160 WASTEWATER PUMPING SYSTEMS

160.01 GENERAL

160.01.01 In situations where the gravity sewer is not feasible, the Town will consider allowing the installation of a sewage pumping station and a force main. Certain factors must be addressed by the Design Professional of the project for consideration by the Town. The factors include:

160.01.01.01 Determine the wastewater flow that would be generated by the total natural drainage basin based upon a combination of the proposed developments and the proposed land use plan, or as directed by the Director of Engineering. The Town may require the pump station to be constructed downstream to serve a larger basin.

160.01.01.02 Evaluate the capacity of the receiving sewer main at the point of discharge and downstream to determine that the line could handle the transferred sewer flow.

160.01.01.03 Perform a cost analysis of the pumping versus gravity alternative. The estimated installed cost of the gravity alternative divided by the estimated installed cost of the pump station alternative must be equal to or greater than 3.5 for the Town to consider allowing a pumping station.

160.01.01.04 The Town reserves the right on any pump station to perform the design and/or construction inspection and administration, with the developer reimbursing the Town in full.

160.01.01.05 The Town reserves the right to disallow pump stations where, in the Town's opinion, it is not efficient or desirable to have another pump station.

160.01.01.06 New developments may be required to take downstream or upstream pump stations off line, or upgrade them per the Town's Master Sewer Plan or as directed by the Director of Engineering.

160.01.02 These specifications apply to all pump stations, force mains, and associated facilities that are to be owned, operated, and maintained by the Town. Design of private pump stations and force mains and associated facilities is not covered by these specifications, and the Owner/Developer shall look for guidance from other appropriate agencies (NCDEQ, NC Plumbing Code, etc.); however, private pump stations that discharge into the Town's collection system shall be grinder pumps or equipped with a grinder manhole.

160.01.03 All aspects of the design of pump stations, force mains, and associated facilities shall, at a minimum, meet the requirements of the latest version of the NCDEQ "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains". Requirements presented in the Standard Specifications hereunder that are more restrictive or go above and beyond the requirements of the Minimum Design Criteria are required by the Town.

160.01.04 All aspects of the design of pump stations, force mains, and associated facilities shall be submitted for review and approval to the Director of Engineering and the Director of Public Utilities. Materials necessary for the review and requiring approval include complete plans, specifications, design reports, and specific equipment submittals for the specific pump station, as described hereunder.

160.01.05 General Design Requirements

160.01.05.01 Pump stations shall be located on a parcel or an easement that is dedicated to the Town. The site shall be directly connected to a dedicated public ROW or have a dedicated access easement to a public ROW.

160.01.05.02 The Town requires sewage grinders, on-site backup power, and odor control facilities at all pump stations, unless the Director of Engineering grants approval otherwise. Sizing of these items shall be based on expected flow volumes and characteristics.

160.01.05.03 All stations shall have a minimum of 2 pumps of equal capacity. The pumps shall be solids handling, submersible or suction lift, centrifugal pumps each capable of pumping flows equal to or in excess of the expected peak flow. The peak flow for design shall be a minimum of 2.5 times the average daily flow, and may be required to be greater for small basins. Where 3 or more pumps are required, they shall be of such capacity that with the largest unit out of service, the remaining units shall have capacity to handle peak sewage flows. Pumps and force mains shall be sized to provide a minimum velocity in the force main of 2.0 feet per second and a maximum velocity of 10 feet per second. The Town reserves the right to require a larger force main size at no cost to the Town based upon operating (power) costs.

160.01.05.04 Pump station structures as well as all associated equipment and appurtenances shall be protected from the 100-year flood, in accordance with 15A NCAC 2T .0305(e).

160.01.05.04.01 a. Such protection measures shall ensure that the pump station shall remain fully functional, operational, and free from physical damage during a 100-year flood.

160.01.05.04.02 b. The pump station shall be protected from inundation of floodwaters by elevating structures at least two-feet above the 100-year flood elevation. An alternate design shall include providing all pump station structures with watertight ports of entry as well as electrical, instrumentation/control, and ventilation systems that are elevated at least two-feet above the 100-year flood elevations.

160.01.05.04.03 The 100-year flood elevation shall be that as identified on the most recent FEMA Flood Insurance Rate map when available or as established through appropriate modeling techniques.

160.01.05.05 All sewage pump stations shall be equipped with an alternate power source consisting of a diesel fueled emergency generator with an automatic transfer switch.

160.01.06 Equipment Warranties

160.01.06.01 All equipment, materials, and systems supplied under this specification shall be provided with a warranty from the manufacturer to the Town stating that the subject equipment, materials, and systems shall be free of defects in workmanship and material, and shall operate as intended under the known conditions, for a minimum period of one year. The warranty shall be in printed form and made applicable to the Town (as Warrantee) at the time of acceptance for maintenance by the Town.

160.02 SUBMITTALS

160.02.01 Design Report

160.02.01.01 A design report signed and sealed by Design Professional is required with the submittal of plans and specifications for any facilities covered under this section that are proposed for construction. This design report shall contain, at a minimum, the following design criteria:

160.02.01.01.01 Total dynamic head calculations for all applicable pumping situations.

160.02.01.01.02 System curve and pump curve analysis used to determine pump selection and operating point.

160.02.01.01.03 Pump station cycle and pump run times covering the high, low and average flows over the entire expected operating period of the pump station.

160.02.01.01.04 Response time available in event of an emergency (time between the high water alarm and the first system overflow at average design flow and peak design flow).

160.02.01.01.05 Pump station flotation/buoyancy calculations.

160.02.01.01.06 Minimum velocity within the force main, including an analysis of the capabilities of the pumps to completely flush any depressed sections of the force main in a single pumping cycle.

160.02.01.01.07 Maximum detention times within the pump station and force main covering the low flows over the entire expected operating period of the pump station.

160.02.01.01.08 An evaluation of the capability of the receiving sewer to handle the peak flow discharge from the proposed facility in addition to the existing or planned peak flows currently handled by the receiving sewer or sewage facility.

160.02.01.01.09 Airflow calculations and chemical dosing calculations for the odor control facilities (if applicable).

160.02.01.01.10 Flow capacity and headloss calculations for the grinder unit.

160.02.01.01.11 Calculations for the sizing of the backup power generator.

160.02.02 Project Review Submittals

160.02.02.01 Project Review Submittals shall be submitted to the Director of Engineering Department for review and approval prior to application for a permit for the pump station or force main, and prior to entering into construction contracts or purchasing any equipment for the pump station or force main. Obtaining permits, entering into construction contracts, or purchasing any equipment in no way obligates the Town to accepting designs or equipment that do not meet the specified standards or other requirements the Town may have.

160.02.02.02 The Project Review Submittals shall include, at a minimum, complete plans and specifications, a design report as described above, and manufacturer's information on specific major equipment listed in this Section. The information submitted on equipment shall include, at a minimum, the name of the manufacturer and the specific model being supplied, fabrication and assembly drawings, detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished. It shall also include any system electrical wiring diagrams and control panel schematics. Additional detail on specific items required for Project Review Submittals on specific equipment can be found in the Appendix.

160.02.03 Testing Results Submittals

160.02.03.01 The results of all testing shall be submitted to the Director of Engineering Department for review prior to continuing progress on the particular equipment. If shop testing is required, results shall be submitted prior to delivery of the equipment. If installation verification is required, results shall be submitted prior to start-up and testing of the equipment. If final start-up tests are required, results shall be submitted prior to final acceptance of the equipment.

160.02.03.02 Three printed copies of all test results are required to be submitted for review.

160.02.03.03 A final, compiled summary of all testing done on all equipment shall be provided to the Town upon completion of the project prior to project closeout and final acceptance. This final, compiled summary shall consist of a single bound printed copy, and an electronic copy (CD) recorded in .PDF format.

160.02.04 Operation and Maintenance Manuals (O&M)

160.02.04.01 Operation and Maintenance (O&M) manuals are required for all equipment and systems furnished under this Section. Three copies shall be supplied to the Town in printed format prior to startup of the subject equipment or systems. The O&M manuals shall contain all of the necessary information for proper operation and maintenance of the subject equipment and systems. At a minimum, the O&M manuals shall contain the following:

160.02.04.01.01 Final approved shop drawings.

160.02.04.01.02 Design data including pump curves and system curves.

160.02.04.01.03 Wiring diagrams and control schematics.

160.02.04.01.04 Detailed inventory of installed equipment, including its functional description, and manufacturer name, address, and phone number (and the same for at least one, but preferably several, local representatives of the manufacturer).

160.02.04.01.05 Operating instructions.

160.02.04.01.06 Troubleshooting techniques.

160.02.04.01.07 Maintenance schedules.

160.02.04.01.08 Assembly and disassembly instructions.

160.02.04.01.09 Instructions for start-up and shutdown, as well as calibration and adjustment.

160.02.04.02 A final, compiled O&M manual covering all equipment and systems supplied, shall be provided to the Town upon completion of the project prior to project closeout and final acceptance. This final, compiled summary shall consist of a single bound printed copy, and an electronic copy (CD) recorded in .PDF format.

160.03 SITE

160.03.01 The site shall be graded to drain away from the pump station, and to remove storm water runoff from the site in a non-erosive manner.

