shall not exceed 0.25 inches of water pressure. The cooling capability of the generator set shall be demonstrated by prototype tests on a representative generator set model.

B. Radiators shall be provided with a duct adaptor flange permitting the attachment of an air discharge duct to direct the radiator air outside according to the manufacturers instructions. The cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment supplier.

C. Rotating parts shall be guarded against accidental contact.

2.07 Engine Exhaust System:

A. Exhaust muffler(s) shall be provided for each engine, the size and type as recommended by the generator set manufacturer. The muffler(s) shall be critical grade. The contractor shall mount the muffler(s) so their weight is not supported by the engine.

B. Flexible exhaust connection(s) shall be provided by the equipment supplier for installation by the contractor as required for connection between the engine exhaust manifold(s) and exhaust line in compliance with applicable codes and standards.

C. An approved thimble must be used where the exhaust pipes passes through walls, partitions or roofs. The thimbles construction must satisfy the building codes, Standards for Chimneys, Fireplaces and Vents. The thimble shall be of sufficient length to extend a minimum distance of nine (9) inches from the faces of the interior and exterior walls. Thimbles installed in the vertical direction shall be equipped with a drip cap.

D. The contractor shall provide an exhaust system condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine.

E. When shown on the Plans, the contractor shall provide a suitable rain cap at the stack outlet with all necessary flanges and fittings for proper installation.

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F. The contractor shall install all exhaust components as shown on the drawings and as required to comply with NFPA 37 and local codes and regulations. Components shall be sized to assure full load operation without excessive back pressure when installed as shown on the drawings. Make provisions as required for pipe expansion and contraction.

G. The entire exhaust system including the exhaust silencer which is installed in the field, except the flexible section, shall be covered with insulation of non-combustible type and jacketed with an aluminum jacket. The insulation shall be rigid hydrous calcium silicate heat insulation for use at temperatures up to 1,200°F, held in place with stainless steel banding and covered with a 0.016 or 0.020 inch aluminum jacket, secured with screws and jacketing lapped a minimum of three (3) inches. The aluminum jacket shall be separately applied at the job site. The insulating material shall be three (3) inches thick. Fittings shall be insulated with calcium silicate insulation cut to fit. It is the intent that no asbestos or asbestos bearing products be used. Flexible sections of the exhaust system shall be protected by a suitable metal guard to prevent personal injury from a burn if in contact with bare flesh.

2.08 Engine Fuel System:

A. All fuel system piping shall be black iron pipe and shall be sized as required for proper fuel flow to engine. The fuel system shall include all supply, return, vent, and fill lines as required. Furnish flexible connections for connecting fuel system to engine in compliance with applicable codes and regulations.

B. The standby generator unit shall include a _____ gallon main skid mounted fuel storage tank, gauges, valves, tank filler fittings, level meter, tank vent fittings, rupture tank and necessary items to comply with applicable codes and regulations. The tank shall be made of corrosion resistant steel.

C. The fuel storage tank shall be provided with a low fuel supply sensing device. The sensing device shall be adjusted to signal low fuel level alarm when the tank contains less than a four (4) hour supply. Alarm to be indicated on generator control panel and on a remote annunciator. Tank gauge shall be positioned so it can be easily read.

D. Contractor shall refill fuel tank to full at the completion of all required performance load testing.

E. Fuel tank and rupture tank must be UL listed or UL approved. Supply sensing device to indicate main fuel tank rupture on

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generator control panel.

F. Contractor to provide necessary piping and fittings to extend the fuel tank vent and fuel tank fill port to an exterior building wall allowing for outside filling and venting of the unit. A lockable fill cap shall be included.

2.09 Battery System

A. Starting batteries for the system shall be flooded, lead-acid storage batteries of the heavy-duty diesel type. Battery voltage will be compatible with starting system voltage requirements. The battery set shall be rated at a minimum of ____ ampere-hours. All cable and clamps shall be supplied.

B. Battery tray(s) shall be provided for the starting batteries and shall conform to NEC 480-7(b). Trays shall be treated to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the tray(s).

C. A wall mounted, current limiting battery charger shall be furnished to automatically recharge battery set. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC Ammeter, DC Voltmeter, and fused AC input. AC input voltage shall be 120 volts, single phase. Charger shall have LED annunciation for low DC volts, rectifier failure, AC power available, loss of AC power, and high DC volts. Include alarm contacts (C form) for all failure and over/under voltage conditions. Amperage output shall be no less than ten (10) amperes. Charger shall be provided in a wall mounted, NEMA 1 enclosure.

2.10 Base Frame

A. The generator set shall be mounted and shipped to the job site on the structural steel frame. Provisions for crane unloading of the complete package shall be designed into the base frame of the unit.

B. The base assembly shall be of sufficient size to mount the engine, in-base fuel tanks, starting batteries, racks and cables, main line circuit breaker, engine-generator control panel, and other items as required for proper operation.

C. The weight of the entire unit consisting of generator set, base and all other specified items including all liquids (i.e., fuel oil, lube oil, and cooling water) shall be calculated by the manufacturer. The base of the unit shall be designed and manufactured

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as a heavy duty, structural steel construction with four (4) point lifting provisions to support the calculated weight. Details and manufacturer's certification of the base construction shall be included with the drawings submitted for approval as well as all weight calculations.

PART III - EXECUTION

3.01 INSTALLATION

A. The Contractor shall complete all preparatory work required to accommodate the standby generator installation, i.e., concrete pad with set anchors, conduit, junction and pull boxes, outlet boxes, brackets and all conduit fittings and accessories, including power connections to generator set heaters, load center, etc., as required. Once completed, the contractor shall arrange for the delivery of the generator unit to the site and proceed with the installation of the same.

B. The installation of the unit shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work. The contractor shall maintain the services of the manufacturer to assist with the installation and testing of the equipment.

C. The generator manufacturer's factory representative will be required to inspect the completed generator unit to insure proper installation. If a problem is detected, the Contractor shall quickly correct the situation as directed.

D. The complete generator unit shall be mounted on a welded steel subbase of sufficient rigidity and strength to maintain alignment of the unit. The base shall be suitable for, and there shall be included, spring type vibro-isolators for mounting the unit on a level surface of a concrete pad. The spring type vibro-isolators shall be supplied by the manufacturer of the generator.

E. The Contractor shall correctly set the emergency and normal service phases so that motor rotation will not reverse upon transfer from normal to emergency feeder.

F. The completed installation of the system shall comply with NFPA 110, the National Electrical Code, and New York State Uniform Fire Prevention and Building Code.

G. Once the unit has been completely installed, the Contractor shall fill the fuel tank with diesel fuel to its maximum capacity. Upon completion of the generator's performance testing, the

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fuel tank should be "topped off" by the contractor with diesel fuel in order that a full tank is turned over to the Owner.

3.02 Painting

A. The engine generator set and associated equipment shall be shop primed and finished coated in accordance with the manufacturer's standard practice prior to shipment. Color shall be selected by the Engineer and an adequate supply of touch-up paint shall be supplied by the manufacturer.

3.03 Shop Test

A. The complete generator unit with its associated equipment shall be tested and the test record approved by the Engineer prior to shipment of the unit.

B. The shop test shall consist of at least, but not be limited to, four hours of full load operation, and in addition, voltage and frequency regulation shall be tested and recorded to show full compliance with this specification. Also, there shall be tested and recorded the respective values at which each of the automatic shutdown devices actually stop the engine.

C. During the shop test, readings shall be taken and recorded every thirty minutes for each of the following:

1. Time
2. Volt for each phase
3. Load
 - a. Amps for each phase
 - b. K.W.
4. Frequency
5. Engine jacket water temperature
6. Lubricating oil pressure

3.04 Field Test

A. After the installation of all equipment has been completed. The contractor shall complete a preliminary system test of the unit with representative of the manufacturer present. The purpose of the test is to fine tune and adjust the equipment. As soon as conditions permit, the unit shall be subject to a final acceptance test under actual operating conditions to determine that operation is satisfactory without the overheating of any part and to be free from excessive vibration throughout the entire range of speeds and loads.

B. Before running the field test, the Contractor shall submit for the Engineer's approval a copy of the proposed log sheet on

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which shall be recorded the load and all corresponding temperatures and pressures as well as the total quantity of fuel consumed during the test.

C. All expenses for conducting a satisfactory field test shall be paid by the contractor.

D. The generator unit manufacturer's service representative shall be present during the field test.

E. Verify that the equipment is properly installed.

F. Check all auxiliary devices for proper operation, including battery charger, jacket water heater, etc.

G. Test all alarms and safety shutdown devices for proper operation and annunciation.

H. Check all fluid levels.

I. Start engine and check for exhaust leaks, oil leaks, fuel leaks, vibrations, etc.

J. Verify proper voltage and phase rotation at the transfer switch before connecting to the load.

K. Perform a 4-hour load bank test at 1.0 power factor at full nameplate load using a reactive load bank and cables supplied by the local generator dealer.

L. Observe and record operating data at 15 minute intervals.

M. Connect the generator to building load and verify that the generator will start and run all loads in the pumping station. Measure site harmonics as generator set provides power.

N. Supply the Owner with the startup and test report.

3.05 DATA TO BE SUBMITTED WITH INSTALLATION DRAWINGS

A. Drawings showing setting plan of the complete generator unit; foundation plan; exhaust silencer; starting battery; battery charger; fuel tank; louver hood assembly kit; and all other items requiring space for installation.

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SECTION 16220 - 3.05

- B. Engine Data
 - 1. Manufacturer
 - 2. Model
 - 3. Number of cylinders
 - 4. R.P.M.
 - 5. Bore x stroke
 - 6. Rated Capacity B.H.P.
 - 7. Piston speed, fpm
 - 8. Make and model and descriptive literature of governor

- C. Generator Data
 - 1. Manufacturer
 - 2. Model
 - 3. Rated K.V.A.
 - 4. Rated K.W.
 - 5. Voltage
 - 6. Temperature rise above 40 degrees C. ambient
 - a. Stator by thermometer
 - b. Field by resistance
 - c. Class of insulation

- D. Generator Efficiency Including Excitation Losses and at 1.0 P.F.
 - 1. Full load
 - 2. 3/4 load
 - 3. 1/2 load

- E. Generator Unit and Accessories Including Fuel Tank and Load Bank
 - 1. Weight of skid mounted unit
 - 2. Overall length
 - 3. Overall width
 - 4. Overall height
 - 5. Exhaust pipe size
 - 6. C.F.M. of air required for combustion and ventilation
 - 7. Heat rejected to jacket water and lubrication oil B.T.U./Hr.
 - 8. Heat rejected to room by engine and generator B.T.U./Hr.
 - 9. Size of louver opening necessary for efficient operation of exhaust air.

