

**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 Daphne Utilities 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. Variable speed pumping shall be utilized when in the sole opinion of the Owner would improve the operation and maintenance of the station. 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. All hardware shall be stainless steel.

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 Daphne Utilities' 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.
6. Refer to Division I and Division II for additional information on required material/equipment certifications.

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, minimum eight (8) inches of crushed aggregate, and one and a half (1½) inches of Bituminous Wearing Surface Mix 429-A. These access driveways shall be constructed in accordance with the Alabama Department of Transportation Standard Specifications, latest edition or authority having jurisdiction.
- B. Fencing: The Contractor shall include in the sewage pumping station construction of a fence. The specified chain link is the DU standard but wood is also permitted per site specific conditions.

The wood privacy fence shall be 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 (metal sleeves for bottom of the post shall be utilized), 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 (color to be confirmed with Owner prior to order/installation) 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 Daphne Utilities prior to construction or installation regardless of the plans. Should the Contractor fail to verify the location and orientation of such items with Daphne Utilities, 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 is 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 Daphne Utilities' 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 Daphne Utilities. Lining shall be performed in accordance with the lining product manufacturer's recommendations.

An aluminum access hatch with safety grate shall be installed on all lift station wet wells. Each "Safe Hatch" shall be designed to combine covering of the hole per OSHA standard 1910.23 and shall include fall through protection and controlled confine space entry.

The safety grate shall be made of 6061-T6 aluminum with a minimum ultimate strength of 38,000 p.s.i. and a minimum yield strength of 35,000 p.s.i., as per A.S.T.M. B221. Grate design shall use safety factors as defined in the "Specifications for Aluminum Structures", by the Aluminum Association, Inc., 5th addition, December 1986 for "Bridge Type Structures".

Aluminum grating shall be designed to withstand a minimum live load of 300 pounds per square foot. Deflection shall not exceed 1/150th of the span. Aluminum grate openings shall be 5" x 5", which will allow for visual inspection of the pit and float adjustment, once the access hatch is open. Each aluminum grate shall be provided with a permanent hinging system, which will lock the grate in the 90 degree position once opened.

Design of the system must assure fall through protection is in place after the door has been closed, thereby protecting the next operator. Each grate shall have an opening arm, with a red vinyl grip handle, which will allow opening of the grate, while providing the grate as a barrier between the operator and the pit. The opening arm shall also be equipped with a controlled confined space entry locking device (lock provided by others). This locking device will prevent unauthorized entry to the confined space. The grating system will allow anyone to make visual inspection and float adjustments without entering the confined space.

Grate shall be painted with O.S.H.A. type safety orange paint. Welding shall be in accordance with ANSI/AWS d1.2-90 Structural Welding Code for Aluminum.

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 Owner.

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. Bypass pumps are preferred but generators may be considered depending on site conditions and operational and maintenance considerations as determined solely by Daphne Utilities for each site. Supervisory Control and Data Acquisition (SCADA) systems in accordance with the SCADA systems currently in use by Daphne Utilities sewer system for monitoring operating conditions of the pump station from remote sites shall be installed at new sewage pumping stations.

- 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:
 - i. Acceleration rate.
 - ii. Deceleration rate.
 - iii. Speed limit.
 - iv. 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/Panel: (This section has been updated to current DU practices.)

1. The control system shall be designed to operate the required number of pumps specified at the power characteristics detailed on the plans. The control function shall provide for the operation of the pumps under normal conditions, and shall alternate the pumps on each pump down cycle to equalize the run time. In the event the incoming flow exceeds the pumping capacity of the lead pump, subsequent pumps shall automatically start to handle the increased flow. As the flow decreases, the pumps shall cut off at the elevations as shown on the plans. Should the primary controller or transducer fail, the panel shall have an independent backup float control system to operate the pumps until the primary control is repaired.
2. The control shall function as described below. The equipment listed below is a guide and does not relieve the supplier from supplying a system that will function as necessary for a complete and operational system.
3. The enclosure shall be a NEMA 4X Stainless steel enclosure. The enclosure shall be a wall mount type with a minimum depth of 10" sized to adequately house all the components. Enclosures larger than 60" high x 36" wide shall be provided with 12" high leg stands. The enclosure door gaskets shall be rubber composition with a retainer or seamless foamed in place to assure a positive weatherproof seal. The gasket material shall not retain memory. The door shall open a minimum of 180 degrees. A polished aluminum dead front inner door shall be mounted on a continuous aircraft type hinge and shall contain cutouts for mounted equipment and provide protection of personnel from live internal wiring. Cutouts for breaker handles shall be provided to allow operation of breakers without entering the compartment. All control switches, indicator pilot lights, elapsed time meters, and other operational devices shall be mounted on the external surface of the dead front. The dead front shall open a minimum of 150 degrees to allow access to equipment for maintenance. A 3/4" break shall be formed around the perimeter of the dead front to provide rigidity. The back plate shall be manufactured of 12 gauge sheet steel and be finished with a primer coat and two [2] coats of baked on white enamel. All hardware mounted to the subpanel shall be accomplished with machine thread tapped holes. Sheet metal screws are not acceptable. All devices shall be permanently identified using engraved name plates. Use of DYMO type labels is not acceptable
4. The panel power distribution shall include all necessary components and be completely wired with tinned, stranded copper conductors rated at 90 degrees c. All conductor terminations shall be as recommended by the device manufacturer. All circuit breakers shall be heavy duty thermal magnetic or motor circuit protectors similar and equal to SQUARE D type FAL. The control circuit shall individually be controlled by a heavy duty breaker. Circuit breakers shall be indicating type, providing "on-off-trip" positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position indicating "trip". Thermal magnetic motor breakers shall be quick-make and quick-break on manual and automatic operation and have inverse time characteristics secured through the use of bimetallic tripping elements supplemented by a magnetic trip. Breakers shall be designed so that an overload on one pole automatically trips and opens all legs. Field installed handle ties shall not be acceptable.

