

STANDARD SPECIFICATIONS FOR
CONSTRUCTING SANITARY SEWER FACILITIES
DIVISION III - CONSTRUCTION SPECIFICATIONS

SECTION 6

GENERAL SPECIFICATIONS FOR SEWAGE PUMPING STATION

6.01 SCOPE:

These Specifications form a part of the Contract Documents and shall govern for the construction of sewage pumping stations. The Work covered by this Section includes the furnishing of all labor, equipment, and materials, and performing all operations in connection with the construction and installation of Sewage Pumping Stations complete with pumps, piping, wet well, electrical work and all necessary auxiliary equipment. The station shall be complete and in strict accordance with this section of the specifications and the applicable plans, the standard practices and ordinances of the Utilities Board of the City of Daphne, Alabama, and subject to the terms and conditions of the Contract. Sewage pumping stations shall be designed to remain fully operational and accessible during a one hundred (100) year flood event. Refer to appendix for standard drawings and details.

Where variable speed pumping is specified, all additional considerations relative thereto shall be provided including but not limited to pumps, controls, buildings, shelters, and accessories. Referenced standard drawings are intended to reflect single speed pumping and shall be considered only as a general guide where variable pumping is specified.

6.02 MATERIALS:

Only PVC or Stainless Steel shall be used in wet wells.

6.03 INTENT OF PLANS AND SPECIFICATIONS:

The intent of the plans and specifications associated with this Section is to provide a completed sewage pumping station which will function as intended and is ready for operation in accordance with the Utilities Board of the City of Daphne's standard practices.

The Contractor understands the operation of a sewage pump station and its appurtenances. Therefore, it shall be the responsibility of the Contractor as a part of this Work through careful quality control and coordination with the Engineer to avoid all conflicts occurring during construction such as available space, routings, mismatched or otherwise incompatible component selection, incomplete systems, substitutions, etc.

Where inter-system components, devices, adapters, etc. are not specified or noted in the design, but required to complete the system, it shall be the responsibility of the Contractor to provide such items and material as a part of this Work.

Unless otherwise noted, items specified herein by manufacturer or trade name shall be used as a guide to quality and inherent features and compatibility with existing systems.

Special drawings and specifications shall be submitted by the Contractor for the Engineer's evaluation covering all equipment, controls, material, and construction procedures.

The plans and specifications included herein reflect single speed pumping. Where variable speed pumping is specified, all additional requirements associated therewith shall be met by the Contractor. Special drawings and specifications shall be submitted by the Contractor for the Engineer's evaluation covering all equipment, controls, material, and construction procedures for variable speed pumping.

The actual field installation shall reflect only that material and equipment submitted and approved by the Engineer. Any work performed without an approved submittal and considered not acceptable by the Engineer shall be removed and reworked at the Contractor's expense.

6.04 SUBMITTALS AND TESTS:

A. Submittals:

Prior to installation of any material or equipment, the Contractor shall submit for approval of the Engineer, five sets of required submittal material indicating item identification, manufacturer, type, size, ratings, and other descriptive information required for adequate evaluation. Pumps submittals should include Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSH), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

Submittal drawings shall provide layout of mechanical equipment and anchor bolt locations for station. Contractor piping connections and station access clearances shall be dimensioned relative to the station centerline. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system. Wiring diagrams shall be submitted where item function description necessitates, and as required by the Engineer. Submittals shall be conspicuously marked to denote departures from the design references shown on the plans or specified. The Contractor shall be responsible for reimbursing the Engineer for redesign of other components to accommodate substantial materials or equipment. Incomplete submittals will not be evaluated.

Submittals shall bear a stamp or specific written indication that the Contractor has satisfied his responsibilities under the Contract with respect to the Contractor's review of the submission.

Omissions and/or design revisions made in submittals shall not relieve the Contractor from the responsibility of providing the omitted item or required material as a part of this Work. Approval by the Engineer shall not constitute acceptance of an erroneous or incomplete system submittal.

1. Material submittals shall be manufacturer's catalog sheets or similar published data marked to denote only the item or items covered by the submittal. Materials of unique production shall have special submittal attention to give complete identification of the materials being proposed.

2. Equipment submittals shall present the equipment for evaluation as a unit piece including all component parts by manufacturer's designation. Submittals shall be marked to denote only the equipment being proposed and shall be complete including electrical, physical, and operational data. Additional supporting data shall be provided where necessary.
3. Fabrications, assemblies, and special productions shall have submittals of unique preparation to present the finished item completely identified. Such shop drawings shall include all material, components and assembly work.
4. Systems composed of multiple component parts or subsystems shall have submittals to denote the system as a completed composite. All component parts and subsystems shall be identified.
5. Documentation of the finished installation shall be made as a part of final acceptance and shall include corrected submittals, operation and maintenance publications, and other data necessary to accurately define the final field installation.

B. Tests, Instructions and Reports:

The following listed items shall be required in addition to other special requirements within these Specifications.

1. Written conductor insulation resistance test.
2. Written ground rod resistance test.
3. Local public electrical inspector's certificate.
4. Operational demonstration test.
5. Certified pump curves.
6. Operation and maintenance manuals.

6.05 SITE WORK:

In general, clearing shall consist of the removal and disposal of all undergrowth, brush, logs, trash and other objectionable obstructions. All materials cleared from the site shall be disposed of off the site by the Contractor at no extra cost to the Owner. It is the intent that the entire area within the limits of the sewage pumping stations as shown on the plans shall be cleared, backfilled, and graded with four (4) inches of crushed stone surfacing for proper storm water drainage in accordance with the specifications contained herein. All areas surrounding the sewage pumping station shall be grassed with solid sod in accordance with Erosion Control section.

- A. Access Driveways: The Contractor shall include in the sewage pumping station construction a Bituminous Pavement Access Driveway including select backfill, eight (8) inches of crushed aggregate, and one and a half (1½) inches of Bituminous Wearing Surface Mix 416-A. These access driveways shall be constructed in accordance with the Alabama Department of Transportation Standard Specifications, latest edition.

- B. Fencing: The Contractor shall include in the sewage pumping station construction a six (6) foot high wood privacy fence. The wood privacy fence shall be constructed of first class wood to the lines indicated on the plans and shall include treated 4" x 4" wood posts set a minimum of 36 inches deep in the ground in concrete and spaced no greater than 8 feet on center, three (3) treated 2" x 4" wood stringers between each set of posts, treated number 2 pine or better 6" x 3/4" fence boards with dog eared tops, galvanized fasteners and hardware, 12 foot double leaf swing type heavy duty service traffic gate matching the fence, a pedestrian gate, and a brass weatherproof padlock (4-pin tumbler type, minimum) and keys.

With approval from the Owner, a chain link fence may be installed. The fence fabric shall be zinc-coated Class II steel chain link per ASTM A-392 with green coating, two inch mesh, number 9 gauge with three strands of galvanized barbed wire on 45 degree angle arms at top of galvanized steel line posts, of H Columns with nominal weight of not less than 4.1 pounds per foot. All corner, end, and pull posts shall be 2-7/8 inches OD (minimum) standard galvanized steel pipe or 3-1/2 inches by 3-1/2 inches rolled formed sections with integral fabric loops, 5.14 pounds minimum per foot. Corner posts shall be braced in both directions and gate posts shall be braced to the nearest line or corner post. Pipe posts shall have tops which exclude moisture. Top rails shall be a minimum of 1-1/4 inch (6.11 inch O.D.) standard weight galvanized steel pipe. Total height of fence shall be seven feet with the wire fabric being six feet. Spacing of posts shall be uniform and not exceed ten feet. Line posts shall be set in concrete bases 36 inches deep and ten inches in diameter, minimum. All corner, gate and brace posts shall be set in a foundation 36 inches deep minimum and 14 inches in diameter minimum. Traffic gate shall be double leaf swing type for a twelve foot opening. Both the travel gate and pedestrian gate shall be heavy duty service matching the fence. There shall be a furnished brass weatherproof padlock for the gate and keyed to match the Owner's system.

- C. Water Service: One (1) each 3/4" water service with hose bibb shall be located within the fenced area.
- D. Location and Orientation: Location and orientation of gates, hatches, control panels, and other appurtenances shall be field verified by the Utilities Board of the City of Daphne, Alabama prior to construction or installation regardless of the plans. Should the Contractor fail to verify the location and orientation of such items with the Utilities Board of the City of Daphne, he shall remove and relocate the item(s) at no additional expense to the Owner.

6.06 EXCAVATION FOR PIPES AND STRUCTURES:

- A. General: The Contractor shall perform excavation of every description regardless of the nature of the materials encountered. Trenches or foundations for pipes or structures shall be excavated to the lines, grades, and elevations shown on the plans. Trench and structure excavations shall be of sufficient size to permit the placing of pipes and forms.
- B. Overcuts: If at any point in excavating for structures, material is excavated beyond the neat lines upon or against which concrete is to be placed, the overcut shall be filled with reef shell, crushed slag or crushed stone fill properly compacted, or with concrete, as directed by the Engineer. The proposed elevations and positions for the different structures are shown on the plans. However, the Engineer reserves the right to make such modifications as in his opinion are necessary to carry out the intent of the plans or specifications. No payment will be made for overcuts or reef

shell, crushed slag or crushed stone fill in overcuts. Reef shell, crushed slag or crushed stone shall be as specified in the Board's Standard Specifications.

- C. Dewatering: The Contractor shall remove any water which may be found or may accumulate in the trenches and shall perform all work necessary to keep them clear of water while the foundations are being laid, the masonry being constructed, or pipe laying is in progress. Such removal shall be accomplished by means of a well point system or other approved means. Comprehensive plans for dewatering operations, if used, shall be submitted prior to installation. No extra payment will be made for dewatering.

6.07 CONCRETE:

The minimum compressive strength required at 28 days is 3,000 pounds per square inch. Field specimens and laboratory tests shall be made in accordance with the standards of the American Society of Testing Materials. The minimum amount of water shall be used to produce a workable mix and shall not exceed six U.S. gallons per sack of cement. Concrete and associated materials shall also be in accordance with those specified for manhole structures.

6.08 WET WELL:

The foundation of the wet well shall consist of a reinforced concrete slab poured on undisturbed earth in accordance with details shown on the plans.

The barrel of the wet well shall be constructed of sections of reinforced concrete pipe conforming to ASTM 3 Specification Designation C76, Class II. Concrete for pipe shall be Type II Portland Cement with 100 percent calcareous aggregate.

The diameter, height, opening and other details shall be as shown on the plans. Minimum diameter shall be eight feet.

Joints shall be made with rubber gaskets or an approved equal.

The wet well concrete interior shall be coated with a lining material in accordance with the manhole lining methods and products approved by the Utilities Board of the City of Daphne, Alabama. Lining shall be performed in accordance with the lining product manufacturer's recommendations.

An aluminum access hatch with safety grate as manufactured by Syracuse or Engineer approved equal shall be installed on all lift station wet wells.

6.09 PAINTING AND TOUCH-UP:

All electrical equipment, cabinets, and items shall require protective painting shall be painted in accordance with the item manufacturer's standards except that this shall not be less than a three-coat system suitable for the exposure intended in this Project. After installation, items including welded seams shall be thoroughly cleaned of grease, dirt, rust, and foreign matter and repainted or touched-up as required with the same color paint applied at the factory.