160.03.02 The site shall be stabilized by crushed stone, low maintenance vegetative ground cover or other suitable materials. No vegetative ground cover is allowed within the fenced area, unless otherwise approved by the Director of Engineering. Visual screening and landscaping shall be provided in accordance with the approved site plan.

160.03.03 The site shall be secured by an 8-foot high chain link fence topped with 3 strands of barbed wire placed at an outward 45 degree angle. Fence products shall be only new materials using hot dipped galvanized iron or steel components and aluminum coated fabric. Gates shall permit 180 degree opening, be located so as to provide vehicle accessibility, and be a minimum width of 12 feet. All posts shall be set in concrete. Dark green aluminum slats shall be placed in the fence fabric around the entire perimeter for privacy.

160.03.04 The pump station site shall permit the loading and removal of all equipment (pumps, grinders, generators, etc.) from the pump station site with an appropriately sized truck and/or crane.

160.03.05 The site shall feature adequate turn around areas for a WB-40 service vehicle and provide a minimum 12 foot wide access road to the site with grades not to exceed 10%. If chemical feed systems are included, additional turning radius may be required.

160.03.06 Access road shall consist of an all-weather surface (minimum of 6” ABC) with minimum 20’ long paved strip from roadway. No driveways may be located off of access road. Access road shall be fully contained within a minimum 20 foot wide combined access and utility easement, platted by the Developer.

160.03.07 The site shall feature locks and security features as dictated by the Public Utilities Department along with all necessary OSHA signage. The site shall feature a minimum high pressure sodium vapor light of 600 watt (minimum) capacity to illuminate the pump station area. The light shall be mounted on a Class V utility pole at a height of 30 feet and controlled by means of a photo cell and an HOA switch located on the light pole, unless otherwise approved by the Director of Engineering. Unless otherwise directed, light shall be provided by the local power utility and added to the Town's account in accordance with Section 070 – Lighting, Street Signage, and Street Marking.

160.03.08 Pump stations shall have a metered potable water supply from the Town water distribution system. The supply shall have an approved backflow prevention system. A minimum of one freeze proof yard hydrant is required within the fenced area. Emergency shower and eye washing basin shall be provided in pump stations with chemical facilities.

160.04 STRUCTURES

160.04.01 General

160.04.01.01 The submersible pump station structures shall consist, at a minimum, of a grinder manhole, a wet well, and a valve vault. Large, integrated structures are permissible, however, there shall be walls separating the portions of the structure listed above. Pump station structures other than the wet well shall be provided with a means to remove any accumulated water and wastewater from the structure.

160.04.01.02 Access hatches for equipment and personnel shall be provided for all structures, and sized appropriately. All access hatches shall be integrally cast in the structure or flush mounted. Access hatches shall be square and constructed of ¼-inch thick aluminum diamond pattern plate with steel hinges on an aluminum frame.

160.04.01.03 Cover slabs for wet well and valve vaults shall be reinforced concrete with integral cast in place access hatch covers with fall protection in accordance with these specifications. Cover slabs shall be reinforced as per ACI Code and specially reinforced around openings. Access covers shall be double leaf or single leaf (as required) aluminum diamond pattern floor hatch of 1/4-inch (minimum) thickness capable of withstanding 150 psf without permanent damage. Each leaf shall open 90 degrees and be attached to the frame by steel hinges. The door shall have a lock in the open position and vinyl grip handle to release lock for closing.

160.04.01.04 Any portion of a pump station structure that is open and would allow floodwater entry into the wastewater system shall be built with a top elevation of 2 feet above the 100-year flood elevation. All structures not meeting the elevation requirement that could allow entry of floodwater into the wastewater system shall be sealed watertight with a vent elevated a minimum of 2 feet above the 100-year flood elevation.

160.04.02 Wet Well

160.04.02.01 The wet well shall have a minimum diameter of 6 feet, and shall be large enough to easily accommodate the removal of each pump and a basket strainer. The wet well shall be designed to have an operating volume sufficient to provide pump

operating cycles to match the manufacturer's recommendations. The pump operating cycles shall be between two and eight times per hour at design daily flow (without being excessively deep), unless otherwise authorized by the Director of Engineering.

160.04.02.02 The wet well shall be constructed of precast concrete manhole sections or cast-in-place concrete. Extended bases or another foundation shall be used to provide adequate bearing surface and flotation protection if needed. All concrete shall have a minimum 28-day compressive strength of 3000 PSI.

160.04.02.03 Precast concrete manhole wet wells shall conform to specifications as listed in Section 100. If precast manhole units are utilized, they shall conform to the requirements of ASTM C478, with watertight joints per ASTM C443 with durable mastic sealing compound. Structures may be either circular or rectangular in shape but shall have vertical walls.

160.04.02.04 Cast-in-place wet wells shall be properly designed by a Design Professional and include appropriate structural support, waterproofing, exterior coating, structure covers, access hatches, etc.

160.04.02.05 At a minimum, wet wells shall have a downturned vent made from ductile iron with flanged joint pipe fittings. An insect screen shall be included at the exposed end of the vent pipe. The screen shall be bronze or aluminum insect screening. Forced air venting is also allowed and shall be required on individual pump stations in conjunction with odor control measures, depending on circumstances.

160.04.02.06 Wet wells and wet well piping shall be coated with an approved epoxy coating at 80-mils. Care shall be taken to ensure no epoxy coating is applied to the pump coupling face, the guide rails, or any other part that needs to allow movement or replacement on a regular basis. See Section 100 and the Approved Manufacturers List for more information on epoxy coatings.

160.04.02.07 Interior Corrosion Protection - The interior surface of the wet well shall be thoroughly cleaned of all oils, latence, dirt, loose concrete, etc. All voids or surface blemishes shall be filled or repaired using Calcium Aluminate (mortar). The joints of pre-cast units shall receive three (3) coats of mortar so as to achieve a smooth surface at each joint. After the interior patching has thoroughly dried, the entire surface of the wet well interior shall receive 2 coats Sherwin Williams Sher-Flex or equivalent with a total dry film thickness of 80-125 mils, and all nicks and scratches shall be touched up prior to acceptance. If material other than Sherwin Williams Sher-Flex is proposed, it shall be approved by the DPW prior to use. Alternatives to this coating system may be added to the approved manufacturer’s list in the Appendix. The manufacturer’s recommendations for the coating shall supersede these requirements upon approval from the Director of Engineering.

160.04.02.08 Fall-Through Prevention System - A fall-through prevention system shall be provided with the wet well hatch doors. The system shall be a grate consisting of two leafs made of 6061-T6 aluminum hinged on the same side of the hatch. The grate shall be designed to withstand a minimum pedestrian load of 300 lbs. per square foot. The grate openings shall be 4" x 6" to allow both visual and limited accessibility for maintenance purposes when the grate is closed. The leafs of the grate will pivot on aluminum hinge devices with 316 SS hardware that permit them to rotate upward 90

degrees and automatically lock in place. Aluminum pull rods will be attached to the grates leafs so the operator is positioned with the grate between him and the hatch's opening whenever he raises a leaf. Each grate leaf will have a rod made from 316 SS that automatically engages to secure the leaf in its open position, and can be lifted upward to permit the grate leaf to close. The hatch cover will not be able to shut until the grate is closed, thereby insuring the grate is in position when the next operator opens the hatch cover. The grate shall have an OSHA safety yellow finish to increase visual awareness of the safety hazard.

160.04.03 Valve Vaults

160.04.03.01 The valve vault shall, at a minimum, consist of a precast concrete manhole base section at least 6 feet in diameter, or a cast in place concrete, custom built section, or a precast concrete rectangular structure at least 6 feet square. The valve vault shall be complete with positive drainage to a drain that goes to the wet well, access ladder attached to the vault wall, and access cover cast in the top slab. The drain pipe between the valve vault and the wet well shall have a back water valve at the wet well end, and shall have at least one Victaulic type coupling to allow for differential movement.

160.04.04 Manholes

160.04.04.01 Any manholes installed on the pump station site need to meet the standards described in Section 150. All manholes installed on the pump station site shall receive an interior coating of an approved epoxy resin.

160.04.05 Buildings

160.04.05.01 Modular buildings to house chemical feed facilities shall be adequate to provide sufficient storage, clearance, and containment of chemicals. A removable roof or roof sections shall be required to allow sufficient access to all equipment and tanks within the building. All supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be designed and sealed by a Design Professional.

160.04.05.02 On a case by case basis, a building may be required to house all electrical and control equipment. This building shall be of precast, prefabricated, or built in place construction.

160.04.05.03 All buildings located on a pump station site shall have the first floor elevation a minimum of 2 feet above the 100-year flood elevation.

160.05 PIPING AND VALVES

160.05.01 Materials: shall be as specified in Section 100.

160.05.02 Suction and discharge piping shall be Class 50 ductile iron flanged pipe in accordance with AWWA Specifications C141. Discharge piping and valves shall produce a minimum head loss while maintaining a minimum velocity of 2.5 feet per second. All exposed piping shall have adequately sized and located thrust rods. Other materials may

be considered upon recommendation of the equipment supplier and with approval from the Director of Engineering.

160.05.03 The discharge connection elbow shall be a straight through fitting with no flap valve and shall be permanently installed in the wet well along with the discharge piping. The pumps shall be automatically connected to the discharge connection elbow when lowered into place. The entire weight of the pump shall bear upon the guides and base support with no part of the pump bearing directly on the floor of the wet well. A stainless steel chain shall be provided for lifting each pump from the wet well. All hardware used shall be 316 stainless steel.