5. Motor starters shall be open frame, across the line NEMA rated with individual overload protection in each leg. Motor starter contact and coil shall be replaceable from the front of the starter without removing from its mounted position. Overload heaters shall be block type, utilizing melting alloy spindles, and shall have visual trip indication. Overload shall be sized for the full load amperage draw of the pumps. Definite purpose contactors, fractional size starters and IEC contactor relays shall not be acceptable.
6. Control transformers shall be provided to provide the 120 VAC and/or 24 VAC for control circuits when required. Transformers shall be fused on the primary and secondary circuits. The secondary windings shall be grounded.
7. A lightning-transient protector with tell-tale warning lights on each phase to indicate loss of protection on the individual phases shall be provided. The device shall be solid state with a response time of less than 5 nanoseconds with withstanding surge capacity of 6500 amperes. Unit shall be instant recovery, long life and have no holdover currents.
8. The Phase Monitor shall be a 12 pin, plug in style unit. The Phase Monitor shall monitor Under Voltage, Phase Reversal, Loss of Power and Phase Imbalance. The motor starter circuits shall be de-energized upon sensing of any of the faults and shall automatically restore service upon return to normal power. The Phase Monitor shall be available to monitor Over Voltage as an option. The output relay shall be DPDT rated at 10A at 240 VAC. The Phase Monitor shall be model 001-230-1212, or model 001-480-1212 as manufactured by Motor Protection Electronics.
9. The alarm light shall be a weatherproof, shatterproof, red light fixture with a 40 watt bulb or LED equivalent to indicate alarm conditions. The alarm light shall be turned on by the high level alarm and flash until the condition has been corrected. An open contact shall be provided for remote monitoring.
10. A duplex pump controller shall be provided with analog input for level control. The controller shall contain four output 10 amp relays for pump call, and for low and high level alarms. A regulated 24VDC power supply shall be provided for powering a pressure transducer circuit. The controller shall include a red LED vertical bar graph to display the level as well as pump call and alarm levels. LED's shall be provided for level setting and simulation. The controller shall include a 10 second power-up and a 5 second lag pump delay to prevent pump operation immediately after a power interruption. The analog input shall be transient protected. The controller shall be UL 508 listed as a control device and be specified by DU in the appendix. The controller shall contain a Zero adjustment used to make the bar graph display zero feet of water for an input of 4.0mA, and a Span adjustment used to select the point on the bar graph display that corresponds to an input of 20 ma.
11. All electrical connections shall be made by quick disconnect, phoenix style connectors.

12. A three position HOA switch shall be provided for each pump. The switch shall be NEMA 4x rated with 10 amp contacts except when provided on a dedicated controller. A position indicating legend plate shall be provided. The HOA switches shall be mounted on the inner dead front door unless provided in the controller units.
13. A green run pilot indicator shall be mounted on the dead front door. Level indicator lights or indicators shall be provided. An elapsed time meter shall be mounted on the dead front door. The meter shall operate on 120 VAC, shall indicate in hours [6 digits] and tenths and shall be non-resettable.
14. The alternator shall be a plug in, solid state unit with lead-lag-auto selector and test switches except when provided in a dedicated control device. The unit shall operate on 120 vac and provide DPDT ten amp rated contacts. Two LEDs shall indicate the next position to run as lead pump.
15. A thermal heater and thermostat shall be installed to maintain the internal temperature of the enclosure above the dew point.
16. Control wiring shall be copper, tinned, UL1015, 18ga. minimum.
17. The panel shall also be provided with an independent back up float control circuit to operate the pumps as a standard duplex station should the main controller or level transducer fail. Four float switches shall be provided for pump off, lead pump on, lag pump on and high water alarm.
18. The panel shall be provided with a seal leakage/over temp monitoring unit model PMR2 as manufactured by MPE electronics or Engineer approved equal. The PMR2 performs both Motor Over-Temperature and Seal Leakage Monitoring in one unit, can be powered by 120VAC, 24VAC, or 24VDC, has relay contacts rated for 8 Amps at 120VAC, and comes in a case.

The PMR2 is deadfront mountable so that the deadfront door need not be opened to see the status of the Seal Leakage condition and Pump Over-Temperature, as well as power indication, the Auto/Manual reset select switch, and the reset pushbutton.

The PMR2 applies 12 VDC to the sensor and measures the current flow through the sensor. The sensor controls the current in the circuit. If the sensor current is in the normal range the Temperature Alarm Relay is energized to allow normal pump operation. If the sensor circuit becomes shorted, the 12 VDC is turned off and all LEDs flash. With the sensor current below the Trip Point, the Overtemp Indication is turned on. If the sensor current increases above the Trip Point, the Leakage Indication is turned on.

19. A submersible transducer manufactured from 316 stainless steel, containing a piezo resistive sensor with output signals proportional to applied pressure shall be supplied. The electronics shall be padded in a silicon compound for protection and have 316 stainless or plastic composite device protecting the sensing face of the transducer. The transducer shall operate from a power supply voltage of 10-30 VDC and supply a

4-20ma signal proportional to water level into the controller. The control signal shall be transmitted via a vented, molded polyurethane jacketed cable. The cable shall be gripped by a neoprene grommet and potted in place. The transducer shall be protected by a desiccant and surge arrestor. Surge protection shall be provided for the transducer. The suppressor shall be a dual pair [four wire] module implementing three stage hybrid technology to address over voltage transients and fault currents. The surge suppressor shall be supplied with a female connector and be part number PC642 as manufactured by EDCO or Engineer/Owner approved equal.