Unless otherwise approved by the Engineer, and in addition to the normal approval action, all items with carbon steel enclosures installed out-of-doors, in corrosive areas, or in wet or damp areas shall be thoroughly cleaned of surface films after installation and given one coat

of Indurall rapid-dry epoxy primer H-1175 and two final coats of Indurall two-part epoxy paint "Perma-Clean", or approved equal in color approved by the Engineer.

Painting of "Suction Lift" Station Building shall receive a minor one coat of exterior primer and two coats of high grade latex paint and the colors shall be selected by the Owner (Barber Post Stripped Color accent).

6.10 CONTINUITY OF OPERATIONS:

The Contractor, as a part of this work, shall provide all stand-by facilities, power systems, etc. in order to maintain the operations of existing facilities throughout the construction phases of the new work. The Contractor shall schedule his work with that of the Owner in order to coordinate all interruptions of the existing facilities operations to suit the Owner's schedule. All temporary facilities and provisions shall be made after being submitted to the Owner and approved thereby.

6.11 DEFINITION OF ACCEPTANCE:

System acceptance shall be defined as the point in time, in addition to the Contract requirements, when all of the following requirements have been fulfilled:

- A. All submittals and documentation have been submitted, reviewed and approved.
- B. Two (2) copies of all Operations and Maintenance Manuals shall have been submitted on all equipment items.
- C. The complete system has successfully completed all testing requirements.
- D. All fees, permits and reports have been satisfactorily completed.
- E. All Owner's staff personnel training programs have been completed.
- F. Beneficial use by the Owner has occurred following the two year warranty period.
- G. All warranty deeds/easements have been properly recorded.

6.12 CLEAN-UP:

After final operation tests, the interior and exterior of the station shall be cleared of all trash and debris and left in final operating condition. Final grading of the site and restoration of surfaces with grass shall be in strict accordance with the applicable drawings, standard specifications, and City of Daphne Public Works office.

6.13 GENERAL PUMP REQUIREMENTS

- A. Supplier's/Manufacturer's Services: The Contractor shall furnish the services of qualified technical personnel representing the manufacturer or group of manufacturers for each equipment grouping or system within the project, for checking the installation, making the necessary adjustments, placing the equipment in operation, and during acceptance tests. The representatives shall be available and scheduled with the Owner to instruct operating personnel in the use, operation, and maintenance of the equipment during the initial on-line operating period. All components and equipment shall be installed in accordance with the recommendations of the manufacturer.

Operating tests shall be performed by the manufacturer's representative on all equipment in the presence of the Owner and the Engineer or their representatives in order to demonstrate the entire facility to be complete, functional, and ready to be placed in operation.

Operating instructions shall be given to the Owner's regular operating personnel by the equipment manufacturer's representative where complex equipment is provided and by the Contractor for other equipment in order to thoroughly familiarize the operators in the correct procedures and functions for operating and maintaining the facility.

- B. Start-Up: The Contractor shall furnish the services of an engineer, representing the manufacturer or group of manufacturers for each equipment grouping or system within the Project, for checking the installation, making the necessary adjustments, placing the equipment in operation, and during acceptance tests. This includes the remote monitoring system and the computer system in the central control room. The representatives shall be available for no less than one 8-hour day scheduled with the Owner to instruct operating personnel in the use, operation, and maintenance of the equipment during the initial online operating period. All components and equipment shall be installed in accordance with the recommendations of the manufacturer.

Operating tests shall be made on all equipment in the presence of the Owner and the Engineer or their representatives in order to demonstrate the entire facility to be complete, functional and ready to be placed in operation.

Operating instructions shall be given to the Owner's regular operating personnel by the equipment manufacturer's representative where complete equipment is provided and by the Contractor for other equipment in order to thoroughly familiarize the operators in the correct procedures and functions for operating and maintaining the facility.

- C. Variable Speed Pumps:

1. Where a variable speed pump installation is provided, the pump manufacturer/supplier shall furnish the pumps and associated variable frequency controlling system as sole-source responsibility. The manufacturer/supplier shall provide a written guarantee for the pumps and controls as a single unit installation relative to materials quality and durability, system performance, and coordinated completeness of the overall system.
2. Performance curves for the variable speed pumps shall be submitted to show families of curves for the ranges of pressures, flows, and speeds anticipated at the specific location of the pumps within the hydraulic system.
3. Variable speed pumps shall include a manual switch to steady speed for when the pump dies.

- D. Pump Identification Plate: A 16 gauge stainless steel identification plate shall be securely mounted on each pump in a readily visible location. The plate shall bear

the ¼-inch die-stamped equipment identification number that is assigned each pump.

- E. Lifting Lugs: Equipment weighing over 100 pounds shall be provided with lifting lugs.
- F. Performance Tests: Prior to acceptance by Owner, the Contractor shall perform field tests on all completed pump and control system assemblies, as required by the Pump Specification Sheets, to demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is in safe and in optimum working condition, and conforms to the specifications to the satisfaction of the Engineer. A test log shall be presented to the Engineer upon the completion of each test that records the following:
 - 1. Flow, in gallons per minute.
 - 2. Pump discharge pressures as measured by calibrated gauges, converted to feet of the liquid pumped and corrected to pump datum as defined by Hydraulic Institute Standards, calculated velocity heads at the discharge flanges, and total head, all tabulated in feet.
 - 3. Applied voltage and amperage measured for each phase.
 - 4. Pump control and liquid level control.
 - 5. Complete nameplate data.
 - 6. Calibration of all instrumentation equipment.
 - 7. Testing of manual and automated control devices.
 - 8. Note any undue noise, vibrating or other operating problems.

6.14 GENERAL ELECTRIC REQUIREMENTS FOR PUMP STATIONS:

- A. Electric Power Metering The Contractor shall provide all labor and materials required for a complete installation to meter electrical power usage in accordance with the power company's detailed requirements. Meter location shall be as shown on the plans.

The Contractor, at his own expense, shall provide power and all necessary temporary wiring as required to perform his work. After completion of the permanent electrical connections, the Contractor shall be required as a part of this work to secure all utility services from the respective utility companies and shall pay all monthly bills until such time as acceptance of the equipment is made by the Owner.

Upon acceptance, the Contractor can have the respective utility companies transfer their billing to the Owner's name.

- B. Electrical Service: When required and as instructed by the Owner, the Contractor shall request three-phase power service from the utility company and shall make arrangements for the utility company to bill the Owner directly for any installation charges, other than those associated with power metering, for the service.

- C. Emergency Standby Power: New sewage pumping stations shall be equipped with emergency standby power either generator or bypass pumps as determined by the Utilities Board of the City of Daphne, Alabama for each site. Supervisory control and data acquisition (SCADA) systems in accordance with the SCADA systems currently in use by the Utilities Board of the City of Daphne sewer system for monitoring operating conditions of the pump station from remote sites shall be installed at new sewage pumping
- D. All electrical material and equipment provided by the Contractor shall be new and free of defects. All work performed under this section of the specifications shall be carried out by skilled workers regularly engaged in the performance of such duties. The entire electrical installation shall be not less than that required by the latest edition of the National Electrical Code, the Occupational Safety and Health Act, and all electrical codes locally enforced in the project area. The Contractor shall obtain all permits required by local ordinances and after completion of the work, shall give the Engineer a certificate of final inspection and approval from the local Electrical Inspection Office. Any expenses connected with such inspection and certificate shall be borne by the Contractor.

Electrical material and equipment shall be designed in accordance with the latest requirements of applicable standards such as NEMA, ANSI, IEEE, and where listings are available for such items, shall be approved by the Underwriters Laboratories, Inc. Equipment, components, material, etc., rated by other standards and agencies including but not limited to IEC, VDE, and DIN will not be considered equal to NEMA, ANSI, IEEE, and UL. Electrical items shall be standard cataloged products of manufacturers regularly engaged in the manufacture of such products, unless otherwise noted.

- E. Grounding:
1. Non-current carrying metal parts of electrical items such as cabinets, enclosures, frames, etc., and the neutral conductor shall be grounded in accordance with the National Electrical Code unless additional grounding requirements are indicated. Grounding conductors shall be copper, sized as noted. Special grounding system features shall be provided as indicated.
 2. All conduit runs installed for lighting and power loads shall contain a grounding conductor throughout the entire length of the run forming a part of the grounding system. The grounding system shall be electrically continuous throughout the electrical system and shall be connected to earth ground at the point of power service and as otherwise indicated.
 3. Ground rods shall be copper welded steel type, 3/4 inch diameter, 20'-0" length, minimum. If additional length is necessary it shall be provided. Ground rods shall be driven to 1'-0" (minimum) below finished grade when located away from structures or unless otherwise indicated and shall be electrically connected with suitable cast type ground clamps or exothermic welding. Ground rods shall extend above ground when near structures and do not pose a tripping hazard.
 4. Resistance to ground of each ground rod shall not exceed 5 ohms when measured during dry weather. In the event this value is not obtained, one additional rod or rod section equal to that tested shall be driven. Should the additional rod or section fail to achieve the required value, the Engineer shall

be immediately notified. A written record of all resistance measurements and test dates shall be submitted to the Engineer prior to completion of the project.

F. Lightning and Surge Protection:

1. Lightning protector units shall be provided for power circuit protection at the main service connection point and elsewhere as noted on the plans. Lightning protectors provided shall be listed on the materials and approved manufacturers for three and single phase circuits respectively.

G. Insulation Tests:

1. Circuit insulation tests shall be performed to prove each circuit free of faults after all wiring is completed prior to equipment and fixture connections, and again after the installation is complete and ready for use.
2. Tests shall be made at the main electrical service connection between all conductors and between line conductors and ground. Tests shall be made with a 1,000 Vdc instrument capable of accurately measuring the resistance involved. Readings shall be taken in the presence of the Engineer or his representative for each test and the written results of each test shall be submitted to the Engineer.

H. Conduit:

1. Steel conduit shall be provided unless otherwise indicated and shall be heavy-wall, rigid galvanized type bearing the Underwriters Laboratories, Inc. label of approval. Conduit minimum size shall be 1/2 inch. Fittings for rigid steel conduit shall be threaded types made up with conductive waterproof compound. Seal-off fittings shall be provided as required by the National Electrical Code.
2. All conduits shall be clean and free from dents, scars, or other deformities. Connections shall be made watertight and bushings shall be provided where smooth hubs are not encountered. Changes in directions shall be made with symmetrical bends or conduit boxes. Field made bends shall be made with an approved hickey or conduit bending apparatus. Conduit runs shall be installed parallel or perpendicular to structural members. Conduit hangers and supports shall be provided at intervals recommended by the manufacturer and the National Electrical Code. Underground conduit runs shall be installed at least 1'-6" below finished grade unless other depths are indicated. Plain earth used for backfill shall be free from objectionable material such as rocks, glass, metal, wood, etc. and shall be tamped to surrounding earth density.
3. All conduits routed from the RTU/Control Panel to the wet-well shall include an expansion proof seal at the control box. Seals shall be poured with sealant as per the National Electrical Code.