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SECTION 16220 - 3.06

3.06 SPARE PARTS/TOOLS

A. The Contractor shall furnish and deliver to the Owner the following spare parts:

1. Two spare heating elements for the water jacket heater.
2. Set of oil filter elements.
3. Set of fuel filter elements.
4. Set of air cleaner elements.
5. Hydrometer for testing anti-freeze solution.
6. Test kit for checking chemical condition of coolant.
7. Test kit for checking chemical condition of oil.
8. Specialty tools recommended by the manufacturer for regular maintenance and minor repairs of the unit.

3.07 TRAINING

A. The equipment manufacturer's representative shall provide, as part of this contract, a minimum of eight (8) hours of system operation training to the Owner. The training will be provided at the generator site and/or the designated District facility.

3.08 INSTRUCTION MANUALS

A. The Contractor shall provide, four (4) bound, printed copies and two (2) copies in electronic form (CD-ROM, PDF Format) of an Operation and Maintenance Manual. The manuals shall be inclusive of all pertinent data and drawings necessary for proper maintenance and operation of the stand-by generator and its accessories. Include a listing of recommended spare parts.

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SECTION 16230 - ENGINE RADIATOR AIRFLOW COOLED LOAD BANK

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, appurtenances and incidentals to install complete an engine radiator airflow cooled resistive load bank as a permanent on site component of the standby engine generator system.

1.02 RELATED WORK

- A. Electrical work is specified under Division 16.
- B. Stand-by generator unit is specified under Division 16.
- C. Louver assembly specified under Division 15.

1.03 SUBMITTALS

A. Submit to the engineer for approval six (6) complete sets of shop drawings, schematics, and wiring diagrams which show in detail the load bank and its installation and connections to the work of other sections. Included with this submittal shall be foundation drawings showing location and size of foundation bolts (if any), flange connections to the duct work, and six (6) complete operating and maintenance manuals and parts list.

1.04 WARRANTY

A. The complete Load Bank including control panel shall be warranted for a period of two (2) years from the date of final acceptance of the unit by the Owner after the unit has satisfactorily passed the on-site performance testing. The warranty shall be all inclusive of all labor, parts, travel costs, etc. for the repair. Multiple warranties for individual components (load banks, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided prior to the installation of the equipment. This warranty shall be a written document certified by the company. In the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

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SECTION 16230 - PART I

1.05 SUBSTITUTE EQUIPMENT

A. Equipment has been selected to meet performance requirements and the space limitations allowed within the building structure. All equipment furnished shall be equal in every way to that specified herein, including quality, operation, function and size. If alternate equipment is substituted, the Contractor shall be totally responsible for all changes to the proposed and/or existing facilities and additional construction/engineering costs made necessary for installation of equipment other than that specified. The substitute equipment shall cause no additional cost to the Owner or his Engineer, and the Contractor shall verify all work with the equipment manufacturer. A complete set of shop drawings, diagrams, and details shall be prepared specifically showing how the substitute equipment fits with the project specifications/layouts. Standard and typical drawings will not be acceptable.

PART II - PRODUCTS

2.01 GENERAL

A. The generator load bank shall be a factory assembled unit, specifically designed and equipped to function as a component of a stand-by engine generator system. The load bank shall be a completely, self-contained unit for mounting in the radiator air stream. The unit shall include all resistive load elements, load control devices, protective devices and fasteners.

B. The load bank and its controller shall be the product of a single manufacturer, to create one source of supply and responsibility.

C. The unit shall be compatible to the stand-by generator and shall not effect or degrade the cooling compatibilities of the generator system.

2.02 LOAD BANK DESIGN/RATING

A. The load bank shall be completely self-contained unit for mounting in the radiator air stream. It shall include all resistive load elements, load control devices, load element branch circuit fuse protection, main load bus and terminals, control terminals, system protection devices NEMA 1 enclosure for indoor units and a control cabinet.

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B. The unit shall be rated at ___ kw; _____ volts at a 0.8 power factor; 3 phase; 60 Hertz and shall have the capability to step load in four (4) equal increments up to 80% of the set output.

C. The power source to the unit shall be 3 phase, 3 wire plus a ground. Additional control wire connections shall be provided as described herein or as recommended by the manufacturer.

D. The NEMA Type 1 enclosure shall be galvanized steel, unit construction, consisting of a power section, for installation and wiring of the load elements and a control section for installation and wiring of control components. The control sections shall be physically and thermally isolated from both the hot load elements and the heated airflow. Mounting adapters suitable for this installation method shall be supplied with the load bank.

E. The load elements shall be UL listed, labeled or recognized, totally enclosed, sealed and weatherproof with an electrically grounded outer sheath such that the element can not be electrically short circuited by external foreign objects and personnel are protected against accidental electrical shock. Elements shall be individually replaceable. Open wire type elements in which the electrically live conductors are exposed and which can be short circuited to each other or to ground by foreign objects or by the breakage of an element or an element support shall not be permitted. All resistive elements shall be made of corrosion resistant wire.

F. Branch circuit fuse protection for each load branch circuit (maximum of 50 kW) shall be provided. The fuses shall be 200,000 A.I.C. current limiting type. One magnetic contractor shall be supplied for each fused branch circuit for load control.

G. Load bank power wiring shall be 150° C insulated. The main terminals shall be barrier type power terminal block with compression type terminals to accept stranded building wire. Provide chassis ground stud with compression type terminal.

H. Control wiring shall be 105° C insulated. Control power shall be derived internally from the main load bus. Control and protective circuits shall operate at 120V via control power transfer or line neutral circuit and shall be fused.

I. The load bank shall include a comprehensive protection system to protect against overheating. An over temperature sensor shall be mounted in the top of the core. The system shall function to disconnect the load elements from the power source and activate an

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alarm upon sensing a loss of cooling airflow, or an exhaust air temperature greater than 300° F.

2.03 CONTROL PANEL

A. A NEMA 1 control panel for manual operation shall be supplied and it shall be wall mounted and located in the control room as shown on the contract drawings. The complete panel shall include the following features:

1. Control power on-off push buttons.
2. Normal operation indicator lamp (LED Type).
3. Master load control switch.
4. Load step control switches.
5. Cooling failure alarm indicator lamp (LED Type) with contact for remote indication alarm.
6. Kilowatt Meter (digital)
7. Volt Meter (digital)
8. Frequency Meter
9. Utility Power Failure Interlock

2.04 LOAD BANK SUPPORT

A. Adjustable mounting feet and floor anchors shall be supplied to provide base support for the in-line load bank assemble. The mounting feet shall be supplied by the manufacturer of the load bank.

2.05 ACCEPTABLE MANUFACTURERS

A. The load bank shall be a product of a firm regularly engaged in the design and manufacture of generator load banks. The manufacturer shall demonstrate at least ten (10) years experience with successful installations of load banks similar or equal to the load bank specified herein.

B. The load bank shall be a Simplex LBD Series as manufactured by Simplex, Inc., or a Model 711K as manufactured by Avtron Manufacturing Inc. or equal.

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SECTION 16230 - PART III

PART III - EXECUTION

3.01 INSTALLATION

A. The contractor shall complete all preparatory work required to accommodate the load bank assembly. The sheet metal air duct shall be prepared in accordance with the manufacturer's recommendations.

B. The load bank shall be installed within the air duct between the flex transition section to the radiator and air outlet in the wall. A solid sheet metal section of duct work with a maintenance hatches shall be installed at both ends of the load bank assembly.

C. Flange ends of the unit and duct work shall be designed and installed to make a solid, complete, rigid unit in the air stream of the standby generator set.

D. Once the load bank is positioned, the contractor shall install the adjustable mounting feet and secure to the floor.

E. The installation of the unit shall be accomplished in a professional manner by qualified personnel regularly engaged in the experienced in this type of work. The contractor shall maintain the services of the manufacturer to assist with the installation and testing of the equipment. The Electrical Contractor shall wire the Utility Power Failure Interlock between the load bank control and the transfer switch utility power failure contacts.

F. The manufacturer's factory representative will be required to inspect the completed load bank to insure proper installation. If a problem is detected, the Contractor shall quickly correct the situation as directed.

G. The completed installation of the system shall comply with NFPA 110, the National Electrical Code, and New York State Uniform Fire Prevention and Building Code.

3.02 FINAL TESTING

A. After the installation of all equipment has been completed, the contractor shall complete a preliminary system test of the unit with a representative of the manufacturer present. The purpose of the test is to fine tune and adjust the equipment. As soon as conditions permit, the unit shall be subject to a final acceptance test under actual operating conditions. The unit shall be tested with

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the stand-by generator at the full range of loads. All testing shall be witnessed by the Engineer.

B. The manufacturer's service representative shall be present during the field test.

C. All expenses for conducting a satisfactory field test shall be paid by the Contractor.

3.03 SPARE PARTS/TOOLS

A. The Contractor shall furnish and deliver to the Owner the following spare parts:

1. Two branch circuit fuses.
2. Specialty tools recommended by the manufacturer for regular maintenance and minor repairs of the unit.

3.04 TRAINING

A. The equipment manufacturer's representative shall provide, as part of this contract, a minimum of three (3) hours of system operation training to the Owner. The training will be provided at the load bank site and/or the designated District Facility.

3.05 INSTRUCTION MANUALS

A. The Contractor shall provide four (4) bound, printed copies, and two (2) copies in electronic form (CD-ROM, PDF Format) of an Operation and Maintenance Manual. The manual shall be inclusive of all pertinent data and drawings necessary for proper maintenance and operation of the load bank and its accessories.

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Subdivisions and Sanitary Sewer Extensions**

SECTION 16232 - FREE STANDING FORCED AIR COOLED LOAD BANK

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, appurtenances and incidentals to install complete a UL listed free standing forced air cooled resistive load bank as a permanent on site component of the standby engine generator system. The load bank shall be operated in remote, manual control.

1.02 RELATED WORK

- A. Electrical work is specified under Division 16.
- B. Stand-by generator unit is specified under Division 16.

1.03 SUBMITTALS

A. Submit to the engineer for approval six (6) complete sets of shop drawings, schematics, and wiring diagrams which show in detail the load bank and its installation and connections to the work of other sections. Included with this submittal shall be foundation drawings showing location and size of foundation bolts (if any), and six (6) complete operating and maintenance manuals and parts list.

1.04 WARRANTY

A. The complete Load Bank including control panel shall be warranted for a period of two (2) years from the date of final acceptance of the unit by the Owner after the unit has satisfactorily passed the on-site performance testing. The warranty shall be all inclusive of all labor, parts, travel costs, etc. for the repair. Multiple warranties for individual components (load banks, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided prior to the installation of the equipment. This warranty shall be a written document certified by the company. In the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

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1.05 SUBSTITUTE EQUIPMENT

A. Equipment has been selected to meet performance requirements and the space limitations allowed within the building site. All equipment furnished shall be equal in every way to that specified herein, including quality, operation, function and size. If alternate equipment is substituted, the Contractor shall be totally responsible for all changes to the proposed and/or existing facilities and additional construction/engineering costs made necessary for installation of equipment other than that specified. The substitute equipment shall cause no additional cost to the Owner or his Engineer, and the Contractor shall verify all work with the equipment manufacturer. A complete set of shop drawings, diagrams, and details shall be prepared specifically showing how the substitute equipment fits with the project specifications/layouts. Standard and typical drawings will not be acceptable.