20. A final as built drawing encapsulated in Mylar shall be attached to the inside of the front door. Schematics shall be done in ladder logic with wire numbers and line numbers. Real time cross referencing of relay contact to line numbers shall be given as well as written description of component function on each circuit of the drawings. From/to wire and termination reports shall be shown on the as built drawings. Drawings shall be available in HTML format. Terminal strip layouts shall be provided for ease of connecting external devices.
21. All component parts in the control panel shall be permanently identified with engraved legend plates as designated on the drawings. A list of all legends shall be available in Excel format and attached with the schematics on the panel door.
22. All equipment shall be tested to the operational requirements. Each control function shall be activated to check for proper indication.
23. All equipment shall be guaranteed for a period of two years from the date of installation. The guarantee is effective against all defects in workmanship and/or defective component. The warranty is limited to replacement of or repair of the defective equipment.
24. The manufacturer shall be a UL508 shop and provide evidence on the end product.

K. 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.

L. 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 collect 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 the sole opinion of the Owner after evaluating the size of the station, a M800 may be required.

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 Daphne Utilities 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 Daphne Utilities in order to allow Daphne Utilities to develop a schedule of supervised site visitation to suit Daphne Utilities' 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 approved review of required 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 Daphne Utilities/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:
 - i. Control panels
 - ii. Component assemblies
 - iii. Supporting or bracing apparatus
 - iv. 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 Daphne Utilities/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. 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 (This section has been updated to the current standard for the previously acceptable product listed in the appendix)

- A. The use of self-priming pumps versus submersible shall be reviewed with the Owner. Review will consider accessibility, field conditions and operation and maintenance factors. 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 Daphne Utilities. 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 or a manufacturer unit discussed herein.
- B. References: Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.
 1. American National Std. Institute (ANSI)/American Water Works Assoc. (AWWA)

a.	ANSI B16.1	Cast iron pipe flanges and flanged fittings.
b.	ANSI/AWWA C115/A21.51	Cast/ductile iron pipe with threaded flanges.
c.	ANSI 253.1	Safety Color Code for Marking Physical Hazards.
d.	ANSI B40.1	Gages, Pressure and Vacuum.
e.	AWWA C508	Single Swing Check Valves.
 2. American Society for Testing and Materials (ASTM)

a.	ASTM A48	Gray Iron Castings.
b.	ASTM A126	Valves, Flanges, and Pipe Fittings.
c.	ASTM A307	Carbon Steel Bolts and Studs.
d.	ASTM A36	Structural Steel.
 3. Institute of Electrical and Electronics Engineers (IEEE)

a.	ANSI/IEEE Std 100	Standard Dictionary of Electrical Terms.
b.	ANSI/IEEE Std 112	Test Procedure for Polyphase Induction Motors.
c.	IEEE Std 242	Protection of Industrial and Control Power Systems.

4. National Electric Code (NEC)/National Electrical Manufacturers Assoc. (NEMA)
 - a. NEC National Electric Code.
 - b. NEC 701 National Electric Code article 701.
 - c. NEMA Std MG1 Motors and Generators.

5. Miscellaneous References

- a. Ten-State Standards Recommended Standards for Sewage Works.
- b. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
- c. NMTBA and JIC Std National Machine Tool Builders Association and Joint Industrial Council Standards
- d. ISO 9001 International Organization for Standardization.

C. System Description:

1. Contractor shall furnish and install one factory built base mounted, automatic pump station. The station shall be complete with all equipment specified herein, factory assembled on a common steel base.
2. Principal items of equipment shall include two horizontal, self-priming, centrifugal sewage pumps, flex coupled drives, motors, piping, valves, motor control panel, automatic pump control system, and integral wiring.
3. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed herein.

D. Performance Criteria:

1. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have suction connection, and discharge connections for the sized indicated. Each pump shall be selected to perform under the following operating conditions as defined by the project requirements:
 - a. Capacity (GPM) _____
 - b. Total Dynamic Head (FT) _____
 - c. Total Dynamic Suction Lift(FT) _____
 - d. Maximum Repriming Lift (FT) _____
 - e. Minimum TDH (FT) _____
 - f. Maximum TDH (FT) _____
 - g. Maximum Static Suction Lift (FT) _____
 - h. Total Discharge Static Head (FT) _____
 - i. Minimum Submergence Depth (FT) _____
2. Site power furnished to pump station shall be 3 phase, with hertz and volts specified, maintained within industry standards.

E. Submittals:

1. Product Data:

- a. Prior to fabrication, pump station manufacturer shall submit six copies of submittal data for review and approval.
- b. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: 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 (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.

2. Shop 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.

3. Operations Maintenance Manuals:

- a. 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.
- b. 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:
 - i. Functional description of each major component, complete with operating instructions.
 - ii. Instructions for operating pumps and pump controls in all modes of operation.
 - iii. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.

- iv. 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.
 - v. 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.
 - vi. 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.
- c. 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. Quality Assurance:

1. The pumps and pump station manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.
2. The pumps and pump station manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices, technological advances, promoting environmental awareness and continual improvement.
3. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

4. All internal passages, impeller vanes, and recirculation ports shall pass a 2" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.
5. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities.
6. The term "pump manufacturer" or "pump station manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump station manufacturer" and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.
7. Reprime Performance:
 - a. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.
 - b. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.
 - c. Pump must reprime vertical footage specified in the project 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:
 - i. 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.
 - ii. 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.