I. Variable Speed Controls:

1. Pumping stations designed for variable speed pumping shall be two-pump, pump-down, continuous near linear transition flow type unless otherwise

noted herein or on associated Plans. A wet-well mounted analog level sensor shall be provided to produce a 0-20 ma control signal for processing by the control system. Separately mounted NEMA 4X stainless steel (or NEMA 1 for interior use only) enclosed units with adequate structural support racks shall be provided for the variable-speed drive electronics and the two pump motor controllers. Where required by the equipment manufacturer, a building or other approved shelter shall be provided as a part of the work in order to utilize NEMA 12 type enclosures.

2. The control box shall house the common level detecting and speed processing components. These components shall be of solid-state electronic design. The following minimum features shall be provided on the control panel:
 - a. Digital depth of liquid in feet.
 - b. Hand-off-automatic switching for each pump.
 - c. Manual speed set for each pump.
 - d. Running time meter for each pump.
 - e. Overheat alarm light for each pump.
 - f. Seal failure alarm light for each pump.
 - g. High level alarm light.
 - h. Automatic lead pump alternation upon pump-down shut-off.
 - g. Duplex run time meter.

3. Pump motor controller shall be variable frequency, pulse width modulated, voltage source design, and shall be marketed as a successful controller by a nationally known firm as an equal product for a minimum of one year. Internal controller circuitry shall be solid-state electronics. The following minimum features shall be provided:
 - a. Controller horsepower rating shall be a minimum of 1.15 of the pump motor nameplate rating.
 - b. Speed turndown of 10:1 (minimum).
 - c. Internal speed monitoring without remote feedback.
 - d. Hand-off-automatic switch.
 - e. Manual speed set.
 - f. Reset pushbutton.
 - g. Digital speed readout, RPM.
 - h. Internal adjustment settings for:
 - (1) Acceleration rate.
 - (2) Deceleration rate.
 - (3) Speed limit.
 - (4) Overcurrent protection.
 - i. Ambient temperature rating 0-40°C.
 - j. Controller overheat shut-down with alarm indication.
 - k. Motor overheat shut-down.
 - l. Voltage, phase, and frequency input to suit the characteristics of the power supply system at the station location.

J. Control Components:

1. Electronic Duplex Pump Electrical Control System for Lift Stations shall be a Bulletin LC150/(B300)/FP1 Control System as manufactured by US Filter Control Systems in lieu of a D152 Control System. The system shall include

all necessary appurtenances which might normally be considered a part of the complete electrical system for this installation. All of the automatic control equipment is to be supplied by one manufacturer. It shall be factory assembled, wired and tested and covered by complete electrical drawings and instructions. A transducer with stainless steel float backups shall be provided.

2. The Pump Controller - Telemetry Unit shall be able to operate on either 120 AC or 10-30 VDC power sources. The unit shall be battery backed to provide continued system monitoring and alarm annunciation in the event of primary power failure. Unit shall have built in battery charging circuitry to maintain and charge battery. Battery shall be sized to provide a minimum of 4 hours of back up power. Back up battery power will extend to necessary process sensors, local alarm lights, horns and telemetry equipment. A power on LED shall be built on board providing local indication that power is available to the unit. It is the intention of this specification that a standard controller/transceiver be provided, with all of the control and communications features described as a fully-integrated assembly. The controller shall be a U.S. Filter Control Systems LC150.
3. The liquid level of the wet well shall be sensed by a submersible level transducer. The transducer shall be a 3-wire type to operate from the level controller's regulated supply voltage and produce an instrumentation signal in direct proportion to the measured level excursion over a factory-calibrated range of zero to 20 feet of water.
4. The transducer shall be of the solid-state head-pressure sensing type, suitable for continuous submergence and operation and shall be installed in accordance with manufacturer's instructions. The bottom diaphragm face of the sensor shall be installed approximately 6 inches above the wet well floor. The sensor shall be mounted using a stainless steel cable suspension system in a location and as shown on the job plans.
5. The transducer housing shall be fabricated of type 316 stainless steel with a bottom diaphragm 2-5/8" diameter of heavy-duty, limp, foul-free, molded Teflon (TM) bonded to a synthetic rubber back/seal.
6. The sensor shall be suspension-mounted using a US Filter Control Systems Stainless Steel Cable Suspension Mounting Kit. The mounting kit shall consist of a 2' long one-inch NPT type 316 stainless steel pipe with coupling, bolt, cable clamps and hardware. The required length of 1/8 inch diameter 7 x 19 stainless steel cable shall also be provided.
7. The control panel shall include a UL Listed intrinsic safety barrier that has been UL tested with the specific submersible transducer furnished for this application to render the transducer suitable for use in Class 1, Division 1 or 2, Groups A, B, C and D; Class II, Division 1 or 2, Groups E, F and G; and Class III, hazardous locations (which includes a sewage wet well).
8. An independent high level alarm and redundant pump control capability with features as hereinafter listed shall be provided in addition to the specified primary control system. It shall be powered by a 120 VAC circuit breaker.
9. The independent alarm/control panel equipment shall be designed to UL

Industrial Control Panel standards and shall incorporate 120 VAC input power transient protection, a fused primary and a DC power supply with limited 12 VDC to power the intrinsic safety barrier level sensing float circuit(s). The front face of the controller accessible through the operator's door and shall incorporate four red LED indicators; a "control hold" LED, a redundant control "turn on" LED, a high level alarm/monitor LED, a "control contacts" energized LED and a pump "off delay" time control adjustment with a 0-5 minute range.

10. The liquid level shall be sensed by (3) three direct acting float switches. The float switches shall be Bulletin B100, Model LS Floats as manufactured by US Filter Control Systems/Consolidated Electric. The contractor shall furnish, install, and wire the float switches. Each float shall fine-stranded AWG #18 cable with heavy-duty synthetic rubber jacket in lengths as required to run unspliced to the control panel. The floats shall operate on (24/120) volts and used with a pump/alarm controller providing differential pump operation, float indicating LED's and test switches and alarm circuitry as required.
11. The float switches shall be mounted to a 1" pipe utilizing all stainless steel float switch mounting hardware and secured in place by US Filter Control Systems/Consolidated Electric Model 9GCL3 stainless steel mounting clamps.

K. A "man down" button shall be provided on all control panels and shall signal an alarm condition through the remote monitoring system.

L. Automatic Transfer Switch:

An automatic transfer switch shall be provided at all lift stations for generators in accordance with the standard drawings. Manual transfer switches shall only be permitted when a waiver has been requested and granted to waive the generator requirement. In these cases, a manual transfer switch shall be required. Switches shall have positive mechanical interlocking and shall be designed to prevent paralleling of two sources of power. Also, switches shall be rated as necessary to run all electrical components at the lift station site simultaneously.

M. Motors:

Motors for lift stations shall be explosion proof as Class I, Division 2.

6.15 REMOTE MONITORING SYSTEM

A. General: A new radio telemetry system shall be provided by this Work to collection status and alarm conditions at the remote stations and transmit same to the mission communications central control station for displaying, alarming, annunciation, storing and processing into reports, and shall have the capability of "on-off" control of remote driven equipment. The system shall be Model M110 by Mission Communications in lieu of Model M103.

The system shall be composed of the following basic components:

1. Unique field gathering devices and circuits.

2. RTU, including antenna.

The installer shall provide for the supply, installation certification, adjustment, and start-up of a complete, coordinated system which shall reliably perform the specified functions. The Installer shall coordinate his Work to ensure that:

1. All components of the various systems are installed.
2. Each system is complete including items not specifically addressed in these Specifications but required to achieve a fully complete system.
3. The proper type, size and number of wires with their conduits are provided for all components and systems.
4. Proper electric power circuits including wire and conduit are provided for all components and systems.
5. Modifications to the system or inter system components are made to achieve the correct end function.
6. The finished systems have been coordinated to produce function and control installation stability and reliability.
7. All sensing and proper circuits have lightning and surge protection at each grouping connection within the system.

Scheduling: Where the Installer work involves the work of other subcontractors, it shall be the responsibility of the Installer to coordinate his work with that of the other subcontractors such as structures, excavation, supporting means, mechanical equipment, taps, connections, etc.

B. Design Basis:

1. The telemetry system specified herein is based on the Model M110 as manufactured by Mission Communications.
2. Major constituents of this system include, but are not limited to, all materials, equipment, component parts and devices, and work required to implement a complete and operating system. Like items of equipment hereunder shall be the end product of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.

C. Responsibility and Scheduling: The Installer shall accept ultimate responsibility for completion and final acceptance of the overall Project including work done by subcontractors and material and equipment provided by vendors and suppliers. The Installer shall be responsible for coordination of Project execution in order to prevent duplication of work, omissions, and other inter-contract conflicts. References to duties and responsibilities of subcontractor, vendors, suppliers, etc. within these Specifications are intended to be addressed through the Installer's overall responsibility.

The Installer shall accept responsibility for providing all devices such as switches, relays, contacts, etc., and shall not be dependent upon the work of other

subcontractors or the Utilities Board of the City of Daphne relative to the providing of devices, equipment, components, wiring, supporting means, etc.

D. Field Reconnaissance: The Installer shall visit each site involved in this Work in order to gather measured or observed data and shall verify field conditions in order to become eminently familiar with the installation details. The Pumping Station Installer shall schedule all visits with the Utilities Board of the City of Daphne in order to allow the Utilities Board of the City of Daphne to develop a schedule of supervised site visitation to suit the Utilities Board of the City of Daphne's schedule of operations.

E. Shop Drawing Submittals:

1. Hardware Submittals: Before any components are fabricated, and/or integrated into assemblies, or shipped to the site, furnish to the Engineer, and receive his approve review of require submittal copies of full details, Shop Drawings, catalog cuts, and such other descriptive matter and documentation as may be required to fully describe the equipment and to demonstrate its conformity to these Specifications. The decision of the Utilities Board of the City of Daphne/Engineer upon the acceptability of any submittal shall be final. Catalog information shall be submitted for all equipment, regardless of whether or not it is of the same manufacturer as that listed in the Specification.

All submittals shall be complete, neat, orderly, and indexed accordingly. Partial submittals and "general information only" will not be accepted. All components shall be referenced by the instrument designations shown on the Plans.

If, in the opinion of the Engineer, a submittal is not clear, it will be returned to the Installer without approval to be revised accordingly and resubmitted within 30 days.

Specifically, Installer shall submit the following material:

- a. Catalog data and published design data for each unit components manufactured for a specific duty.
- b. Modifications required to be made to a unit component or assembly in order to perform a special function.
- c. All special fabrication other than a published catalog item including but not limited to:
 - (1) Control panels
 - (2) Component assemblies
 - (3) Supporting or bracing apparatus
 - (4) Construction or modification of facilities

Submittals shall bear a stamp or specific written indication that the Installer has satisfied the Installer's responsibilities.

Omissions and/or design revisions made in submittals shall not relieve the Installer from the responsibility of providing the omitted item or required material as a part of this Work. Approval by the

Utilities Board of the City of Daphne/Engineer shall not constitute acceptance of an erroneous or incomplete system submittal.

The Installer, at his option, may submit for evaluation two copies of submittal material, one of which will be marked and returned. The required number of copies corrected as marked, will then be submitted for approval stamping to the Engineer.

2. Interconnecting wiring diagrams showing all component and panel terminal board identification numbers and external wire numbers. This diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes, motor control centers, etc.). Diagrams, device designations, and symbols shall be in accordance with NEMA ICS 1-101.
3. Operation and Maintenance Manuals - The Installer shall provide seven complete sets of bound operating and maintenance manuals for the completed Project. These manuals shall not only include descriptive material, but also drawings and figures bound in appropriate places. The manuals shall include operation and maintenance literature for all components provided in this Section. The submittal literature shall be in sufficient detail to facilitate the operation, removal, installation, adjustment, calibration, and maintenance of each component provided under this Section.