PART II - PRODUCTS

2.01 GENERAL

A. The generator load bank shall be a factory assembled unit, specifically designed and equipped to function as a component of a stand-by engine generator system. The load bank shall be a completely, self-contained unit for mounting outdoors on a concrete pad. The unit shall include all resistive load elements, load control devices, protective devices and fasteners.

B. The load bank and its controller(s) shall be the product of a single manufacturer, to create one source of supply and responsibility.

C. The unit shall be compatible to the stand-by generator and shall not effect or degrade the cooling compatibilities of the generator system.

2.02 LOAD BANK DESIGN/RATING

A. The load bank shall be completely self-contained unit for mounting outdoors on a concrete pad. It shall include all resistive load elements, load control devices, load element branch circuit fuse protection, main load bus and terminals, control terminals, system protection devices NEMA 3R enclosure for outdoor units and a control cabinet(s).

B. The unit shall be rated at ___ kw;
___volts at a 0.8 power factor; 3 phase; 60 Hertz and shall have the capability to step load in four (4) equal increments up to

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80% of the generator output.

C. The power source to the unit shall be 3 phase, 3 wire plus a ground. Additional control wire connections shall be provided as described herein or as recommended by the manufacturer.

D. The NEMA Type 3R enclosure shall be of double wall, unit construction for cool exterior and thermal isolation of the load elements. Cooling airflow through the load bank shall be vertical with intake at the bottom and heated air exiting the top. All air openings to be screened. All interior areas shall be accessible by lockable, hinged doors. Bolt-on panels are not permitted. The enclosure shall be painted with UL listed industrial enamel and process. The load bank enclosure shall include forklift channel and lifting eyes.

E. The load elements shall be UL listed, labeled or recognized, totally enclosed, sealed and weatherproof with an electrically grounded outer sheath such that the element can not be electrically short circuited by external foreign objects and personnel are protected against accidental electrical shock. Elements shall be individually replaceable. Open wire type elements in which the electrically live conductors are exposed and which can be short circuited to each other or to ground by foreign objects or by the breakage of an element or an element support shall not be permitted. All resistive elements shall be made of corrosion resistant wire. Materials in direct contact with the element wire shall be ceramic, installed upon and supported by stainless steel structures. Plastics, glass reinforced plastics and flammable materials are not permitted within the enclosure.

F. Branch circuit fuse protection for each step (maximum of 50 kW) of a load branch circuit shall be provided. The fuses shall be 200,000 A.I.C. current limiting type, extremely fast acting rated at 600 volts. One magnetic contractor shall be supplied for each fused branch circuit for load control.

G. Load bank power wiring shall be 150° C insulated. The main terminals shall be barrier type power terminal block with compression type terminals to accept stranded building wire. Provide chassis ground stud with compression type terminal.

H. Control wiring shall be 105° C insulated. Control power shall be derived internally from the main load bus. Load control and fan motor control circuits shall operate at 120V and control logic at 24 volts via control power isolation SECTION

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transformers which shall be fused with 100,000 AIC, 600 volt rated, current limiting fuses.

I. The forced air cooling system shall use a motor drive propeller fan. Motor shall be a TEFC, 1800 RPM maximum and controlled by a circuit breaker combination motor starter. Provide cooling fan start-stop controls.

J. The load bank shall include a comprehensive protection system to protect against overheating and provide load bank enable/disable permissive circuit and alarms. Protective systems to include: cooling air intake temperature switch set at 120°F, adjustable exhaust air temperature switch set no more than 75°F above the maximum rated temperature rise. The system shall function to disconnect the load elements from the power source and activate an alarm upon sensing a loss of cooling airflow.

K. The control system shall include a Utility Power Fail Interlock circuit to trip the load bank off-line.

2.03 CONTROL PANEL

A. A NEMA 3R rated control panel shall be provided and mounted to the outdoor load bank enclosure. It shall allow load bank operation and control from the outdoor location or be able to select control function from the remote location within the control building.

B. A NEMA 1 control panel for manual operation shall be supplied and it shall be wall mounted and located in the control room as shown on the contract drawings. The complete panel shall include the following features:

1. Control power on-off push buttons.
2. Normal operation indicator lamp (LED Type).
3. Master load control switch.
4. Load step control switches.
5. Fan control switches
6. Cooling failure alarm indicator lamp (LED Type) with contact for remote indication alarm.
7. Kilowatt Meter (digital)
8. Volt Meter (digital)
9. Frequency Meter
10. Utility Power Failure Interlock

2.04 ACCEPTABLE MANUFACTURERS

A. The load bank shall be a product of a firm regularly engaged in the design and manufacture of generator load

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banks. The manufacturer shall demonstrate at least ten (10) years experience with successful installations of load banks similar or equal to the load bank specified herein.

B. The load bank shall be a Simplex LBS Series as manufactured by Simplex, Inc., or a Model LSH as manufactured by Avtron Manufacturing Inc. or equal.

SECTION 16232 PART III - EXECUTION

3.01 INSTALLATION

A. The contractor shall complete all preparatory work required to accommodate the load bank assembly.

B. The load bank shall be installed outdoors as shown on the plans. The unit shall be mounted on a concrete base pad which is constructed with a minimum of one (1) foot above the finished elevation of the location

C. Power and control conduit runs shall be installed underground and in the mounting pad to fully protect and conceal all wiring.

D. The installation of the unit shall be accomplished in a professional manner by qualified personnel regularly engaged in the experienced in this type of work. The contractor shall maintain the services of the manufacturer to assist with the installation and testing of the equipment.

E. The Electrical Contractor shall wire the Utility Power Failure Interlock between the load bank control and the transfer switch utility power failure contacts.

F. The manufacturer's factory representative will be required to inspect the completed load bank to insure proper installation. If a problem is detected, the Contractor shall quickly correct the situation as directed.

G. The completed installation of the system shall comply with NFPA 110, the National Electrical Code, and New York Sate Uniform Fire Prevention and Building Code.

3.02 FINAL TESTING

A. After the installation of all equipment has been completed, the contractor shall complete a preliminary system test of the unit with a representative of the manufacturer present. The purpose of the test is to fine tune and adjust the equipment. As soon as conditions permit, the unit shall be

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subject to a final acceptance test under actual operating conditions. The unit shall be tested with the stand-by generator at the full range of loads. All testing shall be witnessed by the Engineer.

B. The manufacturer's service representative shall be present during the field test.

C. All expenses for conducting a satisfactory field test shall be paid by the Contractor.

3.03 SPARE PARTS/TOOLS

A. The Contractor shall furnish and deliver to the Owner the following spare parts:

1. Two branch circuit fuses.
2. Specialty tools recommended by the manufacturer for regular maintenance and minor repairs of the unit.

3.04 TRAINING

A. The equipment manufacturer's representative shall provide, as part of this contract, a minimum of Three (3) hours of system operations and maintenance training to the Owner. The training will be provided at the load bank site and/or the designated District Facility.

3.05 INSTRUCTION MANUALS

A. The Contractor shall provide four (4) printed, bound copies, and two (2) copies in electronic form (CD-ROM, PDF Format) of an Operation and Maintenance Manual. The manual shall be inclusive of all pertinent data and drawings necessary for proper maintenance and operation of the load bank and its accessories.

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SECTION 16260 - AUTOMATIC TRANSFER EQUIPMENT

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, appurtenances and incidentals to install complete a _____ AMP, _____ Volt, 3 Phase, _____ Wire, automatic transfer/by-pass isolation switch complete with all accessories as described herein. The unit shall be installed in the control room as indicated on the contract drawings.

1.02 RELATED WORK

- A. Electrical work is specified under Division 16.
- B. Standby generator is specified under Division 16.
- C. Power control center is specified under Division 16.

1.03 SUBMITTALS

A. Submit to the Engineer for approval six (6) complete sets of shop drawings, schematics and wiring diagrams which shall show, in detail, the transfer/by-pass isolation switch and installation of the same to the work of other sections.

1.04 QUALIFICATIONS

A. The entire automatic transfer/by-pass isolation switch shall be the product of a single manufacturer, to create one source of supply and responsibility for warranty.

B. A qualifying manufacturer is one who has been regularly engaged in the production of such equipment for the past twenty years. The automatic transfer/by-pass isolation switch described herein, including all components shall be factory built, factory tested, and shipped by this single manufacturer.

C. The unit manufacturer shall provide support services to the Contractor during the construction contract. An accredited factory trained technician shall supervise and offer

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assistance to the Contractor during the installation and testing of the equipment and accessories. Upon completion of final testing and acceptance of the equipment, a qualified representative of the manufacturer shall be present to train personnel designated by the Owner in the proper maintenance and operation of this equipment. A minimum of four (4) hours shall be allowed for this training. Further, the qualified manufacturer shall have a local representative who can provide factory trained service personnel, replacement parts, and technical assistance.

D. The transfer/by-pass isolation switch shall be the standard product as modified by these specifications, of a manufacturer regularly engaged in the production of this type of equipment. The unit to be furnished shall be a standard production model of proven ability and shall be designed, constructed, and installed in accordance with best practices and methods.

E. The unit must be of such physical dimensions as to make a good installation in the opinion of the Engineer, in the space provided and/or as indicated on the Drawings.

1.05 WARRANTY

A. The complete automatic transfer/by-pass isolation switch shall be warranted for a period of two (2) years from the date of final acceptance of the unit by the Owner after the unit has satisfactorily passed the on-site performance testing. The warranty shall be all inclusive of all labor, parts, travel costs, etc. for the repair. Multiple warranties for individual components will not be acceptable. Satisfactory warranty documents must be provided prior to the installation of the equipment. This warranty shall be a written document certified by the company. In the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

1.06 SUBSTITUTE EQUIPMENT

A. All equipment furnished shall be equal in every way to that specified herein, including quality, operation, function and size. If alternate equipment is substituted, the

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Contractor shall be responsible for all changes to the proposed and/or existing facilities and additional construction/engineering costs made necessary for installation. The substitute equipment shall cause no additional cost of the Owner or his Engineer, and the Contractor shall verify all work with the equipment manufacturer. A complete set of shop drawings, diagrams, and details shall be prepared specifically showing how the substitute equipment fits with the project specifications/layouts. Standard and typical drawings will not be acceptable.

PART II - PRODUCTS

2.01 GENERAL

A. The automatic transfer/by-pass isolation switch shall form an integral part of the standby power generating and distribution system. It shall be arranged such that it will automatically supply essentially continuous power to the designated loads from either the commercial power source or the on-site stand-by generator. The switch shall be rated _____ amperes, 3 phase, _ wire, _ pole, _____ volts, 60 Hz.