- iii. 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.
 - iv. Impeller clearances shall be set as recommended in the pump service manual.
 - v. 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.
 - vi. Liquid to be used for reprime test shall be water.
 - d. 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.
- 8. Certified Pump Performance Test:
 - a. Tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4 Acceptance Grade 2B at the specified head, capacity, rated speed and horsepower. The performance tests will validate the correct performance of the equipment at the design head, capacity and speed.
 - b. For pumps utilizing up to (13 HP) motors; but larger than (1.3 HP), tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4.1, as the specified head, capacity, rated speed and horsepower.
- 9. Factory System Test:
 - a. 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.
 - b. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of his choice, at the manufacturer's facility.
- 10. 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.

G. Manufacturer's Warranty:

1. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
 - a. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures (where applicable) are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.
 - b. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.
2. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.
3. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report completed by an authorized manufacturer's representative must be received by manufacturer. The warranty shall become effective in accordance with the project requirements.

H. Product Unitary Responsibility: In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

I. Manufacturer:

1. The pump station system integrator must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

J. Modular Pump Station Enclosure: The Owner shall be consulted during the design phase to determine if an enclosure will be required. DU will base the design on site conditions, size and operational and maintenance conditions.

Unit Base: The unit base shall be comprised of a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than 1/4" thick. 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. Pump Design:

1. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed herein.
2. The pump manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.
3. Materials and Construction Features
 - a. Pump casing: Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:
 - i. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
 - ii. 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.
 - iii. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
 - iv. Liquid volume and recirculation port design shall be consistent with performance criteria listed herein.
 - b. Coverplate: Coverplate shall be cast iron Class 30. Design must incorporate following maintenance features:
 - i. 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.
 - ii. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.

- iii. In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 PSI.
 - iv. Two O-rings of Buna-N material shall seal coverplate to pump casing.
 - v. 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.
 - vi. Easy-grip handle shall be mounted to face of coverplate.
- c. 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:
- i. 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.
 - ii. 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.
 - iii. 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.

- iv. 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.
 - v. 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 stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed herein.
 - vi. 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.
- d. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.
- i. Clearances shall be maintained by a four point external shimless coverplate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The four point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable. Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.
 - ii. 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

- iii. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.
 - e. 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.
 - f. 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.
4. Serviceability:
- a. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.
 - b. No special tools shall be required for replacement of any components within the pump.
5. 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 ball valve and aluminum male quick connect fitting.
6. The following minimum spare parts shall be furnished with the pump station:
- a. One pump mechanical seal
 - b. Required cover plate O-Ring(s)
 - c. One rotating assembly O-Ring(s)
 - d. One set of impeller clearance adjustment spacers

L. 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:

1. One pump mechanical seal complete with all gaskets, seals, sleeves, o-rings and packings required to be replaced during replacement of the seal,
2. Required cover plate O-Ring(s)
3. One rotating assembly O-Ring
4. 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.

M. Valves and Piping:

1. For 4" & 6" Swing Check Valves - Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. 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. Shaft nut shall have double O-rings which shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. 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.
2. For Check Valves Larger than 8 Inches in Diameter - Each pump shall be equipped with a full flow type check valve, capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. 316 stainless steel body ring shall be threaded into the valve port. Valve clapper shall be cast iron, rubber face, and shall swing completely clear of waterway when valve is full open. The seating shall be by a resilient field replaceable ring on the valve disc contacting a bronze or stainless seat ring in the valve body. Hinge pin shall be of 18-8 stainless steel construction and shall be utilized with bronze bushings and packing type seal. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve shall be rated at 175 psi water working pressure, 350 psi hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

3. 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 cast iron 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.
4. Automatic Air Release Valves:
 - a. 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.
 - b. 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.
 - c. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.
 - d. Valves shall be field adjustable for varying discharge heads.
 - e. Connection of the air release valves to the station piping shall include stainless steel fittings.
 - f. 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.
 - g. 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.
5. Piping:
 - a. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.
 - b. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.

- c. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
 - d. 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.
 - 6. Supports and Thrust Blocks:
 - a. 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.
- N. Drive Unit:
 - 1. Pump motors shall be HP specified, 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.
 - 2. Drive Transmission:
 - a. 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.
 - b. 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.
 - c. Precise alignment tolerances of the drive assemblies shall be achieved by means of a belt/sheave laser alignment system resulting in the reduction of vibration, accelerated wear, and premature failure.
 - d. The pump manufacturer shall submit power transmission calculations which document the following:
 - i. Ratio of pump/motor speed.
 - ii. Pitch diameter of driver and driven sheaves.
 - iii. Number of belts required per drive.
 - iv. Theoretical horsepower transmitted per belt, based on vendor's data.
 - v. Center distance between pump and motor shafts.

- vi. Arc-length correction factor applied to theoretical horsepower transmitted.
- vii. Service factor applied to established design horsepower.
- viii. Safety factor ratio of power transmitted/brake horsepower required.

e. Belt Guards:

- i. 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.
- ii. Guards must be completely removable without interference from any unit component, and shall be securely fastened and braced to the unit base.
- iii. 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.
- iv. 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.
- v. Pumps, piping, and exposed steel framework shall be cleaned prior to coating using an approved solvent wipe or phosphatizing cleaner. The part must thoroughly dry before paint application. Open joints shall be caulked with an approved polyurethane sealant. Exposed surfaces shall be applied with one coat of Tnemec Series 69 Polyimide Epoxy Primer and one finish coat of Series 73 Aliphatic Acrylic Polyurethane for a total dry film thickness of 4-6 mils. Finish coat shall be semi-gloss white for optimum illumination and enhancement. The coating shall be corrosion, moisture, oil, and solvent resistant when completely dry. The factory finish shall allow for over-coating and touch-up for 6 months after coating. Thereafter, it will generally require sanding to accept a topcoat or touch-up coating. See Product Data Sheet for additional information.