F. Remote Terminal Units:

1. Remote Terminal Unit (RTU) shall be Mission Communications M103. It shall have battery back-up with charger for 8-hour full load running of RTU and radio. The RTU shall operate on 120 volt A.C. input power. Status diagnostic indicators shall be provided. Each RTU shall be designed and installed to provide "on-off" control capability of equipment from the Central Control Station.
2. Each status and alarm signal circuit shall be protected against electrical transient damage due to direct or indirect overvoltage at each transmitting and receiving device where field routed circuits are installed.

The radio system supplier shall provide the Utilities Board of the City of Daphne a 5-year parts and labor guarantee including lightning damage covering antennas, cables, and transceivers.

G. Tests:

1. General: All elements of the System shall be tested to demonstrate that the total system satisfies all of the requirements of this Specification. All testing materials and equipment shall be provided by the Installer. Where it is not practical to test with real process variables, the Installer shall provide suitable means of simulation. These simulation techniques shall be subject to review by the Engineer. The Installer shall coordinate all of this testing with all other associated subcontractors.
2. Operational Acceptance Test: The objective of these tests is to demonstrate that the system of instrumentation is ready for final operation. The Installer shall prepare check-off sheet(s) for each reporting station. These check-off

and data sheets shall form the basis for these operational tests and this documentation.

6.16 SELF-PRIMING PUMPS:

- A. All self-priming pumps of the same type, frame and size shall be of the same manufacturer and shall have interchangeable parts, and shall be a type and brand listed as approved by the Utilities Board of the City of Daphne, Alabama. The station shall be complete with all equipment specified herein, factory assembled on a common steel base. Self priming pumping facilities shall be enclosed in a wood building with gable roof, asphalt shingles, exhaust fan, window, connection for bypass through the wall and in accordance with the Owner's current standards.
- B. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Principal items of equipment shall include two horizontal, self-priming, centrifugal sewage pumps, V-belt drives, motors, piping, valves, motor control panel, automatic liquid level control system, and integral wiring.
- C. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have properly sized suction and discharge connections. Each pump shall be selected to perform under following operating conditions:

| | |
|----------------------------------|-------|
| Capacity (GPM) | _____ |
| Total Dynamic Head (FT) | _____ |
| Total Dynamic Suction Lift (FT) | _____ |
| Maximum Repriming Lift (FT) | _____ |
| Minimum TDH (FT) | _____ |
| Maximum TDH (FT) | _____ |
| Maximum Static Suction Lift (FT) | _____ |
| Total Discharge Static Head (FT) | _____ |
| Minimum Submergence Depth (FT) | _____ |

- D. Site power furnished to pump station shall be in accordance with the Utilities Board of the City of Daphne's standard for phase, hertz, volts, and wire. Control voltage shall not exceed 128 volts.
- E. Operations Maintenance Manuals: Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

- 1. Functional description of each major component, complete with operating instructions.

2. Instructions for operating pumps and pump controls in all modes of operation.
 3. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
 4. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
 5. Electrical schematic diagram of the pump station circuits shall be in accordance with NMTBA and JIC standards. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
 6. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.
 7. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.
- F. The manufacturer of the pump station shall have a quality management system in place and shall be ISO 9001 certified. The pump station system integrator shall have a quality management system in place and shall be ISO 9001 certified.
- G. All internal passages, impeller vanes, and recirculation ports shall pass a 3" (2.5" on 3" pumps) spherical solid and any trash or stringy material that may pass through the average house collection system. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.
- H. Reprime Performance:
1. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.
 2. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a

completely open system. The need for a suction check valve or external priming device shall not be required.

3. Pump must reprime the necessary vertical feet at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:
 - a. A check valve to be installed down stream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.
 - b. A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.
 - c. The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90 degree elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.
 - d. Impeller clearances shall be set as recommended in the pump service manual.
 - e. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
 - f. Liquid to be used for reprime test shall be water.
4. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

- I. Factory System Test: All components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational test shall duplicate actual performance anticipated for the complete station.

The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described herein.

- J. Unit Base: The unit base shall comprise a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than 1/4" thick, and shall incorporate openings for access to all internal cavities to permit complete

grouting of unit base after installation. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

K. Materials and Construction Features:

1. Pump casing: Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:
 - a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
 - b. Fill port coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.
 - c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
 - d. Liquid volume and recirculation port design shall be consistent with performance criteria specified herein.
2. Coverplate: Coverplate shall be cast iron Class 30. Design must incorporate following maintenance features:
 - a. Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.
 - b. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.
 - c. In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 PSI.
 - d. Two O-rings of Buna-N material shall seal coverplate to pump casing.
 - e. Pusher bolt capability to assist in removal of coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.
 - f. Easy-grip handle shall be mounted to face of coverplate.
3. Rotating Assembly: A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:

- a. Sealplate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.
 - (1) The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
 - (2) The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
 - (3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
- b. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.
- c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the Engineer, in which case AISI 17-4 pH stainless steel shall be supplied.
- d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
- e. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the sealplate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton. Cage and spring to be AISI 316 stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. The seal shall be warranted for a minimum of five years from date of shipment. Should the seal fail within the first two years, the manufacturer shall be obligated, upon notification, to furnish a new seal, without charge to Owner, F.O.B. Factory. The cost of replacement seals thereafter will be on a pro-rated basis as follows: failure within three years, 25% of new seal price; failure within four years, 50% of new seal price; failure within five years, 75% of new

seal price.

- f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.
4. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.
 - a. Clearances shall be maintained by external shimless coverplate adjustment, utilizing collar and adjusting screw design for incremental adjustment of clearances by hand. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings.
 - b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above
 - c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.
 5. Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the coverplate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.
 6. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.
- L. Serviceability: No special tools shall be required for replacement of any components within the pump.
- M. Drive Unit: Pump motors shall be horizontal ODP, 1800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.
- N. Drive Transmission:
1. Power to pumps transmitted V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions.
 2. Each drive assembly shall utilize at least two V-belts providing minimum a

combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer.

3. The pump manufacturer shall submit power transmission calculations which document the following:
 - a. Ratio of pump/motor speed.
 - b. Pitch diameter of driver and driven sheaves.
 - c. Number of belts required per drive.
 - d. Theoretical horsepower transmitted per belt, based on vendor's data.
 - e. Center distance between pump and motor shafts.
 - f. Arc-length correction factor applied to theoretical horsepower transmitted.
 - g. Service factor applied to established design horsepower.
 - h. Safety factor ratio of power transmitted/brake horsepower required.

4. Belt guards:

- a. Pump drives to be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch.
- b. Guards must be completely removable without interference from any unit component, and shall be securely fastened and braced to the unit base.
- c. Metal to be free from burrs and sharp edges. Structural joints shall be continuously welded. Rivet spacing on panels shall not exceed five inches. Tack welds shall not exceed four inch spacing.
- d. The guard shall be finished with one coat of gray W.R. non-lift primer and one coat of orange acrylic alkyd W.R. enamel in accordance with section 3, Color Definitions of ANSI 253.1; Safety Color Code for Marking Physical Hazards.

O. Enclosure Building:

The enclosure building shall be constructed to the limits of and of the materials shown on the appendix of this specification unless noted otherwise on the project plans. All methods of construction shall be in accordance with building codes as required by the applicable building department(s).

P. Station Accessories:

Drain Kit: - Pumps to be supplied with a drain kit for ease of maintenance. The kit shall contain 10' length of reinforced plastic hose with a female quick connect fitting at one end, and factory installed drain fittings in each pump. Fittings include a stainless steel pipe nipple, stainless steel bushing, stainless steel gate valve and aluminum male quick connect fitting.

Spare Parts Kit: The following minimum spare parts shall be furnished with the pump station:

- a) One pump mechanical seal complete with all gaskets, seals, sleeves, o-rings and packings required to be replaced during replacement of the seal,
- b) Required cover plate O-Ring(s)
- c) One rotating assembly O-Ring
- d) One set of impeller clearance adjustment shims (if required)

Gauge Kit: A gauge kit shall be supplied for each pump. Suction pressure must be monitored by a glycerin-filled compound gauge, and discharge pressure by a glycerin-filled pressure gauge. Gauges to be at least 4 inches in diameter, graduated in feet water column. Rated accuracy shall be 1% of full scale reading. Compound gauge shall be graduated -34 to +34 feet water column minimum. Pressure gauge to be graduated 0 to 140 feet water column minimum. Gauges to be factory mounted on a resilient panel with frame assembly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings, including a shutoff valve for each gauge line at the point of connection to suction and discharge pipes.

- Q. Installation: Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

Install, level, align, and lubricate pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump station piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

6.17 SELF PRIMING PUMPS PIPING AND VALVES:

- A. Each pump shall be equipped with a full flow type check valve, capable of passing a 3" spherical solid, with flanged ends rated at 125 pounds and be fitted with an external lever and weight. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron and incorporate a 3" cleanout port. Valve clapper shall have a molded neoprene seating surface

incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings, sealing bushing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

- B. A 3-way plug valve must allow either or both pumps to be isolated from the force main. Valve shall pass 3" spherical solids. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125 pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings, and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseal action. The lever shall have a locking device to hold the plug in the desired position.
- C. Automatic Air Release Valves: An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.

All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric reinforced neoprene or similar inert material.

A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service. Valves shall be field adjustable for varying discharge heads. Connection of the air release valves to the station piping shall include stainless steel fittings.

- D. Piping: Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and minimum class 52 thickness. Flanges shall be cast iron class 125 and comply with ANSI B16.1. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

Bolt holes shall be in angular alignment within 1/2 degrees between flanges. Flanges shall be faced with a gasket finish having concentric grooves a minimum of 0.01 inch deep by approximately 0.03 inch wide, with a minimum of three grooves on any given surface spaced a maximum of 1/4 inch apart.

- E. Supports and Thrust Blocks: Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

6.18 SELF-PRIMING PUMPS ELECTRICAL:

- A. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.
- B. Panel Enclosure:

1. Electrical control equipment shall be mounted within a NEMA 1 stainless steel (NEMA 4X stainless steel when exterior mounted), dead front type, control enclosure. Door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on a removable steel back panel secured to enclosure with collar studs.
2. All control devices and instruments shall be mounted using threaded fasteners, and shall be clearly labeled to indicate function.

C. Branch Components:

1. Motor branch components to be of highest industrial quality, secured to the sub-plate with machine screws and lockwashers. Mounting holes shall be drilled and tapped; self-tapping screws shall not be used to mount any component.
2. Circuit Breakers and Operating Mechanisms:
 - a. A properly sized heavy duty circuit breaker, with RMS interrupting rating for adequate amperes at design volts, shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.
 - b. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position.
3. An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated "0", "00", or fractional size are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils shall be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability.
4. Overload relays shall be solid-state block type, having visual trip indication with trip-free operation. Electrically resetting the overload will cause one (1) normally open and one (1) normally closed isolated alarm/control contact to reset, thus re-establishing a control circuit. Trip setting shall be governed by solid-state circuitry and adjustable current setting. Trip classes shall be 10, 15 and 20. Additional features to include phase loss protection, selectable jam/stall protection and selectable ground fault protection.
5. An overload reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the control panel door.