160.05.04 An external weight check valve and a plug valve shall be provided for the discharge pipe of each pump. A 1/4 turn plug valve shall be provided on the discharge pipe from the valve vault (the beginning of the force main).

160.05.05 Check valves shall be iron bodied, fully bronze mounted with bronze clapper disc and bronze seat ring, and shall have a spring loaded lever arm capable of being mounted on either side of the valve.

160.05.06 Plug valves shall be 1/4 turn, eccentric action and resilient plug facing with heavy duty stainless steel bearings and welded-in corrosion resistant nickel seat. Pump station plug valves shall be "full-port" cross-sectional area perpendicular to the flow of at least 100% of the adjoining pipe.

160.05.07 Plug valves and check valves on the discharge side of each pump shall be located in a valve vault separate from and adjacent to the wet well. A Victaulic type coupling shall be installed on each discharge main between the wet well and the valve vault to allow for differential movement. Valves shall be rated for 175 psi (minimum) working pressure. The plug valve shall be capable of passing a 3-inch solid.

160.05.08 A riser pipe with a quick connect coupling shall be provided to allow for a portable pump connection to bypass the pump station and utilize the force main. The piping for the riser pipe shall be at least the same diameter as the force main piping, and shall have a check valve and plug valve accessible in the same valve vault as the pump valves, or a separate valve vault shall be provided. The riser pipe shall rise vertically from the ground and have a 90 degree elbow to provide for a horizontal connection point. The quick connect coupling shall be located 3 feet above finished grade, and shall be protected by concrete filled bollards. A quick connect cap shall be provided for covering the quick connect opening when not being used. See the Standard Details for additional description of the riser pipe.

160.05.09 A +/- 2% accuracy pressure gauge with a 3-inch or larger dial, stainless steel case, and graduated to 30 PSI shall be provided on each discharge pipe. The gauge shall be installed between the check and plug valves. Isolation seals and cut-off ball valve shall be provided between the gauge and discharge pipe. The gauge shall be oriented so that it is easily legible from the valve vault.

160.05.10 All piping, couplings, fittings, valves, etc. shall be Class 125 flanges meeting ANSI B16.1 Specifications, unless class 250 flanges are required for high head installations.

160.05.11 Anchor Bolts

160.05.11.01 Anchor bolts and nuts shall be furnished as required for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolts shall be at least 3/4 inch in diameter.

160.05.11.02 Anchor bolts shall be accurately located and centered in pipe sleeves having an inside diameter approximately 2.5 times the bolt diameter and a length approximately 8 times the bolt diameter. A square anchor plate with thickness of approximately 0.5 the bolt diameter and side dimensions 4 times the bolt diameter shall be welded to the bottom of each sleeve, with the anchor bolt extended through the plate and welded thereto. Two nuts and a washer shall be furnished with each anchor bolt.

160.05.11.03 Anchor bolts shall be long enough to accommodate 1.5 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete. Bolts shall have a "J" bend anchoring them into the concrete.

160.05.11.04 Anti-seize compound shall be applied to the threads of all stainless steel bolts before assembly.

160.06 ELECTRICAL - GENERAL

160.06.01 All electrical systems associated with any of the items covered under this section shall meet all applicable electrical standards and code requirements, including, but not limited to: ANSI, ASTM, NEMA, IEEE, DEMA, EEI, HEI, ISO, NFPA, SAE, NEC, UL508, as well as any other federal, state, or local codes.

160.06.02 Electrical service to all pump stations shall be 3 phase, 240 VAC or 480 VAC, with automatic transfer switches for automatically starting on-site emergency generators. The electrical power entrance shall be through a meter base, followed by a NEMA 3R heavy duty, single throw, fusible safety switch with a solid neutral. This shall be followed by a NEMA 3R heavy duty, double throw, three pole safety switch which feeds the control panel from one side and heavy duty, circuit breaking 4 wire, 4 pole receptacle assembly from the other side.

160.06.03 Electrical equipment inside the wet well shall meet the requirements for Class I, Division I, Group C/D service.

160.06.04 All of these electrical components shall be suitably sized to be capable of service with all electrically powered equipment running.

160.06.05 All electrical components, including panels, shall be sealed off in accordance with the NEC requirements for electrical service to gas pumps.

160.06.06 The use of rigid conduits is required. PVC shall be used below ground and galvanized steel shall be used above ground. Flexible conduits are only allowed with approval of the Director of Engineering.

160.06.07 Pump station electrical and control equipment shall be located in a building as described above, or under a weatherhood. An aluminum weatherhood with a clear height of 7 feet, an overhang of at least 4 feet and a thickness of 3/16 of an inch shall be provided for control equipment exposed to the weather. The back panel and side panel shall also be 3/16-inch thick aluminum. The support structure for the weatherhood shall be made from structural steel members assembled to provide individual, direct support to the control equipment panel, transfer switch, safety switches, meter base and the weatherhood. The steel frame shall be painted with a two component, high build epoxy polyamide paint system designed for severe service. All weatherhoods shall be provided with a 4-foot fluorescent all-weather light fixture and GFI protected 120 VAC outlet. A concrete pad shall be placed under the weatherhood with a minimum footprint matching the weatherhood top dimensions.

160.06.08 All electrical equipment, including non-submersible motors, electrical panels, control panels, alarm/telemetry systems, backup generators, etc., shall be located a minimum of 2 feet above the 100-year flood elevation.

160.07 PUMPS

160.07.01 General

160.07.01.01 Pumps, motors, and major accessories shall be supplied by a single manufacturer as listed in the Approved Manufacturer's List.

160.07.01.02 Each pumping unit shall be complete with a close-coupled, submersible electric motor, and all other appurtenances specified, or otherwise required for proper operation.

160.07.01.03 The equipment provided under this section shall be suitable for the service conditions and shall be capable of meeting all operating requirements of the pumping system.

160.07.01.04 Each pumping unit including motor and all integral controls shall be rated and labeled for use in a Class 1, Division 1 or Division 2, Group D area as defined by the NEC.

160.07.01.05 Each item of equipment and each part shipped separately shall be identified with indelible markings for the intended service. Tag numbers shall be clearly marked on all shipping labels and on the outside of all containers.

160.07.02 Quality Assurance

160.07.02.01 Quality Standards. Except where modified or supplemented by these specifications, all equipment and materials shall be designed and constructed in accordance with the latest applicable requirements of the standard specifications and codes of ANSI, ASTM, NEC, UL, and other such regularly published and accepted standards as well as state and local codes.

160.07.02.02 Performance and Balance Requirements

160.07.02.02.01 All specified conditions shall be at rated speed unless otherwise indicated.

160.07.02.02.02 Overall (wire-to-water) efficiency for constant speed pumps shall include losses in the pump and motor. Overall (wire-to-water) efficiency for variable speed pumps shall include losses in the pump, motor, adjustable frequency drive, and any transformers supplied as part of the adjustable frequency drive equipment.

160.07.02.02.03 The minimum hydrostatic test pressure shall be 1.5 times shutoff head plus maximum suction pressure.

160.07.02.02.04 Pump performance shall be stable and free from cavitation and noise throughout the specified operating head range at minimum suction submergences. The design running clearance between the impeller inlet and the casing wearing ring (if provided) shall be not less than 0.01 inch or 1 mil per inch of casing wearing ring diameter, whichever is greater.

160.07.02.02.05 When required, pumping units shall be designed so that maximum reverse rotation due to reverse flow at the head as required shall not cause damage to any component. Pump supplier shall coordinate this provision with the motor supplier.

160.07.02.02.06 All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operation speeds is avoided. In any case, the unfiltered vibration velocity, as measured at any point on the machine including top of motor, shall not exceed the maximum velocity as indicated for vertical, end suction, solids handling pumps. At any operating speed, the ratio of rotative speed to the critical speed of a unit or its components shall be less than 0.8 or more than 1.3.

160.07.03 Pumps

160.07.03.01 Pumps shall be submersible, non-clog centrifugal sewage pumps capable of passing a 3-inch sphere. Pumps shall be capable of handling raw, unscreened sewage. Major pump components shall be of gray cast iron devoid of burrs, pits or other irregularities. Suction lift pumps may be preferred in some instances. The pump technology will be selected during the pre-development and design phase in consultation with the Public Utilities Director.

160.07.03.02 The impeller casing shall have well-rounded water passages and smooth interior surfaces free from cracks, porosity, blowholes, or other irregularities. The discharge nozzle shall be flanged, with dimensions and drilling conforming to ANSI B16.1, Class 125. The discharge nozzle shall be flanged and sufficiently rigid to support the pumping unit under all operating conditions.

160.07.03.03 The impeller shall be a semi-open and enclosed recessed one-piece casting with not more than two non-clog passages with the impeller completely out of the flow path. The interior water passages shall have uniform sections and smooth

surfaces and shall be free from cracks and porosity. The impeller shall be dynamically balanced and securely locked to the shaft by means of a key and self-locking bolt or nut.

160.07.03.04 For pumping units 20 horsepower and larger, renewable wearing rings shall be provided in the casing and on the impeller. The rings shall be positively locked in place. For pumping units less than 20 horsepower a renewable wearing ring or axially adjustable wearing plate shall be provided in the casing. Casing wearing ring shall be securely fastened to the impeller casing front cover to provide either an axial or radial running clearance. Axially adjustable wearing plate shall be arranged to permit adjustment of the axial running clearance between the impeller and plate. The wearing plate shall have an outward spiraling groove designed to force stringy solids outward and away from the impeller.