O. Electrical Control Components:

- 1. 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.

2. Panel Enclosure:

- a. Electrical control equipment shall be mounted within a NEMA 1 stainless steel, 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.
- b. All control devices and instruments shall be 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 and component. All control devices shall be clearly labeled to indicate function.
- c. Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.
- d. Pump station components and controls shall conform to third party safety certification. The station shall bear a UL label listed for "Packaged Pumping System". The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The pump station components, panel enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

3. Branch Components:

- a. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. the lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.
- b. Circuit Breakers and Operating Mechanisms
 - i. A properly sized heavy duty circuit breaker shall be furnished for each pump motor. The circuit breakers must be sealed by the manufacturer after calibration to prevent tampering.
 - ii. 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. An additional mechanism(s) shall be provided on the

circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

c. Motor Starters

- i. 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.
- ii. 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.
- iii. An overload reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the control panel door.

d. Phase Monitor:

- i. 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, high voltage, low voltage, and voltage unbalance. An adjustable time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart, following an adjustable time delay, when power conditions return to normal.
- e. The control panel shall be equipped to monitor the incoming power and shut down the pump when required to protect the motor(s) from damage caused by voltage less than 83% of nominal. The motor(s) shall automatically restart when power conditions return to normal.

- f. Transient Voltage Surge Suppressor:
 - i. The control panel shall be equipped with a modular surge arrester to minimize damage to the pump motors and control from transient voltage surges. The suppressor shall utilize thermally protected by heavy duty zinc-oxide varistors encapsulated in a non-conductive housing. Mechanical indicators shall be provided on each phase to indicate protection has been lost. The suppressor shall have a short circuit current rating of 200,000 Amps and a Maximum Discharge current rating [I_{max}] of 40,000 Amperes. Nominal discharge current [I_n] is 20,000 Amperes. Surge arrester according to UL 1449 3rd Edition, Type 2 component assembly.
 - g. The control circuit for pump #2 shall be equipped with a time delay to prevent simultaneous motor starts.

4. Control Circuit:

- a. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
- b. 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.
- c. Pump alternation shall be integral to the liquid level controller. Provisions for automatic alternation or manual selection shall also be integral to the liquid level controller.
- d. Six digit elapsed time meter shall be shall be displayed on the Integrinex™ Standard operator interface to indicate total running time of each pump in "hours" and "tenths of hours". Pump runtime shall be adjustable and password protected.
- e. 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 the Integrinex™ Standard. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the Integrinex™ Standard to interrupt power to the motor. The Integrinex™ Standard will display an alarm banner indicating the 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.

- f. 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.
- g. The lift station shall be equipped with a 3 KVA stepdown transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door. and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.
- h. Wiring:
 - i. 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.
 - ii. All wiring, workmanship, and schematic wiring diagrams shall comply with applicable standards and specifications of the National Electric Code (NEC).
 - iii. All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:
 - 1) Line and Load Circuits, AC or DC PowerBlack
 - 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
 - iv. 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.
 - v. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. 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.

- vi. 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.

- i. Conduit:

- i. 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.

- j. Grounding:

- i. Station manufacturer shall ground all electrical equipment inside the pump station to the control panel back plate. All paint must be removed from the grounding mounting surface before making final connection.
 - ii. The contractor shall provide an earth driven ground connection to the pump station at the main grounding lug in accordance with the National Electric Code (NEC).

- k. Equipment Marking:

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

- 8) Motor circuit breaker trip current rating
- 9) Name and location of equipment manufacturer

- ii. 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.

- iii. 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.

P. Liquid Level Control:

- 1. The manufacturer of the liquid level control system must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.
- 2. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- 3. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.
- 4. The level control system shall be capable of operating as either an air bubbler type level control system, submersible transducer type system, or ultrasonic transmitter type system.
- 5. The level control system shall utilize alternation to select first one pump, then the second pump, then the third pump (if required), to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.
- 6. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second and/or third pump (if required) when the liquid reaches the "lag pump start level", or "standby pump start level" so that all pumps are operating. These levels shall be adjustable as described below.
 - a. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state,

and shall be integrated with other components to perform as described below.

- b. The electronic pressure switch shall be capable of operating on a supply voltage of 12-24Vdc in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Ingress Protection of IP56 for indoor use with closed cell neoprene blend gasket material. Evaluated by Underwriters Laboratories for Pollution Degree 2 device for U.L. and cU.L. Control range shall be 0 to 33.3 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be non-volatile. A Battery backed real time clock shall be standard.
- c. Eleven optically isolated, user defined digital inputs for pump and alarm status. Rated at 10mA at 24Vdc. Eight digital output relays (mechanical contacts), configurable for pump start/stop or alarms. Three relays rated at 12 Amp @ 28Vdc and 120Vac, five relays rated at 3 Amp @ 30Vdc and 120Vac. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators, digital inputs and digital output relays.
 - i. The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations or surges. The transducer range shall be 0-14.5 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 2.5% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.
 - ii. The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and pump status indication for up to 3 pumps. The display shall include a 128 x 64 bit resolution LCD to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.
 - iii. Level adjustments shall be electronic comparator set-points to control the levels at which the lead, lag and standby pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches, and accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment,

artificial level simulation or introduction of pressure to the electronic pressure switch.