B. Both units shall be mounted in a free standing enclosure and bussed together with copper bus to provide a complete and pre-tested assembly. Aluminum bus and/or cable interconnections are not acceptable. Construction shall be such that the contractor need install only the power and control connections.

C. An indoor, ventilated NEMA 1 enclosure with key locked door shall house the transfer and by/pass isolation switches and other control components. The indicating lamps and meters shall mount on the front to be visible without opening doors. Enclosure shall be suitable for floor mounting.

D. The completed unit must meet the requirements of the following regulatory agencies:

1. NFPA 76A: Essential Electrical Systems for Health Care Facilities
2. NFPA 101: Life Safety Code
3. NFPA 110: Standard for Emergency and Standby Power Systems
4. UL 1008: Standard for Safety
5. National Electrical Code (Current Edition)

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2.02 AUTOMATIC TRANSFER SWITCH

A. The transfer switch shall be double throw, actuated by two electrical operators momentarily energize, and connected to the electrical operator by a simple over center type linkage with a minimum transfer time of 400 milliseconds. The transfer switch shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.

B. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneously closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets or springs and shall be silver-tungsten alloy. Separate arcing contact, with magnetic blowouts, shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contractors are not acceptable.

C. The transfer switch shall be equipped with a safe manual operator, permanently attached to the motor operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

D. The transfer switch manual operator shall be capable of manually operating the switch with the door closed.

E. Control components and wiring shall be front accessible. All control wires shall be multiconductor 18 gauge, 600 volt SIS switchboard type point to point harness. All control wire terminations shall be marked with tubular sleeve-type markers.

F. Access to the Bus Connections shall be either through a side panel or front top mounted panel. The main contacts shall be capable of being replaced without major disassembly of the transfer switch.

G. The Automatic Transfer Switch shall be provided with the following control system:

1. A microprocessor based control system shall provide all operational functions of the automatic transfer switch.
2. Provide control with two asynchronous serial

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ports. Two asynchronous serial ports. The controller shall have a real time clock with NiCad battery backup.

3. The Central Processing Unit (CPU) shall be equipped with self diagnostics for periodic checks of memory, I/O, and communications circuits with a watchdog/power fail circuit.
4. The controller shall use standard open architecture communications protocol to allow connection to other controllers or SCADA systems. Interface port shall be RS422/485 compatible.
5. The controller shall be password protected to limit access to qualified personnel
6. The controller display shall be a twenty character, liquid crystal display, with keypad to allow system access.
7. The controller shall include three phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.

G. The transfer switch shall be equipped to provide the following sequence of operation:

1. When the voltage of the normal source drops below 80% or increases to 120% on any phase, or the frequency drops below 90%, or increases to 110%, or 20% voltage differential between phases occurs after an adjustable time delay of 0 to 9999 seconds, factory set at three seconds, to allow for momentary dips, the engine starting contacts shall close to start the generating plant.
2. The transfer switch shall transfer to emergency when the generating plant has reached 90% of rated voltage and frequency. Provide a time delay to control contact transition time on transfer to either source, adjustable 1-225 seconds, factory set at 3 seconds.

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3. After restoration of normal power on all phases to 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source. Provide a switch operator to bypass time delay.
4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds, to allow for cool down before shut-off.

H. The following accessories are to be mounted in the transfer switch enclosures:

1. A keypad initiated test shall be included to simulate a normal power failure for test operation of stand-by plant and transfer switch.
2. Two auxiliary contacts rated 10 amperes, 120 volts, shall be mounted on the main shaft, one closed on normal, the other closed on emergency, both contacts will be wired to a terminal strip for ease of customer connections.
3. Two sets of relay contacts shall be provided to open upon loss of the normal power supply and one set of relay contacts shall be provided to close upon loss of normal power supply.
4. Provide green pilot light to indicate switch in normal position. (commercial power)
5. Provide red pilot light to indicate switch in emergency position. (stand-by power)
6. Provide programmable exerciser to automatically exercise generating plant. Adjustable type with minimum of one minute increments with keypad ability to select "No

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Load" (switch will not transfer) or "Load"
(switch will transfer) exercise period.

7. Provisions to manually transfer loads in case of automatic failure.
8. Provide two sets of normally open dry contacts to indicate a utility power failure. This contact shall be connected to the Alarm system, and Load Bank Controls.
9. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 3 seconds.
10. All pilot lights will be light emitting diode (L.E.D.) Type, Extra Bright Display.

2.03 BYPASS/ISOLATION SWITCH

A. The bypass/isolation switches shall provide a safe and convenient means for manually bypassing and isolating the automatic transfer switch (ATS), regardless of the condition or position of the ATS, with the ability to be used as an emergency back-up system in the event the transfer switch should fail. In addition, the bypass/isolation switch shall be utilized to facilitate maintenance and repair of the automatic transfer switch. The automatic transfer switch shall be completely isolated from the bypass/isolation switch by means of insulating barriers and separate access doors to positively prevent hazard to operating personnel while servicing the automatic transfer switch.

B. Operation of the bypass/isolation switch shall be assured, regardless of the position of the automatic transfer switch.

C. Indicating lights (LED) shall be provided to show the bypass/isolation in bypass position, in fully isolated position, and to indicate source availability.

D. Positive sequencing of all contacts, with no possible intermediate position, shall be accomplished through the manual operators from a dead front location. Electrical testing during maintenance of the automatic transfer switch shall be possible in the bypass position.

E. Inherent double throw (break-before-make) operation shall provide positive assurance against accidental short circuitry of the normal and emergency power sources.

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Arrangements utilizing interlocking of single-throw devices are not acceptable. The operating speed of the contacts shall be independent of the speed at which the handle is moved.

F. The switch shall be manually operated and shall not be dependent upon electrical operators, relays, or interlocks for operation. Manual operation will occur when the door is closed (EMO).

G. The bypass/isolation switch shall be listed by Underwriters Laboratories, Inc., Standard UL-1008, and meet the identical withstand ratings of its associated transfer switch.

H. Both the automatic transfer switch and bypass/isolation switch shall be supplied by the same manufacturer.

I. Include required controls to ensure that the "engine run" circuit remains closed when the switch is in the bypass-to-emergency position, regardless if the associated transfer switch is in the "Normal" position or completely removed from the enclosure.

2.04 ACCEPTABLE MANUFACTURER

A. The automatic transfer/by-pass isolation switch shall be a product of a firm regularly engaged in the design and manufacturer of such equipment. The manufacturer shall demonstrate at least twenty (20) years experience with successful installations of similar or equal to the automatic transfer/by-pass isolation switch specified herein.

B. The automatic transfer/by-pass isolation switch shall be a Russelectric, or equal.

PART III - EXECUTION

3.01 INSTALLATION

A. The Contractor shall install a complete and fully operational automatic transfer/by-pass isolation switch as shown on the Contract Drawings complete with all fittings and conduit and in complete accordance with manufacturer's instructions.

B. Provide required wiring from transfer switch to telemetry system junction box and generator set control panel.

3.02 FINAL TESTING

A. After the installation of all equipment has been

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completed, the Contractor shall complete a preliminary system test of the unit with a representative of the manufacturer present. The purpose of the test is to fine tune and adjust the equipment. As soon as conditions permit, the unit shall be subject to a final acceptance test under actual operating conditions. A service representative from the manufacturer shall be present during the final testing and all tests shall be witnessed by the Engineer.

B. The transfer/by-pass isolation switch shall be tested in conjunction with the on-site standby generator system for a period of not less than four hours to insure a complete working system providing the following functions:

1. Upon power line outage, automatically start the standby plant and when the plant comes up to voltage, disconnect the load from the utility source and transfer it to the standby generator's output.
2. Upon power line return transfer the load back to the utility source and stop the generator.
3. All timers shall be tested using the settings specified by the Engineer for operation of the transfer switch as it is intended to be used.

C. All expenses for conducting a satisfactory field test shall be paid by the Contractor.

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3.03 TRAINING

A. The equipment manufacturer's representative shall provide, as part of this contract, a minimum of four (4) hours of system operation training to the Owner. The training will be provided at the transfer switch site and/or the designated District facility.

3.04 INSTRUCTION MANUALS

A. The Contractor shall provide four (4) hard copies of an Operation and Maintenance Manual, plus two copies in electronic format (CD ROM). The manuals shall be inclusive of all pertinent data and drawings necessary for proper maintenance and operation of the stand-by generator and its accessories.

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SECTION 16400 - SERVICE AND METERING

PART I - GENERAL

1.01 SCOPE OF WORK

A. Electrical power will be supplied by the local electric utility company at _____ volts, 3 phase, 4 wire, 60 Hertz.

The Contractor shall furnish and install, as shown on the plans, a _____ inch plastic coated conduit(s) underground from the electric utility company pole structure to the service building electrical main disconnect.

The Contractor shall furnish and install four #____, stranded copper wire, Type RHH (Vulkene) USE with 600 volt insulation from the service pole to the main breaker through an outdoor Power Company meter cabinet as shown on the drawings. The service wires at the pole shall be terminated as specified by the power company, leaving sufficient wire for their connections, including drip loop.

B. With utility services with direct metering (200 A or less), install a non-fused disconnect in circuit before the meter socket and main breaker, as shown on the plans. Disconnect shall be rated for service equal to or greater than the Main Breaker. Main circuit breaker shall be ____ A, 3 P, solid neutral, ____ volt thermal magnetic molded case type in NEMA I enclosure. Minimum interrupting rating shall be _____ RMS symmetrical amperes at _____ volts.

C. The Contractor shall furnish and install all equipment, wiring and connections required for a complete and ready-to-operate electric power service in full compliance with the requirements of the electric utility serving the project.

D. All work shall be in accordance with the standards, requirements and practices of the local power company serving this installation and shall be subject to its supervision, inspection and approval prior to acceptance by the Owner. All costs incurred for installation of the service shall be paid by the Contractor.

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SECTION 16411 - UNDERGROUND SYSTEM

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install a complete underground system of conduits all as hereinafter specified and shown on the Drawings.

PART II - PRODUCTS

2.01 MATERIALS

A. All underground conduit and fittings (if not concrete encased) shall be PVC coated galvanized conduit as specified under Section 16110. Where encasement is required, heavy-walled(Schedule 80) PVC conduit may be used.

PART III - EXECUTION

3.01 INSTALLATION

A. The minimum cover for duct lines shall be 24 inches unless otherwise permitted by the Engineer in writing.

B. Over each buried electric conduit, the contractor shall provide and place a 3 inch wide plastic tracer tape (with wire). The tape shall be bright red in color and shall be labeled "Caution-Buried Electric Line Below". The tape shall be placed 6 inches below grade and splices where needed shall be made in accordance with the manufacturer's recommendation.

C. At completion of the project, and before final payment, the Contractor shall test the entire length of the pipe using pipe location equipment. Test shall be made only in the presence of the Engineer. Any section of tape which is not continuous or is undetectable shall be removed and re-laid.

