SECTION 11300

GENERAL PROVISIONS

PART 1 GENERAL

1.1 RELATED REFERENCES:

A. Drawings and general provisions of this Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 RELATED SECTIONS:

A. Section 01600 – Product Requirements

B. Section 09900 - Painting

1.3 DESCRIPTION OF WORK:

A. The Work within this section includes, but is not limited to, the furnishing of all equipment, labor and materials and performing all operations necessary to install and test all the equipment, machinery, apparatus, motors, drives, tools, charts and other accessories as specified and in accordance with the specifications, applicable drawings and contract documents.

1.4 QUALITY ASSURANCE:

A. Reference standards shall be the following:

1. American Institute of Steel Construction (AISC)
2. Anti-Friction Bearings Manufacturer's Association (AFBMA)
3. American Society for Testing and Materials (ASTM)
4. Institute of Electrical and Electronics Engineers (IEEE)
5. National Electrical Manufacturers Administration (NEMA)
6. National Electrical Code (NEC)
7. Structural Steel Painting Council (SSPC)
8. Underwriter's Laboratories (UL)

B. Equipment shall be provided by a manufacturer specializing in wastewater treatment equipment with a minimum of 5 years experience and who has supplied equipment similar to that specified in at least three other municipal wastewater treatment facilities.

1.5 REGULATORY REQUIREMENTS:

A. Requirements of Regulatory Agencies: The construction requirements of state, county, or other political subdivision specifications exceeding the requirements of the codes, standards, and approving bodies referenced herein shall be met and complied with.

B. Both UL listings and approvals and NEMA's stamps or seals shall be evidenced where applicable to electrical apparatus forming parts of the process equipment.

1.6 SHOP DRAWINGS:

A. Submit for approval completely dimensioned shop, layout or setting drawings and catalog cuts or other data as required to provide a complete description of system equipment specified in each section of Division 11.

B. Submit shop drawings certified for construction by the manufacturer and approved by the CONTRACTOR which includes location of electrical connections, wiring diagrams, anchor bolt layout, details indicating construction and materials of construction, diameter of shafting, dimensions and rated horsepower of all motors, gear and bearing ratings, and service factors and weights of principal parts and completely assembled equipment.

1.7 OPERATION AND MAINTENANCE MANUALS:

A. The CONTRACTOR shall submit to ENGINEER for review and approval, three copies of operation and maintenance manuals prepared by the manufacturer/supplier or CONTRACTOR. Submittals shall be provided within four weeks following the receipt of approved shop drawings for each item of equipment listed in this section.

B. The submission and approval of each set of manuals is considered to be part of requirements for furnishing and installing the respective equipment or system. Incomplete or inadequate manuals shall be returned to the CONTRACTOR for correction and resubmission.

C. Each operation and maintenance manual shall include the following information:

1. Erections or installation instructions.
2. Start-up procedures.
3. Recommended and alternative operation procedures.
4. Schedule of preventive maintenance requirements.

5. Schedule of recommended spare parts to be stocked, complete with part number, inventory quantity and ordering information.
6. Detailed maintenance procedures.
7. Schedule of lubrication requirements.
8. Data sheet listing pertinent equipment or system information, as well as the address and telephone numbers of the nearest sales and service representatives

D. Operation and maintenance manuals shall be provided for each of the following items of equipment or system:

1. All sewage grinders
2. Electromagnetic flow meter
3. All pump station pumps and controls
4. Standby engine
5. Air supply systems and aeration diffusers
6. Electric motors
7. Unit heaters
8. All standby generators
9. Automatic transfer switches
10. Ventilation fans
11. Exhaust fans
12. Sliding gate operator
13. All valves
14. Water heater
15. Potable water pressure tank

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. In certain cases throughout Division 11, the product of more than one manufacturer has been indicated as being acceptable. The specifications usually describe one particular manufacturer's product and the drawings are necessarily limited to showing the product of only one manufacturer as indicated in the bidders check-off list. The intention is to indicate the function, quality, and/or grade of the equipment desired. The product of a manufacturer mentioned in the specifications which differs in detail from the one described will be acceptable if, in the opinion of the ENGINEER, said product from the standpoint of function, quality, and/or grade is applicable as a substitute to the one described.

B. If the product of a manufacturer named in the specifications but not shown on the drawings is acceptable to the ENGINEER but differs from the one shown on the drawings to the extent that structural, piping, heating, ventilating, plumbing, electrical or any other changes are required for the proper installation and/or operation of the product, the CONTRACTOR shall be responsible for all costs involved in these changes. All such changes will be subject to the approval of the ENGINEER. Refer to Section 01600 for specific requirements on equipment substitution.

2.2 LUBRICATION:

A. On all equipment, ample means of lubrication shall be provided for bearings and any other metallic parts in sliding contact. Alemite industrial type fittings or equal shall be used for grease lubrication except as otherwise noted herein.

2.3 ELECTRICAL EQUIPMENT:

A. Starters

1. A control transformer and a magnetic starter, when required, for each motor will be furnished and installed by the General CONTRACTOR unless otherwise specified.

B. Motors

1. Motors shall be of sufficient capacity to operate the driven equipment under all conditions of operation without loading beyond the nameplate current or power. The rating of motors offered shall in no case be less than the horsepower shown on the drawings or specified herein except when it can be demonstrated that because the efficiency of the driven equipment is greater than that specified, a lesser horsepower motor will suffice. Both the rating and the characteristics of the motor shall be suitable for the successful operation of the equipment driven under maximum load conditions.

2. Unless specifically designated differently in subsequent portions of these specification, motors 2 horsepower and larger shall be designed to operate on 240/480 volt, 3-phase, 60-hertz AC. Except where explosion proof, or totally enclosed motors or motors designed for outdoor service are specifically called for or required, all motors shall be drip proof, ball bearing type. Unless otherwise noted, all motors shall be designed to operate in an ambient temperature of EF (40EC) in continuous operation with a service factor of 1.15. Explosion proof motors shall comply with all requirements of Class I, Division I, Group D, as defined by the NEC. Motors designed for outdoor service shall have the motor windings protected by U.S. Motors Everseal Solid-Cast Encapsulation, Westinghouse Life-Guard Encapsulation, or equal.

3. All motors shall comply with the standards of the IEEE and the NEMA in all respects except where requirements exceed these standards.

4. Vertical motors shall be provided with thrust bearings adequate for all axial loadings to which they can be subjected in operation.

5. Bearings for motors 2 horsepower and larger shall be rated for 20-year life under AFBMA standards.

6. All controls shall be designed to operate on 120 volt, single-phase, 60 hertz unless otherwise noted.

7. All motors shall be manufacturer designated with a high efficiency rating.

2.4 PAINT

A. Field and Shop Coat Compatibility

1. To ensure satisfactory paint and coating performance, it is a contract requirement that products applied in the shop and field be mutually compatible.

2. The CONTRACTOR shall require fabricators and equipment manufacturers to apply shop coats that are compatible with field coats specified. Paint all equipment in accordance with Section 09900.

2.5 EQUIPMENT ANCHORS:

A. Provide anchors for equipment requiring them. Size anchors for embedding in concrete and sleeve anchors as recommended by equipment manufacturers. When recommendations are not provided, size anchors in the largest diameter that will pass through bolt holes in equipment bases.

B. Stainless Steel Anchor Bolts:

1. ASTM A320 Grade B8, AISC Type 304.

C. Expansion Anchors:

1. Molly Parabolt or Parabond, Phillips Red Head Wedge Anchor or approved substitution.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment with skilled mechanical erection labor in accordance with manufacturer's instructions.

B. Installed equipment shall be inspected, adjusted, approved, and certified satisfactory by the manufacturer.

C. Furnish the ENGINEER with manufacturer's certificates regarding equipment installation prior to initial operations and mechanical performance tests.

D. Electrical Interface:

1. Install or mount, such electrical components or apparatus as provided by product manufacturer's specified in Division 11.

2. Power wiring, including final connections of such to electrical components or

apparatus of Products specified shall be performed as work of the Electrical CONTRACTOR.

E. Shop Painting

1. Prior to painting remove all rust, dust and scale as well as other foreign substances on ferrous metal surfaces to be prime painted in the shop by sandblasting.

2. Sandblasting shall conform to requirements of the latest edition of SSPC-SP6.

3. The ferrous metal surfaces thus cleaned shall be prime painted as soon as possible after cleaning to prevent new rusting.

4. All ferrous metal surfaces of equipment, apparatus, and devices shall receive a shop coat of primer (except acceptable factory finished surfaces) unless otherwise specified or required by the ENGINEER.

F. Painting:

1. Apply shop paint in accordance with SSPC-PA-1.

2. Minimum dry mil thickness at 2 mils.

G. Field Painting: As specified in Section 09900.

3.2 FIELD QUALITY CONTROL:

A. Upon completion of structural work as well as installation and adjustment of equipment in a manner satisfactory to the ENGINEER, the CONTRACTOR with his own forces, including such equipment and other experts as may be necessary (hereinafter collectively referred to as "CONTRACTOR'S personnel") shall place equipment in operation.

B. Give the OWNER at least 7 days written notice prior to placing equipment in operation.

C. Operating procedures during said period are subject to ENGINEER'S approval.

D. Operation of equipment prior to satisfactory completion of performance tests is the CONTRACTOR'S complete responsibility.

E. Designate a day approved by the ENGINEER for commencement of the initial mechanical performance test.

F. Initial Mechanical Performance Test:

1. CONTRACTOR'S personnel, with the personnel of the OWNER observing,

shall demonstrate to the satisfaction of the ENGINEER the mechanical performance of each item of equipment when operated in accordance with the design intent indicated by the drawings and described in the applicable specifications.

2. If the demonstrations are satisfactory to the ENGINEER (or if equipment deficiencies are found, then subsequent to correction of the deficiencies by the CONTRACTOR), the CONTRACTOR shall be given 7 days written notice to conduct the final mechanical performance test.

G. Test Interim:

1. CONTRACTOR'S personnel, without reliance of OWNER'S personnel, shall operate and maintain the equipment in continuous, day-to-day, 24-hour operation except as otherwise approved by the ENGINEER until commencement of the final mechanical performance test.

2. During this interim the CONTRACTOR's personnel shall instruct and train the OWNER'S personnel in their duties.

H. Final Mechanical Performance Test:

1. The final mechanical performance test shall cover a 48-hour period while the plant is in continuous, normal operation.

2. With equipment in continuous, normal operation, the personnel of the OWNER shall assume day-to-day operation of the equipment under the direct supervision of the CONTRACTOR'S personnel beginning with the final tests.

3. CONTRACTOR'S personnel shall demonstrate to the satisfaction of the ENGINEER that equipment is coordinated and that installation complies with the applicable drawings and specifications.

4. Performance tests shall be considered concluded at the end of the 48-hour period designated for the tests if the ENGINEER is satisfied with the test results or should deficiencies be found as a result of said test, then when the deficiencies have been corrected to the satisfaction of the ENGINEER.

I. Operating Costs:

1. Operating costs paid for by the OWNER to consist of:

   a. Electrical power

2. The CONTRACTOR shall provide initial grease, oil and fuel as required.
3.

PART 4 MEASUREMENT AND PAYMENT

4.1 Wages and salaries of OWNER'S personnel prior and subsequent to the initial mechanical performance tests will be paid by the OWNER.

4.2 Wages and salaries of CONTRACTOR'S personnel, including manufacturers' representatives, as may be required for any and all tests specified herein shall be paid by the CONTRACTOR.

4.3 Applicable contract lump sum prices shall include the furnishing of all said services. Said services shall be additional to those furnished in connection with equipment erection, installation, testing, and the correction of deficiencies. Service provided shall consist of furnishing detailed instructions to personnel of the OWNER regarding equipment operations and maintenance after personnel of the OWNER have had an opportunity to become familiar with treatment plant equipment.

4.4 BASIS OF PAYMENT:

A. All equipment shall be paid for as an incidental part of the lump sum item in or on which the equipment is erected (or as an incidental part of the lump sum item covering the alteration of such existing structure in or on which new equipment is erected), and no separate or additional compensation shall be allowed.

END OF SECTION

SECTION 11310
FLINTVILLE AND PRESCOTT PUMP STATIONS

PART 1 - GENERAL

1.1 SCOPE

A. The General Contractor shall furnish and install two (2) factory built above ground pump stations, one each for Flintville Pump Station and Prescott Pump Station. Each station shall be complete with all equipment specified herein; factory installed in a fiberglass reinforced polyester resin enclosure. The principal items of equipment shall include two self-priming, horizontal, centrifugal, V-belt motor driven sewage pumps, valves, internal piping, control panel, liquid level control system and internal wiring.

B. Electrical power to be furnished to the site will be 1 phase, 60 hertz, 240 volts, maintained within plus or minus 10 percent. The available fault current provided at the pump station control panel is 10 kA rms symmetrical. Control voltage shall not exceed 132 volts.

C. The system shall be manufactured by The Gorman-Rupp Company, Mansfield, OH as supplied by Envirep, Inc., Camp Hill, PA (717-761-7884).

1.2 SUBMITTALS

A. Product Data: Prior to fabrication, submit the following to the engineer for approval:

1. Shop drawings providing layout of the mechanical equipment and anchor bolt locations, and indicating the use of Unified National Standard bolts and fasteners. Pipe penetrations shall be dimensional in relation to the station centerline.
2. Electrical ladder logic drawings illustrating motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.
3. Catalog cut sheets for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristics curves showing design duty point capacity (GPM), head (FT), net positive suction head (NPSHR), and hydraulic brake horsepower.
4. Pump Manufacturer's v-belt drive selection calculation summary sheet showing corrected H.P. Per Belt, total H.P. developed, pitch diameter of sheaves, center distance between driver and driven shafts and combined arc-length correction factor applied to theoretical horsepower transmission per v-belt, and all calculations to demonstrate a minimum Safety Factor of 1.5.
5. Certified dimensional drawings indicating size, location and the spherical solids passing capability of the primary recirculation port.
6. Sample of service agreement and service agreement checklist for the specified equipment.
7. Interconnection wiring diagram showing the field wiring between the telephone dialer and the alarms.

8. Copy of certificate with course I.D. number for pump manufacturer's PADEP approved Wastewater Operator Training Program in Pump Maintenance and Troubleshooting course that counts toward Pennsylvania pre-certification experience and continuing education unit requirements.

B. Certified Tests: Prior to shipment of the equipment from the manufacturer's facility, submit the following certified tests to the engineer for approval.

1. Certified copies of factory run pump performance tests. Characteristics of pumps may have a tolerance of plus 10% of rated capacity at rated head or plus 8% at rated head capacity. No minus tolerance will be acceptable. The performance tests will substantiate the correct performance of the equipment at the design head, capacity, suction lift, speed and horsepower as herein specified.
2. Certified reprime performance test data in accordance with procedures herein specified.
3. Certified copies of air release valve closure performance test.
4. Tests shall be certified by a registered professional engineer.

C. Certified System Performance Tests: All components, including the pumps, motors, and controls, will be tested as a complete working system at the pump manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational tests shall simulate actual performance anticipated. Submit certified tests data to the engineer for approval.

D. Operation and Maintenance Manuals:

1. Operation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at the time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
2. Documentation shall be specific to the pump station 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:

    a. Functional description of each major component, complete with operating instructions.
    b. Instructions for operating pumps and pump controls in all modes of operation.
    c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
    d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the

specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.

e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA 70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

3. Operation and maintenance instructions, which rely on vendor cut-sheets and literature, which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.
4. Telephone dialer instructions and interconnection wiring diagram showing the field wiring between the telephone dialer and the alarms.

E. Manufacturer's Field Performance Test Report: The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, instruct operating personnel in the proper operation and maintenance of the equipment. A written report covering the equipment startup shall be mailed from the Manufacturer's startup technician directly to the Owner. At a minimum, the report shall include:

1. Nameplate information.
2. Recordings of gauge readings, total dynamic head and operating speed for each pump.
3. Recordings of level control settings.
4. Certification that equipment has been properly installed and lubricated and is in accurate alignment.
5. Certification that the v-belt drive system has been properly aligned using a laser alignment instrument and v-belts tensioned using a belt-tensioning instrument.
6. Results of electrical tests including voltage readings and amperage readings of all motors.
7. Certification that the equipment has been operated fully loaded and that it operated satisfactorily.
8. Outline in detail any deficiencies noted, and proposed remedial corrections.
9. Confirm proper installation and operation of telephone dialer including actual tripping of each alarm input device, telephone reception, message programming, call out list, proper wiring, and instruction of operating personnel.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Upon request from the engineer, the pumping equipment manufacturer shall demonstrate the following:

1. Proof of financial stability and ability to produce the pumping equipment within the specified delivery schedules.
2. Evidence of the facilities, equipment, and expertise to demonstrate the manufacturer's commitment to long-term customer service and project support.
3. Evidence of adequate local and factory spare parts inventory to provide timely delivery of spare parts.
4. Evidence that the pump manufacturer is an Underwriters Laboratories (UL) panel builder.
5. Evidence that the pumps and pumping equipment are constructed, assembled and tested in the United States by the pump manufacturer. All pump parts including the casing shall be machined at the pump manufacturers' facility located within the United States.
6. To ensure compatibility to existing tools and equipment, all pump internal and external nuts, bolts and hardware, shall be Unified Thread Standard (UNC) per ASME/ANSI standards.
7. Evidence that the pump manufacturer can provide operator training that counts toward Pennsylvania pre-certification experience and continuing education requirements.
8. Consideration will be given only to pump manufacturers meeting the following qualifications:
9.
    a. Twenty years minimum experience successfully producing pumping equipment of the type specified herein.
    b. A minimum of twenty-five installations of pumping equipment of the type specified herein in successful operation for a minimum of ten years.

10. Pump manufacturer must be ISO 9001:2000 certified, with scope of registration including design control and after sales activities.

B. Manufacturer's Representative Qualifications: Upon request from the engineer, the equipment manufacturer's local representative shall demonstrate the following:

1. Evidence of adequate local spare parts inventory to provide timely delivery of spare parts.
2. Evidence of established locally based factory-trained service personnel.
3. Evidence that representative offers comprehensive equipment service agreements for the equipment specified.
4. List of at least ten local municipalities with installations similar to the specified equipment.
5. Evidence that the representative offers full-day operator training seminars on Centrifugal Pump Maintenance and Troubleshooting.
6. Evidence that the representative offers technical design assistance and hydraulic recommendations for pump station design.

7. Certification from manufacturer that the service technician has been factory-trained and is authorized for such duties by the manufacturer.

C. Pump Performance:

1. Design and construct the pumps in accordance with standards of the Hydraulic Institute. The efficiency of the pumps, when operating under conditions of the specified capacities and heads shall be as near peak efficiency as practicable.
2. Design the pumps designated as self-priming centrifugal to pump raw sewage containing solids up to ten percent and stringy materials with a minimum of clogging. Pumps may be protected by screening equipment, but materials passing through may combine by a felting or balling process.

D. Source Quality Control:

1. Obtain pumping equipment, motors, motor starters, pump controls and appurtenances from the pump manufacturer whose responsibility it is to insure that the pumping equipment is properly furnished, coordinated, and tested in accordance with these specifications.
2. 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. The pump control panel including the level controls shall be constructed at the pump manufacturer’s facilities. The pump manufacturer shall be an Underwriters Laboratories (UL) panel builder. The control panel shall meet all UL and Joint Industrial Council (JIC) standards.
4. The manufacturer of the pumping equipment shall provide a listing of similar self-priming sewage pumping systems located in the State of Pennsylvania, for review by the engineer. This listing shall include locations and contact names. Project references provided should include similar size self-priming pumps utilized with variable speed drives and PLC based logic control. These references must serve to demonstrate the pump manufacturer's ability to design complete, fully integrated pumping systems with similar flow rate, total dynamic head and suction lift requirements.

E. Factory System Test:

1. All internal components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the pump manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational tests shall simulate actual performance anticipated for the complete station.
2. Upon request from the engineer, the operational test may be witnessed by the engineer and/or representatives of his choice at the manufacturer's facility.

1.4 MANUFACTURER'S WARRANTY

A. All components of the pumping equipment shall be manufactured, assembled and tested as a unit by the pump manufacturer. The pumping equipment must be a standard catalog item with the manufacturer. The pump manufacturer must assume system responsibility, i.e. the complete pump station assembly must be warranted by the manufacturer as described herein. Individual component warranties are desirable. However, individual warranties honored solely by the manufacturers of each pump station component will not be acceptable.

B. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1. Fiberglass components of the station enclosure shall be warranted for five (5) years for resist UV damage, corrosion from moisture or corrosive soils, or physical failures occurring in normal service, without the need for special protective coatings, when installed according to the manufacturer's recommendations.
2. All other equipment, apparatus, and parts furnished shall be warranted for five (5) years, 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 pumping station and all components when installation is made and use and maintenance is performed in accordance with the manufacturer's recommendations.
3. 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 without cost of parts to the owner.

C. It is not intended that the pump station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

D. The warranty shall become effective upon the acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment, whichever occurs first.

1.5 MANUFACTURER

A. These specifications and accompanying drawings specify and show equipment and materials manufactured by The Gorman-Rupp Company, deemed most suitable for the service anticipated. The contractor shall prepare his bid on the basis of the particular equipment and materials specified for the purpose of determining the low bid. The awarding of the contract shall constitute a contractual obligation to furnish the specified equipment and materials.

B. After execution of the contract, the contractor may request to substitute equipment other than that specified in the contract. Substitutions will only be considered in the event that the equipment proposed for substitution is superior in construction and efficiency to that specified in the contract, and higher quality has been demonstrated by service in a sufficient number of similar installations.

C. In the event the contractor obtains engineer's approval of equipment other than that for which the station was originally designed, the contractor shall, at his own expense, make any changes in the structures, buildings or piping necessary to accommodate the equipment, and shall provide as-built drawings to the engineer.

D. It will be assumed that the cost to the contractor of the equipment proposed to be substituted is less than that of the equipment specified in the contract and, if substitution is approved, the contract price shall be reduced by an amount equal to the savings.

PART 2 - PRODUCTS

2.1 STATION ENCLOSURE

A. The station enclosure shall contain and protect all pumps, interior piping, valves and associated controls. Enclosure shall be 77-inches square and 91-inches high. Enclosure shall incorporate the following design and service features:

1. Access doors shall be supplied on all sides. Doors shall be sized and placed to permit routine maintenance operations through the door openings of the enclosure. For these purposes, routine maintenance shall include pump and motor inspection, drive belt adjustment, and pump cleanout. Doors shall be supplied with tamper-proof hardware.
2. All four sides of the enclosure shall have "split" doors with the top half of the doors lifting upwards and the bottom half opening sideways. The top portion of the doors shall have hardware to prevent premature closing of the door.
3. Doors shall provide access to frequently performed adjustments and inspections of the electrical controls. Hinges shall be the continuous type. Latches shall engage the enclosure at not less than two places, and shall be protected by a keyed lock.
4. One door shall contain a screened vent to maximize airflow for enclosure ventilation.
5. Station enclosure, less base must be completely removable or able to be disassembled following the removal of reusable hardware. After removal or disassembly, no portion of the enclosure (except electrical service entrance) shall project above the surface of the base to interfere with maintenance operations or endanger personnel.
6. Removal or disassembly of the enclosure shall be accomplished by not more than two maintenance personnel without the use of lifting equipment.

B. Materials:

1. Each station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used. Glass fibers shall have a minimum average length of 1 1/4 inches. Major design considerations shall be given to structural stability, corrosion resistance, and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to microorganisms, mildew, mold, fungus, corrosive liquids, and gases, which can reasonably be expected to be present in the environment surrounding the wet well.
2. All interior surfaces of the housing shall be coated with a polyester resin-rich finish. It shall provide: maintenance-free service; abrasion resistance; and protection from sewage, greases, oils, gasoline, and other common chemicals.
3. The outside of the enclosure shall be coated with a suitable pigmented resin compounded to insure long, maintenance-free life.

C. Enclosure Base:

1. The station base shall be constructed of pre-cast, reinforced concrete, bonded inside a fiberglass form covering top and sides, and shall be designed to insure adequate strength to resist deformation of structure during shipping, lifting, or handling. Base shall incorporate drainage provisions, and shall be provided with an opening of sufficient size to permit piping and service connections to the wet well.
2. Station base shall incorporate anchor recesses for securing the pump station to the concrete pad supplied by the contractor in accordance with the station plans.
3. Color used shall de-emphasize the presence of dirt, grease, etc.

D. Exhaust Blower:

1. An exhaust blower shall be mounted in the roof of the enclosure. Blower capacity shall be sufficient to change station air once every two minutes. Blower motor shall be operated automatically and shall be turned on at approximately 70-degrees F and shall turn off at 55-degrees F. Blower motor and control circuit shall be protected by a thermal-magnetic air circuit breaker to provide overcurrent and overload protection. Blower exhaust outlet shall be designed to prevent the entrance of rain, snow, rocks, and foreign material.

E. Station Heater:

1. Pump station shall be provided with a 1300/1500-watt, 115-volt electric heater with cord and grounding plug. Ungrounded heaters shall not be acceptable.

F. Low Station Enclosure Temperature:

1. Each enclosure shall be provided with a thermostat to serve as a low temperature alarm.

2.2 PUMPS

A. Pump Description:

1. Pumps shall be Gorman-Rupp Model V3A60-B horizontal, self-priming, centrifugal pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage.

2. All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of the specified spherical solids passing capability, and any trash or stringy material which may pass through the average house collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump shall not be permitted.

3. The pumps shall have the following characteristics:

Design Characteristics		Flintville Pump Station	Prescott Pump Station
a.	Suction connection, flanged, in	4	4
b.	Discharge connection, flanged, in	3	3
c.	Minimum shutoff head, each pump, ft	50	53
d.	Pump speed, rpm	1350	1400
e.	Maximum NPSH required at design point, ft	2	2
f.	Minimum reprime lift capability, ft	16	16
g.	Spherical solids passing capability, in. diameter	2.5	2.5
h.	Motor horsepower	7.5	7.5
i.	Motor speed, rpm	1750	1750
j.	Impeller diameter, in	9.00	9.00

B. Pump Performance:

1. Each pump must have the necessary characteristics and be properly selected to perform under these operating conditions:

2.

Performance Characteristics		Flintville Pump Station	Prescott Pump Station
a.	Capacity, gpm	115	135
b.	Total dynamic head, ft	43	46
c.	Total dynamic suction lift, ft	16.3	15.3
d.	Maximum static suction lift, ft	15.9	14.7
e.	Discharge static head, ft	10.6	8.3

3. Consideration shall be given to the sanitary sewage service anticipated, in which occasionally debris will lodge between the pump suction check valve and seat, resulting not only in loss of the suction leg, but also in the siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal with proper installation of air release line to atmosphere.

4. In consideration of such occurrence and of the unattended operation anticipated, each pump shall be so designed as to retain adequate liquid in the pump casing to insure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

C. Reprime Performance:

1. Each pump must be capable of the specified reprime lift while operating at the selected pump speed and impeller diameter. Reprime lift is defined as the static height of pump suction centerline above liquid that the pump will prime; and delivery within five minutes on liquid remaining in the pump casing after a delivering pump is shut down with the suction check valve removed. Systems requiring ancillary vacuum generating devices shall not be acceptable. Additional standards under which reprime tests shall be run are:

   a. Piping shall incorporate a discharge check valve down stream from the pump. Check valve size shall be equal (or greater than) the pump discharge diameter.
   b. A ten-foot length of one-inch pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere at all times to duplicate the air displacement rate of a typical pump station fitted with an air release valve.
   c. No restrictions shall be present in pump or suction piping that could serve to restrict the rate of siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a minimum horizontal run of 2 feet and one 90-degree elbow.
   d. The pipe size used for the reprime performance test shall be the same size as the pump suction diameter.
   e. Impeller shall be set at the clearances recommended by the manufacturer in the pump service manual.
   f. Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.
   g. Liquid to be used for reprime test shall be water.