160.07.03.05 The oil chamber shall contain a drain plug and a vent plug. Food grade oil shall be used.

160.07.03.06 Each pump shall be provided with two mechanical rotating shaft seals arranged in tandem and running in an oil chamber. Each interface shall be held in contact by an independent spring system designed to withstand maximum suction submergence. The seals shall require neither maintenance nor adjustment and shall be readily accessible for inspection and replacement. Shaft seals lacking positively driven rotating members or conventional double mechanical seals which utilize a common single or double spring acting between the upper and lower units and requiring a pressure differential to offset external pressure and effect sealing, shall not be acceptable. The seals shall not rely upon the pumped media for lubrication and shall not be damaged if the pumps are run unsubmerged for extended period while pumping under load.

160.07.03.07 All mating surfaces of major components shall be machined and fitted with O-rings where watertight sealing is needed. Sealing shall be accomplished by O-ring contact on four surfaces and O-ring compression in two planes, without reliance on a specific fastener torque or tension to obtain a watertight joint. The use of elliptical O-rings, gaskets, or seals requiring a specific fastener torque value to obtain and maintain compression and watertightness shall not be acceptable. The use of secondary sealing compounds, gasket cement, grease, or other devices to obtain watertight joints shall not be acceptable.

160.07.04 Pump Motors

160.07.04.01 The pump motors shall be sealed submersible type, and shall be 3 phase, 60 Hertz, 240 or 480 VAC motors with a maximum speed of 1800 RPM. The motors shall meet the U.S. requirements of Class I, Division I, Group D for hazardous locations, and shall be sized to non-overloading throughout the entire operating range of the pump.

160.07.04.02 A heated sensor thermostat shall be attached to and embedded in the winding and be connected in series with the motor starter contactor coil to stop the motor if the temperature of the winding is more than 220 degrees Fahrenheit. The thermostat shall reset automatically when the motor cools to a safe operating temperature. The common pump/motor shaft shall be of 416 stainless steel.

160.07.04.03 The motor shall be protected by mechanical seal system as described above. A double electrode shall be mounted in the seal chamber to detect any water entering the chamber through the lower seal. Water in the chamber shall cause a red light to turn on at the control panel. This signal shall not stop the motor but shall act as a warning only.

160.07.04.04 Motors shall be provided by the pump manufacturer and shall be air-filled, totally submersible. Motor nameplate rating shall exceed the maximum power required by the pump in the operating head range. Each motor shall have a voltage, frequency, and phase rating as required and shall have a service factor of 1.15. The stator housing shall be an air-filled, watertight casing. A cooling jacket shall encase the motor housing for each pump where needed to maintain adequate cooling. Cooling jacket shall require no external source of cooling water. Motor insulation shall be moisture resistant, Class F, 180 degrees Celsius. Each motor shall be NEMA Design B for continuous duty at 40 degrees Celsius ambient temperature, and designed for at least 10 starts per hour.

160.07.04.05 Each motor housing shall be provided with a moisture detection system complete with all sensors, control power transformer, intrinsically safe control modules, and relays. The moisture detection system shall be rated for a 120 or 240 VAC supply. The moisture detection system shall provide two normally open dry output contacts rated 5 amps at 120 VAC. The contacts shall close when moisture is detected in the motor housing and the pump shall be shut down. All moisture detection system components shall be furnished by the pump supplier and shall be shipped loose for installation into the motor controller enclosure, or if required to be mounted separately, all components shall be mounted in a NEMA 4 stainless steel enclosure.

160.07.04.06 The motor bearings shall be antifriction, permanently lubricated type. The lower bearing shall be fixed to carry the pump thrust and the upper bearing free to move axially. The bearings shall have a calculated AFBMA L10 Live Rating of 40,000 hours when operating at maximum operating head. Maximum shaft runout at the mechanical seals shall not exceed 2 mils at any point in the operating head range.

160.07.04.07 Thrust bearings shall be protected by bearing temperature switches. The switches shall be normally closed, automatic reset type, rated 5 amps at 120 VAC.

160.07.04.08 Each motor shall be capable of continuous operation in air (unsubmerged) for at least 24 hours under pump full load conditions, without exceeding the temperature rise limits for the motor insulation system.

160.07.04.09 Each motor shall be equipped with one or more multiconductor cable assemblies for power and control. Each multiconductor assembly containing power cables shall be provided with a separate grounding conductor. Each cable assembly shall bear a permanently embossed code or legend indicating the cable is suitable for submerged use. Cable sizing and type shall conform to NEC requirements.

160.07.04.10 Power cables to pumps shall be AWG (min) hypalon jacketed type SPC cable a minimum of thirty (30) feet in length.

160.07.04.11 All cables shall be of sufficient length to terminate in a junction box outside the wet well as indicated on the drawings, with 10 feet of slack that shall be

coiled on a cable hook at the top of the wet well. Each cable shall be supported by AISI Series 300 corrosion-resistant stainless steel Kellems type woven grips to prevent damage to the cable insulation. Mounting of cable supports in the wet well shall be coordinated to prevent damage to the cable.

160.07.04.12 The cable entry water seal shall include a strain relief and a grommet type seal designed so that a specific fastener torque is not required to ensure a watertight submersible seal. The cable entry junction box and motor shall be separated by a stator lead sealing gland or a terminal board. The junction box shall isolate the motor interior from moisture gaining access through the top of the stator housing.

160.07.04.13 Motors with an adjustable frequency type speed controller shall be derated to compensate for harmonic heating effects and reduced self-cooling capability at low speed operation so that the motor does not exceed Class B temperature rise when operating in the installed condition at load with power received from the adjustable frequency drive. All motors driven by adjustable frequency drives shall be supplied with full phase insulation on the end turns and shall meet the requirements of NEMA MG 1, Part 31. In addition to the requirements of NEMA MG 1, Part 31, motors shall be designed to be continually pulsed at the motor terminals with a voltage of 1600 volts ac.

160.07.04.14 Adjustable frequency drives shall be provided as specified by the Director of Engineering on a case by case basis.

160.07.05 Appurtenances

160.07.05.01 The lift out systems shall consist of a straight elbow that bolts to the bottom of the basin, a combination disconnect assembly with a seal flange that mounts to the pump, rail support guides that fasten to the wall of the basin and guide and support brackets that mount to the pump. The guide rails shall be type 304 stainless steel.

160.07.05.02 A discharge base and discharge elbow shall be furnished by the pump manufacturer. The base shall be sufficiently rigid to firmly support the guide rails, discharge piping, and pumping unit under all operating conditions. The base shall be provided with one or more integral support legs or pads suitable for bolting to the floor of the wet well. The face of the discharge elbow inlet flange shall be perpendicular to the floor and shall make contact with the face of the pump discharge nozzle flange. The diameter and drilling of the elbow outlet flange shall conform to ANSI B16.1, Class 125. The pump and motor assembly shall be automatically connected to and supported by the discharge base and guide rails so that the unit can be removed from the wet well and replaced without the need for operating personnel to enter the wet well.

160.07.05.03 The discharge base and pedestal base shall be cast iron or fabricated steel.

160.07.05.04 Each guiderail mounted pumping unit shall be provided with an integral, self-aligning guiderail sliding bracket. The bracket shall be designed to obtain a wedging action between flange faces as final alignment of the pump occurs in the connected position. The bracket shall maintain proper contact and a suitably sealed

connection between flange faces under all operating conditions. The sliding bracket shall be non-sparking.

160.07.05.05 Each guide rail mounted pumping unit shall be equipped with one or more guide rails. Guide rails shall be sized to fit the discharge base and the sliding bracket and shall extend upwards from the discharge base to just below the bottom of the access hatch. An upper guiderail bracket shall be provided at the pump access opening. Guide rails shall be made of stainless steel ASTM A312, Schedule 40S.

160.07.05.06 Each guide rail mounted pumping unit shall be provided with a chain suitable for removing and installing. The chain shall be stainless steel with 4x6 lifting eyes at 10ft intervals starting at the top. A suitable chain hook shall be provided at the top of the wet well.

160.07.05.07 Upper guiderail bracket, cable hooks, and chain hooks shall be AISI type 304 stainless steel.

160.07.05.08 Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

160.07.06 Shop Painting

160.07.06.01 All iron and steel parts which will be in contact with pumped liquid or submerged after installation, including the inside of the casing, the impeller, and the discharge elbow, shall be shop cleaned in accordance with the coating manufacturer's recommendations and painted with the epoxy coating system specified. The coating shall have a dry film thickness of at least 10 mils and shall consist of a prime coat and one or more finish coats. At least 1 quart of the finish coat material shall be furnished with each pump for field touchup.

160.07.06.02 All other iron and steel surfaces, except stainless steel and machined surfaces, shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an oil resistant enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

160.07.06.03 Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.

160.08 PUMP CONTROL SYSTEMS

160.08.01 All components of the pump control systems shall be properly designed and installed to meet all NEC and other industry standards, as well as all federal, state, and local requirements.