D. Control Circuit:

1. A normal duty thermal-magnetic circuit breaker shall protect all control

circuits by interrupting control power.

2. Pump mode selector switches shall permit manual start or stop of each pump individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be heavy duty, oil-tight design with contacts rated NEMA A300 minimum.
3. Pump alternator relay to be electro-mechanical industrial design. Relay contacts to be rated 10 amperes minimum at 120 volts non-inductive. A switch shall permit the station operator to select automatic alternation of pumps, to select pump number one to be "lead" for each pumping cycle, or to select pump number two to be "lead" pump for each pumping cycle.
4. Six digit elapsed time meter (non-reset type) shall be connected to each motor starter to indicate total running time of each pump in "hours" and "tenths of hours". An integral pilot light shall be wired in parallel to indicate that the motor is energized and should be running.
5. A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to a high pump temperature shutdown circuit. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the pump shutdown circuit to interrupt power to the motor. A visible indicator located on the control panel door shall indicate motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.
6. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15 ampere thermal-magnetic circuit breaker.
7. Wiring:
 - a. The pump station, as furnished by the manufacturer, shall be completely wired, except for power feed lines to the branch circuit breakers and final connections to remote alarm devices.
 - b. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).
 - c. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:
 - (1) Line and Load Circuits, AC or DC power Black
 - (2) AC Control Circuit Less Than Line Voltage..... Red
 - (3) DC Control Circuit Blue
 - (4) Interlock Control Circuit from external source Yellow
 - (5) Equipment Grounding Conductor..... Green
 - (6) Current Carrying Ground..... White
 - (7) Hot With Circuit Breaker Open Orange

- d. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.
- e. Motor branch and other power conductors shall not be loaded above 60 degrees C temperature rating, on circuits of 100 amperes or less, nor above 75 degrees C on circuits over 100 amperes. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon insulated shanks. All wires on the sub-plate shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel. All wiring outside the panel shall be routed through conduit.
- f. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices.

8. Conduit:

- a. Factory installed conduit shall conform to following requirements:
 - (1) All conduit and fittings to be UL listed.
 - (2) Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
 - (3) Conduit to be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
 - (4) Conduit shall be sized according to the National Electric Code.

9. Equipment Marking:

- a. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
 - (1) Equipment serial number
 - (2) Supply voltage, phase and frequency
 - (3) Current rating of the minimum main conductor
 - (4) Electrical wiring diagram number
 - (5) Motor horsepower and full load current
 - (6) Motor overload heater element
 - (7) Motor circuit breaker trip current rating
 - (8) Name and location of equipment manufacturer

- b. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
 - c. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.
- E. Liquid Level Control: This specification is intended to cover a complete and operational automatic pump and alarm control system that responds to the wet well level excursions. It is the specific intention of this functional requirement that a standard controller will be employed with features as herein described and that it be a fully-integrated assembly.

Pump controller shall be as previously specified herein as a US Filter/Control Systems Model D152 Duplex Pump Controller as described below:

1. Sequence of Operation:

- a. The controller shall receive the wet well level signal from the level transducer, display it on a 4" LED bar graph on the face of the controller, graphically display eight level adjustments for automatic pump control and abnormal level alarm in a coordinated arrangement with the level display and provide automatic operation of the station pumps and alarms as specified herein.
- b. The pump/alarm Controller shall accept a single, level-proportional analog input signal 1-5 VDC and provide level-differential automatic operation of the pumps and alarms.
- c. The Controller shall display the sensed control level on a 40-segment LED bar graph display. The level shall be displayed in a 0-10 foot range with 3" resolution.
- d. The Controller shall operate directly with the level sensing transducer. The Controller shall include transducer excitation voltage regulation, signal spanning and offsetting and adjustable "quelling" (rate-of-change limiting).
- e. Directly aligned with the calibrated LED bar graph display shall be 8 vertical receptacles with programming pins and adjacent range scales to match the calibrated bar graph giving full-range, level-differential, On/Off operation of pumps and alarms from the sensed level excursion. The receptacles and programming pins shall be gold-plated to insure reliable, long-term operation.
- f. Each of the differential pump control circuits shall be programmable with a "pump-down" capability. The left receptacle of each control stage shall receive the low level (turn-off) programming pin. The right receptacle shall receive the high level (turn-on) programming pin.
- g. Stages 3 and 4 of the Controller shall be labeled Low Level Alarm and High Level Alarm and shall be used to provide adjustable differential level-responsive alarm outputs.

- h. The arrangement of the level and programming display with an integral wet well level scaled mylar overlay shall allow easy setting and viewing of all control adjustments from the front of the Controller mounted on the inner door of the enclosure. A front mounted L.E.D. indicator shall be provided in conjunction with each differential control/alarm stage to show when the stage output is activated.
- i. A 3-position, spring-return-to-center “raise-auto-lower” level simulation switch shall allow the manual creation of a simulated level signal when the switch is raised or lowered from the center “auto” position. By use of this switch, the effective operation of the station’s pumps and alarm systems can be confirmed and the station returned to normal without danger of leaving the station in a “non-automatic” condition.
- j. The Controller shall operate on 120 VAC power and include a rear-accessible, extractor-type input power fuse and power line transient protection. The input power and the control outputs shall be wired to screw/clamp barrier-type terminals on the back of the controller housing able to accept one or two AWG 12 or smaller conductors per terminal. The Controller shall incorporate the pump control output load relays and a common abnormal level alarm output load relay with dry contacts wired to terminals rated 10 amps at 240 VAC.
- k. The Controller shall include abnormal level alarm annunciation circuitry with a front accessible alarm silence pushbutton and rear terminal block connection for an external audible alarm and silence pushbutton.
- l. Upon power-up, the Controller shall go through a timing routine which allows the analog signal and display to stabilize before any control or alarm outputs are enabled. After the stabilization period, the control circuits of the Controller shall be sequentially enabled on a timed-step arrangement, providing staggered starting of the pumps.
- m. In addition to the time delay upon power-up, the differential-level control circuits shall each be forced to an Off condition upon power up so that a level excursion will need to go past their turn-on elevation for them to operate.
- n. The Controller shall provide solid-state automatic pump alternation on successive starts. A front accessible 3-position alternator override switch (1-2, Auto, 2-1) shall provide fixed pump sequence selection as well as automatic alternation.
- o. The Controller front face measurements shall be approximately 8 ½” high by 7 ½” wide. It shall semi-flush mount on the control panel door and have a depth behind the panel of not greater than 3 ½”.
- p. A clear polycarbonate hinged cover shall be provided to prevent unauthorized personnel from tampering with the controller.

F. Submersible Transducer:

1. The liquid level of the wet well shall be sensed by a US Filter/Control Systems Bulletin A1000, Model 157GSCL Submersible Level Transducer. The transducer shall be a 3-wire type to operate from a supply voltage of 10.5 to 24 VDC and produce an instrumentation signal in direct proportion to the measured level excursion over a factory-calibrated range of zero to ten feet of water.
2. The Transducer shall be of the solid-state head-pressure sensing type, suitable for continuous submergence and operation and shall be installed in accordance with manufacturer's instructions. The bottom diaphragm face of the sensor shall be installed 12 inches above the floor. The sensor shall be mounted using a stainless steel cable system.
3. The transducer housing shall be fabricated of type 316 stainless steel with a bottom diaphragm 2-5/8" diameter of heavy-duty, limp, foul-free, molded Teflon™ bonded to a synthetic rubber back/seal.
4. A hydraulic fill liquid behind the diaphragm shall transmit the sensed pressure to a solid-state variable-capacitance transducer element to convert the sensed pressure to a corresponding electrical value. The sensed media shall exert its pressure against the diaphragm which flexes minutely so as to vary the proximity between an internal ceramic diaphragm and a ceramic substrate to vary the capacitance of an electrical field created between the two surfaces. A stable, hybrid, operational amplifier assembly shall be incorporated in the transducer to excite and demodulate the sensing mechanism. The transducer shall incorporate laser-trimmed, temperature compensated, high quality components and construction to provide a precise, reliable, stable output signal directly proportional to the sensed pressure over a factory-calibrated range.
5. The transducer element shall incorporate high over-pressure protection and be designed to withstand intermittent overpressures five times the full scale range being sensed. Metallic diaphragms shall not be acceptable in that they are subject to damage or distortion. Sensing principles employing LVDTs, resistive or pneumatic elements shall not be acceptable.
6. The transducer/transmitter shall include easily accessible offset and span adjustments in the upper assembly. Span shall be adjustable from 100% down to 15% of the sensor range. Fine and coarse adjustments for both span and offset shall be provided, using 25-turn potentiometers. Offset and span adjustments shall be non-interactive, for ease of calibration.
7. The internal pressure of the lower transducer assembly shall be relieved to atmospheric pressure through a heavy duty urethane jacketed hose/cable assembly and a slack PVC bellows mounted in the NEMA 4X vented fiberglass upper assembly. The sealed breather system shall compensate for variations in barometric pressure and expansion and contraction of air due to temperature changes and altitude as well as prevent fouling from moisture and other corrosive elements.
8. The transducer assembly shall be installed and connected with other system

elements and placed in successful operation. It shall be provided with input power and output signal transient protection, associated control elements as specified herein and in accordance with manufacturer's instructions.

9. The sensor shall be suspension-mounted using a US Filter/Control Systems Cable Suspension Mounting Kit or equivalent, consisting of a 2' long 1-inch NPT type 316 SS pipe with coupling, bolt, cable clamps and hardware along with the required length of 1/8 inch diameter 7 x 19 SS cable.
- G. Secondary Lightning Arrestor: The control panel shall be equipped with a secondary lightning arrestor to minimize damage to the pump motors and control from transient voltage surges. The arrestor shall utilize silicon-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps, and a Joule rating of 1500. Arrestors provided shall be listed on the materials and approved manufacturers.
- H. Phase Monitor: The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. An integral time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal. Phase monitors shall be listed on the materials and approved manufacturers.

6.19 SUBMERSIBLE PUMPS:

- A. All submersible pumps of the same type, frame and size shall be of the same manufacturer and shall have interchangeable parts, and shall be a type and brand listed as approved by the Utilities Board of the City of Daphne, Alabama. All screws, small bolts, nuts, washers and miscellaneous items normally subjected to corrosion shall be constructed of Everdur, Monel, bronze, or stainless steel exceeding 12% chrome and 7% nickel. All completed and installed operating pump units and accessories shall be suitable for the intended location and service shall be free of operating problems, unusual vibrations and noise throughout the entire operating range of the equipment. Undesirable operation, vibration, or noise in a pump unit or accessories shall be corrected, and if necessary, the entire unit shall be replaced at no additional cost to the Owner.
- B. General: Motors shall be rated as to full load horsepower values shown on the plans (see Appendices) and shall have electrical characteristics corresponding to the electrical power system at the installation. The motor shall be designed for continuous as well as intermittent operation and shall be non-overloading over the entire operational range of the pump.

Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase).

The motor shall have bearings designed for a minimum B-10 life of 15,000 hours and shall be equipped with moisture sensors located between two mechanical seals in an oil filled seal chamber for external seal failure alarm.