D. Serviceability:

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that due consideration has been given to reducing maintenance costs by incorporating the following features:

a. No special tools shall be required for replacement of any components within the pump. All internal and external threaded fasteners shall be of the Unified National Standard type.
b. The mechanical seal shall be a one-piece cartridge type to allow for easy replacement. Mechanical seals requiring assembly of individual components shall not be acceptable.
c. The pump must be equipped with a removable cover plate, allowing access for service and repair without removing suction or discharge piping.
d. The pump shall be fitted with a replaceable wear plate. Replacement of the wear plate, impeller, and seal shall be accomplished through the removable cover plate without removing suction or discharge piping.
e. The entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping.
f. Removal or installation of the suction check valve shall be accomplished from the top of pump without disturbing the suction piping or completely draining the casing.
g. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.
h. Cover plate impeller clearance adjustment: Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external shimless cover plate adjustment utilizing collar and adjusting screw design for incremental adjustment of clearances by hand. Pumps requiring realignment of belts, couplings, etc., due to clearance readjustment shall not be acceptable. Cover plate shall be capable of being removed without disturbing clearance settings.
i. Rotating assembly impeller clearance adjustment: Additional adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by moving the entire rotating assembly towards the wear plate, to compensate by removal of stainless steel shims between the rotating assembly and the volute.
j. Clearance adjustment which requires movement of the shaft without movement of the entire rotating assembly, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

E. Construction:

1. Pump casing: Made of Gray Iron 30, shall be foot supported, and shall have a horizontal centerline suction and vertical discharge. Suction connection and discharge connection shall be vertically in-line with one another.

a. The casing shall have a top mounted 3-1/2 inch priming fill port with a safety lock bar cover. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detent lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

b. Casing shall have no openings of smaller diameter than the specified sphere size.
c. Casing shall be designed to retain sufficient liquid to ensure automatic repriming and unattended operation.
d. A minimum 1-1/4 inch diameter drain hole shall be provided for attachment of the pump drain kit and to ensure complete and rapid draining.
e. Bolts and other threaded fasteners shall have Unified National Standard threads.
f. Suction flap valve: The suction flap valve shall be externally removable and shall be constructed of molded neoprene with integral steel and nylon reinforcement. A blow-out center shall protect the pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished from the top of the pump without any other disassembly of the pump, without disturbing any piping and without draining the pump. Sole function of the suction flap 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.
g. Pump shall be provided with a separate capped threaded port for use of an optional casing heater.

2. Cover plate: Cover plate shall be Gray Iron 30.

a. Cover plate shall be retained by four (4) nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and the allow removal or service to the impeller, seal, or wear plate.
b. Replaceable wear plate: Secured to the cover plate by welded studs and nuts. The wear plate shall be Carbon Steel 1015. The wear plate shall be of sufficient width to maintain the manufacturer's recommended clearance between the entire edge of each impeller vane and the wear plate. Wear plate attachment hardware shall have Unified National Standard threads and shall be located out of the direct flow path of the liquid into the impeller. Two (2) Buna-N o-rings shall seal cover plate to the pump casing. The wear plate shall be constructed with a minimum of six (6) semi-circular machined channels and a tapered face designed to provide self-cleaning action and ensure that debris is cleared away from and does not collect between the impeller and the wear plate.
c. O-ring Seals: Two (2) Buna-N o-rings shall seal cover plate to the pump casing. The inner cover plate o-rings shall provide a seal between the suction chamber and the discharge chamber of the pump casing to eliminate the possibility of recirculation at the wear plate.
d. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75 PSI.
e. Pusher bolt capability to assist in removal of coverplate. Threaded pusher bolt holes shall be sized to accept same retaining capscrews as used in rotating assembly.
f. Easy-grip handle shall be mounted to face of coverplate.

3. Rotating assembly:

   a. Impeller: Two-vaned, semi-open, non-clog, Ductile Iron 65-45-12 with integral pump out vanes on the back shroud. Impeller shall be balanced and shall thread onto the pump shaft and be secured with a lockscrew and conical washer.
   b. Shaft: Shaft shall be constructed of Alloy Steel 4150.
   c. Mechanical seal: Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be silicon carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design. An external O-ring secures the stationary seat to the seal plate, 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. The seal shall be warranted for five (5) years from date of shipment.
   d. Lubrication: Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Oil 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 with 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. 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 plug with vent. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the vented fill plug.
      3. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

   e. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.
   f. Seal plate: Replaceable seal plate shall be constructed of Gray Iron 30, and shall be bolted to the bearing housing. Seal plate shall be equipped with anti-rotation ribs cast into the seal plate to reduce internal wear and to maximize seal plate and mechanical seal life.
   g. Radial bearings: Single row, anti-friction ball bearings, of ample size and proper design to withstand all radial loads which can reasonably be expected during normal operation. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal shall not be acceptable.
   h. Thrust bearings: Double row, anti-friction ball bearings, of ample size and proper design to withstand all thrust loads which can reasonably be

expected during normal operation. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal shall not be acceptable.

i. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

4. Suction and discharge spools: Each pump shall be equipped with one-piece, cast iron spools, flanged on each end. Each spool shall have one 1-1/4-inch NPT and one 1/4-inch NPT tapped hole with pipe plugs for mounting of gauges or other instrumentation.

2.3 PUMP ACCESSORIES

A. Spare Parts: Furnish the following spare parts for <u>each</u> pumping station:

1. Two (2) Spare Parts Kits, each including one (1) mechanical cartridge seal, one (1) set of rotating assembly adjustment shims, one (1) cover plate o-ring, and one (1) rotating assembly o-ring
2. Four (4) suction flap valve assemblies
3. One (1) belt tensioning gauge - spring loaded
4. Two (2) quarts of seal lubricant
5. Two (2) air pump repair kits for bubbler level control system
6. Two (2) discharge check valve springs

B. Gauge Kit With Vibration Isolation Frame:

1. Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4-inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full-scale reading. Compound gauges shall be graduated -34 feet to +34 feet water column minimum. Pressure gauges shall be graduated 0 to 70 feet water column minimum.
2. Gauges shall be mounted on a vibration isolation frame assembly with resilient panel, frame, and adjustable brackets which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings, and shall include a shutoff valve installed in each gauge inlet at the point of connection to suction and discharge pipes.
3. Gauge kit shall be supplied with stainless steel fittings.

C. Pump Drain Kit:

1. The pump drain kit shall consist of a 10’ length of plastic hose with a quick connect female Kamlock fitting on one end of hose and two sets of fittings for pump drains. Each set of fittings for pump drain includes a pipe nipple, bushing, bronze gate valve and quick connect male Kamlock fitting.
2. Pump drain kit shall be supplied with stainless steel fittings.

D. Self Cleaning Wear Plate:

1. The wear plate shall be constructed with no more than six (6) semi-circular machined channels and a tapered face designed to provide self-cleaning action and ensure that debris is cleared away from and does not collect between the impeller and the wear plate.

2.4 VALVES AND PIPING

A. Check Valves, 4-inch:

1. Each pump shall be equipped with a full flow type check valve, each capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron. The valve shall be equipped with a removable cover plate to permit entry for complete removal and replacement of internal components without removing the valve 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, sealing bushing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 175-PSI water working pressure, 350-PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

B. Plug Valve, 4-inch:

1. Discharge header piping shall include a 3-way plug valve to permit the pump to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125-pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseat action. The lever shall have a locking device to hold the plug in the desired position.

C. Air Release Valves (High-Impact Composite Polyester):

1. Each pump shall be equipped with an Air Mate® air release valve to vent air to atmosphere during initial priming or unattended repriming cycles. The valve shall automatically close operating solely on discharge pressure to prevent recirculation. A visible indication of valve closure shall be evident.
2. Air release valve piping must discharge directly into wet well. ARV piping shall not discharge to a sump.
3. The air release valve shall be constructed of high-impact composite polyester containing not less than 30% glass-filler. The valve body shall incorporate an internal passageway that allows all debris to pass through the valve chamber between operational cycles. The diaphragms shall be Buna-N, Fluorocarbon or EPDM, with a polyester mesh rated for 250 PSI of pressure.

4. The vertical plunger shall be constructed of Acetal and PTFE fluorocarbon filler. The independent, dual diaphragms and single, vertical valve plunger shall incorporate a media fluid that passes through an orifice and separates the actions of each.
5. The valve shall employ an externally-adjustable restrictor for applications below four feet of static discharge head.
6. The valve body shall incorporate passageways having minimal constrictions and no directional course changes integral to the body of the valve. The inlet shall be 1 inch NPT female and the discharge outlet shall be 1-1/4 inch NPT female. The valve shall be mounted horizontally, at 90 degrees to the vertical plunger.
7. The valve shall be capable of operation on applications ranging from four to 400 feet of water column without the need for adjustment or change of springs or other parts.
8. Air release valves shall be connected to pump station piping using stainless steel pipe fittings.
9. Each air release valve shall be provided with an isolation ball valve.

D. Piping:

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and Class 53 thickness flanges shall be cast iron Class 125 and comply with ANSI B16.1 all piping pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
2. Boltholes shall be in angular alignment within ½-degree between flanges. Flanges shall be faced and a gasket finish applied that shall have 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 ¼ inch apart.

E. Supports and Thrust Blocks:

1. Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping.
2. Pump station discharge force main piping shall be anchored with thrust blocks by the contractor where shown on the contract drawings.

F. Gauge Connection Assembly:

1. The header piping shall be equipped with a gauge connection assembly located between the discharge check valve and force main isolation plug valve allowing the operator to easily attach a discharge gauge on any pump for troubleshooting.
2. The gauge assembly shall consist of a 1/4" brass pipe nipple, 1/4" brass full port ball valve and a quick connect fitting.
3. The gauge connection assembly shall be installed in the discharge header piping such that the static and dynamic pressure in the force main can be read at all times unless the force main isolation plug valve is closed for that particular pump.

G. Portable Pump Discharge Connection, 4-inch:

1. The station header pipe shall incorporate a 2-way plug valve to permit emergency access to the pump station force main after isolation of the pumps. Valve body shall be cast iron with flanged end connections drilled to 125-pound standard. The plug valve shall be non-lubricated type, furnished with a drip-tight shutoff plug mounted in stainless steel or Teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface.
2. The bypass connection shall be accessible behind the hinged door on the wet well side of the station enclosure and shall terminate with a male OPW type quick connect fitting.

2.5 DRIVE UNIT

A. Motors:

1. The pump motors shall be horizontal, totally enclosed fan cooled, induction type, with normal starting torque and low starting current characteristics. The motors shall not be overloaded at the design condition or at any head in the operating range as specified.
2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std. 112.
3. Each motor shall be in current NEMA design B cast iron frame with copper windings.
4. Motors shall be NEMA Premium Efficient, per NEMA MG-1, Table 12-12.

B. Drive Transmission:

1. Power shall be transmitted from motors to pumps by means of v-belt drive assemblies. The drive assemblies must be selected to establish proper pump speed to meet the specified operating conditions.
2. Each drive assembly shall have a minimum of two v-belts. In no case will a single belt drive be acceptable. Each v-belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump. Drive systems with a safety factor of less than 1.5 shall not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.
3. V-belts shall be the banded type.

C. Belt Guards:

1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½ inch.
2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component, and shall be securely fastened to the unit base.
3. All metal shall be free of burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than five-inch spacing. Tack welds shall not exceed four-inch spacing.

4. 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.

2.6 FINISH

A. Surface Preparation:

1. Pumps, piping and exposed steel framework shall be prepared utilizing a six-stage surface preparation system including the application of iron phosphate and sealer/rust inhibitor.
2. The method shall provide excellent removal of substrate contaminants and very effectively etch pores in the metal resulting in a superior adhesion of primer and paint.
3. Surface preparation shall be in accordance with United States Government mil spec # MIL-T-704J. Sandblasting shall not be acceptable.

B. Paint:

1. Pumps, piping and exposed steel framework shall be coated with one coat gray W.R. non-lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be low VOC, alkyd based, high solids, semi-gloss white enamel for optimum illumination enhancement and incorporate rust inhibitive additives.
2. The finish coat shall be 1.0 to 1.5 MIL dry film thickness (minimum), resistant to oil mist exposure, solvent contact and salt spray.
3. The factory finish shall allow for over-coating and touch up after final installation.
4. All flanged connections including pumps, valves, piping and fittings shall be painted prior to assembly.

2.7 PUMP CONTROL SYSTEM

A. General:

1. This specification covers a pump control system for the duplex pumping station including motor circuit breakers, starters, thermal overload relays, door mounted operator controls, and liquid level controls.
2. The liquid level control will include an air bubbler level control system, electronic pressure switch, pump sequence control, alarms and pump safety shutdowns.

B. UL Listing:

1. The pump station controls shall be manufactured by the pump manufacturer who shall be a UL panel builder and each assembly shall bear a serialized UL label listed for "Enclosed Industrial Control Panels."

2. The enclosure and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures. Listing for open style industrial control panels or an assembly of listed or recognized components shall not be acceptable.

C. Panel Enclosure:

1. Enclosure shall be constructed in conformance with applicable section of national electrical manufacturers' association (NEMA) standards for Type 1 electrical enclosures. Enclosure shall be fabricated of stainless steel having a minimum thickness of not less than 0.075 inch (14 gauge).
2. Door shall be hinged and sealed with a neoprene gasket and shall be held closed with clamps that are quick and easy to operate. The door shall accommodate the mounting of switches and indicators.
3. Enclosure shall be furnished with a removable back panel, fabricated of steel having a thickness of not less than 0.106 inch (12 gauge), which shall be secured to the enclosure with collar studs. Such panel shall be of adequate size to accommodate all basic components.
4. All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators and instruments shall be mounted through the control panel door. Self-tapping screws shall not be used to mount any components.
5. Each control assembly shall be furnished with main terminals and ground lug for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the loads. The main terminals shall be mounted to allow incoming wire bending space in accordance with article 373 of the national electric code (NEC). A separate terminal strip shall be provided for 115 volt, single-phase control power and shall be segregated from the main terminals. Ten percent of the control terminals shall be furnished as spares.
6. Each control panel shall be provided with a thermostat to serve as a low station temperature alarm.

D. Motor Branch Components:

1. All motor branch components shall be of the highest industrial quality. Operating coils of all AC control devices shall be rated for 120 volts, and shall be suitable for use in a voltage range of 108 to 132 volts, 60 hertz.
2. Circuit Breakers and Operating Mechanisms:
   a. A properly sized heavy-duty air circuit breaker shall be furnished for each pump motor, and shall have a symmetrical RMS interrupting rating of 10,000 amperes at 240 volts. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.
   b. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the "OFF" position
3. Motor Starters:

a. An open frame, across-the-line, NEMA rated magnetic motor starter shall be furnished for each pump motor. Starters of NEMA size 1 and above shall be designed for addition of at least two auxiliary contacts. Starters rated "0", "00", or fractional sizes shall not be acceptable. Power contacts shall be double-break and made of cadmium oxide silver. All motor starters shall be equipped to provide undervoltage release and overload protection.

b. Motor starter contacts shall be easily replaceable without removing the motor starter from its mounted position.

4. Overload Relays:

a. Overload relays shall be of the thermal block-type and shall have visual trip indication with trip-free operation. Pressing of the overload-reset lever shall not actuate the control contact until such time as the overload thermal element is reset. Resetting of the overload-reset lever will cause a snap-action control contact to reset, thus reestablishing a control circuit.

b. Overload reset pushbuttons shall be mounted through the door of the control panel in such a manner as to permit resetting the overload relays without opening the control panel door.

5. Starting Capacitors:

a. Provide starting capacitors for starting single phase motors.

E. Indicators:

1. Indicating lights shall be oil tight type and equipped with integral step-down transformers for long lamp life. Lamps shall be incandescent type rated 14 volts or less with a minimum life of 15,000 hours. Lamps shall be replaceable from the front without opening the control panel door and without the use of tools.
2. Indicating lights will be furnished for the following functions:
   a. Pump No. 1 run
   b. Pump No. 2 run
3. Indicators shall be furnished for the following functions:
   a. High Pump Temperature, No. 1
   b. High Pump Temperature, No. 2

F. Switch Controls:

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
2. Pump mode selector switches shall be connected to permit manual start and manual stop of each pump individually or permit automatic operation under control of the liquid level control system. Manual operation shall override shutdown systems except the motor overload and phase failure relays. Selector switches shall be oil-tight with contacts rated NEMA A300.
3. Pump sequence selector switch shall permit selection of automatic pump alternation, or selection of either pump to run as lead pump for each cycle. Pump alternator relay shall be electro-mechanical industrial design. Relay contacts shall be rated 10 amperes minimum at 120 volts non-inductive.
4. Override switches shall be connected to bypass the level control system and all shutdown systems supplied with it, to provide manual start and manual stop of each pump individually in the event of level control system malfunction.

5. A selector switch shall provide manual alternation of the air pumps in the bubbler system. The switch shall be connected in such a manner that either pump may be selected to operate continuously.
6. A pushbutton switch shall be provided to silence the 115-volt AC alarm circuits while corrective actions are underway. Depressing the alarm silence pushbutton shall also cause the high water alarm circuit to reset when the liquid level has been lowered.

G. High Pump Temperature Shutdown:

1. The control panel shall be equipped with circuitry to override the level control system and shut down the pump motor(s) when required to protect the pump from damage caused by excessive temperature.
2. A thermostat shall be mounted on each pump to detect its temperature. If the pump temperature should rise to a level that could cause pump damage, the thermostat shall cause the pump motor to shut down. A visual mechanical indicator shall indicate that the pump motor has been stopped because of a high temperature condition.
3. The pump shall remain locked out until the pump has cooled and the circuit has been manually reset. Automatic reset of such a circuit shall not be acceptable.

H. Elapsed Time Meters:

1. Six-digit elapsed time meters (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenths of hours".

I. Pump Start Delay and Lockout:

1. Under Utility Power: When a high wetwell level condition is reached (indicating the lead pump is not supporting flow), the lead pump shall be locked out and the lag pump shall start after a five (5) second delay. Under automatic control, two (2) pumps shall not run simultaneously. The HOA switches may be used to manually run both pumps simultaneously.

2. Upon Loss of Utility Power:
   a. The second pump shall be locked out based upon a contact closure from the automatic transfer switch. Only one pump shall be permitted to operate under standby power.
   b. The lead pump shall be equipped with a 10 second time delay after the power has been restored on standby power. This step delay shall prevent the sewage pump from starting at the same time as other station loads when under standby power.

J. Alarm Contacts:
1. Provide separate alarm contacts for the following alarm conditions:
   a. High water (bubbler)
   b. High water (float)
   c. Low water

d. Phase failure
e. High pump temperature, #1
f. High pump temperature, #2
g. Station enclosure low temperature
h. Pump run, #1 (normally open)
i. Pump run, #2 (normally open)
j. Pump run, #1 (normally closed)
k. Pump run, #2 (normally closed)

K. Voltage Monitor:

1. 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 phase-reversal, phase loss and voltage. The motor(s) shall automatically restart when power conditions return to normal.

L. Secondary Surge Arrestor:

1. The control panel shall be equipped with a surge arrestor to minimize damage to the pump motors and control from transient voltage surges. The arrestor shall utilize metal-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps and a Joule rating of 1,500.

M. Transient Voltage Surge Suppression (TVSS):

1. TVSS protection shall be applied on the 120 volt secondary of the control transformer to protect all sensitive electronics powered by the control panel. An acceptable TVSS unit shall be as follows:
   a. Total Protection Solutions (1-800-836-2305) TK-LTE120-30A.
   b. Emerson Network Power Surge Protection (1-800-288-6169) Islatrol IC+130.
   c. There are no Equals.

N. Receptacle and Station Enclosure Task Light:

1. A duplex ground fault interrupter utility receptacle providing 115 VAC, 60 hertz, single-phase current shall be provided. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.
2. Each station enclosure shall be equipped with a fluorescent strip light (17 watt minimum) and associated light switch.

O. Auxiliary Power Transformer:

1. The station shall be equipped with a 3 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary circuits. The primary side of the transformer shall be protected by a thermal-magnetic air circuit breaker, specifically sized to meet the power requirements of the transformer. A mechanical operating mechanism shall be installed on the circuit breaker to provide a means of disconnecting power to the transformer.

2. The padlockable operator handle for the operating mechanism shall be located on the exterior of the control panel with interlocks which prevent opening the door until primary circuit breaker is in the "OFF" position.

P. Auxiliary Contacts:

1. Each pump motor starter shall include a N.C. auxiliary dry contact wired to a terminal strip to interface with the wet well aeration system.

2.8 WIRING

A. General:

1. The pump control as furnished by the manufacturer shall be completely wired except for the power feeder lines to the branch circuit breakers and final connections to remote alarm devices and between control assemblies.
2. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).
3. All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color-coded as follows:

a.	Line and load circuits, AC or DC power	Black
b.	AC control circuit less than line voltage	Red
c.	DC control circuit	Blue
d.	Interlock control circuit, from external source	Yellow
e.	Equipment grounding conductor	Green
f.	Current carrying ground	White
g.	Hot with circuit breaker open	Orange

B. Wire Identification and Sizing:

1. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Motor branch wiring shall be 10-gauge minimum.
2. Motor branch conductors and other power conductors shall not be loaded above 60-degree C temperature rating, on circuits of 100 amperes or less, nor above 75-degree C on circuits over 100 amperes. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the subplate shall be bundled and tied or installed in duct. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit.

C. Wire Bundles:

1. Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles

shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

D. Conduit:

1. All conduit and fittings shall be UL listed.
2. Liquid tight flexible metal conduit shall be constructed of a smooth, flexible, galvanized steel core with a smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
3. Conduit shall 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.

E. Grounding:

1. The pump station manufacturer shall ground all electrical equipment to the closure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections.

2.9 LEVEL CONTROL SYSTEM

A. Liquid Level Control:

1. 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.
2. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.
3. The level control system shall be a Gorman-Rupp Model EPS 2100 air bubbler type level control system.
4. The level control system shall incorporate automatic alternation to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.
5. 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 pump when the liquid reaches the "lag pump start level" so that both 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 12VDC in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Control range shall be 0 to 12.0 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be retained using a non-volatile lithium battery back-up.

c. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators and output relays.

1) 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 0-15 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 0.25% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.

2) 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 the preset start and stop level for both lead and lag pump. The display shall include twenty (20), 0.19" high alpha-numeric characters calibrated 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.

3) Level adjustments shall be electronic comparator set points to control the levels at which the lead and lag 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.

4) Each output relay in the electronic pressure switch shall be solid state. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. The "ON" state of each relay shall be indicated by illumination of a light emitting diode. The

output of each relay shall be individually fused providing overload and short circuit protection. Each output relay shall have an inductive load rating equivalent to one NEMA size 4 contactor. A pilot relay shall be incorporated for loads greater than a size 4 contactor.

d. The electronic pressure switch shall be equipped with an output board, which shall include LED status indicators and a connector with cable for connection to the main unit.
e. 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.
f. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.
g. The electronic pressure switch shall be capable of controlling liquid levels in either a pump up or pump down application.
h. 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, 0-10VDC, or 4-20mA, and one (1) 4-20mA scalable output. Output is powered by 10VDC supply. Load resistance for 4-20mA output shall be 100-400 ohms.
i. The electronic pressure switch shall include a DC power supply to convert 120 VAC control power to 12VDC EPS power. The power supply shall be 500-mA (6W) minimum and be UL listed Class II power limited power supply.
j. The electronic pressure switch shall be contained within a NEMA 1 enclosure including a polyester face and stainless steel case.
k. The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. An indicator, visible on the front of the control panel, 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.

6. 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 oil tight design with contacts rated NEMA A300 minimum.

B. Air Bubbler System:
1. The level control system shall be the air bubbler type, containing air bubbler piping, which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.
2. Two vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater

quantities of air at higher pressures, requiring pressure-reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously. The selector switch shall be oil-tight design with contacts rated NEMA A300 minimum.

3. An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT tapped fitting for connection to the bubbler line.
4. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

2.10 TELEPHONE DIALER - CELLULAR

A. Specifications:

1. Furnish and install a Cellular Telephone Alarm Dialer ("dialer"). Dialer shall be completely factory assembled and tested before shipment. Enclosure shall be NEMA 4X with hinged clear cover suitable for indoor mounting. With the enclosure door open, the device shall be completely "touch-safe" with the exception of the terminal strip. The telephone dialer shall be Model Crystal Ball as manufactured by OmniSite, Greenwood, IN, and as supplied by Envirep, Inc., Camp Hill, PA (717-761-7884).
2. Dialer shall be equipped with a digital cellular radio, GSM
3. Dialer shall monitor four (4) 4-20ma analog input signals for specialized reporting functions. Analog input #1 shall be suitable for use with a level probe or similar device, and shall be configured to report the current value of the input at the time of the daily report. Analog inputs #2, #3 and #4 shall be suitable for use with pump motor amp probe monitors or similar devices, and shall be configured to report the last non-zero values of the inputs at the time of the daily report.
4. Dialer shall be equipped with four (4) output relay sockets rated at 20 amps. Outputs shall be manually energized and de-energized via the Internet.
5. Dialer shall monitor three (3) pump run universal inputs that accept dry contact closures or voltage signals from +/-12VDC/VAC to +/-120 VDC/VAC. These inputs shall monitor pump run time, count pump run cycles and calculate total station flow and pumping rates. The pump run universal inputs shall be connected to motor starter auxiliary run contacts as follows:
   a. Pump #1 run contact
   b. Pump #2 run contact
   c. Pump #3 run contact
6. Dialer shall monitor eleven (11) universal inputs (in addition to the three (3) pump run inputs) that accept dry contact closures or voltage signals from +/-12VDC/VAC to +/-120 VDC/VAC. Input #5 shall also be configurable as a rain gauge input. Inputs #6 and #7 shall also be configurable as counter inputs and shall be capable of accepting pulse inputs from flow meters to report totalized daily flow.
7. The eleven (11) universal inputs shall be configured for alarm conditions as follows:

a. High water, commom
b. Low water
c. High pump temperature, common
d. Drive fault, common
e. Station low temperature
f. Normal power failure
g. Generator running
h. ATS in emergency position
i. Sewage grinder failure (Future at Prescott Road Pump Station)
j. Spare
k. Spare

8. The device shall include the following items:
   a. LCD display, 2 line, 16 character
   b. Four (4) output relay sockets
   c. 10mb Ethernet communications port
   d. Modbus RS232 port
   e. SD memory card slot
   f. Intelligent key for disabling dialer
   g. Battery charging power supply
   h. Battery backup with 0.8 amp-hour gel cell battery
   i. Lightning arrestor – solid state
   j. Removable terminal blocks
   k. UL 508 certification
   l. Antenna
   m. 14 Universal inputs (12VDC – 120 VAC)

B. Functionality and Capabilities

1. System shall be capable of the following functions (reported daily):
   a. Number of pump on/off cycles
   b. Pump run times
   c. Drawdown time
   d. Measured GPM for each pump
   e. Station flow and inflow
   f. Tank level (when connected to a level transducer)
2. All alarm functions shall be processed immediately.
3. All non-alarm functions shall be reported on a daily basis and shall be accessible and displayed over the Internet.
4. Upon alarm condition, the dialer shall make telephone calls, send messages to pagers, and/or send emails to a user programmable contact list.
5. The dialer shall have the ability to be programmed, setup and monitored over the Internet. Password protected web pages shall provide multiple levels of secure access. Web pages shall be used to view current status of alarms, view alarm history, view pump run times and set up the dialer. Local unit setup shall be performed with a keypad and menu system. Units requiring a separate computer for local programming shall not be acceptable.
6. Dialers that require proprietary programming software are not acceptable.
7. Historical data shall be exportable to Microsoft Excel or Word.

8. Monthly fee shall be independent of the number of alarm conditions, phone calls, or information exchange transactions.
9. A toll free phone number shall be provided to receive a current alarm status report and to acknowledge alarms.