- iv. Each digital input can be programmed as pump run, pump HOA, pump high temp, pump moisture/thermal, starter failure (FVNR, RVSS, VFD), and phase failure. Inputs are used for status and alarm indication.
- v. Each output relay in the electronic pressure switch shall be hard contact mechanical style. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. Each output relay shall have an inductive load rating equivalent to one NEMA size 3 contactor. A pilot relay shall be incorporated for loads greater than a size 3 contactor.
- d. The electronic pressure switch shall be equipped with alarm banners with time and date history for displaying alarm input notification. Alarm history will retain a 16 of the most recent alarm events.
- e. The electronic pressure switch shall be equipped with pump start/stop and alarm input delay(s) that have an adjustable delay set points.
- f. An Antiseptic function with a built in timer shall be incorporated in the electronic pressure switch to prevent the well from becoming septic.
- g. The electronic pressure switch shall be capable of jumping to next available pump if current pump is out of service due to pump failure or manual selection. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.
- h. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.
- i. The electronic pressure switch shall be capable of calculating and displaying pump elapse run time. The elapse run time is resettable and adjustable.
- j. The electronic pressure switch shall have internal capability of providing automatic simplex, duplex, and triplex alternation, manual selection of pump sequence operation, and alternation in the event of 1-24 hours of excessive run time.
- k. The electronic pressure switch shall be equipped with a security access code to prevent accidental set-up changes and provide liquid level set-point lock-out. The supervisor access code is adjustable.

- l. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5Vdc, or 4-20mA, and one (1) scalable analog output of either 0-5Vdc, 0-10Vdc or 4-20mA. Output is powered by 10-24Vdc supply. Load resistance for 4-20mA output shall be 100-1000 ohms.
 - m. The electronic pressure switch shall include a DC power supply to convert 120Vac control power to 12 or 24Vdc power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.
 - n. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a high liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.
 - o. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a low liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause for the low wet well level has been corrected and the circuit has been manually reset. A low liquid level condition shall disable all pump motors. When the wet well rises above the low level point, all pump motors shall be automatically enabled. Low water alarm shall be furnished with a dry contact wired to terminal blocks.
 - p. Integrinex Standard Analog Output circuit will be furnished with transient voltage surge suppression to protect related equipment from induced voltage spike from lighting.
- 7. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be a membrane style button integral to the Integrinex Standard level controller.
- 8. Submersible Transducer System:
 - a. The level control system shall utilize a submersible transducer. It shall be a strain gauge transducer with a pressure sensor housed in a 316 SST or Titanium case designed to extend into the wet well. The pressure transducer shall provide a proportional signal for distribution to the display and electronic comparators of the electronic pressure switch, and remainder of the level control system. Sensor range shall be 0-12 ft. W.C. minimum with an over-pressure rating 3 times full scale. The transducer shall have output capability of 1.5-7.5VDC or 4-20mA. The transducer's

polyurethane jacketed shielded cable shall be of suitable length for proper installation into the wet well without splicing.

- b. Submersible transducer will be furnished with transient voltage surge suppression to protect related equipment from an induced voltage spike from lighting.
- c. The Station manufacturer will supply one 115 volt AC alarm light fixture with vapor-tight red globe, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the contractor.

Q. Execution - Examination: 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.

R. Installation:

- 1. 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.
- 2. 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.
- 3. 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.
- 4. 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.

S. Field Quality Control:

- 1. Operational Test:
 - a. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment

meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

- b. After construction debris and foreign material has been removed from the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

2. Manufacturer's Start-up Services:

- a. Coordinate station start-up with manufacturer's technical representative. The representative or factory service technician will inspect the completed installation. He will calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

T. Cleaning: Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

U. Protection: The pump station should be placed into service immediately. If operation is delayed, drain water from pumps and piping. Open motor circuit breakers and protect station controls and interior equipment from cold and moisture. Station is to be stored and maintained per manufacturer's written instructions.

6.17 SUBMERSIBLE PUMPS (This section has been updated to the current standard for the previously acceptable product listed in the appendix. Current standards including increased bearing life, impeller material and controls.)

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 Daphne Utilities. 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 L-10 life of 50,000 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 50 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 Daphne Utilities' list of materials and approved manufacturers.

6.18 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 Daphne Utilities' accepted materials.

6.19 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.

6.20 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.

B. 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 Daphne Utilities' Standard Specifications. Padlocks shall be provided on all lockable items including:
 - a. Service disconnects and transfer switches.
 - b. Control panels.
 - c. Access hatches.

C. 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.

6.21 SUBMERSIBLE PUMP SPECIFICATION SHEET (This section has been updated to DU current practices)

Service: Sewage

Type of Pump: Submersible Non-Clog Sewage Pump

Solids Handling
Capability: Raw, unscreened sewage.
Discharge connection 4" (min.) diameter.

Materials of Construction: Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be of stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

All exposed bolts & nuts 316 stainless steel

Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

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.

Cooling System: 10HP and below - Motors are sufficiently cooled by the surrounding environment or pumped media. A water jacket is not required.

12HP and above - Each unit shall be provided with an integral motor cooling system. A motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F. (40°C.). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

Cable Entry Seal: The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

Motor:

The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of withstanding at least 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.

The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C. ambient and shall have a NEMA Class B maximum operating temperature rise of 80° C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

Bearings:

The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single ball type bearing to handle radial loads. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L_{10} bearing life shall be 50,000 hours at any usable portion of the pump curve.