160.08.02 Enclosure: The pump control system equipment enclosure shall be NEMA type 3R and be of suitable size to house all components. A locking hasp shall be provided in addition to screw clamp type latches. The enclosure shall be fabricated from fiberglass or 14-gauge steel. The top of the enclosure shall serve as a drip shield and the seam free sides shall prevent rain and sleet from entering. The inner panel shall be made of 12-gauge steel and shall be painted white. The enclosure and interior panel shall be painted with heat fused modified polyester powder, electrostatically applied over a phosphatized base. The enclosure shall be ANSI/ASA 61 grey.

160.08.03 Hinged Inner Door: A hinged inner door shall be furnished. Overload reset push buttons, circuit breakers, switches and pilot lights shall be the only components accessible with the door closed. The door shall be hinged and able to be opened when service is required.

160.08.04 Line Terminal Block: A terminal block shall be furnished with properly sized line lugs to accept the main power source entering the control panel. Load lugs shall be adequate to accept all required load side wiring requirements. All live parts shall be fully shielded.

160.08.05 Motor Circuit Breaker (440-480 VAC): A properly sized, molded case, hydraulic-magnetic circuit breaker shall be provided for each pump motor. Line and load sides shall be equipped with lugs properly sized for the horsepower and current rating of the motors. The interrupting rating shall be 5,000 RMS symmetrical amps.

160.08.06 Transformer Primary Circuit Breaker: A properly sized, two pole, molded case transformer primary circuit breaker shall be furnished ahead of the control power 120 VAC power transformer for short circuit protection and disconnecting power to the transformer. The circuit breaker shall conform to the specifications for the motor circuit breakers.

160.08.07 Control Power Transformer: An industrial quality control power transformer shall be furnished to provide control voltage. The transformer shall be furnished to provide adequate KVA rating to provide 120 VAC power for all items required in the control and alarm circuits. The transformer shall be protected in its secondary by properly sized fuse and/or circuit breakers.

160.08.08 Magnetic Contactors and Overload Relays: A magnetic contactor shall be furnished for each motor. A separate, panel mounted, 3 leg (three phase) overload relay shall be supplied for each motor. Each leg of the overload relay shall be equipped with a properly sized overload heater. The contactor and overload relay shall be properly sized for the required horsepower, voltage and phase.

160.08.09 Elapsed Time Meters: Six digit, non-resettable elapsed time meters shall be mounted in the control panel enclosure to record the running time of each pump.

160.08.10 Condensation Strip Heater With Thermostat: A strip heater shall be furnished to prevent condensation within the control panel enclosure. The heater shall be controlled by a panel mounted, adjustable thermostat.

160.08.11 Phase & Voltage Monitor: A phase failure, reversal and under voltage monitor shall be supplied to prevent the motors from running under low voltage, phase loss, or

phase reversal conditions. The monitor shall lock out the control circuit until the problem is corrected and automatically reset.

160.08.12 Lightning and Surge Arrestor: Suitable lightning arrestors shall be provided to protect motors and control equipment from lightning induced line surges.

160.08.13 Thru - Door Overload Reset Push Buttons: Overload reset push buttons shall be provided for each overload relay. Push buttons shall be mounted so that with the inner door closed, overload relays may be reset without entering the high voltage compartment.

160.08.14 Switches: Heavy-duty industrial grade oil-tight switches shall be provided for each pump for "Hand/Off/Automatic" operation selection. They shall be labeled as to the specific pump it controls, and the operation at the specific switch position. The switches shall be 120 VAC. All switch components shall be made of corrosion resistant metals and polyesters. Contact blocks shall be made of see-through polycarbonate for simplified inspection of contacts. Cams and strokers shall be Teflon impregnated for abrasion free service without lubrication.

160.08.15 Pilot Lights: Full voltage heavy-duty industrial grade oil-tight pilot lights shall be provided for each pump indicating that it is currently running. They shall have a green lens and be labeled as to the specific pump it indicates. The pilot lights shall be 120 VAC. All pilot light components shall be made of corrosion resistant metals and polyesters. An insulated socket shall be furnished to eliminate the possibility of shock during bulb change. The lens shall be 22mm and made of lexan.

160.08.16 Seal Fail Alarm Circuit With Test Push Button (Required For Submersible Pumps and Motors): The control panel shall be equipped with a conductance actuated control relay that shall respond to current from a moisture sensor in the pump seal chamber. The relay contacts shall be rated at 16 amps minimum. All molded structural parts shall be of high mechanical and dielectric strength, structural dimensionally stable, arc resistant, thermosetting plastic. The base plate shall be high strength, die-cast aluminum alloy. Solid state type relays shall not be considered acceptable for seal fail monitoring applications. Bulbs shall be “super bright” LED type.

160.08.17 Seal Failure Circuit Test Push Button (Illuminated): Heavy-duty industrial grade oil-tight push buttons shall act as both the seal failure alarm indicator light and the test push button and shall be provided for each submersible pump motor. The push buttons shall be labeled “Seal Fail” and indicate the pump number to which it corresponds. The push button shall be 120 VAC. The push button shall illuminate upon alarm condition and shall be amber in color. Each push button shall include contacts that shall allow testing of the seal failure circuit and pilot light bulb by pushing. All push button components shall be made of corrosion resistant metals and polyesters. Contact blocks shall be made of see-through polycarbonate for simplified inspection of contacts. An insulated socket shall be furnished to eliminate the possibility of shock during bulb change. The lens shall be 22mm and made of lexan.

160.08.18 Pump Alternator Circuit (For Duplex Pump Operation): The electro-mechanical pump alternator relay shall be of industrial design specifically for use in pump applications. It shall have single-pole double-throw heavy-duty 10-amp silver cadmium oxide contacts enclosed in a transparent cover. The snap action contacts shall transfer when the unit is de-energized. The circuit shall never be closed or opened while current is being conducted.

The alternator circuit shall alternate the lead pump position between the pumps and shall allow the lag pump to start in response to a rising water level in the wet well. A four position switch shall be provided on the exterior of the pump control panel. The switch shall have a position for Pump 1, Pump 2, Off, and Auto, and shall be labeled accordingly.

160.08.19 Control Relay(s): Plug-in control relays with 120 VAC coils shall be provided as required. Contact rating shall be 5-amps (minimum). Sockets shall be of the same manufacture as the relays and hold-down clips shall be furnished to prevent relay form sliding out of the socket. Relays shall have indicator lights showing when they are engaged.

160.08.20 High Wet Well Level Alarm: The control panel shall be provided with a suitable alarm circuit to signal a high water condition in the wet well, activated by a separate level control device. Terminals shall be furnished in the control panel for connection of an externally mounted alarm device. A red flashing light and continuous sounding alarm shall be mounted on the top of the weatherhood to indicate the high water condition in the wet well.

160.08.21 Liquid Level Controls: Float actuated mercury level control switches shall be provided for: low level alarm, pumps off, lead pump on, lag pump on, and high level alarm functions. The mercury switch shall be encapsulated in polyurethane foam for corrosion and shock resistance. Level switches shall be weighted to hold desired position in the wet well. The cord connection to the control shall be numbered 16-2, rated for 13-amps, and shall be type SJTO. To ensure optimum longevity, contacts shall be rated for 20 amps at 115 VAC and shall be sealed in a heavy-duty glass enclosure. No junction boxes or cable splices of any kind shall be allowed in the wet well.

160.08.22 High Temperature Shutdown Circuit(s): The pump motor high temperature circuit shall provide terminals for connection of the leads from the temperature sensor provided in the pump motor windings. Upon a high temperature condition in the pump windings, the control power to the pump motor contactor shall be disconnected, thus stopping the pump motor. The pump shall automatically restart when the pump motor temperature returns to an acceptable level.

160.08.23 Ground Lug(s): Equipment ground lug(s) shall be provided for grounding the enclosure. The ground lug(s) shall be suitable for the service provided the enclosure and sized per table 250-95 of the NEC. In all cases, the enclosure shall be adequately grounded per article 250 of the NEC.

160.08.24 Terminals: Terminals shall be provided for connecting mercury float switch leads, temperature sensor and seal fail sensor leads. Terminal blocks shall be rated for 600 volt use and accept a wire range of #22-8. All live parts shall have insulating walls on all sides of the lug. Blocks shall be U.S. recognized.

160.08.25 Construction Standards: The sub-panel shall be drilled and tapped to accept machine thread bolts (self tapping screws are not acceptable). All control wiring shall be 16-AWG machine tool wire, Carol type 76512, or equal. All control wire shall be color coded or numbered in accordance with the standards. Power (motor) shall be in accordance with the 1984 NEC. Major groups of wires shall be contained in plastic wiring trough equal to Panduit type E.

160.08.26 Nameplates: All indicator lights, alarms, selector switches, pushbuttons and major control system components shall be identified with engraved phenolic plastic nameplates, with white lettering on a black background.

160.09 ALARM DIALERS / SCADA / TELEMETRY

160.09.01 The pump station shall be provided with an alarm dialer in a lockable NEMA 4 enclosure. The dialer shall have a 100-word vocabulary and shall be capable of creating customized messages. The operating environment shall withstand from –5 degrees Fahrenheit to 130 degrees Fahrenheit with a 90% relative humidity, non-condensing. The alarm dialer shall operate on 120 VAC, and shall have a rechargeable battery backup capable of providing 4 hours of standby power with surge protectors on the power and telephone lines. The alarm dialer shall have the capability of dialing four phone numbers, and shall work on a standard telephone service. The dialer shall be provided by a manufacturer listed in the Approved Manufacturers List. The dialer enclosure shall be equipped with a thermostatically controlled space heater when it is exposed to the weather.