C. Installation

1. The Electrical Contractor shall install each dialer and provide the following:
   a. 115 VAC, 60 Hz, 15 amp, single-phase power wiring with circuit breaker protection
   b. Good electrical ground connection
   c. Interconnecting alarm and input wiring from monitored equipment and devices to dialer.
   d. Output wiring, if applicable.
   e. Mount dialer in accordance with manufacturer's recommendations.
   f. Mount and wire antenna

D. Startup Service:

1. Manufacturer's service technician shall provide startup and operator training. Start up service shall include complete testing of each individual alarm input and each output. Testing shall include documented verification that all alarms properly trigger the final notification device (cell phone, pager, email, etc.).

E. Warranty:

1. The device shall be supplied by the pump station supplier and shall carry a one (1) year factory warranty. The factory warranty shall cover the cost of all parts and labor for equipment repairs performed at the factory. Warranty shall commence upon startup or 3 months after shipment, whichever occurs first.

F. Cellular Service:

1. Equipment purchase price includes 3 years of cellular service fees commencing at the activation date of the unit. Afterward, cellular service fees shall be billed annually directly to the municipality.

2.11 WET WELL AERATION SYSTEM

A. General: A wet well aeration system including control panel and fiberglass enclosure shall be installed at each pump station with air discharge piping in the wet well as shown on the drawings. Aeration systems shall be Envirep Model 115HB1C.

B. Aeration blower assembly:

1. The aerator shall be capable of producing sustained aeration and sufficient agitation to mitigate formation of grease build-up. The aerator shall be suitable to operate with discharge piping submerged at a depth of at least four feet. The aerator shall

produce continuous, non-pulsating, oil-free air. Inlet and outlet ports shall be 1-1/2 inch FNPT.

2. The aeration blower shall be rated for continuous duty at a maximum speed of 3,450 rpm and operate at a maximum ambient temperature of 104 degrees F. The motor shall be 1.0 hp, 1 phase, 230 volt, 60 Hz with TEFC enclosure and Class B insulation.
3. The following accessories shall be installed with the wet well aeration system:
   a. (1) Gauge kit – including independent, full-range indication of aeration blower inlet and outlet conditions. Total pressure across the aeration blower shall be the difference of the gauge indications.
   b. (1) Filter kit with replaceable filter element and shall be designed to protect the aerator from pre-mature wear.
   c. (1) Spare filter element
   d. (1) Check valve
   e. (1) Discharge ball valve
   f. (1) Relief valve of adequate capacity to provide system protection
   g. (1) Flexible mounting system
   h. (1) Inlet muffler/silencer
4. A set of dry contacts shall be provided in the pump control panel to interface with the aeration system to insure coordination between systems.
5. The discharge piping for the aeration blower shall be installed as shown on the plan sheets. Discharge piping to the wet well shall be minimum 2-inch diameter.
6. Aeration system, including aeration blower, inlet filter, relief valve, gauges, muffler, ball valve and check valve, shall be pre-assembled using schedule 40 galvanized pipe and mounted on an aluminum base using eight flexible vibration isolation mounts.

C. Fiberglass enclosure:

1. A fiberglass enclosure with interior dimensions of 33" long x 21" wide x 24" tall shall be provided to protect the aeration blower assembly. The control panel shall not be mounted inside the fiberglass enclosure.
2. The enclosure shall be provided with intake vents near the top in front, back and on each end, and two vents at the bottom.
3. The enclosure shall be provided with a hinged lid with locking hasp for easy maintenance and service.
4. Provide a vent hood with pressure relief valve discharge piped to exterior of the enclosure.
5. Interior of enclosure shall have foam insulation for sound attenuation, 1" thick minimum.
6. Aeration blower assembly shall fit inside this fiberglass enclosure.

D. Wet Well Aeration System Control Panel:

1. NEMA 4X stainless steel wall mounted panel. Dimensions: 16" wide x 24" tall x 8" deep.
2. Main connections to accept 1/60/230
3. Motor starter, FVNR (across the line), NEMA rated
4. Provide timer and repetitive cycle interval circuit, operator-selectable timing, operational mode selection device, and pump control panel interface. In the

"Automatic" mode, the aerator shall operate in a coordinated manner with the sewage pumping system.

5. HOA switch
6. Control interface for use with pump control panel
7. Control transformer, 120 volt secondary for control circuit

2.12 BASKET STRAINER

A. General:

1. Furnish and install a trash basket and ladder assembly in wet well as shown on the drawings. Furnish and install a portable hoist above the wet well as shown on the drawings. The trash basket shall remove trash and debris from the wastewater influent as it enters the wet well. Basket strainer shall be supplied by Envirep, Inc., Camp Hill, PA, (T) 717-761-7884 and manufactured by Halliday Products, Inc., Series B1A.
2. This equipment shall be provided for both Pump Stations.

B. Basket:

1. The basket shall be fabricated of perforated screen having two (2) inch holes on three (3) inch centers and 0.080 inches thick aluminum. The guide rails shall be extruded aluminum channels to facilities easy operation of the basket. Dimensions of the basket shall be 28" by 18" by 8". A lifting rod bail shall be provided at the top of the basket.

C. Ladder:

1. The ladder shall be constructed of aluminum and consist of two 3-inch channel/rails, rungs, and support brackets. Channels shall hold the basket wheels captive. Ladder rungs shall be fluted, not less than 1" diameter, and shall be spaced on 12-inch centers.

D. Basket Stop:

1. The manufacturer, in order to insure proper positioning of the basket, shall supply an aluminum basket stop, to be field mounted by the Contractor.

E. Safety Extension:

1. Provide an aluminum safety extension to aid the operator in the event that he shall need to enter the wet well. Safety post shall be capable of extending approximately 37-inches above the top frame of the ladder. The safety extension assembly shall be capable of being stored in the wet with the access hatch closed when not in use.

F. Wet Well Hatch:

1. The wet well hatch frame shall be sized as shown on the drawings and cast into the concrete wet well cover. The door leaf shall be flush with the concrete

surface. Leaf and frame shall be aluminum with minimum 1/4" thick diamond pattern plate, suitable to withstand a minimum live load of not less than 300 pounds/square foot. Leafs shall be equipped with stainless steel hinges, a padlock hasp, and an automatic "hold open".

G. Portable Hoist:

1. The stainless steel portable hoist shall permit the strainer basket to be raised above the top of the wet well cover. Hoist shall be have a mast diameter of 3-1/2" in diameter and shall be equipped with a Dutton-Lainson hand winch. Maximum load rating of the hoist shall be no less than 1000 pounds. Hoist shall be supplied by Envirep, Inc.
2. An embedded type stainless steel socket shall be installed for the portable winch stand. Socket shall be provided with a cap of stainless steel construction and a neoprene gasket.
3. Lifting cable shall be 1/4" diameter 304 stainless steel with a safe load rating of no less than 1285 pounds, and shall include a 1-1/2 ton eye hook with stainless steel safety latch for connection to the basket. System shall include a drill capable of connection to and lifting with the hoist.

2.13 REDUNDANT HIGH WATER ALARM FLOAT

A. A float switch shall be mounted in the wet well at each pump station and wired in parallel to the standard high water alarm relay to serve as a redundant high water alarm.

1. Float switch shall be mercury free
2. NEMA 4X stainless steel wet well junction box
3. Float switch shall include an anchor and stainless steel chain
4. Intrinsically safe barrier

PART 3 - EXECUTION

3.1 EXAMINATION

A. General Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Pumping equipment manufacturer shall provide written instructions for proper handling. Immediately after off-loading, contractor shall inspect pumping equipment and appurtenances for shipping damage or missing parts.

B. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all serial numbers and parts lists with shipping documentation. Notify manufacturers representative of any unacceptable conditions noted with shipper.

3.2 INSTALLATION

A. Install, level, and align pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Suction pipe connections must be vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump system piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

C. Check motor and control data plates for compatibility to site voltage. Install and test the electrical ground prior to connecting line voltage to pump control panel.

D. Prior to applying electrical power to motors or control equipment, check all wiring for tight connection. Verify that fuses and circuit breakers conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

E. After all anchor bolts, piping connections are installed, seal all openings between wet well and pump enclosure.

3.3 PROTECTION

A. The pumping equipment should be placed into service soon after delivery of the equipment. If installation is delayed, the pumping equipment and motor control center shall be stored indoors, free of excessive dust, in a low humidity, heated environment.

B. During installation and after the pumping equipment is placed into operation the motor control center shall operate in an environment free of excessive dust, in a low humidity, heated environment.

3.4 FIELD QUALITY CONTROL

A. Prior to acceptance by the 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. Prior to start-up, clean wet well by removing construction debris and foreign material.

3.5 MANUFACTURER'S PRE-STARTUP INSPECTION

A. Coordinate system pre-startup with manufacturers factory-trained service technician. The factory-trained service technician will inspect the installation and answer any installation questions by the Contractor, Engineer, or Owner.

B. Verify that operations and maintenance manual is on site and installation instructions contained in the manual have been followed.

C. Verify that all pumping equipment, piping, level control system, alarms and ancillary equipment has been properly installed and all wiring is complete.

D. Verify that all spare parts for the pumping equipment is on site.

E. Pre-startup inspection shall be a separate trip and shall not be less than two weeks prior to the startup of the equipment.

3.6 MANUFACTURER'S FIELD PERFORMANCE TESTING

A. Coordinate system start-up with manufacturers factory-trained service technician. The factory-trained service technician will inspect the completed installation, calibrate and adjust instrumentation, and correct or supervise correction of defects or malfunctions. Startup shall be performed in the presence of the Engineer and Owner.

B. Equipment startup shall be tested under both utility power and emergency power.

C. General Contractor shall supply clear water of adequate volume to operate the system including the force main through several pumping cycles.

D. Observe and record operation of pumps, suction and discharge gage readings, voltage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment. Test manual and automatic control systems. Test all alarms. Report any undue noise, vibration or other operational problems.

E. Startup shall be a separate trip.

3.7 MANUFACTURER'S OPERATION AND MAINTENANCE TRAINING

A. The manufacturer shall furnish the services of a qualified, factory-trained operations and maintenance serviceman to instruct and train Owner's personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:

1. Theory of operation
2. Actual operation
3. Mechanical maintenance
4. Hydraulic troubleshooting
5. Electrical maintenance
6. Instrumentation and level controls
7. Optimization of the system
8. Alarm circuits
9. Safe operating and working practices and operation of safety devices

B. One (1) training session is required. Training shall be completed after startup services have been performed. Training shall be a separate trip and shall not be less than two weeks after the startup of the equipment. Time, location, and duration of all training sessions shall be coordinated with Owner's personnel.

C. Hands-on training and demonstrations shall use the installed equipment.

D. Supplier shall provide all materials for training and shall provide training manuals to all personnel being trained.

3.8 MANUFACTURER'S EQUIPMENT RE-CERTIFICATION

A. The General Contractor shall require, and cover the cost in his bid, for the manufacturer's factory-trained service technician to return to the site six (6) month's after initial startup of the equipment to perform a final re-certification of the equipment.

B. The re-certification shall consist of demonstrating and certifying that the equipment is meeting the performance requirements of the specifications. Equipment service technician shall perform field-testing of the equipment in the presence of the Owner. Results of all field-testing shall be submitted to the Engineer and the Owner.

3.9 CLEANING

A. 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.

END OF SECTION

SECTION 11320
KLEINFELTERSVILLE PUMP STATION

PART 1 - GENERAL

1.1 SCOPE

A. The General Contractor shall furnish and install one(1) factory built above ground pump station. The station shall be complete with all equipment specified herein, factory installed in a fiberglass reinforced polyester resin enclosure. The principal items of equipment shall include two self-priming, horizontal, centrifugal, V-belt motor driven sewage pumps, valves, internal piping, control panel, liquid level control system and internal wiring.

B. Electrical power to be furnished to the site will be 3 phase, 60 hertz, 208 volts, maintained within plus or minus 10 percent. The available fault current provided at the pump station control panel is 12 kA rms symmetrical. Phase to phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

C. The system shall be manufactured by The Gorman-Rupp Company, Mansfield, OH as supplied by Envirep, Inc., Camp Hill, PA (717-761-7884).

1.2 SUBMITTALS

A. Product Data: Prior to fabrication, submit the following to the engineer for approval:

1. Shop drawings providing layout of the mechanical equipment and anchor bolt locations, and indicating the use of Unified National Standard bolts and fasteners. Pipe penetrations shall be dimensional in relation to the station centerline.
2. Electrical ladder logic drawings illustrating motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.
3. Catalog cut sheets for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristics curves showing design duty point capacity (GPM), head (FT), net positive suction head (NPSHR), and hydraulic brake horsepower.
4. Pump Manufacturer's v-belt drive selection calculation summary sheet showing corrected H.P. Per Belt, total H.P. developed, pitch diameter of sheaves, center distance between driver and driven shafts and combined arc-length correction factor applied to theoretical horsepower transmission per v-belt, and all calculations to demonstrate a minimum Safety Factor of 1.5.
5. Certified dimensional drawings indicating size, location and the spherical solids passing capability of the primary recirculation port.
6. Sample of service agreement and service agreement checklist for the specified equipment.

7. Interconnection wiring diagram showing the field wiring between the telephone dialer and the alarms.
8. Copy of certificate with course I.D. number for pump manufacturer's PADEP approved Wastewater Operator Training Program in Pump Maintenance and Troubleshooting course that counts toward Pennsylvania pre-certification experience and continuing education unit requirements.

B. Certified Tests: Prior to shipment of the equipment from the manufacturer's facility, submit the following certified tests to the engineer for approval.

1. Certified copies of factory run pump performance tests. Characteristics of pumps may have a tolerance of plus 10% of rated capacity at rated head or plus 8% at rated head capacity. No minus tolerance will be acceptable. The performance tests will substantiate the correct performance of the equipment at the design head, capacity, suction lift, speed and horsepower as herein specified.
2. Certified reprime performance test data in accordance with procedures herein specified.
3. Certified copies of air release valve closure performance test.
4. Tests shall be certified by a registered professional engineer.

C. Certified System Performance Tests: All components, including the pumps, motors, and controls, will be tested as a complete working system at the pump manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational tests shall simulate actual performance anticipated. Submit certified tests data to the engineer for approval.

D. Operation and Maintenance Manuals:

1. Operation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at the time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
2. Documentation shall be specific to the pump station 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:

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

d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA 70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

3. Operation and maintenance instructions, which rely on vendor cut-sheets and literature, which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.
4. Telephone dialer instructions and interconnection wiring diagram showing the field wiring between the telephone dialer and the alarms.

E. Manufacturer's Field Performance Test Report: The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, instruct operating personnel in the proper operation and maintenance of the equipment. A written report covering the equipment startup shall be mailed from the Manufacturer's startup technician directly to the Owner. At a minimum, the report shall include:

1. Nameplate information.
2. Recordings of gauge readings, total dynamic head and operating speed for each pump.
3. Recordings of level control settings.
4. Certification that equipment has been properly installed and lubricated and is in accurate alignment.
5. Certification that the v-belt drive system has been properly aligned using a laser alignment instrument and v-belts tensioned using a belt-tensioning instrument.
6. Results of electrical tests including voltage readings and amperage readings of all motors.
7. Certification that the equipment has been operated fully loaded and that it operated satisfactorily.
8. Outline in detail any deficiencies noted, and proposed remedial corrections.

9. Confirm proper installation and operation of telephone dialer including actual tripping of each alarm input device, telephone reception, message programming, call out list, proper wiring, and instruction of operating personnel.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Upon request from the engineer, the pumping equipment manufacturer shall demonstrate the following:

1. Proof of financial stability and ability to produce the pumping equipment within the specified delivery schedules.
2. Evidence of the facilities, equipment, and expertise to demonstrate the manufacturer's commitment to long-term customer service and project support.
3. Evidence of adequate local and factory spare parts inventory to provide timely delivery of spare parts.
4. Evidence that the pump manufacturer is an Underwriters Laboratories (UL) panel builder.
5. Evidence that the pumps and pumping equipment are constructed, assembled and tested in the United States by the pump manufacturer. All pump parts including the casing shall be machined at the pump manufacturers' facility located within the United States.
6. To ensure compatibility to existing tools and equipment, all pump internal and external nuts, bolts and hardware, shall be Unified Thread Standard (UNC) per ASME/ANSI standards.
7. Evidence that the pump manufacturer can provide operator training that counts toward Pennsylvania pre-certification experience and continuing education requirements.
8. Consideration will be given only to pump manufacturers meeting the following qualifications:
   a. Twenty years minimum experience successfully producing pumping equipment of the type specified herein.
   b. A minimum of twenty-five installations of pumping equipment of the type specified herein in successful operation for a minimum of ten years.
9. Pump manufacturer must be ISO 9001:2000 certified, with scope of registration including design control and after sales activities.

B. Manufacturer's Representative Qualifications: Upon request from the engineer, the equipment manufacturer's local representative shall demonstrate the following:
1. Evidence of adequate local spare parts inventory to provide timely delivery of spare parts.
2. Evidence of established locally based factory-trained service personnel.
3. Evidence that representative offers comprehensive equipment service agreements for the equipment specified.
4. List of at least ten local municipalities with installations similar to the specified equipment.
5. Evidence that the representative offers full-day operator training seminars on Centrifugal Pump Maintenance and Troubleshooting.

6. Evidence that the representative offers technical design assistance and hydraulic recommendations for pump station design.
7. Certification from manufacturer that the service technician has been factory-trained and is authorized for such duties by the manufacturer.

C. Pump Performance:

1. Design and construct the pumps in accordance with standards of the Hydraulic Institute. The efficiency of the pumps, when operating under conditions of the specified capacities and heads shall be as near peak efficiency as practicable.
2. Design the pumps designated as self-priming centrifugal to pump raw sewage containing solids up to ten percent and stringy materials with a minimum of clogging. Pumps may be protected by screening equipment, but materials passing through may combine by a felting or balling process.

D. Source Quality Control:

1. Obtain pumping equipment, motors, motor starters, pump controls and appurtenances from the pump manufacturer whose responsibility it is to insure that the pumping equipment is properly furnished, coordinated, and tested in accordance with these specifications.
2. 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. The pump control panel including the level controls shall be constructed at the pump manufacturer’s facilities. The pump manufacturer shall be an Underwriters Laboratories (UL) panel builder. The control panel shall meet all UL and Joint Industrial Council (JIC) standards.
4. The manufacturer of the pumping equipment shall provide a listing of similar self-priming sewage pumping systems located in the State of Pennsylvania, for review by the engineer. This listing shall include locations and contact names. Project references provided should include similar size self-priming pumps utilized with variable speed drives and PLC based logic control. These references must serve to demonstrate the pump manufacturer's ability to design complete, fully integrated pumping systems with similar flow rate, total dynamic head and suction lift requirements.

E. Factory System Test:

1. All internal components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the pump manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational tests shall simulate actual performance anticipated for the complete station.

2. Upon request from the engineer, the operational test may be witnessed by the engineer and/or representatives of his choice at the manufacturer's facility.

1.4 MANUFACTURER'S WARRANTY

A. All components of the pumping equipment shall be manufactured, assembled and tested as a unit by the pump manufacturer. The pumping equipment must be a standard catalog item with the manufacturer. The pump manufacturer must assume system responsibility, i.e. the complete pump station assembly must be warranted by the manufacturer as described herein. Individual component warranties are desirable. However, individual warranties honored solely by the manufacturers of each pump station component will not be acceptable.

B. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

1. Fiberglass components of the station enclosure shall be warranted for five (5) years for resist UV damage, corrosion from moisture or corrosive soils, or physical failures occurring in normal service, without the need for special protective coatings, when installed according to the manufacturer's recommendations.
2. All other equipment, apparatus, and parts furnished shall be warranted for five (5) years, 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 pumping station and all components when installation is made and use and maintenance is performed in accordance with the manufacturer's recommendations.
3. 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 without cost of parts to the owner.

C. It is not intended that the pump station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

D. The warranty shall become effective upon the acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment, whichever occurs first.

1.5 MANUFACTURER

A. These specifications and accompanying drawings specify and show equipment and materials manufactured by The Gorman-Rupp Company, deemed most suitable for the service anticipated. The contractor shall prepare his bid on the basis of the particular

equipment and materials specified for the purpose of determining the low bid. The awarding of the contract shall constitute a contractual obligation to furnish the specified equipment and materials.

B. After execution of the contract, the contractor may request to substitute equipment other than that specified in the contract. Substitutions will only be considered in the event that the equipment proposed for substitution is superior in construction and efficiency to that specified in the contract, and higher quality has been demonstrated by service in a sufficient number of similar installations.

C. In the event the contractor obtains engineer's approval of equipment other than that for which the station was originally designed, the contractor shall, at his own expense, make any changes in the structures, buildings or piping necessary to accommodate the equipment, and shall provide as-built drawings to the engineer.

D. It will be assumed that the cost to the contractor of the equipment proposed to be substituted is less than that of the equipment specified in the contract and, if substitution is approved, the contract price shall be reduced by an amount equal to the savings.

PART 2 - PRODUCTS

2.1 STATION ENCLOSURE

A. The station enclosure shall contain and protect all pumps, interior piping, valves and associated controls. Enclosure shall be 77-inches square and 91-inches high. Enclosure shall incorporate the following design and service features:

1. Access doors shall be supplied on all sides. Doors shall be sized and placed to permit routine maintenance operations through the door openings of the enclosure. For these purposes, routine maintenance shall include pump and motor inspection, drive belt adjustment, and pump cleanout. Doors shall be supplied with tamper-proof hardware.
2. All four sides of the enclosure shall have "split" doors with the top half of the doors lifting upwards and the bottom half opening sideways. The top portion of the doors shall have hardware to prevent premature closing of the door.
3. Doors shall provide access to frequently performed adjustments and inspections of the electrical controls. Hinges shall be the continuous type. Latches shall engage the enclosure at not less than two places, and shall be protected by a keyed lock.
4. One door shall contain a screened vent to maximize airflow for enclosure ventilation.
5. Station enclosure, less base must be completely removable or able to be disassembled following the removal of reusable hardware. After removal or disassembly, no portion of the enclosure (except electrical service entrance) shall project above the surface of the base to interfere with maintenance operations or endanger personnel.
6. Removal or disassembly of the enclosure shall be accomplished by not more than two maintenance personnel without the use of lifting equipment.

B. Materials:

1. Each station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used. Glass fibers shall have a minimum average length of 1 1/4 inches. Major design considerations shall be given to structural stability, corrosion resistance, and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to microorganisms, mildew, mold, fungus, corrosive liquids, and gases, which can reasonably be expected to be present in the environment surrounding the wet well.
2. All interior surfaces of the housing shall be coated with a polyester resin-rich finish. It shall provide: maintenance-free service; abrasion resistance; and protection from sewage, greases, oils, gasoline, and other common chemicals.
3. The outside of the enclosure shall be coated with a suitable pigmented resin compounded to insure long, maintenance-free life.

C. Enclosure Base:

1. The station base shall be constructed of pre-cast, reinforced concrete, bonded inside a fiberglass form covering top and sides, and shall be designed to insure adequate strength to resist deformation of structure during shipping, lifting, or handling. Base shall incorporate drainage provisions, and shall be provided with an opening of sufficient size to permit piping and service connections to the wet well.
2. Station base shall incorporate anchor recesses for securing the pump station to the concrete pad supplied by the contractor in accordance with the station plans.
3. Color used shall de-emphasize the presence of dirt, grease, etc.

D. Exhaust Blower:

1. An exhaust blower shall be mounted in the roof of the enclosure. Blower capacity shall be sufficient to change station air once every two minutes. Blower motor shall be operated automatically and shall be turned on at approximately 70-degrees F and shall turn off at 55-degrees F. Blower motor and control circuit shall be protected by a thermal-magnetic air circuit breaker to provide overcurrent and overload protection. Blower exhaust outlet shall be designed to prevent the entrance of rain, snow, rocks, and foreign material.

E. Station Heater:

1. Pump station shall be provided with a 1300/1500-watt, 115-volt electric heater with cord and grounding plug. Ungrounded heaters shall not be acceptable.

F. Low Station Enclosure Temperature:

1. Each enclosure shall be provided with a thermostat to serve as a low temperature alarm.

2.2 PUMPS

A. Pump Description:

1. Pumps shall be Gorman-Rupp Model V3A60-B horizontal, self-priming, centrifugal pumps, specifically designed for pumping raw, unscreened, domestic sanitary sewage.
2. All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of the specified spherical solids passing capability, and any trash or stringy material which may pass through the average house collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump shall not be permitted.
3. The pumps shall have the following characteristics:

Design Characteristics		Kleinfeltersville Pump Station
a.	Suction connection, flanged, in	4
b.	Discharge connection, flanged, in	3
c.	Minimum shutoff head, each pump, ft	137
d.	Pump speed, rpm	2230
e.	Maximum NPSH required at design point, ft	5
f.	Minimum reprime lift capability, ft	24
g.	Spherical solids passing capability, in. diameter	2.5
h.	Motor horsepower	25
i.	Motor speed, rpm	1750
j.	Impeller diameter, in	9.00

B. Pump Performance:

1. Each pump must have the necessary characteristics and be properly selected to perform under these operating conditions:

Performance Characteristics		Kleinfeltersville Pump Station
a.	Capacity, gpm	200
b.	Total dynamic head, ft	116
c.	Total dynamic suction lift, ft	15.7
d.	Maximum static suction lift, ft	15.4
e.	Discharge static head, ft	55.4

2. Consideration shall be given to the sanitary sewage service anticipated, in which occasionally debris will lodge between the pump suction check valve and seat,

resulting not only in loss of the suction leg, but also in the siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal with proper installation of air release line to atmosphere.

3. In consideration of such occurrence and of the unattended operation anticipated, each pump shall be so designed as to retain adequate liquid in the pump casing to insure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

C. Reprime Performance:

1. Each pump must be capable of the specified reprime lift while operating at the selected pump speed and impeller diameter. Reprime lift is defined as the static height of pump suction centerline above liquid that the pump will prime; and delivery within five minutes on liquid remaining in the pump casing after a delivering pump is shut down with the suction check valve removed. Systems requiring ancillary vacuum generating devices shall not be acceptable. Additional standards under which reprime tests shall be run are:

   a. Piping shall incorporate a discharge check valve down stream from the pump. Check valve size shall be equal (or greater than) the pump discharge diameter.
   b. A ten-foot length of one-inch pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere at all times to duplicate the air displacement rate of a typical pump station fitted with an air release valve.
   c. No restrictions shall be present in pump or suction piping that could serve to restrict the rate of siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a minimum horizontal run of 2 feet and one 90-degree elbow.
   d. The pipe size used for the reprime performance test shall be the same size as the pump suction diameter.
   e. Impeller shall be set at the clearances recommended by the manufacturer in the pump service manual.
   f. Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.
   g. Liquid to be used for reprime test shall be water.

D. Serviceability:

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that due consideration has been given to reducing maintenance costs by incorporating the following features:
   a. No special tools shall be required for replacement of any components within the pump. All internal and external threaded fasteners shall be of the Unified National Standard type.

b. The mechanical seal shall be a one-piece cartridge type to allow for easy replacement. Mechanical seals requiring assembly of individual components shall not be acceptable.

c. The pump must be equipped with a removable cover plate, allowing access for service and repair without removing suction or discharge piping.

d. The pump shall be fitted with a replaceable wear plate. Replacement of the wear plate, impeller, and seal shall be accomplished through the removable cover plate without removing suction or discharge piping.

e. The entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping.

f. Removal or installation of the suction check valve shall be accomplished from the top of pump without disturbing the suction piping or completely draining the casing.

g. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

h. Cover plate impeller clearance adjustment: Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external shimless cover plate adjustment utilizing collar and adjusting screw design for incremental adjustment of clearances by hand. Pumps requiring realignment of belts, couplings, etc., due to clearance readjustment shall not be acceptable. Cover plate shall be capable of being removed without disturbing clearance settings.

i. Rotating assembly impeller clearance adjustment: Additional adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by moving the entire rotating assembly towards the wear plate, to compensate by removal of stainless steel shims between the rotating assembly and the volute.

j. Clearance adjustment which requires movement of the shaft without movement of the entire rotating assembly, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

E. Construction:

1. Pump casing: Made of Gray Iron 30, shall be foot supported, and shall have a horizontal centerline suction and vertical discharge. Suction connection and discharge connection shall be vertically in-line with one another.

a. The casing shall have a top mounted 3-1/2 inch priming fill port with a safety lock bar cover. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detent lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

b. Casing shall have no openings of smaller diameter than the specified sphere size.

c. Casing shall be designed to retain sufficient liquid to ensure automatic repriming and unattended operation.
d. A minimum 1-1/4 inch diameter drain hole shall be provided for attachment of the pump drain kit and to ensure complete and rapid draining.
e. Bolts and other threaded fasteners shall have Unified National Standard threads.
f. Suction flap valve: The suction flap valve shall be externally removable and shall be constructed of molded neoprene with integral steel and nylon reinforcement. A blow-out center shall protect the pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished from the top of the pump without any other disassembly of the pump, without disturbing any piping and without draining the pump. Sole function of the suction flap 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.
g. Pump shall be provided with a separate capped threaded port for use of an optional casing heater.