The motor shall be labeled by Underwriters Laboratory, Inc. or Factory Mutual as approved for use in Class I, Division I, Group D hazardous locations and rated as suitable for submergence in raw sewage.

Pumps shall be of a non-clog design, which will pass 3" diameter solid.

All pumps except grinder pumps shall have a minimum 4" diameter discharge with flange for connecting to a discharge pipe. Grinder pumps shall have a minimum 2" diameter discharge connection.

Unless otherwise specifically noted, not less than 30 feet of heavy duty grease resistant submersible multi-conductor electrical power and pilot cable with grounding conductor shall be provided connected to the motor ready for operation.

Provide not less than five copies of technical information and parts listing, including recommended maintenance, describing pumps and motors including pump performance curve, minimum submersion head for pumps and range of available impeller sizes and their power requirements.

Provide written five year limited warranty (100% 2 years, 50% years 3-5) guarantee for replacement of pump and motor for failure of satisfactory performance and for defective parts of assembly.

Pumps provided for variable speed duty, in addition to requirements specified herein and elsewhere, shall be provided with the following written documentation by the pump manufacturer.

1. The pumps furnished shall be suitable for the variable speed duty at the conditions encountered at the installation location.
2. Equal pumping units shall have been in satisfactory variable speed service for a minimum of one year.

- C. Pump Installation: Pumps shall be installed in accordance with the manufacturer's recommendations and as approved. Where guide bars are indicated, pumps shall be mounted on guide bars as shown on the plans. The size of the guide bars shall be determined by the pump manufacturer. Anchor bolt size shall be as recommended by manufacturer. All miscellaneous metals within the wetwell (brackets, hangers, bolts, guide rails, mounts, etc.) shall be constructed of 6063-T6 aluminum or 304 stainless steel. All aluminum in contact with concrete shall be coated with asphalt mastic meeting ASTM D 491. Coat bolt thread projections with lubricant to facilitate future nut removal.
- D. The Contractor shall provide in a suitable substantial case any special tools or adjustment devices necessary for the proper maintenance and adjustment of the equipment furnished. This shall include all special or unusual items necessary for the dismantling and assembling of all furnished equipment.
- E. Five instruction manuals, clean and unused, shall be delivered to the Owner for the pumps, motors and all accessories. Each instruction manual shall carry the serial number of the piece of equipment to which it applies, design data, operating instructions, lubricating instructions, maintenance instructions, assembly drawings showing location of parts and test curve. Each instruction manual shall be bound in a stiff black folder with the name of the pumping station and the unit numbers or name embossed on the outside.
- F. The Contractor shall furnish and install all necessary break-in lubricants and all final

lubricants as recommended by the manufacturer for all pumps, motors and accessories.

G. Factory Tests:

1. Pumps: A factory test certified by the pump manufacturer's test representative shall be performed on all pumps actually furnished and written notice of the same shall be furnished to the Engineer. Information required to be furnished at the time of test is as necessary to show conformance to specified performance. Tests shall conform to the Hydraulic Institute Standards test code.
2. Motor Tests and Test Reports: As specified in Pump Specification Sheets, pump drivers shall not be overloaded within a 1.0 service factor rating at any point on the pump curve.
3. Balance of Vibration: The rotating parts of each pump and its driving unit shall be dynamically balanced before final assembly. The driving unit alone shall operate without vibration in excess of the limits stated in the latest revision of NEMA MG 1.

H. Functional Test: Prior to plant startup or field performance test, all equipment described in the Pump Specification Sheets following shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a functional test.

I. Spare Parts for pumps shall be furnished to provide 12 months of full time service and special tools required for that service shall be suitably boxed and marked for shipment and storage.

NOTE: See attached Pump Specification Sheets for pump system and performance warranty requirements. All pumps shall be on the Board's list of materials and approved manufacturers.

6.20 SUBMERSIBLE PUMP VALVES AND PIPING:

Valves and piping shall be located as shown on the drawings. Gate valves, check valves, and flanged ductile iron piping shall be in accordance with the Board's accepted materials.

6.21 SUBMERSIBLE PUMPS ELECTRICAL:

A. Conductors:

1. Single conductors installed in raceways shall be copper with AWG sizes as noted and shall have 600 volt rated, type THW/THHN/THWN or XHHW, 75°C (minimum) insulation. Conductors requiring special consideration shall have insulation material and ratings noted on the plans and as required by the National Electrical Code. Type TW insulation shall not be used for any purpose in this contract except ground wire identification only.
2. Lighting and power conductors shall be minimum size No. 12 AWG, with AWG No. 8 and larger to be stranded, and AWG No. 10 and smaller to be solid unless otherwise noted. Conductors shall be stranded where movement, vibration, or other flexing occurs in order to prevent conductor

fatigue. Control conductors may be AWG No. 14 stranded, unless otherwise noted.

3. Insulation colors shall be: green for ground; white for neutral; and black for single phase line conductor. "Stinger" phase conductor of 120/240 V systems shall be orange as per NEC 215.8. Unless otherwise noted, a uniform insulation color scheme for all new three phase systems shall be established as black for phase A, red for phase B, and blue for phase C. Control circuit insulation shall be yellow. Conductors size AWG 10 and larger may be black with entire exposed ends taped with "Scotch #35" or equal by Plymouth, in accordance with color schemes mentioned herein.
4. Direct buried grounding system conductors shall be bare copper, sized as noted.

B. Splices and Terminations:

1. 600 volt system conductors shall be spliced with "Ideal Wire-Nuts" or equal by T & B for AWG No. 10 and smaller for dry areas and machine crimped or bolted connectors with "Scotch 88" or equal by Plymouth, full coverage tape for all other splices. Soldered and taped splices will not be acceptable. Terminations shall be made with mechanical lugs or other acceptable termination features of the equipment supplied.
2. Control conductors shall terminate on box clamp, binding post screw, or set screws only. Soldered, taped and free-standing connections will not be acceptable.

C. Cable Connectors and Supports:

1. Conduit runs into the wet well for cable protection shall be positioned to suit field conditions to achieve an unobstructed passage for removal and installation of pumping units and shall provide close accessibility to allow removal of the cable connector by maintenance personnel from outside and above the wet well.
2. Cables entering conduit protection and as otherwise notified shall be fitted with connectors sized to suit the cable and conduit actually installed. Connectors shall be plastic body and threaded cap type with neoprene or equal internal gas-tight compression gland. Connectors shall be CGB type manufactured by Thomas & Betts, Hubbell or Daniel.
3. Cable grips shall be provided as strain relief for cables and shall be wire mesh offset eye, closed mesh type, all fabricated with 304 stainless steel and shall be sized to suit the cable actually installed. Cable grips shall be Kellems 024-01-XXX series or equal by Daniel Woodhead.

D. Receptacles:

1. Duplex convenience receptacles shall be rated 15 amps, 125 volts, two pole, three wire, grounding type, specification grade, GFI configuration unless otherwise noted. Receptacles shall be brown for unfinished areas and ivory for finished walls. Where installed in damp locations, receptacles shall be installed in weatherproof enclosures.

2. Special receptacles shall be provided as noted and shall have electrical ratings, pole configuration, and number of poles as shown or required. Enclosures, receptacle types, and other special features shall be suitable for the duty and conditions encountered.

E. Switches:

1. Safety switches shall be provided where indicated and elsewhere as required by the National Electrical Code. Safety switches shall be heavy-duty type, with voltage, current, fuses, number of poles, and enclosure types as noted. All switches requiring security including main power service, transfer, and switches installed out-of-doors shall be provided with padlocks as hereinafter specified. NEMA 4X switches shall be installed out-of-doors.

F. Fuses:

1. Unless otherwise noted, fuses provided for motor protection and other general purpose loads shall be dual-element type, "Buss Fusetron" or equal by Shawmut, with voltage and current ratings as required.
2. Control circuit fuses shall be "Buss FNM" for 120 volt circuits and "Buss KTK" for 480 volt circuits or equal by Shawmut. Unless otherwise noted, control circuit fuses shall be installed in terminal strip mounted switch action fuse blocks rated for 15 amps at 600 volts.

G. Circuit Breakers:

1. Branch and feeder circuit breakers shall be thermal-magnetic, molded case, industrial type, unless otherwise noted, and shall be listed by the Underwriters Laboratories, Inc. for not less than 14,000 amps symmetrical interrupting at 480 volts. Voltage, trip and frame current ratings, and number of poles shall be as indicated or required. Circuit breakers shall have trip-free operating handles with trip current rating permanently molded therein.
2. Circuit breakers provided as an integral part of combination motor starters may be as specified herein or may be magnetic only type manufactured specifically for motor protection duty and set for the actual motor nameplate data.
3. Circuit breakers provided to serve 120 volt lighting, receptacles, and other small loads shall be rated by Underwriters Laboratories, Inc. for not less than 10,000 amps symmetrical interrupting and otherwise shall be as specified herein. Multiple circuit breakers shall be factory assembled and sealed. Tandem type breakers and bailed tied handles of single unit breakers are not acceptable for this work.

H. Motor Starters:

1. Starters shall be sized in whole increment NEMA designation with voltage rating poles and enclosure as noted or otherwise required. Starters shall be Furnace ESP-100. Starters shall be approved by the Underwriters Laboratories, Inc. Ambient temperature compensated overcurrent protection shall be provided in each ungrounded phase of the circuit and shall be sized to suit the motor provided. Auxiliary equipment including contacts, selector

switches, pushbuttons, lights, control power transformer, fuses, etc. shall be provided as noted or otherwise required.

2. Starters shall be designed and rated in accordance with NEMA Table 2-321-1. Ratings by IEC, VDE, DIN, etc. will not be considered for this work. Terminal temperature rise rating shall not exceed 50° C. Operating coils and overcurrent sensors shall be readily and independently replaceable in the field without requiring complete starter exchange.
3. Starters indicated as being combination type shall be circuit breaker type motor circuit protector combination type set to suit the motor provided.
4. Starters shall be magnetic type, full voltage, non-reversing, NEMA Size 1 minimum with wiping style contacts, unless otherwise noted.

I. Special Control Panel:

1. Control panel shall be surface mounted NEMA 4X 304 stainless steel Hoffman style A-SSLP type construction. Control components shall be as indicated on the plans. Control panels shall be provided with padlocks as specified hereinafter. Dimensions shall be as shown on the plans. Stainless steel cabinets shall be brushed finished. All drilling and cutting shall be smooth and escutcheon plates or bezel rings shall be provided on all openings.
2. Control components and associated items shall be as shown on the plans and in accordance with other applicable paragraphs of this specification. Component arrangements shall be as shown on the plans. Panel manufacturer shall completely wire the panel using AWG No. 14 (minimum) conductors rated XHHW, 75° C (minimum). Each end of all conductors shall be identified with permanent type markers corresponding to shop drawing wiring diagram submitted for the control panel. All field wiring shall be connected to terminal strip or lugs of starters, contractors, or other larger components. Each conductor within the panel shall be labeled at each end for identification.
3. Shop drawings showing physical dimensions, component placement, and complete coordinated composite control diagrams and elementary diagrams shall be submitted to the Engineer for approval and shall show the individual control components by manufacturer's catalog number and the wire numbers actually connected in the completed installation. Complete coordinated drawings are to include all devices internal and external to the control panel.