160.09.02 The pump station telemetry units shall be compatible with the Town's current SCADA system. The Town shall not be required to purchase additional software to operate the telemetry unit.

160.09.03 The alarm dialer shall monitor the following conditions

160.09.03.01 High Water Conditions

160.09.03.02 Power Failure

160.09.03.03 Pump Trouble, including seal failure and high temperature signals from all pumps

160.09.03.04 Grinder Failure

160.09.04 The Town may allow a cellular dialer such as "Omni-Site" or approved equal. Dialer technology will be selected during the pre-development and design phase in consultation with the public utilities Director.

160.10 GRINDERS

160.10.01 General

160.10.01.01 A wastewater grinder shall be provided at each pump station for the intended purpose of grinding solids in the influent flow to the pump station.

160.10.01.02 The entire grinder unit and accessories necessary to provide a fully functional wastewater grinder system shall be supplied and warranted by a single manufacturer. The list of acceptable manufacturers is provided in the Approved Manufacturers List.

160.10.01.03 The wastewater grinder shall be placed in a separate manhole or other influent structure prior to the wet well, but still within the pump station site. The grinder

shall be able to be removed from the influent structure by means of a guide rail and lifting cable assembly without entering the influent structure. Another means of solids removal such as a trash basket or bar rack shall be provided for installation when the grinder unit is out of service for extended periods.

160.10.01.04 The wastewater grinder shall be hydraulically driven. The electric motor and hydraulic power unit shall be above ground in a sound attenuated weatherproof enclosure. The hydraulic hoses shall extend down to the drive unit on the grinder in the influent structure.

160.10.01.05 The wastewater grinder unit shall have a complete and separate control panel providing all settings, monitoring, and control options required, as well as the ability to send alarm signals back to the alarm dialer and telemetry system.

160.10.01.06 The equipment shall be installed as recommended by the manufacturer, and in compliance with all OSHA, local, state and federal codes and regulations.

160.10.01.07 The grinder unit power supply shall match the pump station power supply. Standard pump station power supply is 3 phase, 240 or 480 VAC.

160.10.01.08 Each unit of equipment shall be provided with a corrosion resistant substantial metal nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, manufacturer's name and location, and important performance data.

160.10.02 Quality Assurance

160.10.02.01 Quality Standards. Except where modified or supplemented by these specifications, all equipment and materials shall be designed and constructed in accordance with the latest applicable requirements of the standard specifications and codes of:

160.10.02.01.01 ASTM A536-84 - Standard Specifications for Ductile Iron Castings

160.10.02.01.02 ASTM A36 - Standard Specifications for Carbon Steel Plate

160.10.02.01.03 AISI 304 - Stainless Steel

160.10.02.01.04 AISI 4140 - Heat Treated Hexagon Steel

160.10.02.01.05 AISI 4130 - Heat Treated Alloy Steel

160.10.02.01.06 AISI 1018 - Carbon Steel

160.10.02.01.07 45-50 Rockwell C

160.10.02.01.08 National Electrical Manufacturers Association (NEMA)

160.10.02.01.09 National Electrical Code (NEC)

160.10.02.01.10 Underwriters Laboratory (UL and cUL)

160.10.02.02 Qualified manufacturers shall have a minimum of 5 years experience in the manufacturing of grinding and controlling equipment and a minimum of 20 installations at equivalent applications. Manufacturer shall submit a listing of names and dates of installations for verification by the Engineering Department.

160.10.03 Grinder System Equipment

160.10.03.01 Screen Drum

160.10.03.01.01 A horizontally rotating screen drum shall be located in the channel and shall direct all solids in the flow stream into a dual counter-rotating shaft grinder. The screen drum shall be self-cleaning and driven by the grinder drive mechanism.

160.10.03.01.02 Screen drum shall consist of a helical coil mounted to vertical supports and stub shafts. Screen shall be made of a stainless steel spiral coil drum. The coil stock diameter shall be 1/4-inch with 1/4-inch spacing. Drum support skeleton shall be constructed of Grade 304 stainless steel. The support skeleton shall include hubs for mounting of drum stub shafts. Vertical members shall provide support for the coil. Drum shafts shall be made of Grade 304 stainless steel with a tensile strength of not less than 95,000 PSI. The shaft diameter shall be a minimum of 1.5 inch.

160.10.03.01.03 Radial and axial loads of the screen shafts shall be borne by two sealed oversized deep-groove ball bearings. Bearings shall be protected by a combination of a replaceable and independent tortuous path device and end face mechanical seals. Face materials shall be a minimum of tungsten carbide to tungsten carbide, not requiring an external flush or any type of lubrication. Products requiring continuous or occasional lubrication or flushing shall not be accepted. The mechanical seal shall be rated at 90-PSI continuous duty by the seal supplier. The bearings and seals shall be housed in a replaceable cartridge that supports and aligns the bearings and seals, as well as protects the shafts and end housings. O-rings shall be made of Buna-N elastomers. Each seal face shall be locked to provide positive drive on the rotating face and a positive lock on the static face. This positive lock on the seal faces is critical to long seal life in applications where grit or other abrasive materials are present.

160.10.03.02 Grinder

160.10.03.02.01 Grinder shall be a two-shaft design, capable of continuous operation, processing wet or dry. Barminuters, comminuters, or other single shaft devices utilizing a single rotating cutter bar with stationary cutters shall not be acceptable. Grinders designed with cutter and spacer cartridges rather than individual cutters and spacers shall not be acceptable.

160.10.03.02.02 Two-shaft design shall consist of two parallel shafts alternately stacked with inter-meshing 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 the speed of the drive shaft.

160.10.03.02.03 Each grinder shall include a guide plate, frame, end housings, covers, shafts, side rails, hydraulic motor, cutters, spacers, bearings and seals.

160.10.03.02.04 The combination of the grinder and the screen shall not cause more than 5 inches of headloss, assuming a downstream head of 7 inches, when passing the peak design flow.

160.10.03.02.05 95% of the particles exiting the grinder shall be no larger than ½-inch.

160.10.03.02.06 Frame shall be made of 316 stainless steel. Frame shall be designed for channel installation and shall house the drum and grinder assembly.

160.10.03.02.07 Grinder end housings shall be A536-84 ductile iron with a cast-in-place flow deflector, designed to protect the bushings while guiding solids directly into the cutting chamber. The cutting chamber shall have a nominal height of 18 inches.

160.10.03.02.08 Top covers shall be A536-84 ductile iron and bottom covers shall be A36 hot rolled plates.

160.10.03.02.09 The grinder drive and driven shafts shall be made of AISI 4140 heat treated hexagon steel with a tensile strength rating of not less than 149,000 PSI. Each shaft hex shall be a minimum of 2 inches in width.

160.10.03.02.10 The inside profile of the side rail shall be concave to follow the radial arc of the cutters. The side rail shall be affixed to the grinder and maintain a clearance not to exceed 5/16-inch between the major diameter of the cutter and the concave arc of the side rail. This clearance shall act to direct larger particles toward the cutters to assure fineness of grind. High flow side rails shall have evenly spaced slots which increase flow and decrease head loss. Side rails shall be of ASTM A536 cast ductile iron.

160.10.03.03 Guide Plate and Frame

160.10.03.03.01 A guide plate and frame insert shall be provided by the manufacturer for inserting the grinder/screen assembly into the wet well. The insert shall allow for easy removal and replacement of the grinder/screen assembly, without fasteners.

160.10.03.03.02 The insert shall be a one piece welded fabrication specifically designed for the grinder/screen assembly and shall be made of 316 stainless steel. The insert shall be anchored to the wet well/manhole with stainless steel anchor bolts.

160.10.03.03.03 The screen/grinder assembly shall be provided with suitable lifting eyes (at least two) sized to support the assembly during insertion/removal in the frame.

160.10.03.04 An overflow bar screen shall be provided, fully coordinated with the guide plate and frame assembly. The overflow bar screen shall be constructed entirely of

316 stainless steel. Bars shall be 1/2-inch diameter with 2-inch clear spacing between the bars. The bar screen shall be constructed such that any flow not passing through the grinder unit due to malfunction or exceptionally high flows shall pass through the bar screen. The bar screen shall extend three feet above the top of the rotating screen/grinder assembly. The bar screen shall not interfere with the removal and replacement of the rotating screen/grinder assembly from the wet well. No pathway for solids larger than the bar spacing to pass the assembly shall be permitted with the screen/grinder unit and bar screen in place.

160.10.03.05 The required running torque per horsepower shall be minimum 1,500 inch-pound continuously and 2,350 inch-pound at momentary load peaks.

160.10.03.06 Cutters and Spacers

160.10.03.06.01 The inside configuration of cutters and spacers shall be hexagonal so as to fit the shafts with a total clearance not to exceed 0.015-inches across the flats to assure positive drive and increase the compressive strength of the spacers.

160.10.03.06.02 Cutters and spacers shall be AISI 4130 heat treated alloy steel, surface ground for uniformity and through-hardened to a minimum 45-50 Rockwell C.