2. Cover plate: Cover plate shall be Gray Iron 30.

a. Cover plate shall be retained by four (4) nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and the allow removal or service to the impeller, seal, or wear plate.
b. Replaceable wear plate: Secured to the cover plate by welded studs and nuts. The wear plate shall be Carbon Steel 1015. The wear plate shall be of sufficient width to maintain the manufacturer's recommended clearance between the entire edge of each impeller vane and the wear plate. Wear plate attachment hardware shall have Unified National Standard threads and shall be located out of the direct flow path of the liquid into the impeller. Two (2) Buna-N o-rings shall seal cover plate to the pump casing. The wear plate shall be constructed with a minimum of six (6) semi-circular machined channels and a tapered face designed to provide self-cleaning action and ensure that debris is cleared away from and does not collect between the impeller and the wear plate.
c. O-ring Seals: Two (2) Buna-N o-rings shall seal cover plate to the pump casing. The inner cover plate o-rings shall provide a seal between the suction chamber and the discharge chamber of the pump casing to eliminate the possibility of recirculation at the wear plate.
d. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75 PSI.
e. Pusher bolt capability to assist in removal of coverplate. Threaded pusher bolt holes shall be sized to accept same retaining capscrews as used in rotating assembly.
f. Easy-grip handle shall be mounted to face of coverplate.

3. Rotating assembly:

a. Impeller: Two-vaned, semi-open, non-clog, Ductile Iron 65-45-12 with integral pump out vanes on the back shroud. Impeller shall be balanced and shall thread onto the pump shaft and be secured with a lockscrew and conical washer.

b. Shaft: Shaft shall be constructed of Alloy Steel 4150.

c. Mechanical seal: Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be silicon carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design. An external O-ring secures the stationary seat to the seal plate, 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. The seal shall be warranted for five (5) years from date of shipment.

d. Lubrication: Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Oil 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 with 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. 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 plug with vent. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the vented fill plug.
   3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

e. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

f. Seal plate: Replaceable seal plate shall be constructed of Gray Iron 30, and shall be bolted to the bearing housing. Seal plate shall be equipped with anti-rotation ribs cast into the seal plate to reduce internal wear and to maximize seal plate and mechanical seal life.

g. Radial bearings: Single row, anti-friction ball bearings, of ample size and proper design to withstand all radial loads which can reasonably be expected during normal operation. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal shall not be acceptable.

h. Thrust bearings: Double row, anti-friction ball bearings, of ample size and proper design to withstand all thrust loads which can reasonably be expected during normal operation. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal shall not be acceptable.

i. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

4. Suction and discharge spools: Each pump shall be equipped with one-piece, cast iron spools, flanged on each end. Each spool shall have one 1 1/4-inch NPT and one 1/4-inch NPT tapped hole with pipe plugs for mounting of gauges or other instrumentation.

2.3 PUMP ACCESSORIES

A. Spare Parts: Furnish the following spare parts:

1. Two (2) Spare Parts Kits, each including one (1) mechanical cartridge seal, one (1) set of rotating assembly adjustment shims, one (1) cover plate o-ring, and one (1) rotating assembly o-ring
2. Four (4) suction flap valve assemblies
3. One (1) belt tensioning gauge - spring loaded
4. Two (2) quarts of seal lubricant
5. Two (2) air pump repair kits for bubbler level control system
6. Two (2) discharge check valve springs

B. Gauge Kit With Vibration Isolation Frame:

1. Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4-inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full-scale reading. Compound gauges shall be graduated -34 feet to +34 feet water column minimum. Pressure gauges shall be graduated 0 to 230 feet water column minimum.
2. Gauges shall be mounted on a vibration isolation frame assembly with resilient panel, frame, and adjustable brackets which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings, and shall include a shutoff valve installed in each gauge inlet at the point of connection to suction and discharge pipes.
3. Gauge kit shall be supplied with stainless steel fittings.

C. Pump Drain Kit:

1. The pump drain kit shall consist of a 10’ length of plastic hose with a quick connect female Kamlock fitting on one end of hose and two sets of fittings for pump drains. Each set of fittings for pump drain includes a pipe nipple, bushing, bronze gate valve and quick connect male Kamlock fitting.
2. Pump drain kit shall be supplied with stainless steel fittings.

D. Self Cleaning Wear Plate:

1. The wear plate shall be constructed with no more than six (6) semi-circular machined channels and a tapered face designed to provide self-cleaning action and ensure that debris is cleared away from and does not collect between the impeller and the wear plate.

2.4 VALVES AND PIPING

A. Check Valves, 6-inch:

1. Each pump shall be equipped with a full flow type check valve, each capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron. The valve shall be equipped with a removable cover plate to permit entry for complete removal and replacement of internal components without removing the valve 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, sealing bushing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 175-PSI water working pressure, 350-PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

B. Plug Valve, 6-inch:

1. Discharge header piping shall include a 3-way plug valve to permit the pump to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125-pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseat action. The lever shall have a locking device to hold the plug in the desired position.

C. Air Release Valves (High-Impact Composite Polyester):

1. Each pump shall be equipped with an Air Mate® air release valve to vent air to atmosphere during initial priming or unattended repriming cycles. The valve shall automatically close operating solely on discharge pressure to prevent recirculation. A visible indication of valve closure shall be evident.
2. Air release valve piping must discharge directly into wet well. ARV piping shall not discharge to a sump.
3. The air release valve shall be constructed of high-impact composite polyester containing not less than 30% glass-filler. The valve body shall incorporate an internal passageway that allows all debris to pass through the valve chamber between operational cycles. The diaphragms shall be Buna-N, Fluorocarbon or EPDM, with a polyester mesh rated for 250 PSI of pressure.

4. The vertical plunger shall be constructed of Acetal and PTFE fluorocarbon filler. The independent, dual diaphragms and single, vertical valve plunger shall incorporate a media fluid that passes through an orifice and separates the actions of each.
5. The valve shall employ an externally-adjustable restrictor for applications below four feet of static discharge head.
6. The valve body shall incorporate passageways having minimal constrictions and no directional course changes integral to the body of the valve. The inlet shall be 1 inch NPT female and the discharge outlet shall be 1-1/4 inch NPT female. The valve shall be mounted horizontally, at 90 degrees to the vertical plunger.
7. The valve shall be capable of operation on applications ranging from four to 400 feet of water column without the need for adjustment or change of springs or other parts.
8. Air release valves shall be connected to pump station piping using stainless steel pipe fittings.
9. Each air release valve shall be provided with an isolation ball valve.

D. Piping:

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and Class 53 thickness flanges shall be cast iron Class 125 and comply with ANSI B16.1 all piping pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
2. Boltholes shall be in angular alignment within ½-degree between flanges. Flanges shall be faced and a gasket finish applied that shall have 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 ¼ inch apart.

E. Supports and Thrust Blocks:

1. Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping.
2. Pump station discharge force main piping shall be anchored with thrust blocks by the contractor where shown on the contract drawings.

F. Gauge Connection Assembly:

1. The header piping shall be equipped with a gauge connection assembly located between the discharge check valve and force main isolation plug valve allowing the operator to easily attach a discharge gauge on any pump for troubleshooting.
2. The gauge assembly shall consist of a 1/4" brass pipe nipple, 1/4" brass full port ball valve and a quick connect fitting.
3. The gauge connection assembly shall be installed in the discharge header piping such that the static and dynamic pressure in the force main can be read at all times unless the force main isolation plug valve is closed for that particular pump.

G. Portable Pump Discharge Connection, 4-inch:

1. The station header pipe shall incorporate a 2-way plug valve to permit emergency access to the pump station force main after isolation of the pumps. Valve body shall be cast iron with flanged end connections drilled to 125-pound standard. The plug valve shall be non-lubricated type, furnished with a drip-tight shutoff plug mounted in stainless steel or Teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface.
2. The bypass connection shall be accessible behind the hinged door on the wet well side of the station enclosure and shall terminate with a male OPW type quick connect fitting.

2.5 DRIVE UNIT

A. Motors:

1. The pump motors shall be horizontal, open drip proof, induction type, with normal starting torque and low starting current characteristics. The motors shall not be overloaded at the design condition or at any head in the operating range as specified.
2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std. 112.
3. Each motor shall be in current NEMA design B cast iron frame with copper windings.
4. Motors shall be NEMA Premium Efficient, per NEMA MG-1, Table 12-12.

B. Drive Transmission:

1. Power shall be transmitted from motors to pumps by means of v-belt drive assemblies. The drive assemblies must be selected to establish proper pump speed to meet the specified operating conditions.
2. Each drive assembly shall have a minimum of two v-belts. In no case will a single belt drive be acceptable. Each v-belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump. Drive systems with a safety factor of less than 1.5 shall not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.
3. V-belts shall be the banded type.

C. Belt Guards:

1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½ inch.
2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component, and shall be securely fastened to the unit base.

3. All metal shall be free of burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than five-inch spacing. Tack welds shall not exceed four-inch spacing.
4. 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.

2.6 FINISH

A. Surface Preparation:

1. Pumps, piping and exposed steel framework shall be prepared utilizing a six-stage surface preparation system including the application of iron phosphate and sealer/rust inhibitor.
2. The method shall provide excellent removal of substrate contaminants and very effectively etch pores in the metal resulting in a superior adhesion of primer and paint.
3. Surface preparation shall be in accordance with United States Government mil spec # MIL-T-704J. Sandblasting shall not be acceptable.

B. Paint:

1. Pumps, piping and exposed steel framework shall be coated with one coat gray W.R. non-lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be low VOC, alkyd based, high solids, semi-gloss white enamel for optimum illumination enhancement and incorporate rust inhibitive additives.
2. The finish coat shall be 1.0 to 1.5 MIL dry film thickness (minimum), resistant to oil mist exposure, solvent contact and salt spray.
3. The factory finish shall allow for over-coating and touch up after final installation.
4. All flanged connections including pumps, valves, piping and fittings shall be painted prior to assembly.

2.7 PUMP CONTROL SYSTEM

A. General:

1. This specification covers a pump control system for the duplex pumping station including motor circuit breakers, reduced voltage motor starters, thermal overload relays, door mounted operator controls, and liquid level controls.
2. The liquid level control will include an air bubbler level control system, electronic pressure switch, pump sequence control, alarms and pump safety shutdowns.

B. UL Listing:

1. The pump station controls shall be manufactured by the pump manufacturer who shall be a UL panel builder and each assembly shall bear a serialized UL label listed for "Enclosed Industrial Control Panels."

2. The enclosure and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures. Listing for open style industrial control panels or an assembly of listed or recognized components shall not be acceptable.

C. Panel Enclosure:

1. Enclosure shall be constructed in conformance with applicable section of national electrical manufacturers' association (NEMA) standards for Type 1 electrical enclosures. Enclosure shall be fabricated of stainless steel having a minimum thickness of not less than 0.075 inch (14 gauge).
2. Door shall be hinged and sealed with a neoprene gasket and shall be held closed with clamps that are quick and easy to operate. The door shall accommodate the mounting of switches and indicators.
3. Enclosure shall be furnished with a removable back panel, fabricated of steel having a thickness of not less than 0.106 inch (12 gauge), which shall be secured to the enclosure with collar studs. Such panel shall be of adequate size to accommodate all basic components.
4. All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators and instruments shall be mounted through the control panel door. Self-tapping screws shall not be used to mount any components.
5. Each control assembly shall be furnished with main terminals and ground lug for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the loads. The main terminals shall be mounted to allow incoming wire bending space in accordance with article 373 of the national electric code (NEC). A separate terminal strip shall be provided for 115 volt, single-phase control power and shall be segregated from the main terminals. Ten percent of the control terminals shall be furnished as spares.
6. The control panel shall be provided with a thermostat to serve as a low temperature alarm.

D. Motor Branch Components:

1. All motor branch components shall be of the highest industrial quality. Operating coils of all AC control devices shall be rated for 120 volts, and shall be suitable for use in a voltage range of 108 to 132 volts, 60 hertz.
2. Circuit Breakers and Operating Mechanisms:
   a. A properly sized heavy-duty air circuit breaker shall be furnished for each pump motor, and shall have a symmetrical RMS interrupting rating of 12,000 amperes at 208 volts. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.
   b. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the "OFF" position.

E. Reduced Voltage Starters:

1. Reduced Voltage Starters

a. A reduced voltage, solid state motor starter shall be furnished for each pump motor. The power section shall consist of six back-to-back SCRs rated 208 to 480 volts, 50/60 hertz. The power section shall be capable of 300% rated current for 30 seconds. The SCRs shall have a minimum repetitive peak inverse voltage rating of 1400 volts at 480 volts. Operating temperature range shall be 0 to 50 degrees C at altitudes up to 2000 meters without derating.

b. The starter shall be capable of soft starting the pump and be adjustable from 2 to 30 seconds. Ramp time is load dependent. Fault diagnostics shall be displayed on the starter and shall include stalled motor, start fault, temperature fault and line fault.

c. Pump Control option: The starter shall provide smooth acceleration and deceleration using an algorithm, which approximates the torque requirements of a centrifugal pump. The starter's microcomputer shall analyze motor variables and generate control commands, which will minimize surges in the system. Pump stop time shall be adjustable from 0 to 120 seconds.

d. Protective features

1) The starter shall be equipped with the following protective features:

a) Built in Overload relay, Class 10, 15, 20 or 30 trip, Ambient insensitive, Thermal Memory
b) Stall protection-0-10s after start ramp
c) Jam protection-0-10s after up-to-speed
d) Phase rebalance
e) Underload-0-99%, 0-99s
f) Undervoltage-0-99%, 0-99s
g) Overvoltage-0-99%, 0-99s
h) Voltage Unbalance-0-25%
i) Excessive starts per hour

e. Operator Interface

1) The starter shall be equipped with a digital display and data entry terminal mounted on the exterior of the starter enclosure door. The operator interface shall be an English language display and include the following data:

a) Volts Phase to Phase
b) Current each Phase
c) Watts
d) KWh
e) Elapsed Time
f) Motor Thermal Usage
g) Power Factor
h) Fault Display

i) Fault Buffer (last five faults in code)
j) Set-up Parameters

2. Bypass contactors

a. Each solid-state reduced voltage motor starter shall be provided with a bypass contactor.
b. When the pump motor is up to speed, the bypass contactor shall be "pulled in" for "run" in order to reduce the amount of heat produced by the reduced voltage starter.
c. When the pump motor is called to "Stop", the bypass contactor shall "drop out" and allow for the reduced voltage starter to take over in order to provide for smooth deceleration of the pump motor.

3. Converter modules

a. Each motor branch circuit shall include a control module.
b. Control module shall provide three-phase current feedback to the solid-state reduced voltage starter for metering and overload protection during phase rebalance and bypass operation.

F. Indicators:

1. Indicating lights shall be oil tight type and equipped with integral step-down transformers for long lamp life. Lamps shall be incandescent type rated 14 volts or less with a minimum life of 15,000 hours. Lamps shall be replaceable from the front without opening the control panel door and without the use of tools.

2. Indicating lights will be furnished for the following functions:
a. Pump No. 1 run
b. Pump No. 2 run

3. Indicators shall be furnished for the following functions:
a. High Pump Temperature, No. 1
b. High Pump Temperature, No. 2

G. Switch Controls:

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
2. Pump mode selector switches shall be connected to permit manual start and manual stop of each pump individually or permit automatic operation under control of the liquid level control system. Manual operation shall override shutdown systems except the motor overload and phase failure relays. Selector switches shall be oil-tight with contacts rated NEMA A300.
3. Pump sequence selector switch shall permit selection of automatic pump alternation, or selection of either pump to run as lead pump for each cycle.

Pump alternator relay shall be electro-mechanical industrial design. Relay contacts shall be rated 10 amperes minimum at 120 volts non-inductive.

4. Override switches shall be connected to bypass the level control system and all shutdown systems supplied with it, to provide manual start and manual stop of each pump individually in the event of level control system malfunction.
5. A selector switch shall provide manual alternation of the air pumps in the bubbler system. The switch shall be connected in such a manner that either pump may be selected to operate continuously.
6. A pushbutton switch shall be provided to silence the 115-volt AC alarm circuits while corrective actions are underway. Depressing the alarm silence pushbutton shall also cause the high water alarm circuit to reset when the liquid level has been lowered.

H. High Pump Temperature Shutdown:

1. The control panel shall be equipped with circuitry to override the level control system and shut down the pump motor(s) when required to protect the pump from damage caused by excessive temperature.
2. A thermostat shall be mounted on each pump to detect its temperature. If the pump temperature should rise to a level that could cause pump damage, the thermostat shall cause the pump motor to shut down. A visual mechanical indicator shall indicate that the pump motor has been stopped because of a high temperature condition.
3. The pump shall remain locked out until the pump has cooled and the circuit has been manually reset. Automatic reset of such a circuit shall not be acceptable.

I. Elapsed Time Meters:

1. Six-digit elapsed time meters (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in "hours" and "tenths of hours".

J. Pump Start Delay and Lockout:

1. Under Utility Power: When a high wetwell level condition is reached (indicating the lead pump is not supporting flow), the lead pump shall be locked out and the lag pump shall start after a five (5) second delay. Under automatic control, two (2) pumps shall not run simultaneously. The HOA switches may be used to manually run both pumps simultaneously.

2. Upon Loss of Utility Power:
   a. The second pump shall be locked out based upon a contact closure from the automatic transfer switch. Only one pump shall be permitted to operate under standby power.
   b. The lead pump shall be equipped with a 10 second time delay after the power has been restored on standby power. This step delay shall prevent the sewage pump from starting at the same time as other station loads when under standby power.

K. Alarm Contacts:

1. Provide separate alarm contacts for the following alarm conditions:

a. High water (bubbler)
b. High water (float)
c. Low water
d. High pump temperature, #1
e. High pump temperature, #2
f. Drive fault, #1
g. Drive fault, #2
h. Station enclosure low temperature
i. Pump run, #1 (normally open)
j. Pump run, #2 (normally open)
k. Pump run, #1 (normally closed)
l. Pump run, #2 (normally closed)

L. Secondary Surge Arrestor:

1. The control panel shall be equipped with a surge arrestor to minimize damage to the pump motors and control from transient voltage surges. The arrestor shall utilize metal-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps and a Joule rating of 1,500.

M. Transient Voltage Surge Suppression (TVSS):

1. TVSS protection shall be applied on the 120 volt secondary of the control transformer to protect all sensitive electronics powered by the control panel. An acceptable TVSS unit shall be as follows:
   a. Total Protection Solutions (1-800-836-2305) TK-LTE120-30A.
   b. Emerson Network Power Surge Protection (1-800-288-6169) Islatrol IC+130.
   c. There are no Equals.

N. Receptacle and Station Enclosure Task Light:

1. A duplex ground fault interrupter utility receptacle providing 115 VAC, 60 hertz, single-phase current shall be provided. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.
2. Each station enclosure shall be equipped with a fluorescent strip light (17 watt minimum) and associated light switch.

M. Auxiliary Power Transformer:

1. The station shall be equipped with a 3 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary circuits. The primary side of the transformer shall be protected by a thermal-magnetic air circuit

breaker, specifically sized to meet the power requirements of the transformer. A mechanical operating mechanism shall be installed on the circuit breaker to provide a means of disconnecting power to the transformer.

2. The padlockable operator handle for the operating mechanism shall be located on the exterior of the control panel with interlocks which prevent opening the door until primary circuit breaker is in the "OFF" position.

N. Auxiliary Contacts:

1. Each pump motor starter shall include a N.C. auxiliary dry contact wired to a terminal strip to interface with the wet well aeration system.

2.8 WIRING

A. General:

1. The pump control as furnished by the manufacturer shall be completely wired except for the power feeder lines to the branch circuit breakers and final connections to remote alarm devices and between control assemblies.
2. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).
3. All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color-coded as follows:

a.	Line and load circuits, AC or DC power	Black
b.	AC control circuit less than line voltage	Red
c.	DC control circuit	Blue
d.	Interlock control circuit, from external source	Yellow
e.	Equipment grounding conductor	Green
f.	Current carrying ground	White
g.	Hot with circuit breaker open	Orange

B. Wire Identification and Sizing:

1. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Motor branch wiring shall be 10-gauge minimum.
2. Motor branch conductors and other power conductors shall not be loaded above 60-degree C temperature rating, on circuits of 100 amperes or less, nor above 75-degree C on circuits over 100 amperes. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the subplate shall be bundled and tied or installed in duct. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit.

C. Wire Bundles:

1. Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

D. Conduit:

1. All conduit and fittings shall be UL listed.
2. Liquid tight flexible metal conduit shall be constructed of a smooth, flexible, galvanized steel core with a smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
3. Conduit shall 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.

E. Grounding:

1. The pump station manufacturer shall ground all electrical equipment to the closure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections.

2.9 LEVEL CONTROL SYSTEM

A. Liquid Level Control:

1. 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.
2. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.
3. The level control system shall be a Gorman-Rupp Model EPS 2100 air bubbler type level control system.
4. The level control system shall incorporate automatic alternation to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.
5. 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 pump when the liquid reaches the "lag pump start level" so that both 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 12VDC in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Control range shall be 0 to 12.0 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be retained using a non-volatile lithium battery back-up.

c. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators and output relays.

1) 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 0-15 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 0.25% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.

2) 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 the preset start and stop level for both lead and lag pump. The display shall include twenty (20), 0.19" high alpha-numeric characters calibrated 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.

3) Level adjustments shall be electronic comparator set points to control the levels at which the lead and lag 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.

4) Each output relay in the electronic pressure switch shall be solid state. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. The "ON" state of each relay shall

be indicated by illumination of a light emitting diode. The output of each relay shall be individually fused providing overload and short circuit protection. Each output relay shall have an inductive load rating equivalent to one NEMA size 4 contactor. A pilot relay shall be incorporated for loads greater than a size 4 contactor.

d. The electronic pressure switch shall be equipped with an output board, which shall include LED status indicators and a connector with cable for connection to the main unit.

e. 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.

f. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.

g. The electronic pressure switch shall be capable of controlling liquid levels in either a pump up or pump down application.

h. 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, 0-10VDC, or 4-20mA, and one (1) 4-20mA scalable output. Output is powered by 10VDC supply. Load resistance for 4-20mA output shall be 100-400 ohms.

i. The electronic pressure switch shall include a DC power supply to convert 120 VAC control power to 12VDC EPS power. The power supply shall be 500-mA (6W) minimum and be UL listed Class II power limited power supply.

j. The electronic pressure switch shall be contained within a NEMA 1 enclosure including a polyester face and stainless steel case.

k. The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. An indicator, visible on the front of the control panel, 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.

6. 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 oil tight design with contacts rated NEMA A300 minimum.

B. Air Bubbler System:

1. The level control system shall be the air bubbler type, containing air bubbler piping, which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals for the remainder of the level control system.

2. Two vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure-reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable. A selector switch shall be furnished to provide manual alternation of the air pumps. The switch shall be connected in such a manner that either pump may be selected to operate continuously. The selector switch shall be oil-tight design with contacts rated NEMA A300 minimum.
3. An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT tapped fitting for connection to the bubbler line.
4. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

2.10 TELEPHONE DIALER - CELLULAR

A. Specifications:

1. Furnish and install a Cellular Telephone Alarm Dialer ("dialer"). Dialer shall be completely factory assembled and tested before shipment. Enclosure shall be NEMA 4X with hinged clear cover suitable for indoor mounting. With the enclosure door open, the device shall be completely "touch-safe" with the exception of the terminal strip. The telephone dialer shall be Model Crystal Ball as manufactured by OmniSite, Greenwood, IN, and as supplied by Envirep, Inc., Camp Hill, PA (717-761-7884).
2. Dialer shall be equipped with a digital cellular radio, GSM
3. Dialer shall monitor four (4) 4-20ma analog input signals for specialized reporting functions. Analog input #1 shall be suitable for use with a level probe or similar device, and shall be configured to report the current value of the input at the time of the daily report. Analog inputs #2, #3 and #4 shall be suitable for use with pump motor amp probe monitors or similar devices, and shall be configured to report the last non-zero values of the inputs at the time of the daily report.
4. Dialer shall be equipped with four (4) output relay sockets rated at 20 amps. Outputs shall be manually energized and de-energized via the Internet.
5. Dialer shall monitor three (3) pump run universal inputs that accept dry contact closures or voltage signals from +/-12VDC/VAC to +/-120 VDC/VAC. These inputs shall monitor pump run time, count pump run cycles and calculate total station flow and pumping rates. The pump run universal inputs shall be connected to motor starter auxiliary run contacts as follows:
   a. Pump #1 run contact
   b. Pump #2 run contact
   c. Pump #3 run contact
6. Dialer shall monitor eleven (11) universal inputs (in addition to the three (3) pump run inputs) that accept dry contact closures or voltage signals from +/-12VDC/VAC to +/-120 VDC/VAC. Input #5 shall also be configurable as a rain gauge input. Inputs #6 and #7 shall also be configurable as counter inputs

and shall be capable of accepting pulse inputs from flow meters to report totalized daily flow.

7. The eleven (11) universal inputs shall be configured for alarm conditions as follows:

   a. High water, common
   b. Low water
   c. High pump temperature, common
   d. Drive fault, common
   e. Station low temperature
   f. Sewage grinder failure
   g. Normal power failure
   h. Generator running
   i. ATS in emergency position
   j. Spare
   k. Spare

8. The device shall include the following items:
   a. LCD display, 2 line, 16 character
   b. Four (4) output relay sockets
   c. 10mb Ethernet communications port
   d. Modbus RS232 port
   e. SD memory card slot
   f. Intelligent key for disabling dialer
   g. Battery charging power supply
   h. Battery backup with 0.8 amp-hour gel cell battery
   i. Lightning arrestor – solid state
   j. Removable terminal blocks
   k. UL 508 certification
   l. Antenna
   m. 14 Universal inputs (12VDC – 120 VAC)

B. Functionality and Capabilities

1. System shall be capable of the following functions (reported daily):
   a. Number of pump on/off cycles
   b. Pump run times
   c. Drawdown time
   d. Measured GPM for each pump
   e. Station flow and inflow
   f. Tank level (when connected to a level transducer)
2. All alarm functions shall be processed immediately.
3. All non-alarm functions shall be reported on a daily basis and shall be accessible and displayed over the Internet.
4. Upon alarm condition, the dialer shall make telephone calls, send messages to pagers, and/or send emails to a user programmable contact list.
5. The dialer shall have the ability to be programmed, setup and monitored over the Internet. Password protected web pages shall provide multiple levels of

secure access. Web pages shall be used to view current status of alarms, view alarm history, view pump run times and set up the dialer. Local unit setup shall be performed with a keypad and menu system. Units requiring a separate computer for local programming shall not be acceptable.

6. Dialers that require proprietary programming software are not acceptable.
7. Historical data shall be exportable to Microsoft Excel or Word.
8. Monthly fee shall be independent of the number of alarm conditions, phone calls, or information exchange transactions.
9. A toll free phone number shall be provided to receive a current alarm status report and to acknowledge alarms.