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SECTION 16450 - GROUNDING SYSTEM

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install a complete grounding system in strict accordance with Article 250 of the National Electrical Code and as hereinafter specified and shown on the Drawings.

1.02 MATERIAL SPECIFIED ELSEWHERE

A. Wire shall be as specified under Section 16120 WIRES AND CABLES.

B. Conduit shall be as specified under Section 16110 RACEWAYS AND FITTINGS.

PART II - PRODUCTS

2.01 MATERIALS

A. Ground Rods

1. Ground rods shall be copper clad steel with sizes as shown on the Drawings. Ground rods shall be Copperweld, Anaconda or equal.

PART III - EXECUTION

3.01 INSTALLATION

A. Entrance circuit breaker neutral bus shall be grounded to two 8'-0" x 3/4" Copperweld ground rods.

B. Equipment grounding conductors shall be run with the phase conductors.

C. Liquid tight flexible metal conduit in sizes 1-1/2 in. and larger shall have bonding jumpers.

D. Ground rods shall be Copperweld, Anaconda or equal. Sizes shall be as shown on the Drawings.

E. Grounding electrodes shall be driven as required. Where rock is encountered, grounding plates may be used in lieu of grounding rods.

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F. Grounding plates shall be of copper, 1/4-in. x 24-in. x 24-in.

G. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and similar items shall be grounded.

H. Exposed connections shall be made by means of approved grounding clamps. Exposed connections between different metals shall be sealed with No-Oxide Paint Grade A, or equal. All buried connections shall be made by welding process equal to Cadweld or Thermo-weld, or Engineer approved compression type connections.

I. All underground conductors shall be laid slack and where exposed to mechanical injury, shall be protected by pipes or other substantial guards. If guards are iron pipe or other magnetic material, conductors shall be electrically connected to both ends of the guard. Connections shall be made as specified previously.

J. The Contractor shall exercise care to insure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.

3.02 TESTS

A. The Contractor shall test the ground resistance of the system. All test equipment shall be provided by the Contractor and approved by the Engineer. Dry season resistance of the system shall not exceed five ohms. If such resistance cannot be obtained with the system as shown, the Contractor shall provide additional grounding as directed by the Engineer, without additional payment.

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SECTION 16500 - LIGHTING SYSTEM

PART I - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish and install complete lighting systems including panelboards, lighting fixtures, receptacles, switches, and all necessary accessories and appurtenances, required as hereinafter specified and shown on the Drawings.

1.02 MATERIAL SPECIFIED ELSEWHERE

A. Panelboards shall be as specified under Section 16134.

B. Conduit shall be as specified under Section 16110.

C. Wire shall be as specified under Section 16120.

1.03 STANDARDS

A. All lighting fixtures shall be in accordance with the current edition of the National Electrical Code and shall be constructed in accordance with the latest edition of the Underwriters Laboratories "Standards for Safety, Electric Lighting Fixtures." All lighting fixtures shall be Underwriters Laboratories labeled.

PART II - PRODUCTS

2.01 MATERIALS

A. Switches

1. Wall switches shall be of the indicating, toggle action, flush mounting type rated 20A at 120/277 volts, back/side wired. All switches shall conform to FSUL - WS896 and UL20.

2. Wall switches shall be of the following types and manufacturer or equivalent.

a. Single pole - Pass & Seymour #PS20AC1-CSL, Hubbell #HBL1221ILC, or equal.

b. Double pole - Pass & Seymour, Catalog No. PS20AC2-RED, Hubbell #HBL1222P2, or equal.

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c. Three way - Pass & Seymour, Catalog No. PS20AC3-CSL, Hubbell #HBL1223ILC, or equal.

d. Four way - Pass & Seymour, Catalog No. PS20AC4-RED, Hubbell #HBL1224R, or equal.

3. Explosion-proof switches shall be 20 Amp, 125 volt mounted in a Crouse-Hinds Co. Type EFS enclosure, Killark Type XS, or equal.

4. Weatherproof switches shall be 20-A, 125 volt mounted in a type FS box with gasketed cover, Crouse-Hinds Cat. No. DS128, Killark Type F ST, or equal.

B. Receptacle

1. Wall receptacles shall be of the following types, manufacturer or equivalent.

a. Duplex, 20A, 125V, 2P, 3W, grounding type; Arrow, Hart & Hegeman, Catalog No. 5739, General Electric #GE-4108, Hubbell #5362, or equal.

b. Weatherproof, 20A, 125V, 2P, 3W; General Electric #4108 with #9226-5 W.P. cover, Hubbell #5362 with #5205 W.P. cover, or equal. Where FS condulets are used, use General Electric #5206 cast aluminum cover or Crouse-Hinds #WLRD-1 cover.

c. Explosion-proof, 20A, 125V, 3P, 2W; Crouse-Hinds, #CPS152-201, or equal. Furnish one Crouse-Hinds CPP512, or equal, for every two receptacles.

C. Device Plates

1. Plates for flush mounted devices shall be of the required number of gangs for the application involved and shall be 302 (18-8) high nickel stainless steel of the same manufacturer as the device.

D. Lighting Fixtures

1. Lighting fixture types shall be as listed below by letter designation and as shown on the Drawings. The catalog numbers listed are given as a guide to the design and quality of fixture desired. Equivalent designs and equal quality fixtures of other manufacturers will be acceptable. Letter designations on the Plans refer to fixture types in the following tabulation:

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- Type A Industrial fluorescent fixture with two 4', 40 watt, rapid start lamps, 10% upward component, porcelain enameled reflectors. Daybrite CFI-10 Cat . #40211-4, Benjamin Lite-Line #FL-1024-4U, or equal.
- Type B 70W high pressure sodium wallighter luminaire, grey finish with Lexan refractor, G.E. Type WL-100 Wallighter #C751N541 with photoelectric control , Spero #W74-70-LGWL-PCWL, or equal.
- Type C 150W incandescent lighting fixture with globe, Crouse-Hinds Type EVCX201, Killark, or equal.
- Type D 100W incandescent vaporproof lighting fixture with globe and guard, Crouse-Hinds Type VXHF25GP, or equal.

E. Lamps

1. Incandescent lamps shall be inside frosted, extended service, 2500 hour life.

2. All lamps shall be of one manufacturer and shall be as manufactured by Sylvania, General Electric, Philips, or equal.

3. Fluorescent lamps shall be energy-efficient type utilizing lite-white efficient phosphor combination to provide 3050 initial lumens at 34 nominal watts per lamp instead of standard 40 watt F40 CW lamp. Lamps to be #F40LW/RS, GE Watt-Miser II, or equal.

4. High pressure sodium vapor lamps shall be of wattage specified, for use with ANSI Specification, high pressure sodium ballasts, clear, universal burning, GE Lucalox, or equal meeting ANSI codes. 70 watt -#S62ME-70; 100 watt - #S54SB-100; 150 watt - #S55SC-150.

F. Ballasts

1. Fluorescent fixture lamp ballasts shall be energy-saving type usable with F40 lite-white energy-saving lamps. Ballast performance with such lamps shall be certified by a nationally-recognized independent testing laboratory.

Performance certification shall be conducted per ETL procedure B 20.2 in accordance with American National Standard C82.2 test methods. Ballast case temperature shall not exceed 90 degree C.

Ballasts shall be high power factor, U.L. listed, 120 volt, Class P, warranted for three years or more.

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2. Ballasts for high pressure sodium vapor fixtures shall be high power factor 120 volt, U.L. listed, reactor type, suitable for lamp specified, G.E., Westinghouse, or equal.

G. Flexible Fixture Hangers

1. Flexible fixture hangers used in non-hazardous areas shall be type ARB and flexible fixture supports used in hazardous areas shall be type BC as manufactured by the Crouse-Hinds Co., equivalent by Appleton Electric Co., or equal.

PART III - EXECUTION

3.01 INSTALLATION

A. Each fixture shall be a completely finished unit with all components, mounting and/or hanging devices necessary, for the proper installation of the particular fixture in its designated location and shall be completely wired ready for connection to the branch circuit wires at the outlet.

B. When fixtures are noted to be installed flush, they shall be complete with the proper accessories for installing in the particular ceiling involved. All flush mounted fixtures shall be supported from the structure and shall

not be dependent on the hung ceilings for their support.

C. Flexible fixture hangers shall be used for all pendent mounted fixtures.

3.02 REPLACEMENT

A. Lamps used during the building construction, prior to two weeks from completion of the work, shall be removed and replaced with new lamps.

3.03 CLEANING UP

A. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Engineer.

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SECTION 16720 - ALARM ANNUNCIATOR SYSTEM

PART I - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install a system to send alarms to an annunciator in control room and relay it to a designated Treatment Plant via Radio Telemetry.

1.02 DESCRIPTION OF SYSTEM

A. The following typical conditions are to be monitored. Specific conditions are covered under Section 16800, and listed on the plans

1. Valve chamber flood
2. Pump #1 fail
3. Pump #2 fail
4. Wet well high
5. Wet well low
6. Intrusion
7. Smoke detector
8. Generator Alarm
9. Utility power fail.

A signal from any of the above will light its annunciator nameplate and close a re-transmit relay that will be used to transmit a trouble signal to a designated Treatment Plant via telemetry.

PART II - PRODUCTS

2.01 ANNUNCIATOR

A. Features

1. Inputs

Supply annunciator with inputs for field devices that can provide input from either normally open or normally closed, wetted (voltage supplied) or dry (voltage free), contacts. Input selection shall be accomplished by software or hardware. Inputs shall be optically isolated with an adjustable response time from 50 to 250 milliseconds. Field contact voltage shall be jumper selectable from 12, 24, 48, 125 VDC or 120 VAC.

2. Display

White light, replaceable Light Emitting

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Diodes (LED) will be supplied with unit, minimum of two lamps per window. Window size shall be half height at 1.5 x 3.0 inches. Window color shall be manufacturers' standard color, Owner selected for alarm priority, laser printed transparency or engraved window legends.

3. Alarm Sequence

Alarm sequence will be software selectable with dual color sequences, customized flash rates, and up to four first out groups, if specified. The primary sequence will cause the annunciator window to flash until acknowledged at which time the light will remain on. If the alarm clears, the light will automatically reset.

4. Controls

Annunciator shall provide integral test, acknowledge, silence, and reset with LED status lights. Configurable switch and external push button inputs.

5. Outputs

Provide auxiliary relays which are software configurable in a normally open contact to re-transmit alarms for the purpose of telemetry. Common relays are to be provided which can be software configured for critical alarms and local audio devices. Provide an internal 80db audio device for local alarm notification.

6. Communication

Provide configurable communications for serial Modbus, DNP3.0, OPC Server, and serial ASCII formats.

7. Connections

Fixed barrier terminal blocks for 12 GA wiring maximum, ring, spade, or bare wire termination. Include communications ports for Serial and Ethernet connections.

8. Mechanical

Semi-flush mounting in a NEMA 1 wall mounted cabinet with sufficient room to include components for intrusion system.