6.22 SUBMERSIBLE PUMPS CONTROLS:

A. Control Components:

1. Selector switches, pushbuttons, and indicator lights, unless otherwise noted, shall be round style, heavy-duty, oil-tight type equal to Square D Class 9001, Type K or Cutler-Hammer Type T and shall have nameplate lettering as noted on the plans. Miniature style units will not be acceptable unless otherwise noted on the plans. Operator mechanism including locking ring and legend plate shall be a corrosion resistant material. Operators installed exposed to corrosive atmospheres or wet areas shall be NEMA 4X rated.

Switch contacts shall be arranged for the configuration and duty as indicated and operating handles shall be easily operated by hand without the use of tools. Pushbuttons shall be momentary or maintained contact type as indicated. Switches and pushbuttons located remotely from the controller shall be with lockout features. Indicator light lenses shall be glass type with color as noted. Lamp replacement shall require removal of the front mounted lens cap only. Where control unit exhibits corrosion or other physical failure during the contract time frame, the Contractor shall replace the entire item at the expense of the Contractor.

2. Control relays shall be equal to Square D, Type X, 300 volt, fixed mounting type, molded case frame industrial type, with number of poles, contact arrangements, and operating voltages indicated. Contacts shall be convertible type. Relays noted to have time delay actions shall be adjustable type with time delay values as notes. Contacts shall be convertible type and shall be readily replaceable without requiring complete relay exchange. Open style, "Ice Cube" style, and plug-in type relays will not be considered for this work unless specifically noted on the plans. Relays shall be NEMA rated and Underwriters Laboratories, Inc. approved. Ratings by IEC, VDE, DIN, etc. will not be considered for this work. Relays with special voltage ratings or designated as special purpose relays shall be provided where indicated.
3. Power failure relays shall be plug-in type with special fixed mounted socket and shall be rated for the voltage supplied to the facility. The relay shall have a 20% (minimum) adjustable range below normal voltage rating and output contacts rated for 3 amps at 115 volts. Relay shall be Time-Mark No. 258B or equal by General Manufacturing Company.
4. Running time meters shall be non-reset type, 2-inch nominal diameter semi-flush mounted, synchronous a.c. motor driven type with sealed case and shall have a six digit register for direct reading of hours and tenths. Meters installed in corrosive or wet atmospheres shall be of corrosion resistant material and gasketed for water tightness. Meters shall be rated for 60 Hz and voltage as indicated.
5. Transducers – Lift station shall utilize US Filter Control Systems transducer Model 157-GSCI-1-15-15-45.
6. Two-state alternator shall be electro-mechanical type with continuous duty coil and contacts rated for 10 amps at 120 volt. Alternation shall occur on de-energization. Alternator shall be Furnas 47AB10 or Engineer approved equal.

C. Special Hardware:

1. Nameplates provided to identify component duty or associated equipment on control centers, special panels, etc. shall be black laminated plastic type with white engraved characters as indicated and shall be fastened with screws. Adhesive attachment methods will not be acceptable.
2. Legend plates for pilot lights, switches, etc. shall reflect wording shown on the plans and shall be non-corrosive metal types fastened by the device locking ring.

3. Concrete masonry inserts shall be self-driven expansion type "Phillips Red Head" or equal by Star.
4. Padlocks shall be brass weatherproof padlock for the gate, of the four-pin tumbler type (minimum) and the Owner shall be provided with keys as noted in the Board's Standard Specifications. Padlocks shall be provided on all lockable items including:
 - a. Service disconnects and transfer switches.
 - b. Control panels.
 - c. Access hatches.

D. Miscellaneous: All devices, equipment, and materials not definitely specified or noted, that are required for complete installations, shall be furnished and manufactured for the purpose intended and shall be installed in conformance with good accepted practice for the conditions encountered. All hardware such as straps, supports, bolts and nuts shall be a minimum of 304 stainless steel.

6.23 SUBMERSIBLE PUMP SPECIFICATION SHEET:

| | |
|-----------------------------|--|
| Service: | Sewage |
| Type of Pump: | Submersible Non-Clog Sewage Pump |
| Solids Handling Capability: | Raw, unscreened sewage. Discharge connection 4" (min.) diameter. |
| Materials of Construction: | Casing Cast iron, Class 35B with smooth surfaces |
| | All exposed bolts & nuts 316 stainless steel |
| Pump exterior | Factory sprayed with an acrylic zinc phosphate primer with a polyester resin paint finish. All surfaces in contact with sewage including the impeller other the stainless steel surfaces shall be protected by the same factory applied primer. |
| Shaft | Stainless steel ANSI 431. Mechanical rotating shaft seal system. Seals shall run in an oil reservoir. Lapped seal faces must be hydrodynamically lubricated at a constant rate. The lower seal unit, between the pump and oil chamber, shall contain one stationary and one positively driven tungsten carbide ring. The upper seal unit, between the oil sump and motor housing, shall contain one stationary tungsten carbide ring and one positively driven rotating carbon ring. Each interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment but shall be easily inspected and replaceable. The |

pump shaft shall rotate on two permanently lubricated bearings with a B-10 bearing life of 40,000 hours when operating at or near the best efficiency point.

| | |
|--------------------|---|
| Impeller | Cast iron, Class 35 B, dynamically balanced, double shrouded, non clogging, single vane design. |
| Guide rails | Stainless steel, 1" (min.) diameter, or Engineer approved pump removal system, whichever is greater. |
| Volute & Wear Ring | Volute shall be single piece design capable of passing any size solid which can pass through the impeller. Wear ring shall be stationary ring made of nitrile rubber molded with a steel ring insert. |
| Upper Bearing | Single row deep groove ball bearing. |

All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber o-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machine surfaces. This will result in controlled compression of nitrile rubber o-rings without the requirement of a specific torque limit.

Installation: The pump shall have a discharge connection elbow connected to a vertical discharge pipe. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. The pump shall be automatically aligned and connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service without a need for personnel to enter the wet well.

Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact. Sealing of the discharge interface by means of a diaphragm, o-ring, or other devices will not be acceptable. No portion of the pump or the guide support system other than the discharge connection shall bear directly on the floor of the sump. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 40 ft.

A 4" (min.) cast iron discharge connection with anchor bolts, upper guide bar bracket, 20 feet of galvanized lifting chain, and 40 feet of hypalon jacketed type SPC cable, P-MSHA approved and sized according to N.E.C. and ICEA standards shall also be provided.

Drive Motor: 1. 15 Horsepower (min.) submersible, 120/230 V, 3 Phase, 4 Wire, 60 Hz
2. Design: Induction, Squirrel-cage rotor, housed in an air filled,

- 3. watertight chamber
- 4. NEMA Design - Type B
- 5. Windings: Copper, Class H Insulated
- 6. Service Factor: 1.15 continuous
- 7. Design Temperature: 40° C ambient (max.)
- 8. Non-overloading at any point on pump curve
- 9. Explosion Proof
- 10. Motor Terminal Board
- 11. Stator shall be heat-shrink fitted and shall be insulated by the trickle impregnation method using Class H monomer free polyester resin
- 12. Motor Winding Over-temperature Thermostats
- 13. Seal Failure Moisture Probe

Guaranteed Performance: GPM TDH RPM EFF HP

Design _____ (max.) _____ (max.)
 High Head _____
 Low Head _____

Warranty: The pump manufacturer shall warrant the unit being supplied to the Utilities Board of the City of Daphne against defects in workmanship and material for a period of five (5) years or 10,000 hours.

Experience: Pump manufacturer's direct sales and service representative shall have local experience directly related to the proposed pumps and adjoining equipment.

Manufacturer(s): Pumps complying with the specified parameters and as included on the Utilities Board of the City of Daphne's list of approved pump manufacturers shall be acceptable.

Model No.: (List Model Number).

6.24 GRINDER PUMP SPECIFICATION SHEET: to be owned by Daphne Utilities

Service: Sewage
 Type of Pump: Packaged Grinder Pump
 Hardware: 300 Series Stainless Steel
 Square Rings: Buna N
 Motor Housing: Cast Iron, ASTM A-48, Class 30
 Cord Cap: Cast Iron, ASTM A-48, Class 30
 Volute: Cast Iron, ASTM A-48, Class 30
 Seal Plate: Cast Iron, ASTM A-48, Class 30
 Impeller: Bronze, 85-5-5-5
 Vortex with Pump-out Vanes, Dynamically Balanced

Shredding Ring: Hardened 440C Stainless Steel 56-60 Rockwell C

Grinder Impeller: Hardened 440C Stainless Steel 56-60 Rockwell C

Shaft: 416 Stainless Steel

Shaft Seal: (Primary) Mechanical Silicon – rotating Face Carbide –

Stationary Face Buna N – Elastomer 300 Stainless Steel

(Secondary) Mechanical Carbon – Rotating Face Ceramic – Stationary Face

Bearings (Upper): Single Row, Ball, Oil Lubricated Bearings

Bearings (Intermediate): Single Row, Ball, Oil Lubricated Bearings

Bearings (Lower): Sleeve

Installation: 1. The Pump shall have a discharge connection elbow connected to a vertical discharge pipe. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. The pump shall be automatically aligned and connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service without a need for personnel to enter the wet well.

2. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact. Sealing of the discharge interface by means of a diaphragm, o-ring, or other devices will not be acceptable. No portion of the pump or the guide support system other than the discharge connection shall bear directly on the floor of the sump. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 40 ft.

Drive Motor: 1. Horsepower (min.) submersible, 120/230 V, 3 Phase, 60 Hz

2. Windings: Open Type, Class F Insulated

3. Service Factor: 1.15 continuous

4. Temperature not to exceed Class B ratings

5. Non-overloading at any point on pump curve

6. Explosion Proof

Seals: Type 21, Silicon, Carbide Dual Mechanical Seal Construction

Basin: Filament would be fiberglass/resin, 24 hour storage, minimum 6 feet diameter

Basin Cover: Aluminum tread plate with hinged access hatch

Valves: All valves shall be in accordance with Daphne Utilities Standards

Liftout System: Shall be C-channel slide rail system, stainless steel. A stainless steel lifting cable shall be attached to the pump.

Controls: Controls shall be in accordance with Daphne Utilities Standards and shall include back up floats.

RTU: Shall be Mission M110

Warranty: The pump manufacturer shall warrant the unit being supplied to the Owner against defects in the workmanship and material for a period of five (5) years or 10,000 hours.

Manufacturer(s): Acceptable manufacturers include Milwaukee, E-One or Barnes Pump.