C. Installation

1. The Electrical Contractor shall install the dialer and provide the following:
   a. 115 VAC, 60 Hz, 15 amp, single-phase power wiring with circuit breaker protection
   b. Good electrical ground connection
   c. Interconnecting alarm and input wiring from monitored equipment and devices to dialer.
   d. Output wiring, if applicable.
   e. Mount dialer in accordance with manufacturer's recommendations.
   f. Mount and wire antenna

D. Startup Service:

1. Manufacturer's service technician shall provide startup and operator training. Start up service shall include complete testing of each individual alarm input and each output. Testing shall include documented verification that all alarms properly trigger the final notification device (cell phone, pager, email, etc.).

E. Warranty:

1. The device shall be supplied by the pump station supplier and shall carry a one (1) year factory warranty. The factory warranty shall cover the cost of all parts and labor for equipment repairs performed at the factory. Warranty shall commence upon startup or 3 months after shipment, whichever occurs first.

F. Cellular Service:

1. Equipment purchase price includes 3 years of cellular service fees commencing at the activation date of the unit. Afterward, cellular service fees shall be billed annually directly to the municipality.

2.11 WET WELL AERATION SYSTEM

A. General: A wet well aeration system including control panel and fiberglass enclosure shall be installed at <u>each</u> pump station with air discharge piping in the wet well as shown on the drawings. Aeration systems shall be Envirep Model 115HB3C.

B. Aeration blower assembly:

1. The aerator shall be capable of producing sustained aeration and sufficient agitation to mitigate formation of grease build-up. The aerator shall be suitable to operate with discharge piping submerged at a depth of at least four feet. The aerator shall produce continuous, non-pulsating, oil-free air. Inlet and outlet ports shall be 1-1/2 inch FNPT.
2. The aeration blower shall be rated for continuous duty at a maximum speed of 3,450 rpm and operate at a maximum ambient temperature of 104 degrees F. The motor shall be 1.0 hp, 3 phase, 208 volt, 60 Hz with TEFC enclosure and Class B insulation.
3. The following accessories shall be installed with the wet well aeration system:
   a. (1) Gauge kit – including independent, full-range indication of aeration blower inlet and outlet conditions. Total pressure across the aeration blower shall be the difference of the gauge indications.
   b. (1) Filter kit with replaceable filter element and shall be designed to protect the aerator from pre-mature wear.
   c. (1) Spare filter element
   d. (1) Check valve
   e. (1) Discharge ball valve
   f. (1) Relief valve of adequate capacity to provide system protection
   g. (1) Flexible mounting system
   h. (1) Inlet muffler/silencer
4. A set of dry contacts shall be provided in the pump control panel to interface with the aeration system to insure coordination between systems.
5. The discharge piping for the aeration blower shall be installed as shown on the plan sheets. Discharge piping to the wet well shall be minimum 2-inch diameter.
6. Aeration system, including aeration blower, inlet filter, relief valve, gauges, muffler, ball valve and check valve, shall be pre-assembled using schedule 40 galvanized pipe and mounted on an aluminum base using eight flexible vibration isolation mounts.

C. Fiberglass enclosure:

1. A fiberglass enclosure with interior dimensions of 33" long x 21" wide x 24" tall shall be provided to protect the aeration blower assembly. The control panel shall not be mounted inside the fiberglass enclosure.
2. The enclosure shall be provided with intake vents near the top in front, back and on each end, and two vents at the bottom.
3. The enclosure shall be provided with a hinged lid with locking hasp for easy maintenance and service.
4. Provide a vent hood with pressure relief valve discharge piped to exterior of the enclosure.
5. Interior of enclosure shall have foam insulation for sound attenuation, 1" thick minimum.
6. Aeration blower assembly shall fit inside this fiberglass enclosure.

D. Wet Well Aeration System Control Panel:

1. NEMA 4X stainless steel wall mounted panel. Dimensions: 16" wide x 24" tall x 8" deep.
2. Main connections to accept 3/60/208
3. Motor starter, FVNR (across the line), NEMA rated
4. Provide timer and repetitive cycle interval circuit, operator-selectable timing, operational mode selection device, and pump control panel interface. In the "Automatic" mode, the aerator shall operate in a coordinated manner with the sewage pumping system.
5. HOA switch
6. Control interface for use with pump control panel
7. Control transformer, 120 volt secondary for control circuit

2.12 REDUNDANT HIGH WATER ALARM FLOAT

A. A float switch shall be mounted in the wet well and wired in parallel to the standard high water alarm relay to serve as a redundant high water alarm.

1. Float switch shall be mercury free
2. NEMA 4X stainless steel wet well junction box
3. Float switch shall include an anchor and stainless steel chain
4. Intrinsically safe barrier

PART 3 - EXECUTION

3.1 EXAMINATION

A. General Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Pumping equipment manufacturer shall provide written instructions for proper handling. Immediately after off-loading, contractor shall inspect pumping equipment and appurtenances for shipping damage or missing parts.

B. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all serial numbers and parts lists with shipping documentation. Notify manufacturers representative of any unacceptable conditions noted with shipper.

3.2 INSTALLATION

A. Install, level, and align pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Suction pipe connections must be vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump system piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

C. Check motor and control data plates for compatibility to site voltage. Install and test the electrical ground prior to connecting line voltage to pump control panel.

D. Prior to applying electrical power to motors or control equipment, check all wiring for tight connection. Verify that fuses and circuit breakers conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

E. After all anchor bolts, piping connections are installed, seal all openings between wet well and pump enclosure.

3.3 PROTECTION

A. The pumping equipment should be placed into service soon after delivery of the equipment. If installation is delayed, the pumping equipment and motor control center shall be stored indoors, free of excessive dust, in a low humidity, heated environment.

B. During installation and after the pumping equipment is placed into operation the motor control center shall operate in an environment free of excessive dust, in a low humidity, heated environment.

3.4 FIELD QUALITY CONTROL

A. Prior to acceptance by the 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. Prior to start-up, clean wet well by removing construction debris and foreign material.

3.5 MANUFACTURER'S PRE-STARTUP INSPECTION

A. Coordinate system pre-startup with manufacturers factory-trained service technician. The factory-trained service technician will inspect the installation and answer any installation questions by the Contractor, Engineer, or Owner.

B. Verify that operations and maintenance manual is on site and installation instructions contained in the manual have been followed.

C. Verify that all pumping equipment, piping, level control system, alarms and ancillary equipment has been properly installed and all wiring is complete.

D. Verify that all spare parts for the pumping equipment is on site.

E. Pre-startup inspection shall be a separate trip and shall not be less than two weeks prior to the startup of the equipment.

3.6 MANUFACTURER'S FIELD PERFORMANCE TESTING

A. Coordinate system start-up with manufacturers factory-trained service technician. The factory-trained service technician will inspect the completed installation, calibrate and adjust instrumentation, and correct or supervise correction of defects or malfunctions. Startup shall be performed in the presence of the Engineer and Owner.

B. Equipment startup shall be tested under both utility power and emergency power.

C. General Contractor shall supply clear water of adequate volume to operate the system including the force main through several pumping cycles.

D. Observe and record operation of pumps, suction and discharge gage readings, voltage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment. Test manual and automatic control systems. Test all alarms. Report any undue noise, vibration or other operational problems.

E. Startup shall be a separate trip.

3.7 MANUFACTURER'S OPERATION AND MAINTENANCE TRAINING

A. The manufacturer shall furnish the services of a qualified, factory-trained operations and maintenance serviceman to instruct and train Owner's personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:

1. Theory of operation
2. Actual operation
3. Mechanical maintenance
4. Hydraulic troubleshooting
5. Electrical maintenance
6. Instrumentation and level controls
7. Optimization of the system
8. Alarm circuits
9. Safe operating and working practices and operation of safety devices

B. One (1) training session is required. Training shall be completed after startup services have been performed. Training shall be a separate trip and shall not be less than two weeks after the startup of the equipment. Time, location, and duration of all training sessions shall be coordinated with Owner's personnel.

C. Hands-on training and demonstrations shall use the installed equipment.

D. Supplier shall provide all materials for training and shall provide training manuals to all personnel being trained.

3.8 MANUFACTURER'S EQUIPMENT RE-CERTIFICATION

A. The General Contractor shall require, and cover the cost in his bid, for the manufacturer's factory-trained service technician to return to the site six (6) month's after initial startup of the equipment to perform a final re-certification of the equipment.

B. The re-certification shall consist of demonstrating and certifying that the equipment is meeting the performance requirements of the specifications. Equipment service technician shall perform field-testing of the equipment in the presence of the Owner. Results of all field-testing shall be submitted to the Engineer and the Owner.

3.9 CLEANING

A. 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.

END OF SECTION

SECTION 11330
SCHAEFFERSTOWN PUMP STATION

PART 1 - GENERAL

1.1 SCOPE

A. The General Contractor shall furnish and install one (1) factory built base mounted pumping system. The principal items of equipment shall include two (2) vertically staged, dual volute, self-priming, horizontal, centrifugal, v-belt motor driven sewage pumps, one water cooled standby engine, valves, piping, control panel, liquid level control system, and internal wiring.

B. Electrical power to be furnished to the site will be 3 phase, 60 hertz, 480 volts, maintained within plus or minus 10 percent. The available fault current provided at the pump station control panel is 14 kA rms symmetrical. Phase to phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

C. The pumping equipment shall be manufactured by The Gorman-Rupp Company, Mansfield, OH as supplied by Envirep, Inc., Camp Hill, PA (717-761-7884).

1.2 SUBMITTALS

A. Product Data: Prior to fabrication, submit the following to the engineer for approval:

1. Shop drawings providing layout of the mechanical equipment and anchor bolt locations, and indicating the use of Unified National Standard bolts and fasteners.
2. Electrical ladder logic drawings illustrating motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.
3. Catalog cut sheets for major items of equipment, materials of construction, major dimensions, motor and belt drive data, pump characteristics curves showing design duty point capacity (GPM), head (FT), net positive suction head (NPSHR), and hydraulic brake horsepower.
4. Pump Manufacturer's v-belt drive selection calculation summary sheet showing corrected H.P. Per Belt, total H.P. developed, diameter of sheaves, center distance between driver and driven shafts and combined arc-length correction factor applied to theoretical horsepower transmission per belt, and all calculations to demonstrate a minimum Safety Factor of 1.5.
5. Certified dimensional drawings indicating size, location and the spherical solids passing capability of the primary recirculation port.
6. Sample of service agreement and service agreement checklist for the specified equipment.

7. Interconnection wiring diagram showing the field wiring between the telephone dialer and the alarms.
8. Drawing indicating proper placement of thermally-actuated intake and exhaust louvers.
9. Copy of certificate with course I.D. number for pump manufacturer's PADEP approved Wastewater Operator Training Program in Pump Maintenance and Troubleshooting course that counts toward Pennsylvania pre-certification experience and continuing education unit requirements.

B. Certified Tests: Prior to shipment of the equipment from the manufacturer's facility, submit the following certified tests to the engineer for approval.

1. Certified copies of factory run pump performance tests. Characteristics of pumps may have a tolerance of plus 10% of rated capacity at rated head or plus 8% at rated head capacity. No minus tolerance will be acceptable. The performance tests will substantiate the correct performance of the equipment at the design head, capacity, suction lift, speed and horsepower as herein specified.
2. Certified reprime performance test data in accordance with procedures herein specified.
3. Certified copies of air release valve closure performance test.
4. Tests shall be certified by a registered professional engineer.

C. Certified System Performance Tests: All components, including the pumps, motors, and controls, will be tested as a complete working system at the pump manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head, capacity, rated speed and horsepower. Factory operational tests shall simulate actual performance anticipated. Submit certified tests data to the engineer for approval.

D. Operation and Maintenance Manuals:

1. Operation shall be in accordance with written instructions provided by the pump system manufacturer. Comprehensive instructions supplied at the time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
2. Documentation shall be specific to the pumping equipment supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall system design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:
    a. Functional description of each major component, complete with operating instructions.

b. Instructions for operating pumps and pump controls in all modes of operation.
c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
d. Support data for commercially available components not produced by the system manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
e. Electrical schematic diagram of the pump control circuits shall be in accordance with NFPA 70. 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 system operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
f. Mechanical layout drawing of the pumping equipment and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

3. Operation and maintenance instructions, which rely on vendor cut-sheets and literature, which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.
4. Telephone dialer instructions and interconnection wiring diagram showing the field wiring between the telephone dialer and the alarms.

E. Manufacturer's Field Performance Test Report: The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, instruct operating personnel in the proper operation and maintenance of the equipment. A written report covering the equipment startup shall be mailed from the Manufacturer's startup technician directly to the Owner. At a minimum, the report shall include:

1. Nameplate information.
2. Recordings of gauge readings, total dynamic head and operating speed for each pump.
3. Recordings of level control settings.
4. Certification that equipment has been properly installed and lubricated and is in accurate alignment.

5. Certification that the belt drive system has been properly aligned at the installed site using a laser alignment instrument and that belts have been tensioned at the installed site using a belt tensioning instrument.
6. Results of electrical tests including voltage readings and amperage readings of all motors.
7. Certification that the equipment has been operated fully loaded and that it operated satisfactorily.
8. Outline in detail any deficiencies noted, and proposed remedial corrections.
9. Confirm proper installation and operation of telephone dialer including actual tripping of each alarm input device, telephone reception, message programming, call out list, proper wiring, and instruction of operating personnel.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Upon request from the engineer, the pumping equipment manufacturer shall demonstrate the following:

1. Proof of financial stability and ability to produce the pumping equipment within the specified delivery schedules.
2. Evidence of the facilities, equipment, and expertise to demonstrate the manufacturer's commitment to long term customer service and project support.
3. Evidence of adequate local and factory spare parts inventory to provide timely delivery of spare parts.
4. Evidence that the pump manufacturer is an Underwriters Laboratories (UL) panel builder.
5. Evidence that the pumps and pumping equipment are constructed, assembled and tested in the United States by the pump manufacturer. All pump parts including the casing shall be machined at the pump manufacturers' facility located within the United States.
6. To ensure compatibility to existing tools and equipment, all pump internal and external nuts, bolts and hardware, shall be Unified Thread Standard (UNC) per ASME/ANSI standards.
7. Evidence that the pump manufacturer can provide operator training that counts toward Pennsylvania pre-certification experience and continuing education requirements.
8. Consideration will be given only to pump manufacturers meeting the following qualifications:

    a. Twenty-five years minimum experience successfully producing pumping equipment of the type specified herein.
    b. A minimum of twenty-five installations of pumping equipment of the type specified herein in successful operation for a minimum of ten years.
9. Pump manufacturer shall be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.

B. Manufacturer's Representative Qualifications: Upon request from the engineer, the equipment manufacturer's local representative shall demonstrate the following:

1. Evidence of adequate local spare parts inventory to provide timely delivery of spare parts.
2. Evidence of established locally based factory-trained service personnel.
3. Evidence that representative offers comprehensive equipment service agreements for the equipment specified.
4. List of at least ten local municipalities with installations similar to the specified equipment.
5. Evidence that the representative offers full-day operator training seminars on Centrifugal Pump Maintenance and Troubleshooting.
6. Evidence that the representative offers technical design assistance and hydraulic recommendations for pump station design.
7. Certification from manufacturer that the service technician has been factory-trained and is authorized for such duties by the manufacturer.

C. Pump Performance:

1. Design and construct the pumps in accordance with standards of the Hydraulic Institute. The efficiency of the pumps, when operating under conditions of the specified capacities and heads shall be as near peak efficiency as practicable.
2. Design the pumps designated as self-priming centrifugal to pump raw sewage containing solids up to ten percent and stringy materials with a minimum of clogging. Pumps may be protected by screening equipment, but materials passing through may combine by a felting or balling process.

D. Source Quality Control:

1. Obtain pumping equipment, motors, motor starters, pump controls and appurtenances from the pump manufacturer whose responsibility it is to insure that the pumping equipment is properly furnished, coordinated, and tested in accordance with these specifications.
2. 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. The pump control panel including the level controls shall be constructed at the pump manufacturer's facilities. The pump manufacturer shall be an Underwriters Laboratories (UL) panel builder. The control panel shall meet all UL and Joint Industrial Council (JIC) standards.
4. The manufacturer of the pumping equipment shall provide a listing of similar self-priming sewage pumping systems located in the State of Pennsylvania,

for review by the engineer. This listing shall include locations and contact names. Project references provided should include similar size self-priming pumps utilized with variable speed drives and PLC based logic control. These references must serve to demonstrate the pump manufacturer's ability to design complete, fully integrated pumping systems with similar flow rate, total dynamic head and suction lift requirements.

E. Factory System Test:

1. 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 tests shall simulate actual performance anticipated.
2. Upon request from the engineer, the operational test may be witnessed by the engineer and/or representatives of his choice at the manufacturer's facility.

1.4 MANUFACTURER'S WARRANTY

A. All components of the pumping equipment shall be manufactured, assembled and tested as a unit by the pump manufacturer. The pumping equipment must be a standard catalog item with the manufacturer. The pump manufacturer must assume system responsibility, i.e. the pumping equipment must be warranted by the manufacturer as described herein. Individual component warranties are desirable. However, individual warranties honored solely by the manufacturers of each component will not be acceptable.

B. The pump manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
1. All equipment, apparatus, and parts furnished shall be warranted for five (5) years, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, 0-rings, etc. The pump manufacturer shall be solely responsible for warranty of the pumping equipment components when installation is made and use and maintenance is performed in accordance with the manufacturer's recommendations.
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 without cost of parts to the owner.

C. It is not intended that the pump manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

D. The warranty shall become effective upon the acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment, whichever occurs first.

1.5 MANUFACTURER

A. These specifications and accompanying drawings specify and show equipment and materials manufactured by The Gorman-Rupp Company, deemed most suitable for the service anticipated. The contractor shall prepare his bid on the basis of the particular equipment and materials specified for the purpose of determining the low bid. The awarding of the contract shall constitute a contractual obligation to furnish the specified equipment and materials.

B. After execution of the contract, the contractor may request to substitute equipment other than that specified in the contract. Substitutions will only be considered in the event that the equipment proposed for substitution is superior in construction and efficiency to that specified in the contract, and higher quality has been demonstrated by service in a sufficient number of similar installations.

C. In the event the contractor obtains engineer's approval of equipment other than that for which the system was originally designed, the contractor shall, at his own expense, make any changes in the structures, buildings or piping necessary to accommodate the equipment, and shall provide as-built drawings to the engineer.

D. It will be assumed that the cost to the contractor of the equipment proposed to be substituted is less than that of the equipment specified in the contract and, if substitution is approved, the contract price shall be reduced by an amount equal to the savings.

PART 2 - PRODUCTS

2.1 PUMPS

A. Pump Description:
1. Pump shall be Gorman-Rupp Model VS3A60-B horizontal, self-priming, centrifugal, specifically designed for pumping raw, unscreened, domestic sanitary sewage.
2. Pump shall be vertically staged incorporating a lower and upper volute casing united by a ductile iron transition chamber, allowing for a direct and smooth flow path to the impeller in the upper casing.
3. Pump suction and discharge connections of the lower casing shall be vertically inline with one another.
4. The cover plates and rotating assemblies shall be interchangeable between both casings.
5. The discharge port of the upper casing shall be capable of being rotated to allow for multiple pipe connection orientations.

6. All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of the specified spherical solids passing capacity, and any trash or stringy material which may pass through the average house collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump shall not be permitted.
7. The pumps shall have the following characteristics:

a.	Suction connection, flanged, in.	4
b.	Discharge connection, flanged, in.	3
c.	Minimum shutoff head, each pump, ft.	250
d.	Pump speed, rpm	2100
e.	Maximum NPSH required at design point, ft.	8
f.	Minimum reprime lift capacity, ft.	24
g.	Spherical solids passing capability, in.	2.5
h.	Motor horsepower	50
i.	Motor speed, rpm	1750
j.	Impeller diameter, in.	9

B. Pump Performance:

1. Each pump must have the necessary characteristics and be properly selected to perform under these operating conditions:

a.	Capacity, gpm	380
b.	Total dynamic head, ft.	189
c.	Total dynamic suction lift, ft.	17.2
d.	Maximum static suction lift, ft.	15.8
e.	Static discharge head, ft.	121.7

2. Consideration shall be given to the sanitary sewage service anticipated, in which occasionally debris will lodge between the pump suction check valve and seat, resulting not only in loss of the suction leg, but also in the siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal with proper installation of air release line to atmosphere.

3. In consideration of such occurrence and of the unattended operation anticipated, each pump shall be so designed as to retain adequate liquid in the pump casing to insure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

C. Reprime Performance:

1. Each pump must be capable of the specified reprime lift while operating at the selected speed and impeller diameter. Reprime lift is defined as the static height of pump suction centerline above liquid that the pump will prime; and

delivery within five minutes on liquid remaining in the pump casing after a delivering pump is shut down with the suction check valve removed. Systems requiring ancillary vacuum generating devices shall not be acceptable. Additional standards under which reprime tests shall be run are:

a. Piping shall incorporate a discharge check valve down stream from the pump. Check valve size shall be equal (or greater than) the pump discharge diameter.
b. A ten-foot length of one-inch pipe shall be installed between pump and discharge check valve. This line shall be open to atmosphere at all times to duplicate the air displacement rate of a typical pump system fitted with an air release valve.
c. No restrictions shall be present in pump or suction piping which could serve to restrict the rate of siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a minimum horizontal run of 2 feet and one 90-degree elbow.
d. The pipe size used for the reprime performance test shall be the same size as the pump suction diameter.
e. Impeller shall be set at the clearances recommended by the manufacturer in the pump service manual.
f. Reprime lift repeatability shall be demonstrated by five sequential reprime cycles.
g. Liquid to be used for reprime test shall be water.

D. Serviceability:

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that due consideration has been given to reducing maintenance costs by incorporating the following features:
   a. No special tools shall be required for replacement of any components within the pump. All internal and external threaded fasteners shall be of the Unified National Standard type.
   b. The mechanical seal shall be a one-piece cartridge type to allow for easy replacement. Mechanical seals requiring assembly of individual components shall not be acceptable.
   c. The pump must be equipped with a removable cover plate, allowing access for service and repair without removing suction or discharge piping.
   d. The pump shall be fitted with a replaceable wear plate. Replacement of the wear plate, impeller, and seal shall be accomplished through the removable cover plate without removing suction or discharge piping.
   e. The entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping.
   f. Removal or installation of the suction check valve shall be accomplished from the top of pump without disturbing the suction piping or completely draining the casing.

g. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

h. Cover plate impeller clearance adjustment: Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external shimless cover plate adjustment utilizing collar and adjusting screw design for incremental adjustment of clearances by hand. Pumps requiring realignment of belts, couplings, etc., due to clearance readjustment shall not be acceptable. Cover plate shall be capable of being removed without disturbing clearance settings.

i. Rotating assembly impeller clearance adjustment: Additional adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by moving the entire rotating assembly towards the wear plate, to compensate by removal of stainless steel shims between the rotating assembly and the volute.

j. Clearance adjustment which requires movement of the shaft without movement of the entire rotating assembly, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

E. Construction:

1. Pump casing: Made of Gray Iron 30, shall be foot supported, and shall have a horizontal centerline suction and vertical discharge. Suction connection and discharge connection shall be vertically in-line with one another.

a. The casing shall have a top mounted 3-1/2 inch priming fill port with a safety lock bar cover. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detent lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

b. Casing shall have no openings of smaller diameter than the specified sphere size.

c. Casing shall be designed to retain sufficient liquid to ensure automatic repriming and unattended operation.

d. A minimum 1-1/4 inch diameter drain hole shall be provided for attachment of the pump drain kit and to ensure complete and rapid draining.

e. Bolts and other threaded fasteners shall have Unified National Standard threads.

f. Suction flap valve: The suction flap valve shall be externally removable and shall be constructed of molded neoprene with integral steel and nylon reinforcement. A blow-out center shall protect the pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished from the top of the pump without any other disassembly of the pump, without disturbing any

piping and without draining the pump. Sole function of the suction flap 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.

g. Pump shall be provided with a separate capped threaded port for use of an optional casing heater.

2. Cover plate: Cover plate shall be Gray Iron 30.

a. Cover plate shall be retained by four (4) nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and the allow removal or service to the impeller, seal, or wear plate.

b. Replaceable wear plate: Secured to the cover plate by welded studs and nuts. The wear plate shall be Carbon Steel 1015. The wear plate shall be of sufficient width to maintain the manufacturer's recommended clearance between the entire edge of each impeller vane and the wear plate. Wear plate attachment hardware shall have Unified National Standard threads and shall be located out of the direct flow path of the liquid into the impeller. Two (2) Buna-N o-rings shall seal cover plate to the pump casing. The wear plate shall be constructed with a minimum of six (6) semi-circular machined channels and a tapered face designed to provide self-cleaning action and ensure that debris is cleared away from and does not collect between the impeller and the wear plate.

c. O-ring Seals: Two (2) Buna-N o-rings shall seal cover plate to the pump casing. The inner cover plate o-rings shall provide a seal between the suction chamber and the discharge chamber of the pump casing to eliminate the possibility of recirculation at the wear plate.

d. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75 PSI.

e. Pusher bolt capability to assist in removal of coverplate. Threaded pusher bolt holes shall be sized to accept same retaining capscrews as used in rotating assembly.

f. Easy-grip handle shall be mounted to face of coverplate.

3. Rotating assembly:

a. Impeller: Two-vaned, semi-open, non-clog, Ductile Iron 65-45-12 with integral pump out vanes on the back shroud. Impeller shall be balanced and shall thread onto the pump shaft and be secured with a lockscrew and conical washer.

b. Shaft: Shaft shall be constructed of Alloy Steel 4150.

c. Mechanical seal: Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be silicon carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by

virtue of a dual O-ring design. An external O-ring secures the stationary seat to the seal plate, 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. The seal shall be warranted for five (5) years from date of shipment.

d. Lubrication: Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Oil 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 with 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. 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 plug with vent. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the vented fill plug.
   3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

e. Atmospheric isolation: The shaft bearings shall be isolated from the seal cavity with an air gap to provide positive protection of the bearings in the event of a seal leak and to provide for external monitoring of the seal integrity.

f. Seal plate: Replaceable seal plate shall be constructed of Gray Iron 30, and shall be bolted to the bearing housing. Seal plate shall be equipped with anti-rotation ribs cast into the seal plate to reduce internal wear and to maximize seal plate and mechanical seal life.

g. Radial bearings: Single row, anti-friction ball bearings, of ample size and proper design to withstand all radial loads which can reasonably be expected during normal operation. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal shall not be acceptable.

h. Thrust bearings: Double row, anti-friction ball bearings, of ample size and proper design to withstand all thrust loads which can reasonably be expected during normal operation. Pump designs in which the same oil lubricates both the shaft bearings and the shaft seal shall not be acceptable.

i. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

4. Suction and discharge spools: Each pump shall be equipped with one-piece, cast iron spools, flanged on each end. Each spool shall have one 1 1/4-inch NPT

and one 1/4-inch NPT tapped hole with pipe plugs for mounting of gauges or other instrumentation.