Mechanical Seals:

Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

Pump Shaft:	The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T. Shaft sleeves will not be acceptable.
Impeller:	The impeller shall be of ASTM A 532 (Alloy III A), 25% chrome cast iron (HARD IRON), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 6% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The Impeller shall be locked to the shaft and held by an impeller bolt.
Guide Rails:	Stainless steel, 1" (min.) diameter, or Engineer approved pump removal system, whichever is greater.
Volute & Wear Ring:	The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable volute insert ring containing spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide the relief path and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The internal volute bottom shall provide effective sealing between the multi-vane semi-open impeller and the volute. The insert ring shall be cast of (ASTM A-48 Class 35B cast iron or ASTM A 532 (Alloy III A), 25% chrome cast iron)
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. Per Project Requirements Horsepower (min.) submersible, 120/230 V, 3 Phase, 4 Wire, 60 Hz
2. Design: Induction, Squirrel-cage rotor, housed in an air filled, watertight chamber
3. NEMA Design - Type B
4. Windings: Copper, Class H Insulated
5. Service Factor: 1.15 continuous
6. Design Temperature: 40°C ambient (max.)
7. Non-overloading at any point on pump curve
8. Explosion Proof
9. Motor Terminal Board
10. Stator shall be heat-shrink fitted and shall be insulated by the trickle impregnation method using Class H monomer free polyester resin
11. Motor Winding Over-temperature Thermostats
12. Seal Failure Moisture Probe

Guaranteed Performance:	<u>GPM</u>	<u>TDH</u>	<u>RPM</u>	<u>EFF</u>	<u>HP</u>
Design High Head	_____	_____	_____ (max.)	_____	_____ (max.)
Low Head	_____	_____			

Warranty: The pump manufacturer shall warrant the unit being supplied to Daphne Utilities 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 Daphne Utilities list of approved pump manufacturers shall be acceptable.

Model No.: (List Model Number).

6.22 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:	<ol style="list-style-type: none"> 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. 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):	Pumps complying with the specified parameters and as included on Daphne Utilities list of approved pump manufacturers shall be acceptable.

6.23 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:	<ol style="list-style-type: none"> 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. XX Per Project Requirements 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.

6.24 BYPASS PUMPS (New Section)

Engine driven bypass pumps shall be skid mounted, self-contained, natural gas fueled. The pump shall be sized to pump peak flow without the engine operating above its continuous horsepower or torque range. The pump shall be a dry-type self-priming unit with minimum 3" spherical solids handling capability. The installation shall be designed for outdoor, all-weather applications. All installations shall include critical grade sound attenuation enclosures. The unit and/or enclosure shall be painted gray. The system shall be manufactured complying with the specified parameters and as included on Daphne Utilities list of approved bypass pump manufacturers shall be acceptable.

A. Product:

1. The pump shall be installed on a reinforced concrete foundation designed to absorb engine and pump vibrations and not transmit vibrations or loads to the pump station wet well.
2. Pump Manufacturer shall provide the included data during submittal process for the design of the slab.
3. Pump inlet suction piping shall be isolated from the pump with a flanged elastomeric expansion joint coupling bolted to the pump suction inlet flange. The pump suction piping shall be supported independently from the pump.
4. Pump discharge piping shall be isolated from the pump with a flanged elastomeric expansion joint coupling, with expansion control rods, bolted to the pump discharge outlet check valve flange. The pump discharge piping shall be supported independently from the pump.

5. The system shall include a trickle charger and battery for automatic starting upon failure of the electrical power service.
6. The bypass pump specified will be used to pump raw sewage. The pump manufacturer shall supply the pump and accessories.
7. Priming shall be accomplished with the use of a vacuum pump capable of producing 50 cfm maximum and driven via belt from the pump shaft will be provided. Stainless steel float linkage will be installed in the float box. A positive seating vacuum priming valve shall be utilized to prevent water carry-over to the vacuum pump or atmosphere.
8. The sound attenuation enclosure shall be critical grade. The enclosure shall be aluminum with heavy powder coat finish.
9. The pump shall be capable of static suction lifts to 25 vertical feet above sea level. It shall also be capable of operation using extended suction lines.
10. The unit shall have a thermostatically controlled block heater.
11. The pumping system shall include a programmable digital control system with a touch-pad for user input to automatically start and stop the pump. The controls shall include, but not be limited to, the following features:
 - a. Manual remote or automatic starting capabilities
 - b. Security levels to allow limited or full access to control functions
 - c. Programmable relays and 66 selectable features, including pump running, and pump failure
 - d. RD-232 and RD-485 communications ports to enable communication with SCADA and alarm equipment
 - e. Capable of automatically throttling engine rpm in response to changing pressures, level, flow transducers
 - f. Maintain an "event history" of all warning alarms (up to 32)
 - g. User can pre-set engine rpm to maintain flow and head parameters when running unattended