6.25 GRINDER PUMP SPECIFICATION SHEET: not to be owned by Daphne Utilities

| | |
|--------------------------|---|
| Service: | Sewage |
| Type of Pump: | Packaged Grinder Pump, Semi Positive Displacement or other High Head Pumps |
| Hardware: | 300 Series Stainless Steel |
| Square Rings: | Buna N |
| Motor Housing: | Cast Iron, ASTM A-48, Class 30 |
| Cord Cap: | Cast Iron, ASTM A-48, Class 30 |
| Volute: | Cast Iron, ASTM A-48, Class 30 |
| Seal Plate: | Cast Iron, ASTM A-48, Class 30 |
| Impeller: | Bronze, 85-5-5-5 Vortex with Pump-out Vanes, Dynamically Balanced |
| Shredding Ring: | Hardened 440C Stainless Steel 56-60 Rockwell C |
| Grinder Impeller: | Hardened 440C Stainless Steel 56-60 Rockwell C |
| Shaft: | 416 Stainless Steel |
| Shaft Seal: | (Primary) Mechanical Silicon – Rotating Face Carbide – Stationary Face Buna N – Elastomer 300 Stainless Steel |
| | (Secondary) Mechanical Carbon – Rotating Face Ceramic Stationary Face |
| Bearings (Upper): | Single Row, Ball, Oil Lubricated Bearings |
| Bearings (Intermediate): | Single Row, Ball, Oil Lubricated Bearings |
| Bearings (Lower): | Sleeve |

- Installation:
1. The Pump shall have a discharge connection elbow connected to a vertical discharge pipe. The discharge connection elbow shall be permanently installed in the wet well along with the discharge piping. The pump shall be automatically aligned and connected to the discharge connection elbow when lowered into place, and shall be easily removed for inspection or service without a need for personnel to enter the wet well.
 2. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact. Sealing of the discharge interface by means of a diaphragm, o-ring, or other devices will not be acceptable. No portion of the pump or the guide support system other than the discharge connection shall bear directly on the floor of the sump. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 40 ft.

| | |
|------------------|---|
| Drive Motor: | <ol style="list-style-type: none"> 1. 1 Horsepower (min.) submersible, 120/230 V, 3 Phase, 60 Hz 2. Windings: Open Type, Class F Insulated 3. Service Factor: 1.15 continuous 4. Temperature not to exceed Class B ratings 5. Non-overloading at any point on pump curve 6. Explosion Proof |
| Seals: | Type 21, Silicon, Carbide Dual Mechanical Seal Construction |
| Basin: | The minimum allowable diameter of the wet well shall be two feet, and the minimum allowable depth shall be three feet. Allowable materials shall be fiberglass/resin or HDPE. |
| Basin Cover: | HDPE and Fiberglass shall be the acceptable materials for the basin cover. |
| Valves: | The pump discharge shall be equipped with a gravity operated, flapper type valve built into the discharge piping. |
| Liftout System: | Shall be C-channel slide rail system, stainless steel. A stainless steel lifting cable shall be attached to the pump. |
| Controls: | An external remote control panel with an alarm is preferred, but at a minimum a quick disconnect with a high level alarm will be accepted. |
| Warranty: | The pump manufacturer shall warrant the unit being supplied to the Owner against defects in the workmanship and material for a period of five (5) years or 10,000 hours. |
| Manufacturer(s): | Acceptable manufacturers include E-One or Myers Pump. |

6.26 GENERATORS:

A General:

1. The standard for generators shall be natural gas unless a waiver is requested and grant by Daphne Utilities. All waivers granted are at the sole discretion of Daphne Utilities after reviewing the project specific circumstances. If a waiver is granted, a proposal shall be submitted for a diesel driven generator.
2. The Supplier shall be a company specializing in packaged engine generator system with minimum three years experience. The Supplier shall be an authorized distributor of an engine generator manufacturer with service facilities within 100 miles of project site at time of delivery. The supplier must carry sufficient inventory to cover no less than 80% parts service within 24 hours and 95% within 48 hours. If, within the two-year warranty period of the unit, spare parts are not available within the time frame described herein, the manufacturer shall provide and connect a portable unit to be used until the parts are received and installed and the original unit is again operational. If warranty work is necessary, the Supplier shall supply all parts and labor

required to restore the engine generator system to operational condition.

3. Supplier shall provide a two-year warranty for all major parts and equipment.
4. Furnish service and maintenance of packaged engine generator system for two years from date of delivery. Maintenance shall include a 6-month inspection and annual PM each year with oil and filter changes, and oil testing. Manufacturer shall provide the owner the option to extend the maintenance contract at the end of the two-year period.

B. Submittals and Tests:

1. Submittals:

- a. Submit product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, enclosure, vibration isolators, fuel system, tank and radiator.
- b. Submit manufacturer's installation instructions. Include instructions for normal operation, routine maintenance requirements, service manuals for engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.
- c. Submit manufacturer's certification stating that "This is to certify that we have examined the Plans and Specifications for this Project and have ascertained that this generator and accessories are suitable for the purpose and use intended."
- d. Submit manufacturer's operation and maintenance data.
- e. Furnish one set of tools per generator for preventative maintenance of the engine generator system. Package tools in adequately sized metal toolbox with provisions for storage within the unit enclosure.
- f. Provide two additional sets of each fuel, oil, and air filter element required for each engine generator system.

C. Warranty

1. Engine and generator set shall carry a Standard Two Year Warranty for Standby Power Systems. Contractor shall provide a scheduled maintenance agreement with a local generator manufacturer's authorized Dealer. Contractor shall provide a startup inspection by the authorized dealer and act as Owner's agent in obtaining warranty service.

D. Design and Construction:

1. Manufacturer:

- a. Engine and generator set shall be manufactured by one of the following manufacturers:

Generac Power Systems
Katolight Corporation
Kohler Power Systems

2. Engine:

- a. The engine shall be of a water cooled inline or V-type, four stroke cycle, Natural Gas internal combustion engine.
- b. The engine shall be sufficient to operate at 100 percent rated load for the duration of any power outage at specified elevation and ambient limits.
- c. The engine speed shall be rated at 1800 rpm.
- d. The engine governor shall be a mechanical type (under 200 KW) and isochronous type (200 KW and larger) to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. (Governor shall be capable of providing regulation when the load has a high reactive/capacitive component)
- e. The engine safety devices shall shutdown the engine on low water level, high water temperature, low oil pressure, over speed, and engine overcrank. Limits shall be selected by manufacturer. All safety devices shall be connected to a common fault output for future connection.
- f. The DC starting system with positive engagement, number and voltage of starter motors shall be in accordance with manufacturer's instructions. Remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel shall be included. When this switch is not in "REMOTE" (Auto), it shall output a fault signal to the common fault alarm.
- g. The Engine Block Heater shall be suitable for operation at 120 volts.
- h. The radiator shall use glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F (43 degrees C). Radiator airflow restriction shall be 0.5 inches of water (9.34 mm of mercury), maximum.
- i. Engine Accessories shall include fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-drive water pump, water temperature gauge, and lube oil pressure gage on engine-generator control panel.
- j. Mounting shall provide unit with suitable vibration isolators for mounting on structural concrete base.

3. Generator:

- a. The generator shall be an ANSI/NEMA MG 1 three phase, four pole, reconnectible brushless synchronous generator with brushless exciter.
- b. The generator shall have a unit capacity suitable to run all pumps at the lift station.
- c. The generator insulation shall be ANSI/NEMA MG 1, Class F.
- d. The generator shall have a 150 degree C standby temperature rise.
- e. The generator enclosure shall be ANSI/NEMA MG 1 rated and shall be open drip proof.
- f. Voltage Regulation shall include generator-mounted volts per Hertz exciter-regulator to match engine and generator characteristics, with voltage regulation +/- two percent from no load to full load and shall include manual controls to adjust voltage drop +/- 5 percent voltage level and voltage gain.
- g. The generator shall be capable of delivering full load amps with up to 5% total harmonic distortion.
- h. The generators shall have PMG (permanent magnet generator) exciters.
- h. The manufacturer shall provide computer generated analysis of the generator showing that the proposed generator is capable of starting and operating electrical loads of the wattage ratings necessary. The system should be design to accommodate loads starting at the same time.

4. Accessories:

- a. Fuel System: Natural Gas.
- b. Exhaust Silencer: Critical type silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, suitable for horizontal orientation, sized in accordance with engine manufacturer's instructions.
- c. Batteries: Heavy duty, diesel starting type lead-acid storage batteries, with cold cranking amps and ampere-hour rating as required by the manufacturer. Match battery voltage to starting system. Include necessary cables and clamps.
- d. Battery Tray: Plastic coated metal, constructed to contain spillage of electrolyte.
- e. Battery Charger: Ten ampere, float-type, current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave rectifier, DC voltmeter

and ammeter, and 120 volts AC fused input. Provide enclosure to meet ANSI/NEMA 250, Type 1 requirements. Battery chargers shall be mounted within the generator enclosure.

- f. Line Circuit Breaker: NEMA AB 1 molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole; sized in accordance with ANSI/NFPA 70. Include battery-voltage operated shunt trip, connection to open circuit breaker on engine failure. Mount unit in enclosure to meet ANSI/NEMA 250, Type 1 requirements. The breakers shall be clearly and appropriately marked in 2-inch high numbers and letters.

- g. Engine-Generator Control Panel: ANSI/NEMA 250, Type 1 generator mounted control panel enclosure with engine and generator controls and indicators. Include provision for padlock and the following equipment and features:
 - 1. Frequency Meter: 45-65 Hz range, 3-1/2 inch (89 mm) dial.
 - 2. AC Output Voltmeter: 3-1/2 inch (89 mm) dial, 2 percent accuracy, with phase selector switch.
 - 3. AC Outlet Ammeter: 3-1/2 inch (89 mm) dial, 2 percent accuracy, with phase selector switch.
 - 4. Output voltage adjustment.
 - 5. Push-to-test- indicator lamps, one each for low oil pressure, high water temperature, overspeed, and overcrank.
 - 6. Engine start/stop selector switch.
 - 7. Engine running time meter.
 - 8. Oil pressure gage.
 - 9. Water temperature gage.
 - 10. Auxiliary Relay: 3 PDT, operates when engine runs, with contact terminals prewired to terminal strip.
 - 11. Remote Alarm Contacts: Pre-wire SPCT contacts to terminal strip for remote alarm functions required by ANSI/NFPA 99. Also included in this alarm shall be a "Not in Automatic" signal.
 - 12. Provision for regularly scheduled starting and operation of engine generator for maintenance purposes.
 - 13. Overvoltage shutdown.
 - 14. Microprocessor control panel which shall include a common fault contact for connection to existing or future SCADA systems by others.

- h. Sound attenuating enclosure: reinforced steel housing allowing access to control panel and service points, with lockable doors, fixed louvers, and panels. Enclosure shall be sized large enough to house battery rack, battery charger, and silencer.
- i. Enclosure to be in Engineer's Choice of Color which may not be the Manufacturers standard color. The Owner's selected color shall be provided at no additional costs to the Owner.
- j. The generator shall be made in the United States of America.
- k. The generator shall have an isolated neutral bus installed in an easily accessible location adjacent to or near the line circuit breaker.

E. Tests, Instructions, and Reports:

- 1. Factory Test: Prior to delivery to the job site, the genset shall be load bank tested at 100% of rated load for a minimum of two hours to verify that each component functions properly as a part of the assembly.
- 2. Functional Test: Prior to facility startup or final acceptance, all equipment described herein shall be inspected for proper connection and satisfactory performance by means of a functional test. The Contractor shall demonstrate to the satisfaction of the Owner that the new generator and all associated components function properly as intended.
- 3. Field Quality Control Test: Field inspection and testing will be performed in accordance with the manufacturer's recommendations. After installation, the manufacturer shall provide full load test utilizing portable test bank, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, automatic shutdown, and return to normal.

During test, record the following at 20-minute intervals:

- 1. Kilowatts.
- 2. Amperes.
- 3. Voltage.
- 4. Coolant temperature.
- 5. Room temperature
- 6. Frequency.
- 7. Oil pressure.

F. Training:

- 1. Provide service and operational training to the Owner.

END OF SECTION