F. Low Station Temperature:

1. The control panel shall be provided with a thermostat to serve as a low temperature alarm.

2.2 PUMP ACCESSORIES

A. Spare Parts:

1. Furnish the following spare parts for common stock:
   a. One (1) complete rotating assembly
   b. Two (2) impellers
   c. Two (2) impeller socket head capscrews
   d. Two (2) impeller washers
   e. Two (2) wear plates with attachment hardware
   f. Two (2) seal plates
   g. Two (2) impeller shafts
   h. Two (2) complete AirMate air release valves
   i. Two (2) AC air pumps for bubbler level control system

2. Furnish the following spare parts for the Schaefferstown Pump Station:

   a. Four (4) Spare Parts Kits, each including one (1) mechanical cartridge seal, one (1) set of rotating assembly adjustment shims, one (1) cover plate o-ring, and one (1) rotating assembly o-ring
   b. Four (4) suction flap valve assemblies
   c. One (1) belt tensioning gauge - spring loaded
   d. Two (2) quarts of seal lubricant
   e. Two (2) air pump repair kits for bubbler level control system
   f. One (1) DC air pump for bubbler level control system
   g. Two (2) discharge check valve springs

B. Gauge Kit With Vibration Isolation Frame:

1. Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin-filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4-inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full-scale reading. Compound gauges shall be graduated -34 feet to +34 feet water column minimum. Pressure gauges shall be graduated 0 to 460 feet water column minimum.
2. Gauges shall be mounted on a vibration isolation frame assembly with resilient panel, frame, and adjustable brackets which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and

fittings, and shall include a shutoff valve installed in each gauge inlet at the point of connection to suction and discharge pipes.

3. Gauge kit shall be supplied with stainless steel fittings.

C. Pump Drain Kit:

1. Each pump shall be equipped with a pump drain kit shall consist of a 10' length of plastic hose with a quick connect female Kamlock fitting on one end of hose and two sets of fittings for pump drains. Each set of fittings for pump drain includes a pipe nipple, bushing, bronze ball valve and quick connect male Kamlock fitting.
2. Pump drain kit shall be supplied with stainless steel fittings.

D. Self Cleaning Wear Plate:

1. The wear plate shall be constructed with no more than six (6) semi-circular machined channels and a tapered face designed to provide self-cleaning action and ensure that debris is cleared away from and does not collect between the impeller and the wear plate.

2.3 VALVES AND PIPING

A. Check Valves, 6-inch:

1. Each pump set shall be equipped with two (2) full flow type check valves. Each check valve shall be capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. The valve seat shall be constructed of stainless steel and shall be replaceable. The valve body shall be cast iron. The valve shall be equipped with a removable cover plate to permit entry for complete removal and replacement of internal components without removing the valve 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, sealing bushing shall have double o-rings. O-rings shall be easily replaceable without requiring access to interior of valve body. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

B. Plug Valve, 6-inch:

1. Discharge header piping shall include a 3-way plug valve to permit the pump to be isolated from the force main. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125 pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings and shall have a resilient facing bonded to the

sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseat action. The lever shall have a locking device to hold the plug in the desired position.

C. Air Release Valves (High-Impact Composite Polyester):

1. Each pump shall be equipped with an Air Mate® air release valve to vent air to atmosphere during initial priming or unattended repriming cycles. The valve shall automatically close operating solely on discharge pressure to prevent recirculation. A visible indication of valve closure shall be evident.
2. Air release valve piping must discharge directly into wet well. ARV piping shall not discharge to a sump.
3. The air release valve shall be constructed of high-impact composite polyester containing not less than 30% glass-filler. The valve body shall incorporate an internal passageway that allows all debris to pass through the valve chamber between operational cycles. The diaphragms shall be Buna-N, Fluorocarbon or EPDM, with a polyester mesh rated for 250 PSI of pressure.
4. The vertical plunger shall be constructed of Acetal and PTFE fluorocarbon filler. The independent, dual diaphragms and single, vertical valve plunger shall incorporate a media fluid that passes through an orifice and separates the actions of each.
5. The valve shall employ an externally-adjustable restrictor for applications below four feet of static discharge head.
6. The valve body shall incorporate passageways having minimal constrictions and no directional course changes integral to the body of the valve. The inlet shall be 1 inch NPT female and the discharge outlet shall be 1-1/4 inch NPT female. The valve shall be mounted horizontally, at 90 degrees to the vertical plunger.
7. The valve shall be capable of operation on applications ranging from four to 400 feet of water column without the need for adjustment or change of springs or other parts.
8. Air release valves shall be connected to pump station piping using stainless steel pipe fittings.
9. Each air release valve shall be provided with an isolation ball valve.

D. Piping:

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness. Flanges shall be cast iron class 125 and comply with ANSI B16.1. All piping pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
2. Boltholes shall be in angular alignment within ½-degree between flanges. Flanges shall be faced and a gasket finish applied that shall have 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 ¼ inch apart.

E. Supports and thrust blocks:

1. General Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping.
2. Pump station discharge force main piping shall be anchored with thrust blocks by the contractor where shown on the contract drawings.

F. Gauge Connection Assembly:

1. The header piping shall be equipped with a gauge connection assembly located between the discharge check valve and force main isolation plug valve allowing the operator to easily attach a discharge gauge on any pump for troubleshooting.
2. The gauge assembly shall consist of a 1/4" brass pipe nipple, 1/4" brass full port ball valve and a quick connect fitting.
3. The gauge connection assembly shall be installed in the discharge header piping such that the static and dynamic pressure in the force main can be read at all times unless the force main isolation plug valve is closed for that particular pump.

2.4 FABRICATED STEEL BASE

A. One fabricated steel base shall be provided for each pump set, including drive assembly. The base shall comprise a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than ¼" thick, and shall incorporate openings for access to all internal cavities to permit complete grouting of unit base after installation. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

B. General Contractor shall provide and install grout in fabricated steel base.

2.5 DRIVE UNIT

A. Motors:

1. The pump motors shall be horizontal, open drip-proof, induction type, with normal starting torque and low starting current characteristics. The motors shall not be overloaded at the design condition or at any head in the operating range as specified.
2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std. 112.

3. Each motor shall be in current NEMA design B cast iron frame with copper windings.
4. Motors shall be NEMA Premium Efficient, per NEMA MG-1, Table 12-12.

B. Drive Transmission:

1. Power shall be transmitted from motors to pumps by means of v-belt drive assemblies. The drive assemblies must be selected to establish proper pump speed to meet the specified operating conditions.
2. Each drive assembly shall have a minimum of two v-belts. In no case will a single belt drive be acceptable. Each v-belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump. Drive systems with a safety factor of less than 1.5 shall not be considered sufficient for the service intended. Computation of safety factors shall be based on performance data published by the drive manufacturer.
3. V-belts shall be the banded type.

C. Belt Guards:

1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½ inch.
2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component, and shall be securely fastened to the unit base.
3. All metal shall be free of burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than five-inch spacing. Tack welds shall not exceed four-inch spacing.
4. 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.

2.6 WATER COOLED STANDBY ENGINE

A. Type:

1. Standby engine shall be a LPG fueled, water cooled type, and shall have continuous duty power rating suitable for the horsepower requirements of the pump, after derating to factors set forth under performance.
2. Engine shall be cooled by an integral forced water-cooling system capable of maintaining safe engine operating temperature under expected operating loads, and subject to the expected maximum ambient temperatures in the pump station enclosure. Engine shall have a cooling media reservoir. Reservoir shall also allow for expansion and contraction of the cooling media under normal use.

3. The standby engine shall have the following characteristics:
   a. Continuous output rating (at sea level): 90 HP @ 2800 RPM; 80 HP @ 2500 RPM; 63 HP @ 1800 RPM
   b. Maximum engine speed: 2800 RPM
   c. Maximum required combustion air: 43 CFM
   d. Minimum cooling air through radiator: 10,030 CFM
   e. Maximum heat dissipation through radiator: 318,600 BTU/HR
   f. Maximum exhaust gas temperature: 1,400 degrees Fahrenheit
   g. Minimum radiator shutter size: 30" square
   h. Exhaust pipe size: 3" diameter

B. Equipment:

1. The engine shall be equipped with all controls and components required for manual and automatic operation when used with the engine controls and DC level control system described in these specifications. Such components shall include, but not be limited to, the following:
   a. 12 volt DC electrical system with starter and alternator
   b. Storage battery, 84 ampere-hour capacity minimum
   c. Elapsed running time meter
   d. Tachometer
   e. Sensors for engine temperature, oil pressure, and overspeed
   f. Critical grade muffler designed to limit engine noise to a level acceptable in a residential area
   g. Switch for manual operation of the cranking motor, mounted on or near the engine
   h. Electronic speed adjustment switch. Allows operator to choose one of the following modes of operation: Normal operating speed or idle speed.
   i. Charging system voltage sensing and indicating display system.
   j. Solenoid fuel lock-off valve suitable for use with natural gas or LPG service.
   k. LP gas primary pressure regulator, 10 psi for tank.
   l. LP gas secondary pressure regulator, 13 inches for engine.
   m. LP gas pressure regulator, 2 psi for LP gas manifold.
   n. Lube oil pressure gauge
   o. Jacket water temperature gauge

2. Engine electrical equipment shall be wired to a terminal board in the engine control panel mount adjacent to the engine. Contractor shall wire to matching terminals in the pump control panel.

C. Performance:

1. Because the engine shall be required to operate during emergency situations, the following minimum performance standards shall be used for engine selection:

a. Engine speed shall be controlled by an electronic, governor-controlled throttle that shall maintain the preset speed over the range of expected pumping loads. This speed shall not be less than 1800 rpm to insure adequate cooling, nor more than 2800 rpm so that internal engine wear is held to a minimum. This governed speed shall not be acceptable if it is greater than that speed at which the engine torque and horsepower curves intersect. Engine manufacturer's published performance curves shall be submitted for review to support engine selection.
b. The engine shall develop approximately 95 percent of manufacturer's published performance after a reasonable run-in period.
c. For selection of engine size, engine performance shall be derated according to manufacturer's specifications to allow for decreased performance if installed at elevations more than 1000 feet above sea level.
d. For selection of engine size, engine performance shall be derated according to manufacturer's specifications to allow for decreased performance in an ambient temperature of 100-degrees F, which can reasonably be expected in the pump station.
e. Engine rating shall be further reduced to conform to engine manufacturer's recommendations for continuous service applications.

2. Brake horsepower requirements of pump shall not exceed calculated engine horsepower after derating for power available after run-in, derating for temperature compensation, and derating for altitude compensation.

D. Clutch and Coupling:

1. Power shall be transmitted from engine to pump by shaft coupling through a centrifugal clutch.
2. Centrifugal clutch shall be designed to remain disengaged until engine has reached some speed greater than idle speed to reduce starting loads. Once engaged, clutch shall be rated to transmit power continuously until engine speed has been reduced below disengagement speed. Clutch shall disengage completely while engine is not operating.

E. Belt Guards:

1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½ inch.
2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component, and shall be securely fastened to the unit base.

3. All metal shall be free of burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than five-inch spacing. Tack welds shall not exceed four-inch spacing.
4. The guard shall be primed with a minimum of 1.5 mils of zinc-based synthetic primer. A finish acrylic enamel coating (minimum 1.5 mils) shall be applied in accordance with section 3, color definitions of ANSI 253.1; 1967, safety color code for marring physical hazards.

2.7 FINISH

A. Surface Preparation:
1. Pumps, piping and exposed steel framework shall be prepared utilizing a six-stage surface preparation system including the application of iron phosphate and sealer/rust inhibitor.
2. The method shall provide excellent removal of substrate contaminants and very effectively etch pores in the metal resulting in a superior adhesion of primer and paint.
3. Surface preparation shall be in accordance with United States Government mil spec # MIL-T-704J. Sandblasting shall not be acceptable.

B. Paint:

1. Pumps, piping and exposed steel framework shall be coated with one coat gray W.R. non-lift primer and one coat white acrylic alkyd W.R. enamel. Paint shall be low VOC, alkyd based, high solids, semi-gloss white enamel for optimum illumination enhancement and incorporate rust inhibitive additives.
2. The finish coat shall be 1.0 to 1.5 MIL dry film thickness (minimum), resistant to oil mist exposure, solvent contact and salt spray.
3. The factory finish shall allow for over-coating and touch up after final installation.
4. All flanged connections including pumps, valves, piping and fittings shall be painted prior to assembly.

2.8 PUMP CONTROL SYSTEM

A. General:

1. This specification covers a pump control system for the duplex series-connected pumping station including motor circuit breakers, reduced voltage motor starters, pump motor overload protection, door mounted operator controls, and liquid level controls.
2. The liquid level control will include an air bubbler level control system, electronic pressure switch, pump sequence control, alarms and pump safety shutdowns.

B. UL Listing:

1. The pump controls shall be manufactured by the pump manufacturer who shall be a UL panel builder and each assembly shall bear a serialized UL label listed for "Enclosed Industrial Control Panels."
2. The enclosure and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures. Listing for open style industrial control panels or an assembly of listed or recognized components shall not be acceptable.

C. Panel Enclosure:

1. Enclosure shall be constructed in conformance with applicable section of national electrical manufacturers' association (NEMA) standards for Type 1 electrical enclosures. Enclosure shall be fabricated of steel having a minimum thickness of not less than 0.075 inch (14 gauge). Interior and exterior surfaces shall be enamel over phosphatized surfaces.
2. Door shall be hinged and sealed with a neoprene gasket and shall be held closed with clamps that are quick and easy to operate. The door shall accommodate the mounting of switches and indicators.
3. Enclosure shall be furnished with a removable back panel, fabricated of steel having a thickness of not less than 0.106 inch (12 gauge), which shall be secured to the enclosure with collar studs. Such panel shall be of adequate size to accommodate all basic components.
4. All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators and instruments shall be mounted through the control panel door. Self-tapping screws shall not be used to mount any components.
5. Each control assembly shall be furnished with main terminals and ground lug for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the loads. The main terminals shall be mounted to allow incoming wire bending space in accordance with article 373 of the national electric code (NEC). A separate terminal strip shall be provided for 115 volt, single phase control power and shall be segregated from the main terminals. Ten percent of the control terminals shall be furnished as spares.
6. The control panel shall be provided with a thermostat to serve as a low station temperature alarm.

D. Motor Branch Components:

1. All motor branch components shall be of the highest industrial quality. Operating coils of all AC control devices shall be rated for 120 volts, and shall be suitable for use in a voltage range of 108 to 132 volts, 60 hertz.
2. Circuit Breakers and Operating Mechanisms:

    a. A properly sized heavy duty air circuit breaker shall be furnished for each pump motor, and shall have a symmetrical RMS interrupting rating of 14,000 amperes at 480 volts. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.

b. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the "off" position.

E. Reduced Voltage Starters:

1. Reduced Voltage Starters

a. A reduced voltage, solid state motor starter shall be furnished for each pump motor. The power section shall consist of six back-to-back SCRs rated 208 to 480 volts, 50/60 hertz. The power section shall be capable of 300% rated current for 30 seconds. The SCRs shall have a minimum repetitive peak inverse voltage rating of 1400 volts at 480 volts. Operating temperature range shall be 0 to 50 degrees C at altitudes up to 2000 meters without derating.

b. The starter shall be capable of soft starting the pump and be adjustable from 2 to 30 seconds. Ramp time is load dependent. Fault diagnostics shall be displayed on the starter and shall include stalled motor, start fault, temperature fault and line fault.

c. Pump Control option: The starter shall provide smooth acceleration and deceleration using an algorithm, which approximates the torque requirements of a centrifugal pump. The starter's microcomputer shall analyze motor variables and generate control commands, which will minimize surges in the system. Pump stop time shall be adjustable from 0 to 120 seconds.

d. Protective features
   1) The starter shall be equipped with the following protective features:
      a) Built in Overload relay, Class 10, 15, 20 or 30 trip, Ambient insensitive, Thermal Memory
      b) Stall protection-0-10s after start ramp
      c) Jam protection-0-10s after up-to-speed
      d) Phase rebalance
      e) Underload-0-99%, 0-99s
      f) Undervoltage-0-99%, 0-99s
      g) Overvoltage-0-99%, 0-99s
      h) Voltage Unbalance-0-25%
      i) Excessive starts per hour

e. Operator Interface
   1) The starter shall be equipped with a digital display and data entry terminal mounted on the exterior of the starter enclosure door. The operator interface shall be an English language display and include the following data:
      a) Volts Phase to Phase

b) Current each Phase
c) Watts
d) KWh
e) Elapsed Time
f) Motor Thermal Usage
g) Power Factor
h) Fault Display
i) Fault Buffer (last five faults in code)
j) Set-up Parameters

2. Bypass contactors
   a. Each solid-state reduced voltage motor starter shall be provided with a bypass contactor.
   b. When the pump motor is up to speed, the bypass contactor shall be "pulled in" for "run" in order to reduce the amount of heat produced by the reduced voltage starter.
   c. When the pump motor is called to "Stop", the bypass contactor shall "drop out" and allow for the reduced voltage starter to take over in order to provide for smooth deceleration of the pump motor.

3. Converter modules

   a. Each motor branch circuit shall include a control module.
   b. Control module shall provide three-phase current feedback to the solid-state reduced voltage starter for metering and overload protection during phase rebalance and bypass operation.

F. Indicators:

1. Indicating lights shall be oil tight type and equipped with integral step-down transformers for long lamp life. Lamps shall be incandescent type rated 14 volts or less with a minimum life of 15,000 hours. Lamps shall be replaceable from the front without opening the control panel door and without the use of tools.

2. Indicating lights will be furnished for the following functions:
   a. Pump No. 1 run
   b. Pump No. 2 run
   c. Engine low oil pressure
   d. Engine high temperature
   e. Engine overspeed
   f. Engine overcrank
   g. 115 Volt power available
   h. Pumping system disabled

3. Indicators shall be furnished for the following functions:
   a. High Pump Temperature, No. 1

b. High Pump Temperature, No. 2

G. Switch Controls:

1. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
2. Pump mode selector switches shall be connected to permit manual start and manual stop of each pump individually or permit automatic operation under control of the liquid level control system. Manual operation shall override shutdown systems except motor overload and phase failure relays. Selector switches shall be oil-tight with contacts rated NEMA A300.
3. Pump sequence selector switch shall permit selection of automatic pump alternation, or selection of either pump to run as lead pump for each cycle. Pump alternator relay shall be electro-mechanical industrial design. Relay contacts shall be rated 10 amperes minimum at 120 volts non-inductive.
4. Override switches shall be connected to bypass the level control system and all shutdown systems supplied with it, to provide manual start and manual stop of each pump individually in the event of level control system malfunction.
5. A selector switch shall provide manual alternation of the air pumps in the bubbler system. The switch shall be connected in such a manner that either pump may be selected to operate continuously.
6. A pushbutton switch shall be provided to silence the 115-volt AC alarm circuits while corrective actions are underway. Depressing the alarm silence pushbutton shall also cause the high water alarm circuit to reset when the liquid level has been lowered.

H. High Pump Temperature Shutdown:

1. The control panel shall be equipped with circuitry to override the level control system and shut down the pump motor(s) when required to protect the pump from damage caused by excessive temperature.
2. A thermostat shall be mounted on each pump to detect its temperature. If the pump temperature should rise to a level that could cause pump damage, the thermostat shall cause the pump motor to shut down. A visual mechanical indicator shall indicate that the pump motor has been stopped because of a high temperature condition.
3. The pump shall remain locked out until the pump has cooled and the circuit has been manually reset. Automatic reset of such a circuit shall not be acceptable.

I. Elapsed Time Meters:

1. Six-digit elapsed time meters (non-reset type) shall be connected to each motor starter to indicate the total running time of each pump in “hours” and “tenths of hours”.

J. Pump Start Delay:

1. The lag pump will be equipped with a fixed five-second time delay to prevent simultaneous motor starts.

K. Alarm Contacts:

1. Provide separate alarm contacts for the following alarm conditions:
   a. High water (bubbler)
   b. High water (float)
   c. Low water
   d. EQ aeration ON
   e. High pump temperature, #1
   f. High pump temperature, #2
   g. Drive fault, #1
   h. Drive fault, #2
   i. Engine failure
   j. 12 volt DC power failure
   k. Pump run, #1 (normally open)
   l. Pump run, #2 (normally open)
   m. Dry well flood
   n. Pump run, #1 (normally closed)
   o. Pump run, #2 (normally closed)
   p. Pumping system disabled
   q. Station enclosure low temperature

L. Secondary Surge Arrestor:

1. The control panel shall be equipped with a surge arrestor to minimize damage to the pump motors and control from transient voltage surges. The arrestor shall utilize metal-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps and a Joule rating of 1,500.

M. Receptacle:

1. A duplex ground fault interrupter utility receptacle providing 115 VAC, 60 hertz, single-phase current shall be provided. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

N. Auxiliary Power Transformer:

1. The control panel shall be equipped with a 3 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary circuits. The primary side of the transformer shall be protected by a thermal-magnetic air circuit breaker, specifically sized to meet the power requirements of the transformer. A mechanical operating mechanism shall be installed on the

circuit breaker to provide a means of disconnecting power to the transformer.

2. The padlockable operator handle for the operating mechanism shall be located on the exterior of the control panel with interlocks which prevent opening the door until primary circuit breaker is in the "OFF" position.

O. Auxiliary Contacts:

1. Each pump motor starter shall include a N.C. auxiliary dry contact wired to a terminal strip to interface with the wet well aeration system.

2.9 WIRING

A. General:

1. The pump control as furnished by the manufacturer shall be completely wired except for the power feeder lines to the branch circuit breakers and final connections to remote alarm devices and between control assemblies.
2. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).
3. All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color-coded as follows:

a.	Line and load circuits, AC or DC power	Black
b.	AC control circuit less than line voltage	Red
c.	DC control circuit	Blue
d.	Interlock control circuit, from external source	Yellow
e.	Equipment grounding conductor	Green
f.	Current carrying ground	White
g.	Hot with circuit breaker open	Orange

B. Wire Identification and Sizing:

1. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Motor branch wiring shall be 10-gauge minimum.
2. Motor branch conductors and other power conductors shall not be loaded above 60-degree C temperature rating, on circuits of 100 amperes or less, nor above 75-degree C on circuits over 100 amperes. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be of the ring tongue type with nylon insulated shanks. All wires on the subplate shall be bundled and tied or installed in duct. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit.

C. Wire Bundles:

1. Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

D. Conduit:

1. All conduit and fittings shall be UL listed.
2. Liquid tight flexible metal conduit shall be constructed of a smooth, flexible, galvanized steel core with a smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
3. Conduit shall 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.

E. Grounding:

1. The pump control manufacturer shall ground all electrical equipment to the enclosure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections.

2.10 LEVEL CONTROL SYSTEMS

A. Operation:

1. Pump station shall operate on utility power while such power is available, except for exercise periods as specified herein. When operating on utility power, operation of pumps and motors shall be controlled by the level control system on AC power as specified herein. During a failure of utility power and during exercise periods, operation of the pump with the standby engine shall be controlled by an independent DC powered level control system and the engine control system specified herein. Transfer from AC power to DC power shall occur as follows.
2. Normal to standby transfer relays and other controls shall be provided to accomplish the following functions:

    a. Time delay after failure of utility power before transfer from AC power to DC power. Relay shall be manually adjustable from 0.2 to 60 seconds.
    b. Time delay after restoration of utility power before transfer from DC power to AC power. Relay shall be manually adjustable from 0 to 30 minutes.

c. Automatic override of time delay after power restoration, upon occurrence of: engine or engine control failure as specified under engine control system; failure of DC power; high wet well level as detected by the level control system.
d. Manual override of time delay on restoration of normal power. Momentary pushbutton or similar device shall be acceptable.
e. Time delay after transfer from DC power to AC power before application of AC power to motor of pump with standby engine. Such relay shall be preset at approximately 15 seconds to permit engine to stop completely before motor is started.
f. Indicate the presence of utility power. Such indicator shall be the press-to-test type to permit the operator to verify failure of utility power.

3. These functions and interlocks shall be applicable only to the motor of the pump furnished with the standby engine. No hindrance shall be included for the motor starter and motor branch circuit for the pump which does not have the standby engine.
4. Immediately upon restoration of utility power after power interruption, and during exercise periods, the pump which does not have the standby engine shall be permitted to run if operation of that pump is required by the level control system.

B. Exercise Periods:

1. Controls shall be provided to cause regular use of the standby engine. Such exercise of standby components shall occur to maintain these components in a ready condition, and to discover malfunctions before emergency conditions arise.
2. Exercise periods shall be established by a manually adjustable exercise timer. Timer shall provide a 7-day timing cycle, and shall permit the selection of one or more exercise periods of 15-minute duration, or multiples thereof, which shall repeat every 7 days.
3. Exercise Operation:

a. During exercise periods, timer shall simulate a loss of utility power to transfer circuits described herein. After transfer from AC power to DC power, the level control system shall operate the pump with the standby engine through the engine control system as described in these specifications.
b. If the standby engine is operating at the end of the exercise period, it shall continue to operate until one of the following conditions occurs: the level control system stops the engine through the engine control system, or the delay on restoration of utility power relay times out.
c. Upon occurrence of either of these conditions, operation of the engine shall cease, and operation of the pump with the standby

engine shall revert to control by the level control system on AC power.

d. During exercise periods, utility power shall remain available to the motor of the pump that does not have the standby engine.

C. AC Powered Liquid Level Control System:

1. 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.
2. The AC level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.
3. Each level control system shall be furnished as an air bubbler type level control system; however, it must be capable of being operated as a submersible transducer type system or ultrasonic transmitter type system.
4. The level control system shall incorporate automatic alternation to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.
5. The level control system shall utilize an electronic pressure switch that 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 pump when the liquid reaches the "lag pump start level" so that both 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 12VDC in an ambient temperature range of -10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Control range shall be 0 to 12.0 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be retained using a non-volatile lithium battery back-up.
   c. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators and output relays.

      1) 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 0-15 PSI, temperature compensated from -40 degrees C (-40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 0.25% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.

2) 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 the preset start and stop level for both lead and lag pump. The display shall include twenty (20), 0.19" high alpha-numeric characters calibrated 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.

3) Level adjustments shall be electronic comparator set points to control the levels at which the lead and lag 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.

4) Each output relay in the electronic pressure switch shall be solid state. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. The "ON" state of each relay shall be indicated by illumination of a light emitting diode. The output of each relay shall be individually fused providing overload and short circuit protection. Each output relay shall have an inductive load rating equivalent to one NEMA size 4 contactor. A pilot relay shall be incorporated for loads greater than a size 4 contactor.

d. The electronic pressure switch shall be equipped with an output board which shall include LED status indicators and a connector with cable for connection to the main unit.

e. 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.

f. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.

g. The electronic pressure switch shall be capable of controlling liquid levels in either a pump up or pump down application.

h. 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, 0-10VDC, or 4-20mA, and one (1) 4-20mA scalable output. Output is powered by 10VDC supply. Load resistance for 4-20mA output shall be 100-400 ohms.

i. The electronic pressure switch shall include a DC power supply to convert 120VAC control power to 12VDC EPS power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.

j. The electronic pressure switch shall be contained within a NEMA 1 enclosure including a polyester face and stainless steel case.

k. The electronic pressure switch shall be equipped with an electronic comparator and solid state output relay to alert maintenance personnel to a high liquid level in the wet well. An indicator, visible on the front of the control panel, 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.

6. 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 oil tight design with contacts rated NEMA A300 minimum.

D. DC Powered Liquid Level Control System:

1. A separate DC level control system shall start and stop the pump/engine in response to changes in wet well level. The electronic pressure switch used in the DC level control system shall be identical to and interchangeable with the electronic pressure switch in the AC level control system.

E. Air Bubbler System:

1. The level control system shall be the air bubbler type, containing air bubbler piping which extends into the wet well. A pressure sensor contained within the electronic pressure switch shall sense the air pressure in this piping to provide wet well level signals.
2. AC Air Pumps: Two vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure-reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable.
3. DC Air Pump: One vibrating reed, industrial rated, air pumps shall be furnished to deliver free air at a rate of approximately 5 cubic feet per hour

and a pressure not to exceed 7 psi. Liquid level control systems utilizing air compressors delivering greater quantities of air at higher pressures, requiring pressure-reducing valves, air storage reservoirs, and other maintenance nuisance items will not be acceptable. The DC air pump shall run continuously when AC power is lost and provide air to the air bubbler system when under DC control.

4. An air bell constructed of PVC 3 inches in diameter shall be provided for installation at the outlet of the air bubbler line in the wet well. The air bell shall have a 3/8" NPT tapped fitting for connection to the bubbler line.
5. An air flow indicator gauge shall be provided and connected to the air bubbler piping to provide a visual indication of rate of flow in standard cubic feet per hour.