160.10.03.06.03 Cutter configuration shall consist of both shafts with 11-tooth cam cutters. To maintain particle size, the height of the tooth shall not exceed ½-inch above the root diameter. Cutter root diameter overlap shall not be less than 1/16-inch or greater than 1/4-inch to maintain the best possible cutting efficiency while incurring the least amount of frictional losses.

160.10.03.06.04 The cutter shall exert a minimum force of 650 pounds per horsepower continuously and 960 pounds per horsepower at momentary peaks loads at the tooth tip.

160.10.03.07 The radial and axial loads of the cutter shafts shall be borne by four sealed oversized deep grooved ball bearings. The bearings shall be protected by a combination of a replaceable and independent tortuous path device and end face mechanical seals. Face materials shall be a minimum of tungsten carbide to tungsten carbide not requiring an external flush or any lubrication. The mechanical seal shall be rated at 90 PSI continuous duty. The bearings and seals shall be housed in a replaceable cartridge that supports and aligns the bearings and seals as well as protects the shafts and end housings. O-rings shall be made of Buna-N elastomers. Products requiring continuous or occasional lubrication or flushing shall not be acceptable.

160.10.03.08 Hydraulic Power Unit

160.10.03.08.01 The hydraulic power pack shall include the following:

160.10.03.08.01.01 16-inch x 16-inch x 15-inch, epoxy coated, 10 gallon (US) capacity reservoir

160.10.03.08.01.02 Positive displacement pump driven by a 5 horsepower TEFC, C-face, electric motor

160.10.03.08.01.03 Combination oil level and oil temperature gauge

160.10.03.08.01.04 10-micron return line oil filter

160.10.03.08.01.05 Oil temperature limit switch set at 160 degrees Fahrenheit

160.10.03.08.01.06 Oil level switch

160.10.03.08.01.07 Filler breather

160.10.03.08.01.08 Pressure switch preset at 2,850 PSI

160.10.03.08.01.09 120 VAC 4-way solenoid valve

160.10.03.08.01.10 Relief valve preset at 3,000 PSI

160.10.03.08.01.11 2½-inch, 0-3,000 PSI oil filled gauge

160.10.03.08.01.12 Suction strainer

160.10.03.08.01.13 Flexible hose rated for a minimum 3,500 PSI working pressure, length as required per plans.

160.10.03.08.02 The hydraulic power unit shall be rain resistant, suitable for outdoor installation, located as shown on the drawings. The unit shall be installed in accordance with the manufacturer's recommendations.

160.10.03.08.03 The entire hydraulic system shall be designed for 3,000 PSI maximum pressure. At idle load conditions, the system operating pressure shall be in the 200 to 400 PSI range. Continuous operating pressure above 2,000 PSI is not acceptable. As solids are encountered, pressure shall be automatically increased on a demand basis to provide the required torque necessary to continue rotation of the cutters. Should the grinder demand pressure in excess of 2,850 PSI, a pressure switch shall instantly activate and a 4-way valve be shifted. The rotation of the cutters shall instantly reverse for about one-half (½) to one (1) revolution or about ½-second. At the end of this time, the valve shall again be shifted and the cutters return to the forward direction.

160.10.03.08.04 If the obstruction has been cleared, the unit shall continue to operate in the forward direction. If the obstruction has not cleared, the reversing sequence shall repeat until the torque requirement is reduced or until it has had to repeat the reversing cycle nine (9) times within a 45-second time span. If nine (9) reversals have occurred within 45 seconds, the controller shall shut down the hydraulic unit and activate an overload relay and illuminate an indicating light.

160.10.03.08.05 Hydraulic connections between the torque motor and the power pack shall consist of two ½-inch flexible hoses rated for 3,500 PSI each. The

manufacturer shall supply sufficient length of hydraulic hose to accommodate location of the power pack and hydraulic drive motor as shown on the drawings.

160.10.03.08.06 Upon completion of installation, the hydraulic power unit shall be filled with a high quality fluid with a viscosity of approximately 100 to 250 SSU at 100 degrees Fahrenheit, with good chemical stability and anti-foaming properties. The grades of hydraulic fluid shall be in accordance with the manufacturer's recommendations.

160.10.03.09 Enclosure: A fiberglass enclosure shall be provided to completely cover the hydraulic power pack and motor. The enclosure cover shall be of one-piece FRP construction, mounting on a one-piece FRP flanged base. The enclosure cover shall be hinged on one side with a spring-loaded hook on the opposite side. The entire hydraulic power pack shall be exposed when the cover is opened. Hinges and hook assemblies shall be stainless steel. The enclosure base shall be secured to the concrete slab with stainless steel anchor bolts. An adjustable polypropylene weather proof vent shall be provided on the top side of the enclosure to prevent heat buildup and trapped vapors. A thermostatically controlled exhaust fan with FRP weather hood shall be provided. The exhaust fan shall be powered from the control panel. Finished exterior surface shall be white polyester gelcoat with UV inhibitor. The enclosure shall be provided with dual purpose acoustical foam unless otherwise directed by the Director of Engineering.

160.10.03.10 Electric Motors.

160.10.03.10.01 Electric motors for the grinder shall be suitable for the intended service. Typical motor sizing is 5 horsepower, 60 Hertz, 240 or 480 VAC. All motors shall be NEMA Design "B" and TEFC.

160.10.03.10.02 The motor shall be Baldor, Reliance, U.S. Motor, or equal.

160.10.03.11 System Controls.

160.10.03.11.01 Each grinder system shall be provided with a single control panel suitable for mounting on an electrical rack or building wall. The control panel shall include all power and control circuits to provide the functional requirements specified herein.

160.10.03.11.02 A programmable controller shall be included in the panel. Upon the grinder encountering a jam or overload condition, the controller shall stop the grinder and screen and reverse their direction of rotation to clear the obstruction. If the jam is cleared, the controller shall return to normal operation. If the jam condition persists, the controller shall repeat the reversing cycle up to eight additional times within 45 seconds (total of nine cycles) before signaling a grinder overload condition. Upon a grinder overload condition, the controller shall shut down the grinder and screen and activate an overload contact.

160.10.03.11.03 If a power failure occurs while the grinder is running, the grinder shall resume running when power is restored. A 0-60 second adjustable time delay device shall be included in the control panel to select time delay until restart after power restoration. If the grinder is stopped due to an overload condition and

a power failure occurs, the overload indicator shall reactivate when power is restored.

160.10.03.11.04 The control panel shall provide overcurrent protection. The overload relay shall be adjustable so that the range selected includes the FLA rating and service factor.

160.10.03.11.05 The control panel shall be equipped with a Hand-Off/Reset-Auto (HOA) selector switch. In the Off/Reset position, the motor shall not run. In the Hand position, the motor shall run continuously. In the Auto position, the grinder shall stop and start by remote control signal. The control panel shall include dry contacts for future addition by others of a remote maintained contact start/stop control signal when in Auto mode. The control panel shall not allow remote resetting of overload condition. Overload reset shall be accomplished by switching the HOA switch to the Off/Remote position.

160.10.03.11.06 The oil temperature limit switch, oil level switch, pressure switch and 4-way solenoid valve shall all be pre-wired to a single, manufacturer-provided, NEMA 4X junction box on the power pack. Terminals shall be provided in the control panel and in the power pack-mounted junction box for field wiring between these devices and the control panel. Terminals shall also be provided in the control panel and in the junction box for field wiring between the control panel and the hydraulic power pack motor.

160.10.03.11.07 The controller shall indicate each of the following statuses with an indicator light on the panel face:

160.10.03.11.07.01 Power On

160.10.03.11.07.02 Run

160.10.03.11.07.03 Grinder Overload

160.10.03.11.07.04 Motor Overload

160.10.03.11.07.05 Oil Overtemperature

160.10.03.11.07.06 Low Oil Level

160.10.03.11.08 Engraved phenolic laminate plastic identification nameplates, with white letters on black background, shall be provided for each switch, indicator light, gauge, etc. on the control panel and in the system.

160.10.03.11.09 The controller shall be rated at 208/230/460 VAC, 3 phase, 60 Hertz.

160.10.03.11.10 A single enclosure shall house all power and control devices, relays, terminal blocks and motor starter. Control and indicating devices shall be mounted in the front of the enclosure. Indicating lights shall be integral transformer type with low voltage long life 6-volt lamps. Lamps and selector switches shall be heavy duty type. The control panel and all control devices shall

be NEMA 4X. Enclosure shall be NEMA 4X stainless steel, equipped with full hinged door, suitable for exterior mounting as shown on the drawings.

160.10.03.11.11 A lockable disconnect switch shall be provided on the outside of the control panel to disconnect power to the entire grinder system.

160.10.03.11.12 One set of normally open (NO) contacts shall be provided in the control panel for remote indication of each of grinder "fail" and grinder "run" status. Grinder overload, motor overload, oil overtemperature, low oil level, and oil pressure alarms shall be ganged together to a common grinder "fail" alarm. The control panel shall provide 120 VAC power to these alarm circuits for remote indication at an existing alarm dialer system.

160.10.03.11.13 Contacts shall be provided for a future remote maintained contact emergency stop pushbutton, to be provided by others. These contacts shall be jumpered.

160.10.03.11.14 Motor starter shall be full voltage type with 120-volt operating coil and captive terminal screws. Overload relay shall be mounted directly to the contactor. The relay shall be sized to the motor full load amperage (FLA).