9. Power Requirement

Annunciator shall be powered by a separate circuit from panelboard - 120 VAC.

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SECTION 16720 - PART II

B. Acceptable Manufacturers

1. The manufacturer of the annunciator shall provide a complete working system and demonstrate that they have been engaged in manufacturing annunciator systems for a minimum of ten (10) years.

2. System to be manufactured by Ametek Power Instruments, Panalarm Model 90A, or approved equal.

2.02 FLOOD ALARM

Provide in areas specified, a conductive level sensing system, B/W Controls or equal. Relay to be B/W Series 5400 to be installed within the NEMA I annunciator enclosure. B/W Controls Type D shielded stainless steel electrodes shall be suspended from a Type FR56 holder. Electrode rods shall be installed to provide a maximum of two inches of level before alarming with holder installed a minimum of twelve (12) inches above finished floor.

2.03 SMOKE DETECTOR

The smoke detectors shall have the following features:

- a. Dual-technology photoelectric and ionization principles shall provide early warning fire detection.
- b. Reference chamber shall automatically adjust for atmospheric pressure, temperature and humidity changes.
- c. Automatic reset upon clearing of smoke from chamber.
- d. Push-to-test disc.
- e. One hundred percent solid state circuitry.
- f. Shall mount onto most standard j-boxes.
- g. Contacts rated 5A, 120V.
- h. Detection equipment shall be as manufactured by Kidde, Model PI2100 , or equal.

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2.03 UNAUTHORIZED ENTRY

Provide tamper proof switches at doors and connect as shown in schematics on the Plans, with door key switch to de-energize system so authorized personnel can enter without causing alarm. Key switch locks are to be mounted in NEMA 4 enclosure with security hardware to prevent easy removal of cover. All locks to be keyed alike using District specified interchangeable core. Stations to be Square D Class 9001 Type KY-197, or equal. Relays to be Square D Class 850 Type C, or equal. Provide replaceable LED (Light Emitting Diode) pilot light at each key switch location to indicate unauthorized entry system has been turned off. Light to be illuminated when alarm system is by-passed. Pilot light to be red indicating light in NEMA 4 enclosure. Alarm components are to be installed in annunciator enclosure with alarm output connected to annunciator system.

PART III - EXECUTION

3.01 INSTALLATION

A. The alarm system shall be installed complete and tested to the Owner's satisfaction before acceptance. The Electrical Contractor will provide all interface equipment required to connect the Radio Telemetry equipment specified in Section 16800.

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SECTION 16800 - RADIO TELEMETRY SYSTEM

PART I - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish and install all materials, equipment, structures, and incidentals, and perform all work, required to complete, tune, optimize and place into satisfactory operation, the Radio Telemetry System as shown and specified. The Radio Telemetry System shall transmit remote pumping station status, alarm signals, and data to the designated Treatment Plant where the information shall be received, displayed and printed. The Radio Telemetry System shall also transmit interrogation information, data, and system modifications from the designated Treatment Plant to each of the remote sites in its' prospective area to initiate status and alarm reports. Work under this section includes, electrical installation, excavation and backfill, concrete, structural, site restoration and other work required to furnish a complete installation. Excavated areas shall be reseeded or replanted as required. Wall penetrations shall be completely patched and sealed, and shall be finished to match existing finish on both sides. All work shall conform to the requirements of the applicable Specification sections.

1.02 RELATED WORK

- A. Division 2, Excavation and Backfilling
- B. Division 2, Landscaping
- C. Division 16, Electrical Work

1.03 INTENT

A. The Contract Drawings show the principal elements of the installation; however, they are not intended as detailed working drawings, but as a complement to the Specifications to clarify the principal features of the Radio Telemetry System.

B. It is the intent of this section that all equipment and devices furnished and installed under this and other sections be properly connected and interconnected with other equipment so as to render the installation complete for successful operation regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Contract Drawings.

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C. The Contractor under this Section shall assume complete unit responsibility for the installation of the radio telemetry equipment and appurtenances, which shall include mast, antenna, transmission cables, power supply, control wiring, dry contacts, and etc.

D. The conduit and cable sites and quantity, equipment dimension and components are approximate. The Contractor shall provide sizes and quantities required for equipment furnished.

E. The cost of the Radio Telemetry equipment and the path study are included in Appendix " " .

1.04 Quality Assurance

A. Requirements of Regulatory Agencies:

1. Codes: All material and equipment shall be installed in conformance with the standards of the National Electrical Code, and any local codes which may apply. In case of conflicts, the most restrictive code shall apply.
2. Permits: The Contractor shall obtain all permits required to commence work, and upon completion of the work, shall obtain any permits necessary to place the system in full operation.
3. Regulations: All material, antenna, mast(s), transmitters and receiving equipment shall be installed in conformance to the Rules and Regulations of the Federal Communication Commission Part 90, Part 0, Part 1, Part 2 and Part 17 and the requirements of the FAA.
4. Tests by Independent Regulatory Agencies:
 - a. Electrical material and equipment shall be new and shall bear the label of the Underwriters Laboratory, Inc., wherever standards have been established and label service regularly applies.

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- b. Radio equipment shall be of the type listed in the FCC's current "Radio Equipment List, Equipment Suitable for Licensing."
- B. Equipment Manufacturers Services: Retain a factory-trained manufacturer's representative with demonstrated ability and experience in installation and operation of the specific radio telemetry equipment. The representative shall perform the following services.
1. Check the installation of his equipment for compliance with the manufacturer's recommendation.
 2. Test and calibrate all components of the telemetry system.
 3. Inspect the complete installation and within 10 days prepare an inspection report to be sent to the Engineer. Items to be addressed in the report are as follows:
 - a. List of deficiencies found
 - b. Recommended corrective action for all deficiencies
 - c. Certification that the equipment is properly installed and adjusted except as noted.
 4. Review and approve all applicable shop drawings prior to submission. The approval shall be identified by a special stamp and signature on the submittal.

1.05 SUBMITTALS

A. SHOP DRAWINGS

1. Submit for all electrical materials and radio equipment, including masts and if required, towers showing proposed methods of installation.

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2. Shop drawing shall include manufacturer's literature, specifications, wiring diagrams and all engineering data necessary to fully describe electrical and electronic equipment and materials and to substantiate compliance with the Specifications and include the following:
 - a. Complete block diagram of Radio Telemetry System showing all components at all locations.
 - b. Actual location of in place conduit and cable routing with number and size of conductors.
 - c. Control wiring diagram with terminal numbers and all control devices identified.
 - d. List of pertinent transmitter and receiver data, including RF output power, operating frequency, power consumption and requirements, and antenna type and characteristics.
3. As part of the shop drawing submittal, the contractor shall include a copy of the required path study.

B. RECORD DRAWINGS

Prepare and submit comprehensive record drawings for principal radio telemetry work performed under this section. Submit for approval prior to final submission. Final submission shall be in accordance with final contract record drawing requirements.

1.06 PRODUCT DELIVERY STORAGE AND HANDLING

A. Delivery of Materials: Contractor shall check with manufacturers and vendors as to the physical sizes of equipment to ensure that it will fit into spaces assigned and shall instruct manufacturers and vendors as to the maximum shipping sizes of equipment.

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B. Storage and Handling of Material: Conform to the requirements of General Contract Condition 50, "Storage and Handling of Materials".

1.07 JOB CONDITIONS

A. The Contractor shall examine the site with respect to the condition of the premises, location of and/or connection to existing facilities and any obstructions which may be encountered. The Contractor shall immediately report any different conditions or obstructions, which may affect the work, to the Engineer. This shall be done prior to ordering any materials or preparing shop drawings.

1.08 GUARANTEE

A. In addition to the manufacturer's standard guarantee, the Contractor shall include the services of qualified factory-trained servicemen to correct all defects due to faulty product design, calibration, materials or workmanship commencing with the time the equipment is placed in operation and extending throughout the Guarantee period stated in the General Conditions.

PART II - PRODUCTS

2.01 RADIO REMOTE STATION STATUS UNITS

A. Install a Motorola MOSCAD status and control unit, Model No. F6973.

B. Status units to be complete with power supply to receive 120 volt AC, rectified to a DC voltage, and nickel-cadmium battery which will provide 8 hours standby operation. Battery power pack shall automatically operate the status unit when input power fails. A power fail signal shall be transmitted to the central control unit whenever incoming power fails.

C. The remote terminal unit (RTU) is to be an intelligent, modular unit capable of both data acquisition and local data processing. It is able to monitor and control local equipment in a stand alone mode as well as being an intelligent node in a distributed processing system. It will be microprocessor based to allow reconfiguration and optimization to occur via software only. Input/Output (I/O) modules are connected to a basic processor module by plugging them into the

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motherboard on the RTU rack to facilitate changes and future expansion.

A personal computer is to be used for program development and for download either directly to the RTU or through the systems communication channel(s). Each RTU's database will be merged into a single Central System database to automate the definition of the Central.

The RTU must be supplied with the number of type of I/O points as indicated elsewhere in the plans and specifications. Future expansion may be made by simply plugging in additional I/O modules to the I/O bus on the motherboard. Each RTU must be supplied with the following minimum configuration:

- | | |
|-------------------------|----------------------------|
| A. Mother Board | E. Power Supply |
| B. I/O Box | F. Battery |
| C. Enclosure | G. I/O Modules Required |
| D. CPU Processor Module | H. Communication Interface |

D. Units shall have capacity to handle a minimum of 16 digital status points (surge protected), 8 analog inputs, and 16 control outputs. Status points shall correspond in paragraph 3.04 of this section. Actual capacity of I/O, analog, and control shall be determined by the specific Contract and shown on the plans.

E. Status unit is to also include a six-slot panel, one CPU Module, an 8 AMP a.c. operated power supply, nickel-cadmium battery, open door switch, 20-watt Motorola two-way radio with lightning protection.

When indicated on the status point table, certain unused analog transmitting circuits shall be utilized to transmit status conditions with voice capability. This will be accomplished through use of a resistor/relay circuit with a set point indicating "on" or "off: positions or status transmission to central station. This circuit will be designed and incorporated into remote status unit by Motorola where required.

Provide a schematic diagram for this circuit with values of components used so the Owner can convert other spare analog circuits to status if desired in the future.

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Installation contractor will make use of shielded wire from contact points to status and control units, and keep dry status contact points isolated from high potential or high current circuits as much as practicable. Motorola, or their authorized representative, shall install filter/MOV protective circuits where necessary to eliminate false induced signals.

2.02 ENCLOSURES

A. Inside Mounting

Housing for status unit is to be NEMA 4

B. Outside Mounting

Housing is to be large enough to include one status unit in a NEMA 3R weatherproof Stainless Steel, Type 316 cabinet with hasp for padlocks. Include protective rainshield around NEMA 3R cabinet made of fabricated 316 stainless steel as additional weather protection. All mounting/locking hardware shall be stainless steel.