2.11 ENGINE CONTROL SYSTEM

A. Functional Description: Engine control system shall be designed to accomplish the following tasks:
   1. Permit the operator to select mode of engine operation, providing manual start and stop of the engine to override the level control system and cranking circuit if required.
   2. Crank the engine upon start command from the level control system, and stop the engine upon a stop command.
   3. Stop the cranking sequence if the engine fails to start after a reasonable number of attempts, and provide an alarm indication of failure to start.
   4. While the engine is operating, continuously monitor engine speed, temperature and oil pressure.
   5. Stop the engine for excessive speed, excessive cylinder head temperature, or insufficient oil pressure, and provide an alarm indication of shutdown and its cause.
   6. Maintain the charge on the engine storage battery.
   7. Provide an alarm indication for loss of 12-volt DC power for the level control system and engine control system.

B. Sequence of Operation:

   1. Upon operator selection of automatic operation, when the level control system provides a start command, the engine control system shall start the engine cranking motor for a short period of time. If the engine does not start, the system shall stop the cranking motor for a short period of time, then resume cranking. Typically, five 10-second cranking periods, each followed by a 10-second rest period should be considered a reasonable effort to start the engine. When the engine starts, a sensor on the engine or elsewhere in the system shall stop the cranking cycle and reset the cranking circuit for the next start.
   2. If the engine does not start within the preset number of attempts, the cranking circuit shall be deenergized, a failure to start indicator on the control panel shall be illuminated, and an external alarm device shall be

energized. Control of the pump with the standby engine shall be returned to the AC power.

3. Once the engine has started normally, the engine control system shall monitor engine speed, cylinder head temperature, and oil pressure. Upon engine failure from any cause, system shall provide an alarm indication, illuminate an indicator, and energize and external alarm device as specified below.
4. During periods when the AC level control system is fully operative, a battery charger shall continuously charge the engine storage battery.

C. Circuit Details: Switch or other device shall be provided and connected to perform as follows:

1. When automatic operation is selected, engine shall start and stop under control of the engine control system.
2. When manual operation is selected, engine-cranking motor shall be controlled by a manual pushbutton or other device on the engine. Once started, engine shall run until OFF is selected, or engine failure circuit stops engine.
3. Operator can stop engine if it is running, and prevent it from starting during maintenance or repair.

D. Engine Failure: Engine failure circuits shall stop the engine, illuminate a labeled indicator on the control panel, and energize an external alarm device for each of the following conditions:

1. Engine speed exceeds maximum overspeed setting.
2. Engine temperature exceeds safe operating temperature as specified by the engine manufacturer.
3. Engine oil pressure falls below engine manufacturer's specified recommendations. System must override or bypass this function during cranking and for several seconds after starting to permit engine to build up oil pressure.

E. Battery Charger: Engine control system shall be furnished with one battery charger, designed and connected to operate on 115 volts AC, 60 hertz to maintain the charge on the 12 volt DC storage battery supplied with the engine. Battery charger shall incorporate the following design features:

1. Automatic charge sensing and charging rate adjustment circuit.
2. Integral current limit circuit to limit charging rate.
3. Charging rate ammeter
4. Fuse for protection of charging circuit.

F. Power: Operating power for the engine control system, except the battery charger, shall be provided by the storage battery furnished with the standby engine.

2.12 TELEPHONE DIALER - CELLULAR

A. Specifications:

1. Furnish and install a Cellular Telephone Alarm Dialer ("dialer"). Dialer shall be completely factory assembled and tested before shipment. Enclosure shall be NEMA 4X with hinged clear cover suitable for indoor mounting. With the enclosure door open, the device shall be completely "touch-safe" with the exception of the terminal strip. The telephone dialer shall be Model Crystal Ball as manufactured by OmniSite, Greenwood, IN, and as supplied by Envirep, Inc., Camp Hill, PA (717-761-7884).
2. Dialer shall be equipped with a digital cellular radio, GSM
3. Dialer shall monitor four (4) 4-20ma analog input signals for specialized reporting functions. Analog input #1 shall be suitable for use with a level probe or similar device, and shall be configured to report the current value of the input at the time of the daily report. Analog inputs #2, #3 and #4 shall be suitable for use with pump motor amp probe monitors or similar devices, and shall be configured to report the last non-zero values of the inputs at the time of the daily report.
4. Dialer shall be equipped with four (4) output relay sockets rated at 20 amps. Outputs shall be manually energized and de-energized via the Internet.
5. Dialer shall monitor three (3) pump run universal inputs that accept dry contact closures or voltage signals from +/-12VDC/VAC to +/-120 VDC/VAC. These inputs shall monitor pump run time, count pump run cycles and calculate total station flow and pumping rates. The pump run universal inputs shall be connected to motor starter auxiliary run contacts as follows:
   a. Pump #1 run contact
   b. Pump #2 run contact
   c. Pump #3 run contact
6. Dialer shall monitor eleven (11) universal inputs (in addition to the three (3) pump run inputs) that accept dry contact closures or voltage signals from +/-12VDC/VAC to +/-120 VDC/VAC. Input #5 shall also be configurable as a rain gauge input. Inputs #6 and #7 shall also be configurable as counter inputs and shall be capable of accepting pulse inputs from flow meters to report totalized daily flow.
7. The eleven (11) universal inputs shall be configured for alarm conditions as follows:

   a. High water common
   b. Low water
   c. High pump temperature, common
   d. Drive fault, common
   e. Engine failure
   f. 12 volt DC power failure
   g. Sewage grinder failure
   h. Flowmeter totalizer pulse
   i. MTS in standby power position (generator operating)
   j. Spare
   k. Spare

8. The device shall include the following items:
   a. LCD display, 2 line, 16 character
   b. Four (4) output relay sockets
   c. 10mb Ethernet communications port
   d. Modbus RS232 port
   e. SD memory card slot
   f. Intelligent key for disabling dialer
   g. Battery charging power supply
   h. Battery backup with 0.8 amp-hour gel cell battery
   i. Lightning arrestor – solid state
   j. Removable terminal blocks
   k. UL 508 certification
   l. Antenna
   m. 14 Universal inputs (12VDC – 120 VAC)

B. Functionality and Capabilities

1. System shall be capable of the following functions (reported daily):
   a. Number of pump on/off cycles
   b. Pump run times
   c. Drawdown time
   d. Measured GPM for each pump
   e. Station flow and inflow
   f. Tank level (when connected to a level transducer)
2. All alarm functions shall be processed immediately.
3. All non-alarm functions shall be reported on a daily basis and shall be accessible and displayed over the Internet.
4. Upon alarm condition, the dialer shall make telephone calls, send messages to pagers, and/or send emails to a user programmable contact list.
5. The dialer shall have the ability to be programmed, setup and monitored over the Internet. Password protected web pages shall provide multiple levels of secure access. Web pages shall be used to view current status of alarms, view alarm history, view pump run times and set up the dialer. Local unit setup shall be performed with a keypad and menu system. Units requiring a separate computer for local programming shall not be acceptable.
6. Dialers that require proprietary programming software are not acceptable.
7. Historical data shall be exportable to Microsoft Excel or Word.
8. Monthly fee shall be independent of the number of alarm conditions, phone calls, or information exchange transactions.
9. A toll free phone number shall be provided to receive a current alarm status report and to acknowledge alarms.

C. Installation

1. The Electrical Contractor shall install the dialer and provide the following:
   a. 115 VAC, 60 Hz, 15 amp, single-phase power wiring with circuit breaker protection
   b. Good electrical ground connection

c. Interconnecting alarm and input wiring from monitored equipment and devices to dialer.
d. Output wiring, if applicable.
e. Mount dialer in accordance with manufacturer's recommendations.
f. Mount and wire antenna

D. Startup Service:

1. Manufacturer's service technician shall provide startup and operator training. Start up service shall include complete testing of each individual alarm input and each output. Testing shall include documented verification that all alarms properly trigger the final notification device (cell phone, pager, email, etc.).

E. Warranty:

1. The device shall be supplied by the pump station supplier and shall carry a one (1) year factory warranty. The factory warranty shall cover the cost of all parts and labor for equipment repairs performed at the factory. Warranty shall commence upon startup or 3 months after shipment, whichever occurs first.

F. Cellular Service:

1. Equipment purchase price includes 3 years of cellular service fees commencing at the activation date of the unit. Afterward, cellular service fees shall be billed annually directly to the municipality.

2.13 WET WELL AERATION SYSTEM

A. General: A wet well aeration system including control panel shall be installed at the pump station with air discharge piping in the wet well as shown on the drawings. Aeration system shall be Envirep Model 115WB3D.

B. Aeration blower assembly:

1. The aerator shall be capable of producing sustained aeration and sufficient agitation to mitigate formation of grease build-up. The aerator shall be suitable to operate with discharge piping submerged at a depth of at least ten feet. The aerator shall produce continuous, non-pulsating, oil-free air. Inlet and outlet ports shall be 2 inch FNPT.
2. The aeration blower shall be rated for continuous duty at a maximum speed of 3,450 rpm and operate at a maximum ambient temperature of 104 degrees F. The motor shall be 1.5 hp, 3 phase, 460 volt, 60 Hz with TEFC enclosure and Class B insulation.
3. The following accessories shall be installed with the wet well aeration system:

a. (1) Gauge kit – including independent, full-range indication of aeration blower inlet and outlet conditions. Total pressure across the aeration blower shall be the difference of the gauge indications.
b. (1) Filter kit with replaceable filter element and shall be designed to protect the aerator from pre-mature wear.
c. (1) Spare filter element
d. (1) Check valve
e. (1) Discharge ball valve
f. (1) Relief valve of adequate capacity to provide system protection
g. (1) Flexible mounting system
h. (1) Inlet muffler/silencer

4. A set of dry contacts shall be provided in the pump control panel to interface with the aeration system to insure coordination between systems.
5. The discharge piping for the aeration blower shall be installed as shown on the plan sheets. Discharge piping to the wet well shall be minimum 2-inch diameter.
6. Aeration system, including aeration blower, inlet filter, relief valve, gauges, muffler, ball valve and check valve, shall be pre-assembled using schedule 40 galvanized pipe and mounted on an aluminum base using eight flexible vibration isolation mounts.

C. Wet Well Aeration System Control Panel:

1. NEMA 12 stainless steel wall mounted panel. Dimensions: 16" wide x 24" tall x 8" deep.
2. Main connections to accept 3/60/480 volt power.
3. Motor starter, FVNR (across the line), NEMA rated
4. Provide timer and repetitive cycle interval circuit, operator-selectable timing, operational mode selection device, and pump control panel interface. In the "Automatic" mode, the aerator shall operate in a coordinated manner with the sewage pumping system.
5. HOA switch
6. Control interface for use with pump control panel
7. Control transformer, 120 volt secondary for control circuit

2.14 REDUNDANT HIGH WATER ALARM FLOAT

A. A float switch shall be mounted in the wet well and wired in parallel to the standard high water alarm relay to serve as a redundant high water alarm.

1. Float switch shall be mercury free
2. NEMA 4X stainless steel wet well junction box
3. Float switch shall include an anchor and stainless steel chain
4. Intrinsically safe barrier

PART 3 - EXECUTION

3.1 EXAMINATION

A. General Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Pumping equipment manufacturer shall provide written instructions for proper handling. Immediately after off-loading, contractor shall inspect pumping equipment and appurtenances for shipping damage or missing parts.

B. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all serial numbers and parts lists with shipping documentation. Notify manufacturers representative of any unacceptable conditions noted with shipper.

3.2 INSTALLATION

A. Install, level, and align pump station as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Suction pipe connections must be vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump system piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

C. Check motor and control data plates for compatibility to site voltage. Install and test the electrical ground prior to connecting line voltage to pump control panel.

D. Prior to applying electrical power to motors or control equipment, check all wiring for tight connection. Verify that fuses and circuit breakers conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

E. After all anchor bolts, piping connections are installed, seal all openings between wet well and pump enclosure.

3.3 PROTECTION

A. The pumping equipment should be placed into service soon after delivery of the equipment. If installation is delayed, the pumping equipment and motor control center shall be stored indoors, free of excessive dust, in a low humidity, heated environment.

B. During installation and after the pumping equipment is placed into operation the motor control center shall operate in an environment free of excessive dust, in a low humidity, heated environment.

3.4 FIELD QUALITY CONTROL

A. Prior to acceptance by the 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. Prior to start-up, clean wet well by removing construction debris and foreign material.

3.5 MANUFACTURER'S PRE-STARTUP INSPECTION

A. Coordinate system pre-startup with manufacturer's factory-trained service technician. The factory-trained service technician will inspect the installation and answer any installation questions by the Contractor, Engineer, or Owner.

B. Verify that operations and maintenance manual is on site and installation instructions contained in the manual have been followed.

C. Verify that all pumping equipment, piping, level control system, alarms and ancillary equipment has been properly installed and all wiring is complete.

D. Verify that all spare parts for the pumping equipment is on site.

E. Pre-startup inspection shall be a separate trip and shall not be less than two weeks prior to the startup of the equipment.

3.6 MANUFACTURER'S FIELD PERFORMANCE TESTING

A. Coordinate system start-up with manufacturer's factory-trained service technician. The factory-trained service technician will inspect the completed installation, calibrate and adjust instrumentation, and correct or supervise correction of defects or malfunctions. Startup shall be performed in the presence of the Engineer and Owner.

B. Equipment startup shall be tested under both utility power and emergency power.

C. General Contractor shall supply clear water of adequate volume to operate the system including the force main through several pumping cycles.

D. Observe and record operation of pumps, suction and discharge gage readings, voltage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment. Test manual and automatic control systems. Test all alarms. Report any undue noise, vibration or other operational problems.

E. Startup shall be a separate trip.

3.7 MANUFACTURER'S OPERATION AND MAINTENANCE TRAINING

A. The manufacturer shall furnish the services of a qualified, factory-trained operations and maintenance serviceman to instruct and train Owner's personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:

1. Theory of operation
2. Actual operation
3. Mechanical maintenance
4. Hydraulic troubleshooting
5. Electrical maintenance
6. Instrumentation and level controls
7. Optimization of the system
8. Alarm circuits
9. Safe operating and working practices and operation of safety devices

B. One (1) training session is required. Training shall be completed after startup services have been performed. Training shall be a separate trip and shall not be less than two weeks after the startup of the equipment. Time, location, and duration of all training sessions shall be coordinated with Owner's personnel.

C. Hands-on training and demonstrations shall use the installed equipment.

D. Supplier shall provide all materials for training and shall provide training manuals to all personnel being trained.

3.8 MANUFACTURER'S EQUIPMENT RE-CERTIFICATION

A. The General Contractor shall require, and cover the cost in his bid, for the manufacturer's factory-trained service technician to return to the site six (6) month's after initial startup of the equipment to perform a final re-certification of the equipment.

B. The re-certification shall consist of demonstrating and certifying that the equipment is meeting the performance requirements of the specifications. Equipment service technician shall perform field testing of the equipment in the presence of the Owner. Results of all field testing shall be submitted to the Engineer and the Owner.

3.9 CLEANING

A. 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.

END OF SECTION

SECTION 11335

SEWAGE GRINDER – SCHAEFFERSTOWN PUMP STATION

PART 1 GENERAL

1.1 SUMMARY

A. This section of the specification describes sewage grinders, hydraulic power pack, and motor controller. The equipment shall be installed as shown on the plans, as recommended by the supplier/manufacturer, and in compliance with all OSHA, local, state, and federal codes and regulations.

B. The number of sewage grinders and motor controllers shall be one (1).

1.2 REFERENCES

A. Grinder shall, as applicable, meet the requirements of the following industry standards:

1. American Society for Testing and Materials (ASTM) A 36: Standard Specification for Carbon Steel Plate

2. American Society for Testing and Materials (ASTM) A 536-84: Standard Specification for Ferritic Ductile Iron Castings

3. American Iron and Steel Institute (AISI) 303 Stainless Steel

4. American Iron and Steel Institute (AISI) 304 Stainless Steel

5. American Iron and Steel Institute (AISI) 4130 Heat Treated Alloy Steel

6. American Iron and Steel Institute (AISI) 4140 Heat Treated Hexagon Steel

7. Rockwell C

1.3 SUBMITTALS

A. Shop Drawing(s):

1. Supplier shall submit five (5) sets of shop drawings. Shop drawings shall include equipment descriptions, specifications, dimensional and assembly drawings, parts lists, and job specific drawings.

B. Closeout Submittals

1. Contractor shall submit three (3) Operation and Maintenance manuals. The manuals shall include equipment descriptions, operating instructions, drawings, troubleshooting techniques, a recommended maintenance schedule, and the recommended lubricants. Refer to Section 11300 for additional requirements in submitting operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Qualified suppliers shall have a minimum 5 years experience at manufacturing two-shafted grinding equipment and motor controls with a minimum of 20 installations with similar equipment. Supplier shall provide a list of names and dates of installations for verification by the Engineer or Owner's Representative.

B. Regulatory Requirements: Motor controllers shall as applicable, meet the requirements of the following Regulatory Agencies.

1. National Electrical Manufacturer's Association (NEMA) Standards

2. National Electrical Code (NEC)

3. Underwriters Laboratory (UL and cUL)

1.5 DELIVERY, STORAGE AND HANDLING

A. The equipment shall be packaged in containers constructed for normal shipping, handling and storage.

B. The containers shall provide adequate protection for the equipment in a dry indoor environment between +40°F (+4.5°C) and +100°F (+37.8°C) until time for installation.

C. Inspect components for damage.

1.6 IDENTIFICATION

A. Each unit of equipment shall be identified with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, supplier's name, and location.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Support system(s), grinder(s), hydraulic power pack(s) and motor controller(s) and

motor(s) shall be in compliance with these specifications and plans and shall be supplied by one of the following manufacturers:

1. JWC Environmental®: Muffin Monster® Model No. 30005-18 for Schaefferstown Pump Station.
2. Approved equal.

B. Manufacturers requesting to be selected as an approved equal shall submit certified documentation showing compliance with these specifications a minimum of ten (10) days prior to bid opening. Selected equipment manufacturers shall be added to the list of approved manufacturers.

C. The manufacturer must certify that the unit can be returned for maintenance to the factory or a local repair facility. The certification shall include a statement that there will be no charge for repair labor.

2.2 SUPPORT SYSTEM

A. General:

1. Provide channel frame of suitable dimension and strength to support grinder in place and direct flows toward cutters. The channel frame shall be of stainless steel Type 304 construction and firmly anchored to the wet well wall.

2. An overflow bar rack shall be provided to assure screening upon possible failure of grinder.

3. A guide rail system shall be provided to permit easy removal of grinder for maintenance. There shall be no need for personnel to enter the wet well.

4. An aluminum basket strainer shall be provided for installation in the channel frame to insure continued screening when the grinder is removed for maintenance or inspection.

5. Each grinder system shall be designed for continuous operation, with or without sewage flow.

2.3 GRINDER(S)

A. General:

1. Each hydraulic grinder shall include cutters, spacers, shafts, bearings and seals, side rails, end housings, covers, reducer, and hydraulic torque motor.

2. The grinder shall be of two-shaft design and be capable of continuous operation, processing wet or dry. Bar screens or single shaft devices utilizing a single rotating

cutter bar with stationary cutters shall not be acceptable. Grinder designed with cutter and spacer cartridges rather than individual cutters and spacers, shall not be acceptable.

3. Two-shaft design shall consist of two parallel shafts alternately stacked with individual intermeshing cutters and spacers positioned on the shaft to form a helical pattern. The two shafts shall counter-rotate with the driven shaft operating at approximately two-thirds (2/3) the speed of the drive shaft.

B. Components:

1. Individual Cutters and Spacers:

a. The cutting chamber shall be a nominal height of 18 inches.

b. Individual cutters and spacers shall be 4130 heat treated alloy steel, surface ground for uniformity and through-hardened to a minimum 52-54 Rockwell C.

c. The inside configuration of both the individual cutters and the individual spacers shall be hexagonal so as to fit the shafts with a total clearance not to exceed 0.015 inch (0.38 mm) across the flats to assure positive drive, minimize wear on the cutters, and increase the compressive strength of the spacers.

d. Cutter configuration shall consist of 11 tooth cam cutters. To maintain particle size, the height of the tooth shall not exceed 1/2 inch (13 mm) above the root diameter. Cutter to cutter root diameter overlap shall be not less than 1/16 inch (1.6 mm) or greater than 1/4 inch (6 mm) to maintain the best possible cutting efficiency while incurring the least amount of frictional losses.

e. The cutters shall exert a minimum force at the tooth tip of 991 lbs/hp (5,911 N/kW) during momentary load peaks.

2. Shafts:

a. Grinder drive and driven shafts shall be made of 4140 heat treated hexagon steel with a tensile strength rating of not less than 149,000 psi (1,027 MPa).

b. Each hexagonal shaft shall measure a nominal 2 inches (51 mm) across parallel surfaces.

3. Intermediate Shaft Support:

a. An intermediate shaft support shall be provided in the center of the cutter stack for all grinders with 40 inch (1,016 mm) cutter stacks. Grinders with 50 inch (1,270 mm) or 60 inch (1,524 mm) cutter stacks shall have two intermediate shaft supports.

b. The intermediate shaft support shall provide additional support for heavier than normal influent grinder demand loads and protection for the seal assemblies.

c. The intermediate shaft support shall be made of a cast 303 stainless steel collar and two bushings. The bushings shall act as bearings to allow the free rotation of the shafts.

4. Shaft Bearings and Seals:

a. The radial and axial loads of the cutter shafts shall be borne by sealed, oversized, deep-groove ball bearings at each end.

b. The bearings shall be protected by a combination of a replaceable and independent tortuous path device and mechanical seals.

c. Face materials shall be of tungsten carbide to tungsten carbide.

d. O-rings shall be made of Buna-N elastomers.

e. Products requiring continuous or occasional lubrication or flushing shall not be accepted.

f. The mechanical seal shall be rated at 90 psi (620 kPa) continuous duty by the seal supplier.

g. The bearings shall be housed in a replaceable cartridge that supports and aligns the bearings and seals, as well as protects the shafts and end housings. The seal elements shall be independent of the stack height, therefore cutter stack tightness shall not affect seal performance. The seal elements shall maintain their factory set preload independent of the cutter stack tightness.

h. Seals shall meet required pressure rating regardless of cutter stack fit. The seal cartridge shall provide seal protection against axial loading on shafts and bearings during shaft deflection.

i. Each seal element shall be positively locked to its corresponding rotating or static cartridge element. This positive lock on the seal elements is critical to long seal life in applications where grit or other abrasive materials are present.

5. Side Rails:

a. The inside profile of the cutter side rails shall be concave to follow the radial arc of the cutters.

b. Clearance between the major diameter of the cutter and the concave arc of the side rails shall not exceed 5/16 inch (7.9 mm).

c. The side rails shall have evenly-spaced slots that increase flow and decrease head loss.

d. The side rails shall be cast of A536-84 ductile iron.

6. End Housings and Covers:

a. Grinder end housings shall be of cast A536-84 ductile iron with a cast-in-place flow deflector, designed to protect the bushings while guiding particles directly into the cutting chamber.

b. Top covers shall be A536-84 ductile iron and bottom covers shall be A 36 hot rolled plates.

7. Hydraulic Motor:

a. The grinder motor shall be a low-speed, high-torque, rotary-power hydraulic torque motor that utilizes the hydraulic pressure developed by the hydraulic power pack.

8. Required Running Torque per Horsepower (kW):

a. At Momentary Load Peaks: 2,298 in-lbs/hp (348 Nm/kW)

9. Paint: Each grinder machine assembly shall be coated with an anti-corrosive coating (such as chlorinated rubber or equivalent) for sewage environment to provide long term effective surface protection.

2.4 GRINDER HYDRAULIC POWER PACK(S)

A. General:

1. The hydraulic power pack shall provide hydraulic pressure and flow to operate the grinder. The hydraulic power pack shall provide pressure, temperature, and level outputs to the controller. The power pack and grinder hydraulic motor shall be designed for smooth operation during frequent starts, stops and reversals.

2. The entire hydraulic system shall be designed for 3,000 psi (20,690 kPa) maximum pressure. Under no load conditions the system operating pressure shall be in the 200 to 400 psi (1,370 to 2,759 kPa) range. Continuous operating pressure greater than 2,000 psi (13,793 kPa) shall not acceptable.

3. As solids are encountered, pressure shall be automatically increased on a demand basis providing the required torque necessary to continue rotation of the cutters.

a. Should an obstruction cause the grinder demand pressure to exceed 2,850 psi (19,655 kPa), a pressure switch shall be activated and a 2-way valve shifted. The rotation of the cutters shall immediately reverse for about one-half (1/2) to one (1) revolution. Following this, the valve shall be shifted and the cutters returned to forward rotation.

b. When the obstruction is cleared the unit shall continue to operate in the forward direction.

c. If the obstruction is not cleared, the reversing sequence shall repeat until the obstruction is cleared or 9 reversals have occurred within 45 seconds. If the reversing sequence has completed and the obstruction has not been cleared, the controller shall de-energize the hydraulic power pack electric motor and activate an overload relay and a fail indicator.

4. Each hydraulic power pack shall be water/rain-resistant and suitable for mounting in a remote location, as required by design parameters of the project.

5. Each hydraulic power pack shall be designed with the capability of adequately cooling the hydraulic fluid during continuous operation.

B. Components:

1. Power packs shall include the following components:

a. 16 inch (406 mm) x 16 inch (406 mm) x 15 inch (381 mm), epoxy coated, 10 gallon U.S. (38 liter) capacity reservoir

b. Suction strainer

c. Positive displacement pump driven by a vertically mounted 5 hp (3.7 kW), TEFC, C face, motor

d. Relief valve preset at 3,000 psi (20,690 kPa)

e. 2-1/2 inch (64 mm), 0 to 5,000 psi (34,450 kPa) oil filled gauge

f. Pressure switch preset at 2,850 psi (19,655 kPa)

g. 110 volt two-port directional valve

h. High pressure return line filter

i. Combination oil level and oil temperature gauge

j. Combination oil level switch and oil temperature limit switch

k. Temperature switch set at 160ºF (71ºC)

l. Filler breather

m. Electrical enclosure

2. Hydraulic connections between the torque motor and the power pack shall consist of two 1/2 inch (13 mm) flexible hoses.

a. The flexible hoses shall be rated for a minimum 3,500 psi (24,138 kPa) working pressure with a 14,000 psi (96,552 kPa) burst pressure.

b. The hose pressure loss between the hydraulic power pack and the grinder torque motor shall not exceed 150 psi (1,034 kPa) at 50˚C (10˚C) above ambient temperature.

c. Hose construction shall withstand corrosive (sewage) wet-well environment.

3. The hydraulic power pack shall be filled with a high quality hydraulic fluid.

a. The hydraulic fluid shall have a viscosity of approximately 100 to 250 SSU at 100ºF (38ºC) with good chemical stability and anti-foaming properties.

b. The grades of hydraulic fluid shall be in accordance with the supplier's recommendations.

c. Fluid reservoir/tank shall have fluid drain valve or port.

2.5 MOTOR CONTROLLER

A. General:

1. The controller shall provide independent control of the hydraulically driven grinder.

2. Controller shall be the supplier's standard UL/cUL listed Model PC2240.

3. The controller shall be rated for 5 hp, 480 volts, 3 phase, 60 Hz.

B. Operation:

1. The controller shall be equipped with a GRINDER ON-OFF/RESET-AUTO three (3) position selector switch.

a. In the OFF/RESET mode the grinder shall not run. In the ON mode the grinder will run.

b. In the AUTO mode the grinder shall start and stop as controlled by a remotely-located dry contact.

c. The grinder shall only be reset by switching the GRINDER ON-OFF/RESET-AUTO switch to the OFF/RESET position.

C. Safety Features:

1. When a grinder jam condition occurs in the grinder ON or AUTO mode the controller shall stop the grinder, then reverse the grinder rotation to clear the obstruction. If the jam is cleared, the controller will return to normal operation. If the jam condition still exists, the controller will go through eight additional reversing cycles within 45 seconds (nine times total) before signaling a grinder overload condition. Upon a grinder overload condition, the controller will shut the grinder off and activate an overload contact.