- h. Track oil and filter usage and alert operator when replacement is recommended
- 12. The engine driven back-up pump system manufacturer shall provide all materials, submittals, and system testing previously noted in this Specification and shall provide system calculations of the pump operating conditions indicating a family of curves for the ranges of pressures, flows, and speeds anticipated at the specific location of the pumps within the hydraulic system.
- 13. The pump design be able to accommodate peak flows at the lift station.
- 14. The casing will be of the end suction design with tangential or centerline discharge outlet. Flange connections shall be ANSI 125# rated. The casing shall have tapped and plugged holes for draining. The casing bore shall be large enough to allow "back pullout" of the impeller without disturbing the casing or suction and discharge piping. The casing shall be supported by the bearing frame.
- 15. The impeller shall be of the enclosed type, cast in one piece. It shall be finished all over, the exterior being turned and the interior being finished smooth and cleaned of all burrs, trimmings, and irregularities. The impeller shall be statically balanced. The impeller will be keyed to the shaft, and fastened with a washer, gasket and cap screw.
- 16. Casing Wearing Ring: The pump casing shall be fitted with a case wear ring to minimize abrasive and corrosive wear to the casing. The case wear ring shall be of the radial type, press fitted into the casing. Wear plates requiring axial adjustment are not acceptable.
- 17. Bearing Frame: The bearing frame shall house a double-row outboard regreaseable thrust bearing. Both bearings shall be selected for a 20,000 hour minimum life at maximum load. The inboard bearing shall not be locked in order to accommodate thermal expansion of the shaft. Lubrication fittings shall be provided in convenient location.
- 18. Mechanical Seal: A dished style backplate with deflector vanes constructed of ASTM A48 Class 30 Grey iron shall be provided, including a single mechanical seal. The design shall allow for continuous operation without the need for external flush water or venting. A standard hardened stainless steel shaft sleeve design shall be provided with an o-ring seal. The shaft sleeve will be Heat Treated 420 stainless steel.

19. Shaft: The outboard shaft extension shall be machined with a keyway to accept a coupling to the driving unit. Water slingers shall be furnished on the inboard shaft extensions.
20. Shaft Sleeve: The pump shaft shall be fitted with a shaft sleeve to minimize shaft wear. The sleeve shall be sealed to the impeller hub by an O-ring, (and shall be positively driven by a pin, key or set screws to the keyway. The use of adhesive compounds to fasten the sleeve to the shaft shall not be accepted.
21. Support: The pump unit shall be mounted to directly to the engine flywheel and driven via a rubber torsional coupling to reduce vibration. The volute shall be supported from the base.
22. Coupling: A Stromag coupling shall be provided to connect the pump to the engine flywheel. It shall be of sufficient size and stiffness to protect the pump from any vibration.
23. Pump Suction and Discharge Fittings: Shall be sized as necessary and shall be a male cam loc on the discharge flange & female cam loc on the suction flange.
24. Check Valve: Pump shall be supplied with a swing type check valve mounted on the discharge of the pump allowing unrestricted flow from the impeller. The check valve shall prevent in-line return of flow when the pump is shut off. Non-return elastomers shall be Nitrile rubber and shall be field replaceable.
25. Drive Unit: The drive unit shall be a natural gas water-cooled engine. The engine shall drive the pump by use of direct connected intermediate drive plate. Starter shall be 12 volt electric. Safety shut down switches for low oil pressure and high temperature shall be provided. Battery shall have 180-amp hour rating. Unit shall include a tachometer and hour meter.
26. Governor: Governor shall be an electronic type. Engine speed shall be adjustable to operate the pump between maximum and minimum design operation speeds.
27. Fuel Source: Natural Gas is preferred but diesel may be submitted if natural gas is not available
28. Exhaust: Exhaust system shall include muffler and anti-rain flapper device.
29. Factory Painting: Pump, engine, and base shall be primed and finished at the place of manufacturer. Materials and dry film thickness for priming and finish paint shall be in accordance with manufacturer's standards.

30. **Manufacturer's Services:** Inspect the system prior to delivery, supervise the startup and testing of the system and certify the system has been properly furnished and is ready for operation. Instruct the owners operating personnel in the proper operation and maintenance of the system for a period of not less than one half day.
31. **Tools and Spare Parts:** The manufacturer shall furnish the following with the portable by-pass pump system: A recommended list of spare parts and 3 operation and maintenance manuals.
32. **Warranty:** The manufacturer shall furnish the following to the owner: A copy of the engine manufacturer's parts and labor warranty. A two-year parts and labor warranty issued by the manufacturer on the portable by pass pump system. This warranty must cover all pump parts, including the mechanical seal and comply with these project specifications.
33. The engine driven back-up pump manufacturer shall warrant the installed system for a minimum of 24 months or the accumulation of 2000 hours operation starting from the date of system acceptance by Daphne Utilities.

6.27 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 comply with the specified parameters and be included on Daphne Utilities list of approved generator manufacturers shall be acceptable.

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, reconnectable 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.
- i. 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:
 - i. Frequency Meter: 45-65 Hz range, 3-1/2 inch (89 mm) dial.
 - ii. AC Output Voltmeter: 3-1/2 inch (89 mm) dial, 2 percent accuracy, with phase selector switch.
 - iii. AC Outlet Ammeter: 3-1/2 inch (89 mm) dial, 2 percent accuracy, with phase selector switch.
 - iv. Output voltage adjustment.
 - v. Push-to-test- indicator lamps, one each for low oil pressure, high water temperature, overspeed, and overcrank.
 - vi. Engine start/stop selector switch.
 - vii. Engine running time meter.
 - viii. Oil pressure gage.
 - ix. Water temperature gage.
 - x. Auxiliary Relay: 3 PDT, operates when engine runs, with contact terminals prewired to terminal strip.
 - xi. 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.
 - xii. Provision for regularly scheduled starting and operation of engine generator for maintenance purposes.
 - xiii. Overvoltage shutdown.
 - xiv. 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:

- a. Kilowatts.
- b. Amperes.
- c. Voltage.
- d. Coolant temperature.
- e. Room temperature
- f. Frequency.
- g. Oil pressure.

F. Training:

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

END OF SECTION