2.03 REMOTE STATIONS ANTENNAS

Remote station antennas are to be single YAGI type, six element construction with a minimum gain of 9.5 db for frequency range 155-165 MHz. Manufactured by Andrew Corporation, Model DB292-B, or equal.

2.04 CONDUCTORS

A. RF coaxial conductors shall be furnished and installed at all sites for connection between antennas and radio transceivers. All conductors shall be furnished and installed with approved straps, Neoprene termination housing, Type N cable terminations and hardware required for a completely secure system. Maximum pulling tensions, as recommended by the manufacturer, shall be strictly adhered to. Splicing of RF cable shall not be permitted. Lightning Arrestor shall be furnished and installed following equipment manufacturers recommendations.

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B. Type:

RF Coaxial Cable at the remote sites shall have the following characteristics:

- Antenna cable will be standard coax with total run under 100 feet. Antenna cable runs in excess of 100 feet will use low loss Heliac cable.
- Cable Diameter - 1/2 inch
- Impedance - 50 ohms at 174 MHZ
- Inner Conductor - copper
- Outer Conductor - copper (corrugated)
- Jacketing - Polyethylene (black)
- Dielectric - Foam polyethylene
- Maximum Attenuation - 0.8dB/200 ft. @ 174 MHz (VSWR=1)
- Minimum Bending Radius - 5 inches or less
- Power Rating - 1 KW @ 174 MHZ

C. RF cables shall be:

1. L1702-50 by Motorola Communications, Inc. or equal.

PART III - EXECUTION

3.01 INSTALLATION

A. GENERAL

1. Install as shown on the drawings and shop drawings and as directed by the manufacturer's representative.
2. Install and fasten all antenna and remote site equipment in accordance with the radio equipment supplier's recommendations. Provide all brackets, fasteners, clamps,

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nuts and bolts to ensure a complete, weatherproof, and secure installation. All devices used to secure the system components shall be stainless or approved corrosion resistant devices.

3. A Motorola Authorized Technician shall connect all wires to the radio telemetry system. Contractor shall supply and install all required conduit and wire.
4. Manufacturer or his designee, shall make all modifications necessary in the designated base station computer software to accept all required data to display all alarms, and additional required information. Contractor shall include this cost in his bid.

B. GROUNDING

1. Ground remote site mast by installing ground rods as required to provide a resistance to ground of 5 ohms or less.
2. Equipment Grounding: Ground all electrical equipment and provide lightning protection in compliance with the National Electric Code.
 - a. Connect ground conductors to conduit with copper clamps straps with ground bushing.
 - b. Connect to piping by welding or brazing
 - c. Connect to equipment by means of lug compressed on cable end. Bolt lug to equipment frame with silicon bronze hardware. Use hole or terminals provided on equipment specifically for grounding. Do not use holddown bolts. Where ground-water provisions are not included, drill suitable holes, and provide lugs.

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3.02 INSPECTION TESTING AND ADJUSTMENTS

A. Inspections: Accompany the installation tests with inspections to demonstrate the following:

1. Connections: All circuits are properly connected in accordance with the drawings and applicable shop drawings.
2. Operation: All circuits and devices are operable.
3. Identification: All conductors are properly identified at each terminal.

B. OPERATION TESTS

1. Operate all switches, equipment and devices to demonstrate suitability and compliance with Specifications and reference standards, except for short circuit interrupting rating or other inherent design features covered by shop tests.
2. Test each electrical system after permanent cables are in place to demonstrate that all circuits and equipment perform satisfactorily and that they are free from improper grounds and short circuits.
3. Check control circuits to determine that operation and sequence are correct and adjust limit switches, pressure switches, float switches, timers and other devices to give proper operation.

C. CABLE TESTS

1. Individually test all 600 volt service cables for insulation resistance between phases and from each phase to ground. Test after cables are installed and before they are put in service with a Megger whose rating is suitable for the tested circuit. Such tests shall meet with the applicable specifications of IPCEA and NEMA.

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2. The insulation resistance for any given conductor shall not be less than the value recommended by the IPCEA or a minimum of megohm for 600 volt and less service if not IPCEA listed. Replace any cable not meeting the recommended value or which fails when tested under full load conditions, with a new cable for the full length.
3. Test all RF cables for shorts, opens, VSWR, insulation resistance and leakage at operating frequencies. Certified copies of all cable tests shall be submitted to the District prior to acceptance. Any defective cables shall be replaced with a new full length.
4. Make all adjustments required to place the radio telemetry system in proper operation.
 - a. Indoor Installations
 - 1) Install MOSCAD unit in an area to allow service to the unit.
 - 2) Terminate all monitored points in a separate junction box with marked wiring on a terminal strip.
 - 3) Antenna lead will be installed in rigid metal conduit from mast to within three feet of MOSCAD unit.

B. ANTENNA INSTALLATION

1. The antenna height shall conform to the height determined by the required path study provided in Appendix D.
2. Antenna mast(s) are to be one piece round, tapered aluminum anchor base pole. A specially manufactured tenon will be supplied for the mast to mount the antenna and lightning rod. Tenon length will be 18 inches long and 2 3/8 inch O.D. Mast to be a series RTA with special T20 tenon, medium bronze painted, complete with all hardware, anchor bolts, templates and covers.

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Manufacturer will be Lithona Hi-Tek or approved equal. Concrete base will include a minimum 1 inch conduit, centered in the base for antenna cable run. Base to be constructed following pole manufacturers recommendation. Concrete base will extend a minimum of one foot above the finished surface elevation.

3. Antenna must be installed as to clear nearby buildings, and as a minimum, must be high enough as not to allow persons to touch the antenna elements while standing on the ground.
4. All antenna masts will utilize a lightning rod installation with rod being attached to the tenon at highest point of mast. Grounding will meet current requirements of the National Electrical Code.
5. Minimize any sharp bends in antenna cable - sharp bends will damage antenna conductors.
6. Use a weatherhead device at the top of the tenon to protect antenna cable.
7. Maintain a minimum of ten-foot separation between antenna and any power or telephone cables.
8. The Contractor shall be responsible for providing a suitable foundation for the telemetry antenna.
9. The Contractor shall install the cable from the antenna to the remote terminal unit.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. 120 volt, 60 Hz power required
- B. Separate circuit breaker for the Radio Telemetry unit.
- C. All wiring color coded and marked.

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- D. All MOSCAD digital inputs must be "dry contact". Isolate inputs from control/power wiring as much as possible.
- E. "As-built" installation drawings included with final O&M submittal.
- F. Each installation will be tested by an authorized Motorola Service representative.
- G. Supply a two year written guarantee for each installation. All guarantees to commence upon acceptance by Erie County.
- H. Supply two (2) hard copies and one (1) electronic form (CD ROM) of all O&M manuals for all equipment provided. Manuals to be turned over to Erie County upon acceptance by the County.

3.04 TYPICAL MONITORING REQUIREMENTS

A. PUMP STATION: Based on individual requirements and station complexity, may include some, all, and/or not limited to the following digital monitoring points.

- 1. MOSCAD Unit Open
- 2. Level Controller PLC Fail
- 3. Valve Control System Fault
- 4. Low Wetwell
- 5. High Wetwell (from Level Control)
- 6. High Wetwell Float (Separate/Redundant)
- 7. Comminutor Fault
- 8. Pump No. X Run
- 9. Pump No. X Failure
- 10. Pump No. X High Bearing Temp
- 11. Pump No. X Check Valve Failure
- 12. Pump No. X Seal Failure
- 13. Pump Motor No. X High Winding Temp
- 14. VFD No. X Fault
- 15. VFD No. X Bypass Fault
- 16. Gas Detected
- 17. Fire Detected
- 18. Unauthorized Entry
- 19. High Pump Station Temp

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20. Low Pump Station Temp
21. Drywell/Chamber Flood
22. Flow Control PLC Failure
23. Utility Power Failure
24. Standby Generator Run
25. Standby Generator Fail
26. Transfer Switch - Normal
27. Transfer Switch - Emergency

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SECTION 16810 - CELLULAR TELEMETRY SYSTEM

PART I - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish and install all materials, equipment, structures, and incidentals, and perform all work, required to complete, tune, optimize and place into satisfactory operation, the Cellular Telemetry System as shown and specified. The Cellular Telemetry System shall transmit remote pumping station status, alarm signals, and data utilizing data networks available from common cellular providers to an Internet website where the information shall be received. The Cellular Telemetry System shall also receive interrogation information, data, and system modifications from the same website to each of the remote sites to initiate status and alarm reports. Work under this section includes, electrical installation, excavation and backfill, concrete, structural, site restoration and other work required to furnish a complete installation. Wall penetrations shall be completely patched and sealed, and shall be finished to match existing finish on both sides. All work shall conform to the requirements of the applicable Specification sections.

1.02 RELATED WORK

- A. Division 2, Excavation and Backfilling
- B. Division 2, Landscaping
- C. Division 16, Electrical Work

1.03 INTENT

A. The Contract Drawings show the principal elements of the installation; however, they are not intended as detailed working drawings, but as a complement to the Specifications to clarify the principal features of the Cellular Telemetry System.

B. It is the intent of this section that all equipment and devices furnished and installed under this and other sections be properly connected and interconnected with other equipment so as to render the installation complete for successful operation regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Contract Drawings.

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C. The Contractor under this Section shall assume complete unit responsibility for the installation of the cellular telemetry equipment and appurtenances, which shall include mast, antenna, transmission cables, power supply, control wiring, dry contacts, and etc.

D. The conduit and cable sites and quantity, equipment dimension and components are approximate. The Contractor shall provide sizes and quantities required for equipment furnished.

E. The cost of the Cellular Telemetry equipment is included in Appendix " " .

1.04 Quality Assurance

A. Requirements of Regulatory Agencies:

1. Codes: All material and equipment shall be installed in conformance with the standards of the National Electrical Code, and any local codes which may apply. In case of conflicts, the most restrictive code shall apply.
2. Permits: The Contractor shall obtain all permits required to commence work, and upon completion of the work, shall obtain any permits necessary to place the system in full operation.
3. Regulations: All material, antenna, mast(s), transmitters and receiving equipment shall be installed in conformance to the Rules and Regulations of the Federal Communication Commission Part 90, Part O, Part 1, Part 2 and Part 17 and the requirements of the FAA.
4. Tests by Independent Regulatory Agencies:
 - a. Electrical material and equipment shall be new and shall bear the label of the Underwriters Laboratory, Inc., wherever standards have been established and

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label service regularly applies.

- b. Radio equipment shall be of the type listed in the FCC's current "Radio Equipment List, Equipment Suitable for Licensing."

B. Equipment Manufacturers Services: Retain a factory-trained manufacturer's representative with demonstrated ability and experience in installation and operation of the specific cellular telemetry equipment. The representative shall perform the following services.