2. If a power failure occurs while the grinder is running, operation will resume running when power is restored as controlled by external Start Delay Controls as defined below.

3. If a power failure occurs while the grinder is in a fail condition the fail indicator shall be reactivated when power is restored as controlled by external Start Delay Controls as defined below.

4. The controller shall provide overload protection for the motor through an overload relay mounted directly on the grinder starters.

5. Short-circuit protection requires that a properly-sized circuit breaker or fuses be installed by the Electrical Contractor.

6. Controller reset shall be from the local panel controls only.

7. Start Delay Controls: Termination points shall be provided in the hydraulic unit control panel for connection of a set of normally closed contacts from the Generator ATS. The lockout control shall delay the start operation of the hydraulic unit when power is transferred to the standby generator. When the ATS contact opens, the hydraulic unit controls shall delay start of the hydraulic motor for an adjustable delay period set initially at 25 seconds.

D. Components:

1. Enclosure:

a. Enclosures shall be minimum NEMA 1, fabricated of fiberglass-reinforced polyester resins, and shall be suitable for wall mounting. Doors shall have hinges and corrosion resistant latches.
b. Enclosure shall house the control devices, relays, terminal blocks, grinder non-

reversing hydraulic power pack oil pump motor starter.

2. Circuit breakers shall be thermal magnetic molded case circuit breakers for branch disconnect service and overload protection of all motors, controls and auxiliary circuits. Equipment motor circuit breakers shall be "E" frame or greater. Starters and breakers shall be sized for five (5) horsepower.

3. Control wiring within each control panel shall conform to the National Electrical Code. All wiring shall be neatly installed and run in plastic raceways to prevent interference with any operating devices.

4. Control Devices:

   a. Operator interface and pilot devices shall be mounted on the enclosure front panel door.

   b. The controller shall have indicator lights for GRINDER RUN, and FAIL.

   c. Indicator lights are LED pilot lights. Lights and the selector switches shall be heavy duty NEMA 4X type.

   d. Control transformer shall be protected by two primary fuses and one secondary fuse. The 120 volt secondary shall have one leg grounded.

   e. One normally open (Form A) 10 ampere relay contact is provided for a RUN signal and one normally open/normally closed (Form C) 10 ampere relay contact is provided for a FAIL signal.

5. Logic Control

   a. PLC control system(s) shall be provided by the grinder manufacturer.

   b. Each PLC shall be programmed so that upon the grinder encountering a jam condition, the motor controller shall stop the grinder and reverse its rotation to clear the obstruction. If the jam is cleared, the controller shall return to normal operation. If the jam condition still exists, the controller shall go through eight (8) additional reversing cycles within 45 seconds (nine (9) times total) before signaling a grinder overload condition. Upon a grinder overload condition, the controller shall shut the grinder off and activate an overload relay.

   c. The logic shall be capable of differentiating between a locked rotor full overload requiring instant reversal and an allowable periodic low level overload allowing an ongoing running period before reversal mode engages.

   d. User selectable modes: Normal, on/off and reverse.

e. Controller indicator lights for POWER ON, OVERLOAD, RUN, LOW OIL LEVEL, and OIL OVERTEMP conditions.

6. Motor Starter:

a. A non-reversing contactor type motor starter shall be provided for the hydraulic power pack oil pump motor.

b. Overload relay (OL) shall be adjustable so that the range selected includes the FLA (full load amperes) rating and service factor.

2.6 SOURCE QUALITY CONTROL

A. Each grinder, hydraulic power pack, and controller shall be factory tested to ensure satisfactory operation.

PART 3 EXECUTION

3.1 INSTALLATION

A. The hydraulic unit and control panel shall be factory wired with the following exceptions that shall be provided by the Electrical Contractor: 480 volt, 3-phase power source, Generator Lockout Control Panel interlock wiring and Power wiring from the hydraulic unit control panel to the hydraulic motor.

B. Grinder(s), hydraulic power pack(s) and motor controller(s) shall be installed in accordance with the supplier's installation instructions, and in compliance with all OSHA, local, state, and federal codes and regulations.

C. Install required fluids to proper levels for operation.

3.2 FIELD QUALITY CONTROL

A. Supplier shall provide the services of a factory-trained representative to check the installation and to start-up each grinder and controller. The factory representative shall have complete knowledge of proper installation, operation, and maintenance of equipment supplied. Representative shall inspect the final installation and supervise a start-up test of the equipment.

B. Pre-operational Check: Before operating system or any components, the Contractor shall make the following checks:

1. Check grinder alignment.

2. Check grinder and drive unit for proper lubrication.

3. Check for proper motor rotation.

C. Start-up Testing:

1. Check mesh of cutters.

2. Check all electrical functions, including auto reversing and current (amp) draw.

3. Verify that the hydraulic power unit is working properly.

D. Equipment Acceptance:

1. The Contractor shall adjust, repair, modify or replace system components that fail to perform as specified and rerun tests until acceptable to Owner and Engineer. Final adjustments shall be made under the direction of a manufacturer's representative.

END OF SECTION

SECTION 11336

SEWAGE GRINDER – KLEINFELTERSVILLE PUMP STATION

PART 1 GENERAL

1.1 SUMMARY

A. This section of the specification describes sewage grinder and motor controller. The equipment shall be installed as shown on the plans, as recommended by the supplier/manufacturer, and in compliance with all OSHA, local, state, and federal codes and regulations.

B. The number of sewage grinder and motor controller shall be one (1).

1.2 REFERENCES

A. Grinder shall, as applicable, meet the requirements of the following industry standards:

1. American Society for Testing and Materials (ASTM) A 36: Standard Specification for Carbon Steel Plate

2. American Society for Testing and Materials (ASTM) A 536-84: Standard Specification for Ferritic Ductile Iron Castings

3. American Iron and Steel Institute (AISI) 303 Stainless Steel

4. American Iron and Steel Institute (AISI) 304 Stainless Steel

5. American Iron and Steel Institute (AISI) 4130 Heat Treated Alloy Steel

6. American Iron and Steel Institute (AISI) 4140 Heat Treated Hexagon Steel

7. Rockwell C

1.3 SUBMITTALS

A. Shop Drawing(s):

1. Supplier shall submit five (5) sets of shop drawings. Shop drawings shall include equipment descriptions, specifications, dimensional and assembly drawings, parts lists, and job specific drawings.

B. Closeout Submittals

1. Contractor shall submit three (3) Operation and Maintenance manuals. The manuals shall include equipment descriptions, operating instructions, drawings,

troubleshooting techniques, a recommended maintenance schedule, and the recommended lubricants. Refer to Section 11300 for additional requirements in submitting operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Qualified suppliers shall have a minimum 5 years experience at manufacturing two-shafted grinding equipment and motor controls with a minimum of 20 installations with similar equipment. Supplier shall provide a list of names and dates of installations for verification by the Engineer or Owner's Representative.

B. Regulatory Requirements: Motor controllers shall as applicable, meet the requirements of the following Regulatory Agencies.

1. National Electrical Manufacturer's Association (NEMA) Standards

2. National Electrical Code (NEC)

3. Underwriters Laboratory (UL and cUL)

1.5 DELIVERY, STORAGE AND HANDLING

A. The equipment shall be packaged in containers constructed for normal shipping, handling and storage.

B. The containers shall provide adequate protection for the equipment in a dry indoor environment between +40°F (+4.5°C) and +100°F (+37.8°C) until time for installation.

C. Inspect components for damage.

1.6 IDENTIFICATION

A. Each unit of equipment shall be identified with a corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, supplier's name, and location.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Support system, grinder, and motor controller and motor shall be in compliance with these specifications and plans and shall be supplied by one of the following manufacturers:

1. JWC Environmental®: Muffin Monster® Model No. 30005-12 for Kleinfeltersville

Pump Station.

2. Approved equal.

B. Manufacturers requesting to be selected as an approved equal shall submit certified documentation showing compliance with these specifications a minimum of ten (10) days prior to bid opening. Selected equipment manufacturers shall be added to the list of approved manufacturers.

C. The manufacturer must certify that the unit can be returned for maintenance to the factory or a local repair facility. The certification shall include a statement that there will be no charge for repair labor.

2.2 SUPPORT SYSTEM

A. General:

1. Provide channel frame of suitable dimension and strength to support grinder in place and direct flows toward cutters. The channel frame shall be of stainless steel Type 304 construction and firmly anchored to the wet well wall.

2. An overflow bar rack shall be provided to assure screening upon possible failure of grinder.

3. A guide rail system shall be provided to permit easy removal of grinder for maintenance. There shall be no need for personnel to enter the wet well.

4. An aluminum basket strainer shall be provided for installation in the channel frame to insure continued screening when the grinder is removed for maintenance or inspection.

5. Each grinder system shall be designed for continuous operation, with or without sewage flow.

2.3 GRINDER(S)

A. General:

1. Each grinder shall include cutters, spacers, shafts, bearings and seals, side rails, end housings, covers, reducer, and motor.

2. The grinder shall be of two-shaft design and be capable of continuous operation, processing wet or dry. Bar screens or single shaft devices utilizing a single rotating cutter bar with stationary cutters shall not be acceptable. Grinder designed with cutter and spacer cartridges rather than individual cutters and spacers, shall not be acceptable.

3. Two-shaft design shall consist of two parallel shafts alternately stacked with individual intermeshing cutters and spacers positioned on the shaft to form a helical pattern. The two shafts shall counter-rotate with the driven shaft operating at approximately two-thirds (2/3) the speed of the drive shaft.

B. Components:

1. Individual Cutters and Spacers:

a. The cutting chamber shall be a nominal height of 18 inches.

b. Individual cutters and spacers shall be 8620 heat treated alloy steel, surface ground for uniformity and through-hardened to a minimum 60-65 Rockwell C.

c. The inside configuration of both the individual cutters and the individual spacers shall be hexagonal so as to fit the shafts with a total clearance not to exceed 0.015 inch (0.38 mm) across the flats to assure positive drive, minimize wear on the cutters, and increase the compressive strength of the spacers.

d. Cutter configuration shall consist of 11 tooth cam cutters. To maintain particle size, the height of the tooth shall not exceed 1/2 inch (13 mm) above the root diameter. Cutter to cutter root diameter overlap shall be not less than 1/16 inch (1.6 mm) or greater than 1/4 inch (6 mm) to maintain the best possible cutting efficiency while incurring the least amount of frictional losses.

e. The cutters shall exert a minimum force at the tooth tip of 2051 lbs/hp (12,234 N/kW) during momentary load peaks.

2. Shafts:

a. Grinder drive and driven shafts shall be made of 4140 heat treated hexagon steel with a tensile strength rating of not less than 149,000 psi (1,027 kPa).

b. Each hexagonal shaft shall measure a nominal 2 inches (51 mm) across parallel surfaces.

3. Intermediate Shaft Support:

a. An intermediate shaft support shall be provided in the center of the cutter stack for all grinders with 40 inch (1,016 mm) cutter stacks. Grinders with 50 inch (1,270 mm) or 60 inch (1,524 mm) cutter stacks shall have two intermediate shaft supports.

b. The intermediate shaft support shall provide additional support for heavier than normal influent grinder demand loads and protection for the seal assemblies.

c. The intermediate shaft support shall be made of a cast 303 stainless steel collar and two bushings. The bushings shall act as bearings to allow the free rotation of the shafts.

4. Shaft Bearings and Seals:

a. The radial and axial loads of the cutter shafts shall be borne by sealed, oversized, deep-groove ball bearings at each end.

b. The bearings shall be protected by a combination of a replaceable and independent tortuous path device and mechanical seals.

c. Face materials shall be of tungsten carbide to tungsten carbide.

d. O-rings shall be made of Buna-N elastomers.

e. Products requiring continuous or occasional lubrication or flushing shall not be accepted.

f. The mechanical seal shall be rated at 90 psi (620 kPa) continuous duty by the seal supplier.

g. The bearings shall be housed in a replaceable cartridge that supports and aligns the bearings and seals, as well as protects the shafts and end housings. The seal elements shall be independent of the stack height, therefore cutter stack tightness shall not affect seal performance. The seal elements shall maintain their factory set preload independent of the cutter stack tightness.

h. Seals shall meet required pressure rating regardless of cutter stack fit. The seal cartridge shall provide seal protection against axial loading on shafts and bearings during shaft deflection.

i. Each seal element shall be positively locked to its corresponding rotating or static cartridge element. This positive lock on the seal elements is critical to long seal life in applications where grit or other abrasive materials are present.

5. Side Rails:

a. The inside profile of the cutter side rails shall be concave to follow the radial arc of the cutters.

b. Clearance between the major diameter of the cutter and the concave arc of the side rails shall not exceed 5/16 inch (7.9 mm).

c. The side rails shall have evenly-spaced slots that increase flow and decrease head loss.

d. The side rails shall be cast of A536-84 ductile iron.

6. End Housings and Covers:

a. Grinder end housings shall be of cast A536-84 ductile iron with a cast-in-place flow deflector, designed to protect the bushings while guiding particles directly into the cutting chamber.

b. Top covers shall be A536-84 ductile iron and bottom covers shall be A 36 hot rolled plates.

7. Reducer

a. The speed reducer shall be a grease-filled planetary-type of reducer with a 500% shock load capacity. The reduction ratio shall be 29:1.

c. The input shaft of the reducer shall be directly coupled to the motor using a three-piece coupling, and the output shaft of the reducer shall be directly coupled with the grinder using a two-piece coupling.

8. Motor:

a. The motor shall be 5 hp (3.7 kW), TENV XP IMM, 1,770 rpm, 208 volt, 3 phase, 60 hertz.

9. Required Running Torque per Horsepower (kW):

a. At Momentary Load Peaks: 4,756 in-lbs/hp.

10. Paint: Each grinder machine assembly shall be coated with an anti-corrosive coating (such as chlorinated rubber or equivalent) for sewage environment to provide long term effective surface protection.

2.4 MOTOR CONTROLLER

A. General:

1. The controller shall provide independent control of the grinder.

2. Controller shall be the supplier's standard UL/cUL listed Model PC2200.

3. The controller shall be rated for 5 hp, 208 volt, 3 phase, 60 Hz.

B. Operation:

1. The controller shall be equipped with a GRINDER ON-OFF/RESET-AUTO three (3) position selector switch.

a. In the OFF/RESET mode the grinder shall not run. In the ON mode the grinder will run.

b. In the AUTO mode the grinder shall start and stop as controlled by a remotely-located dry contact.

c. The grinder shall only be reset by switching the GRINDER ON-OFF/RESET-AUTO switch to the OFF/RESET position.

C. Safety Features:

1. When a grinder jam condition occurs in the grinder ON or AUTO mode the controller shall stop the grinder, then reverse the grinder rotation to clear the obstruction. If the jam is cleared, the controller will return to normal operation. Up to two (2) additional reversing cycles (3 times total) may occur within 30 seconds before the controller de-energizes the grinder motor and activates the grinder fail indicator and relay.

2. If a power failure occurs while the grinder is running, operation will resume when power is restored.

3. If a power failure occurs while the grinder is in a fail condition the fail indicator shall reactivate when power is restored.

4. The controller shall provide overload protection for the motor through an overload relay mounted directly on the grinder starter.

5. Short-circuit protection requires that a properly-sized circuit breaker or fuses be installed by the Electrical Contractor.

6. Controller reset shall be from the local panel controls only.

7. Start Delay Controls: Termination points shall be provided in the grinder control panel for connection of a set of normally closed contacts from the Generator ATS. The lockout control shall delay the start operation of the grinder motor when power is transferred to the standby generator. When the ATS contact opens, the grinder controls shall delay start of the grinder motor for an adjustable period set initially at 25 seconds.

D. Components:

1. Enclosure:

a. Enclosures shall be NEMA 4X, fabricated of fiberglass-reinforced polyester resins, and shall be suitable for wall mounting. Doors shall have hinges and corrosion resistant latches.

b. Enclosure shall house the control devices, relays, terminal blocks, and reversing motor starter.

2. Circuit breakers shall be thermal magnetic molded case circuit breakers for branch disconnect service and overload protection of all motors, controls and auxiliary circuits. Equipment motor circuit breakers shall be "E" frame or greater. Starters and breakers shall be sized for five (5) horsepower.

3. Control wiring within each control panel shall conform to the National Electrical Code. All wiring shall be neatly installed and run in plastic raceways to prevent interference with any operating devices.

4. Control Devices:

a. Pilot devices shall be mounted on the enclosure front panel door.

b. The controller shall have indicator lights for POWER ON, RUN and FAIL.

c. Indicator lights are LED pilot lights. Lights and the selector switches shall be heavy duty NEMA 4X type.

d. Control transformer shall be protected by two primary fuses and one secondary fuse. The 120 volt secondary shall have one leg grounded.

e. Relay contacts shall be included for GRINDER RUN and FAIL signal outputs. The contacts shall be rated 2 amp, 240 VAC, resistive load.

5. Motor Starter:

a. Starter shall be a full-voltage reversing type with 120 volt operating coils.

b. Forward and reverse contactors on the starters shall have both mechanical and electrical interlocks.

c. Overload relay (OL) shall be adjustable so that the range selected includes the FLA (full load amperes) rating and service factor.

2.5 SOURCE QUALITY CONTROL

A. Each grinder and controller shall be factory tested to ensure satisfactory operation.

PART 3 EXECUTION

3.1 INSTALLATION

A. The control panel shall be factory wired with the following exceptions that shall be provided by the Electrical Contractor: 208 volt, 3-phase power source, Standby Generator ATS interlock wiring and power wiring from the control panel to the grinder

unit motor.

B. Grinder and motor controller shall be installed in accordance with the supplier's installation instructions, and in compliance with all OSHA, local, state, and federal codes and regulations.

C. Install required fluids to proper levels for operation.

3.2 FIELD QUALITY CONTROL

A. Supplier shall provide the services of a factory-trained representative to check the installation and to start-up each grinder and controller. The factory representative shall have complete knowledge of proper installation, operation, and maintenance of equipment supplied. Representative shall inspect the final installation and supervise a start-up test of the equipment.

B. Pre-operational Check: Before operating system or any components, the Contractor shall make the following checks:

1. Check grinder alignment.

2. Check grinder and drive unit for proper lubrication.

3. Check for proper motor rotation.

C. Start-up Testing:

1. Check mesh of cutters.

2. Check all electrical functions, including auto reversing and current (amp) draw.

3. Verify that the unit is working properly.

D. Equipment Acceptance:

1. The Contractor shall adjust, repair, modify or replace system components that fail to perform as specified and rerun tests until acceptable to Owner and Engineer. Final adjustments shall be made under the direction of a manufacturer's representative.

END OF SECTION

SECTION 11340

ELECTROMAGNETIC SEWAGE FLOW METER

PART 1 GENERAL

1.1 SCOPE

A. Contractor shall furnish and install an electromagnetic sewage flow meter as described herein and as shown on the drawings.

B. Meter shall be a microprocessor based electro-magnetic flow meter utilizing the latest bi-polar pulsed DC technology for measuring sewage in a force main. Meter shall indicate, totalize and transmit flow in full pipes.

C. A circular chart recorder with data logging capabilities will be used to record and store actual flow data.

1.2 QUALITY ASSURANCE

A. The manufacturer's experience shall include a minimum of twenty (20) installations where equipment of similar size and design has been in operation successfully in a similar process for a minimum of ten years.

B. Acceptable Manufacturers: These specifications and accompanying drawings are based on the use of an Endress and Hauser 6-inch Proline Promag Model 50W flanged electromagnetic flow meter or equal with an ABB, Model C1311JU100G010458L or equal data recorder and all appurtenances for a complete system.

1.3 SUBMITTALS

A. Submit shop drawings and/or manufacturer’s descriptive literature in accordance with Section 11300.

B. Submit operation and maintenance manuals in accordance with Section 11300.

1.4 SERVICE

A. The equipment supplier shall send a factory authorized technician to provide one day of onsite start up service to certify the installation of the equipment, the instruction of plant operating personnel in proper operation and maintenance of the equipment and the initial observation and set-up of the flow meter and data recording system.

PART 2 PRODUCTS

2.1 GENERAL

A. The flow meter shall be installed as shown on the drawings. The flow meter shall transmit a 4-20 mA signal to a remote data recorder. Contractor shall coordinate with the equipment supplier for a satisfactory complete in-place system.

2.2 ELECTROMAGNETIC SEWAGE FLOW METER

A. Magnetic type flow meter shall be supplied as shown on the drawings. The flow meter shall be electromagnetic type which operates based on Faraday's law of induced voltage across any conductors moving in a magnetic field. Accuracy of the system (primary Flow Head and Converter) shall be 0.5% of actual flow rate. Unit shall meet the following:

1. Primary Element:
    a. Measuring Tube: 304 SS
    b. Liner: Polyurethane suitable for municipal wastewater
    c. Process Connection: Class 150 ANSI B16.5, A105 Flange
    d. Electrodes: 316L SS or Hastelloy "C-22"
    e. Calibration: 3-Point, 0.5%
2. Transmitter:
    a. Remote Transmitter:
        1. Powder coated die-cast aluminum.
        2. NEMA 4X housing.
    b. Convert the primary flow meter signal into a 4-20 maDC output, directly proportional to the flow rate.
    c. Adjustable damping shall be available.
    d. An integral rate of flow indicator and 7-digit LCD totalizer shall be included.
    e. Pulse Output: Provide independent passive, open-collector, 30VDC 250 mA, Galvanic Isolated pulse output for totalizer input to Crystal Ball. Pulse putput value and polarity shall be selectable. Maximum pulse width shall be configurable (0.5 to 2000 ms).
    f. Provide adequate length of signal cable between housing and remote transmitter to match installation requirements. Confirm requirements prior to ordering equipment. Specify length on shop drawing submittal for review by Engineer.
    g. Endress & Hauser (Specification Basis) meter shall include grounding electrodes and does not require a grounding ring. Coordinate grounding ring requirements for all substitute meters with the equipment supplier. Include compliance information on the shop drawing submittal.
3. Acceptable Manufacturer:
    a. Endress and Hauser (Specification Basis).
    b. Badger Meter, Inc.
    c. Or approved substitution in accordance with Section 01600.

2.3 DATA RECORDER

A. Include the following data recorder mounted in the pump control panel:

1. Circular Chart Recorder
    a. 1-Pen Circular chart recorder suitable for a 4-20 Ma input signal meeting the following:
        1. General: One (1) pen 10 inch recorder. Recorder shall be of all solid state design, microprocessor based, fully programmable
        2. Mounting: Interior Panel Mount
        3. Enclosure: Gasket NEMA 3R with door mounted glass window
        4. Electrical Connections: External power and signal wiring connections shall be completely water tight
        5. Chart Speed: Configurable from 7 to 32 days/rev
            a. Set for seven (7) days/rev
        6. Power Requirements: 115 Vac +/ 10%, 60 Hz
        7. Process Variable Indication: High contrast 128 x 64 STN dot matrix LCD (graphics) module
        8. Totalizer: Flow inputs shall include non resettable totalization
        9. Measurement Accuracy: +/- 0.1%
        10. Temperature Effect: <0.02% of reading/ºC (0.04% or reading/ºF) or 1V/ºC
        11. Operating Condition:
            a. Temperature: 0 to 55 degrees Celsius
            b. Humidity: 0 to 95% non condensing
        12. Noise Rejection: 120 dB Common mode, >120dB at 50/60Hz Normal (series) mode, >60dB at 50/60Hz
        13. Input Signal: 4-20 Ma DC
        14. Output Signal
            a. 4-20 Ma continuous, 600 Ohms, resolution of 0.1% full scale
        15. Output Contacts: 1 each, rated 5 Amp @ 120 Vac, Form C
        16. Pens: Replaceable fiber tip type
            a. Pen One (1) Red
    b. Data Logging:
        1. Automatically stores totalizer log entries and instantaneous channel data to a Compact Flash card. Once logged to a card, ABB's Data Manager software can be used to analyze the totalizer log and create graphs of the instantaneous data.
        2. Configure the unit to record data once every 60 seconds or as directed by the Owner.
    c. Provide the following expendables & accessories:

1. One year supply chart paper
2. One year's supply of recorder pens
3. Two (2) 128MB Minimum Compact Flash Cards
4. ABB Data Manager Software

d. Acceptable Manufacturer:
   1. ABB: Model C1311JU100G010458L or approved substitution.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment with skilled mechanical erection labor in accordance with manufacturer's instructions.

B. The anticipated length of signal cable required is approximately 50-feet, however, the contractor is responsible for determining the precise length of signal cable required based upon the precise routing of the field conduit.

C. The flow meter shall be calibrated to meet the project flow conditions.

D. Installed equipment shall be inspected, adjusted, approved, and certified by the manufacturer.

E. Furnish the Engineer with manufacturer's certificates regarding equipment installation prior to initial operations and mechanical performance tests.

3.2 MANUFACTURER'S REPRESENTATIVE

A. The Contractor shall provide a factory-trained representative for a minimum of one day to perform initial start up and provide instructions on the proper operation and maintenance of the equipment.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation and adjustment of equipment in a manner satisfactory to the Engineer, the Contractor with his own forces, including such equipment and other experts as may be necessary (hereinafter collectively referred to as "Contractor's personnel") shall place equipment in operation.

B. Give the Owner at least 7 days written notice prior to placing equipment in operation.

C. Operating procedures during said period are subject to Engineer's approval.

D. Operation of equipment prior to satisfactory completion of performance tests is the

Contractor's complete responsibility.

E. Designate a day approved by the Engineer for commencement of the initial mechanical performance test.

F. Initial Mechanical Performance Test: Contractor's personnel, with the personnel of the Owner observing, shall demonstrate to the satisfaction of the Engineer, the mechanical performance of each item of equipment when operated in accordance with the design intent indicated by the Drawings and described in the applicable sections of the Specifications.

G. If the demonstrations are satisfactory to the Engineer (or if equipment deficiencies are found, then subsequent to correction of the deficiencies by the Contractor), the Engineer shall give the Contractor seven days written notice to conduct the final mechanical performance test.

H. Test Interim: Contractor's personnel, without reliance of Owner's personnel, shall operate and maintain equipment in continuous, day to day, 24-hour operation except as otherwise approved by the Engineer until commencement of the final mechanical performance test.

I. During this interim the Contractor's personnel shall instruct and train the Owner's personnel in their duties.

J. Final Mechanical Performance Test:

1. This test shall cover a 48-hour period while the plant is in continuous normal operation.

2. With equipment in continuous normal operation, the Owner's personnel shall assume day to day operation of the equipment under the direct supervision of the Contractor's personnel beginning with the final tests.

3. Contractor's personnel shall demonstrate to the satisfaction of the Engineer that equipment is coordinated and that installation complies with the applicable Drawings and Specifications.

4. Performance tests shall be considered concluded at the end of the 48-hour period designated for the tests if the Engineer is satisfied with the test results or should deficiencies be found as a result of said test, then when the deficiencies have been corrected to the satisfaction of the Engineer.

K. Operating Costs: Operating costs paid for by the Owner to consist of:

1. Electrical power

2. Water

3. Any other materials or utilities required for a normal operation.

L. The Contractor shall provide initial grease, oil and fuel as required.

M. Wages and salaries of Owner's personnel prior and subsequent to the initial mechanical performance tests will be paid by the Owner.

N. Wages and salaries of Contractor's personnel, including manufacturer's representatives, as may be required for all tests specified herein shall be paid by the Contractor.

O. Applicable Contract lump sum prices shall include the furnishing of all said services. Said services shall be additional to those furnished in connection with equipment erection, installation, testing, and the correction of deficiencies. Services provided shall consist of furnishing detailed instructions to personnel of the Owner regarding equipment operations and maintenance after personnel of the Owner have had an opportunity to become familiar with treatment plant equipment.

PART 4 MEASUREMENT AND PAYMENT

A. A. Not used.

END OF SECTION