1. Check the installation of his equipment for compliance with the manufacturer's recommendation.
2. Test and calibrate all components of the telemetry system.
3. Inspect the complete installation and within 10 days and prepare an inspection report to be sent to the Engineer. Items to be addressed in the report are as follows:
 - a. List of deficiencies found
 - b. Recommended corrective action for all deficiencies
 - c. Certification that the equipment is properly installed and adjusted except as noted.
4. Review and approve all applicable shop drawings prior to submission. The approval shall be identified by a special stamp and signature on the submittal.

1.05 SUBMITTALS

A. SHOP DRAWINGS

1. Submit for all electrical materials and radio equipment, including masts and if required, towers showing proposed methods of installation.

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SECTION 16810 - PART I

2. Shop drawing shall include manufacturer's literature, specifications, wiring diagrams and all engineering data necessary to fully describe electrical and electronic equipment and materials and to substantiate compliance with the Specifications and include the following:
 - b. Complete block diagram of Cellular Telemetry System showing all components at all locations.
 - b. Actual location of in place conduit and cable routing with number and size of conductors.
 - c. Control wiring diagram with terminal numbers and all control devices identified.
 - d. List of pertinent transmitter and receiver data, including RF output power, operating frequency, power consumption and requirements, and antenna type and characteristics.

B. RECORD DRAWINGS

Prepare and submit comprehensive record drawings for principal cellular telemetry work performed under this section. Submit for approval prior to final submission. Final submission shall be in accordance with final contract record drawing requirements. Refer to Section 16810, 3.03 H.

1.06 PRODUCT DELIVERY STORAGE AND HANDLING

A. Delivery of Materials: Contractor shall check with manufacturers and vendors as to the physical sizes of equipment to ensure that it will fit into spaces assigned and shall instruct manufacturers and vendors as to the maximum shipping sizes of equipment.

B. Storage and Handling of Material: Conform to the requirements of General Contract Condition 50, "Storage and Handling of Materials".

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1.07 JOB CONDITIONS

A. The Contractor shall examine the site with respect to the condition of the premises, location of and/or connection to existing facilities and any obstructions which may be encountered. The Contractor shall immediately report any different conditions or obstructions, which may affect the work, to the Engineer. This shall be done prior to ordering any materials or preparing shop drawings.

1.08 GUARANTEE

A. In addition to the manufacturer's standard guarantee, the Contractor shall include the services of qualified factory-trained servicemen to correct all defects due to faulty product design, calibration, materials or workmanship commencing with the time the equipment is placed in operation and extending throughout the Guarantee period stated in the General Conditions.

SECTION 16810 - PART II

PART II - PRODUCTS

2.01 CELLULAR REMOTE STATION STATUS UNITS

A. Install an OmniSite brand, "Crystal Ball", or approved equal, cellular telemetry unit as shown on the plans

B. Telemetry unit to be complete with power supply to receive 120 volt AC, rectified to a DC voltage, and nickel-cadmium battery which will provide 12 hours standby operation. Battery power pack shall automatically operate the status unit when input power fails.

C. The Cellular Telemetry Unit (CTU) is to be an intelligent, single unit capable of both data acquisition and local data processing. It is able to monitor and control local equipment. It will be microprocessor based to allow reconfiguration and optimization to occur via a secure website and/or by a secure local keypad. The CTU must be supplied with the number of type of I/O points as indicated elsewhere in the plans and specifications. Future expansion may be made by simply plugging in an additional input module to the bus on the motherboard. Each CTU must be supplied with the following minimum configuration:

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- | | |
|-------------------------|----------------------------|
| 1. Mother Board | 2. Power Supply |
| 3. Antenna | 4. Battery |
| 5. Enclosure | 6. I/O Terminations |
| 7. CPU Processor Module | 8. Communication Interface |

D. Units shall have capacity to handle a minimum of 14 universal inputs rated for use at 12 VDC or 120 VAC, 4 analog inputs isolated to 4KV, 2 dry contact pulse inputs rated from 0-30 Hz, and 4 control outputs, two of which shall be used to control two pumps minimum. Pump control shall be configured by both a 4-20 mA signal and/or floats wired into the system. Status points shall correspond in paragraph 3.04 of this section. Actual capacity of I/O, analog, and control shall be determined by the specific Contract and shown on the plans.

Installation contractor will make use of rigid conduit runs from contact points to the telemetry unit, and keep all input points isolated from high potential or high current circuits as much as practicable.

E. The control shall have a backlit, Vacuum Fluorescent Display, 4 line X 20 character to display controller information. An integral keypad will be included to locally program and retrieve information or parameters. A removable "Smart Key" will be provided to secure the device and prevent unauthorized/unidentified programming of the unit - provide one additional key with system.

F. Unit shall be equipped with a memory card slot for the purpose of updating and storing historical data. The memory card shall be able to store a minimum of one year of data. Historical reporting of runtime, on/off cycles, flow data, and drawdown for up to three pumps shall be included.

Reports and historical data stored in the Unit shall be downloadable to an Excel file format from the host website. The CTU shall update itself a minimum of twice daily through a scheduler, report system status, inflow report, daily average inflow, pump on/off cycles, drawdown time, and rainfall analysis with an optional rain gauge.

G. Provide the system with a RS232, RS485, and Ethernet port for future expansion.

H. The Cellular Telemetry Unit shall have the ability to provide the Owner with the following options: Video, rain gauge, current sensors (0-200 Amperes minimum), a 4-20 mA hydrostatic level transmitter, and solar power system when used in a stand alone location.

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2.02 ENCLOSURES

A. Housing for status unit is to be a weatherproof NEMA 4X, polycarbonate enclosure suitable for outdoor mounting. Enclosure shall be lockable with stainless steel hardware to secure unit.

2.03 REMOTE STATIONS ANTENNAS

A. Remote station antenna shall be manufacturer's standard antenna designed and installed for cellular communications capability. Unit to include a ten (10) foot cable for remote mounting of the antenna, if required.

2.04 CELLULAR UNIT MONITORING

A. The Cellular unit shall communicate through existing commercial cellular systems and be programmable through a secure web site that is accessible from any internet connected computer.

B. The Cellular unit manufacturer shall host a secure web site used for monitoring the supplied CTU. This web site shall allow programming and monitoring of the remote CTU in the field. The monitoring and programming shall be accomplished without the use of additional software other than an Internet connected computer running Explorer 6 or greater.

C. Alarm status and notification shall be accomplished via a web browser logged onto the hosting site, E-mail notification, pager, and voice message from the hosting site. Notification methods shall be selected by the system Owner.

D. All costs of installation, activation and monthly monitoring shall be the responsibility of the Contractor. Monthly monitoring shall be provided for a minimum of three years after the successful activation of the CTU. List cost of Activation and Monthly Monitoring separately in the submittal.

PART III - EXECUTION

3.01 INSTALLATION

A. GENERAL

1. Install as shown on the drawings and shop drawings and as directed by the manufacturer's representative.
2. Install in accordance with the radio equipment supplier's recommendations.

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Provide all brackets, fasteners, clamps, nuts and bolts to ensure a complete, weatherproof, and secure installation. All devices used to secure the system components shall be stainless or approved corrosion resistant devices.

3. A manufacturer's authorized Technician shall connect all wires to the cellular telemetry system. Contractor shall supply and install all required conduit and wire. Contractor shall include this cost in his bid.

B. GROUNDING

1. Equipment Grounding: Ground all electrical equipment and provide lightning protection in compliance with the National Electric Code.
 - b. Connect ground conductors to conduit with copper clamps straps with ground bushing.
 - b. Connect to piping by welding or brazing
 - c. Connect to equipment by means of lug compressed on cable end. Bolt lug to equipment frame with silicon bronze hardware. Use hole or terminals provided on equipment specifically for grounding. Do not use holddown bolts. Where ground-water provisions are not included, drill suitable holes, and provide lugs.

3.02 INSPECTION TESTING AND ADJUSTMENTS

A. Inspections: Accompany the installation tests with inspections to demonstrate the following:

1. Connections: All circuits are properly connected in accordance with the drawings and applicable shop drawings.
2. Operation: All circuits and devices are operable.
3. Identification: All conductors are properly identified at each terminal.

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SECTION 16810 - 3.02

B. OPERATION TESTS

1. Operate all switches, equipment and devices to demonstrate suitability and compliance with Specifications and reference standards, except for short circuit interrupting rating or other inherent design features covered by shop tests.
2. Test each electrical system after permanent cables are in place to demonstrate that all circuits and equipment perform satisfactorily and that they are free from improper grounds and short circuits.
3. Check control circuits to determine that operation and sequence are correct and adjust limit switches, pressure switches, float switches, timers and other devices to give proper operation.
4. Make all adjustments required to place the radio telemetry system in proper operation.
 - a) Install telemetry unit in an area to allow service to the unit.
 - b) Terminate all monitored points in a separate junction box with marked wiring on a terminal strip.

C. ANTENNA INSTALLATION

1. The antenna installation shall be made to the manufacturer's recommendation to assure the efficient transfer of data to and from the cellular system.
2. Minimize any sharp bends in antenna cable - sharp bends will damage antenna conductors.
3. Maintain a minimum of ten-foot separation between antenna and any power or telephone cables.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. 120 volt, 60 Hz power required
- B. Separate circuit breaker for the Cellular

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Telemetry unit.

- C. All wiring color coded and marked.
- D. All inputs must be either 12 VDC or 120VAC. Isolate inputs from control/power wiring as much as possible.
- E. "As-built" installation drawings included with final O&M submittal.
- F. Each installation will be tested by an authorized manufacturer's representative.
- G. Supply a Three (3) year written guarantee for each installation. All guarantees to commence upon acceptance by Erie County.
- H. Supply two (2) bound, hard copies, and one copy in electronic format of all as-build drawings and O&M manuals for all equipment provided. Electronic format shall be CD ROM, PDF format, Maximum 8x speed. Manuals to be turned over to Erie County upon acceptance by the County.

3.04 TYPICAL MONITORING REQUIREMENTS

A. PUMP STATION: Based on individual requirements and station complexity, may include some, all, and/or not limited to the following digital monitoring points.

- 1. Telemetry Unit Open
- 2. Level Controller PLC Fail
- 3. Valve Control System Fault
- 4. Low Wetwell
- 5. High Wetwell (from Level Control)
- 6. High Wetwell Float (Separate/Redundant)
- 7. Comminutor Fault
- 8. Pump No. X Run
- 9. Pump No. X Failure
- 10. Pump No. X High Bearing Temp
- 11. Pump No. X Check Valve Failure
- 12. Pump No. X Seal Failure
- 13. Pump Motor No. X High Winding Temp
- 14. VFD No. X Fault
- 15. VFD No. X Bypass Fault
- 16. Gas Detected
- 17. Fire Detected

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18. Unauthorized Entry
19. High Pump Station Temp
20. Low Pump Station Temp
21. Drywell/Chamber Flood
22. Flow Control PLC Failure
23. Utility Power Failure
24. Standby Generator Run
25. Standby Generator Fail
26. Transfer Switch - Normal
27. Transfer Switch - Emergency

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