160.10.03.12 Spare Parts: The following spare parts shall be provided for each grinder as a minimum:

160.10.03.12.01 Three (3) of each type of fuse found in the system

160.10.03.12.02 Three (3) of each type of lamp bulb found in the system

160.10.03.12.03 One (1) complete set of gaskets

160.10.03.12.04 Three (3) cutters

160.10.03.12.05 Three (3) Spacers

160.10.03.13 The motor controller shall have sufficient space within its enclosure for the storage of motor controller spare parts. Grinder spare parts shall be packaged in suitable containers for long term storage and shall bear labels clearly designating the contents of each package and the equipment for which they are intended.

160.11 GENERATORS

160.11.01 General

160.11.01.01 Backup power shall be provided by an automatically starting on-site generator controlled by an automatic transfer switch. The generator shall be capable of supplying all necessary electrical power for complete operation of the pump station in the event of a failure of the electrical feed supplied by the local grid.

160.11.01.02 The entire generator set, switchgear, and accessories necessary to provide a fully functional backup power system, shall be supplied and warranted by a

single manufacturer. The list of acceptable manufacturers is provided in the Approved Manufacturers List.

160.11.01.03 Each engine-generator unit shall be new and a standard product of the manufacturer and shall be a packaged type unit, fully shop assembled, wired and tested, requiring no field assembly of critical moving parts.

160.11.01.04 The generator shall be sized to start and continuously run all pumps, motors, and other electrical equipment at the pump station site. The pump starting conditions (including delay timers, VFDs, soft starts, reduced voltage starters, etc.) shall be verified for the particular site. The kW rating needed for a particular pump station shall be calculated by a Design Professional or by the generator manufacturer.

160.11.01.05 The voltage, amps, phase, etc., shall be coordinated with the design of the electrical equipment for the particular site. In general, most generators shall be 3 phase, 60 hertz, and 240 or 480 VAC.

160.11.01.06 The engine generator set shall have a complete and separate control panel mounted inside the generator enclosure providing all settings, monitoring, and control options required, as well as the ability to send alarm signals back to the alarm dialer and telemetry system.

160.11.01.07 Each unit of equipment shall be provided with a corrosion resistant substantial metal nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, manufacturer's name and location, and important performance data.

160.11.02 Quality Control

160.11.02.01 Quality Standards. Except where modified or supplemented by these specifications, all equipment and materials shall be designed and constructed in accordance with the latest applicable requirements of the standard specifications and codes of ANSI, ASTM, NEMA, IEEE, DEMA, EEI, HEI, ISO, NFPA, SAE, NEC, UL508, and other such regularly published and accepted standards as well as state and local codes.

160.11.03 Generator Equipment

160.11.03.01 Engine.

160.11.03.01.01 Engine shall be compression ignition type diesel powered, 4 stroke, 6-cylinder, liquid cooled, with a minimum of 130 horsepower, or equal. Alternative fuel types may be accepted upon prior approval of the Director of Engineering and Public Utilities Director.

160.11.03.01.02 Engine shall operate at an RPM of no more than 1800.

160.11.03.01.03 The engine shall be equipped with an electronic governor to maintain 4% drop from no load to full load and +/-0.25% steady state. The electronic governor control shall be furnished as a complete governor and control package.

160.11.03.01.04 Engine shall have a dry type air cleaner, coolant, fuel filters, and oil filters with replaceable elements.

160.11.03.01.05 Engine shall have a lube oil cooler and a fuel lift pump.

160.11.03.02 Generator

160.11.03.02.01 The synchronous generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel.

160.11.03.02.02 Voltage regulation shall be within +/-0.5% at steady state from no load to full load. The momentary voltage drop shall not exceed the specified percent without starter coils dropping out or stalling the engine at any time when applying or starting the specified loads. Recovery to stable operation shall occur within 2 seconds. Unit shall be capable of adjusting voltage under varying load conditions within 16 milliseconds.

160.11.03.02.03 The voltage regulator shall be a totally solid state design, and include electronic voltage buildup, volts per hertz regulation, overexcitation protection, shall limit voltage overshoot on startup, and shall be environmentally sealed.

160.11.03.02.04 The insulation material shall meet NEMA standards for Class H insulation and be fungus resistant.

160.11.03.02.05 The generator shall be a self-excited generator type. The excitation system shall be of brushless construction.

160.11.03.02.06 The generator shall be supplied with a 240 VAC single phase anti-condensation heater protected by a fuse inside the main control panel. When the generator set is not running the heater is automatically connected to the pump station electrical power supply through a power relay mounted in the control panel. Upon receiving a start signal the pump station electrical power supply is automatically disconnected by the power relay and automatically reconnected when the start signal is removed and the engine has stopped.

160.11.03.03 Fuel System

160.11.03.03.01 Each engine-generator unit shall be furnished with a complete fuel system, including an integral fuel tank, fuel filter, fuel shut off valve, and all accessories as required for proper operation. All items shall be suitable for the specified fuel and located inside the enclosure above the base plate and serviceable from inside the enclosure.

160.11.03.03.02 The fuel tank shall have the capacity to provide fuel for a minimum run time of 12 continuous hours at 100% prime load.

160.11.03.03.03 The fuel tank shall be double walled with a rupture basin of 110% capacity. It shall be pressure tested for leaks prior to shipment and have all necessary venting per US142 standards. A locking fill cap, a mechanical reading

fuel level gage, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided.

160.11.03.03.04 The contractor is responsible for providing enough fuel for testing and start-up. The fuel tank shall be filled prior to final acceptance by the Town.

160.11.03.04 Lubrication

160.11.03.04.01 Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

160.11.03.04.02 Lubricants shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment. Unless otherwise specified or permitted, the use of synthetic lubricants shall not be acceptable.

160.11.03.04.03 Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

160.11.03.05 Exhaust System

160.11.03.05.01 Each engine-generator unit shall be furnished with a complete exhaust system including an exhaust silencer, exhaust piping, expansion joints, and accessories as required for a complete operating system.

160.11.03.05.02 A raincap shall be provided to prevent rain from entering the exhaust pipe. The rain cap shall open from exhaust pressure from the engine and shall close when exhaust flow stops. The cap shall be stainless steel counter-balancing with vertical discharge.

160.11.03.06 Starting System

160.11.03.06.01 Each engine-generator unit shall be furnished with a complete electric motor start system including starting motors, battery pack with rack, cables, and battery charger.

160.11.03.06.02 The engine starter shall be a 12-volt DC, solenoid shaft, electric starting system with positive engagement.

160.11.03.06.03 The batteries shall be of the high rate, diesel starting, lead acid type. The batteries shall be sized for five 10 second cranks with battery and engine oil temperature of 30 degrees Fahrenheit and a battery end voltage of 70 percent of system voltage.

160.11.03.06.04 The battery charger shall be current limiting and shall be furnished to automatically recharge the batteries. The charger shall be dual charge rate with

automatic switching to the boost rate when required. Output voltage regulation shall not exceed 1%. The charger shall include temperature compensation, NEMA 2 corrosion resistant enclosure, overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input, on/off switch, remote annunciation of loss of AC power, low battery voltage, and high battery voltage, AC input and DC output circuit breakers or fuses, floating voltage equalization, equalizing timer. AC input voltage shall be 240 V, single phase.

160.11.03.06.05 The battery charger shall have a DC output suitable to supply power for all continuous loads and to recharge the batteries from a full discharge state to normal operating voltage within 8 hours.

160.11.03.06.06 The batteries, battery rack, and battery charger shall be located within the engine-generator enclosure. The battery rack frame shall be constructed of corrosion resistant material.

160.11.03.06.07 The engine-generator shall automatically supply power to the battery charger when it is operating and utility power is not available.

160.11.03.07 Cooling System.

160.11.03.07.01 Each engine-generator unit shall be cooled with unit-mounted radiator cooling system complete with radiator, expansion tank, water pump, belt-driven fan, fan guard, thermostatic temperature control, high-water temperature cutout, and all accessories as required for proper operation. The radiator shall be sized to provide sufficient capacity for cooling of the engine and all other accessories required for proper operation at an ambient temperature of 125 degrees Fahrenheit and taking into account the enclosure static pressure restriction. The fan shall draw air over the engine and discharge through the radiator.

160.11.03.07.02 The cooling system shall be filled with a permanent antifreeze mixture of the ethylene glycol type with rust inhibitor.

160.11.03.07.03 The engine generator unit shall have a 240 VAC coolant heater protected by a safeguard breaker inside the main control panel. A thermoplastic controller is included to regulate the output temperature to within safe limits. When the generator set is not running the heater is automatically connected to the pump station electrical power supply trough a power relay mounted in the control panel. Upon receiving a start signal the pump station electrical power supply is automatically disconnected by the power relay and automatically reconnected when the start signal is removed and the engine has stopped.

160.11.03.08 Enclosure.

160.11.03.08.01 The engine-generator unit, fuel system, control panel, battery rack, battery charger, power panel, exhaust silencer, and other ancillary equipment, shall be housed in a weatherproof enclosure, of the non-walk-in type.

160.11.03.08.02 The enclosure shall consist of a roof, side walls, and end walls, and shall be weatherproof and sufficiently sealed to prevent the entry of rodents.

160.11.03.08.03 The enclosure shall be constructed of 12-gage or heavier metal panels that can be easily removed.

160.11.03.08.04 Doors shall be lockable with stainless steel hardware for access to the engine-generator, controls, and accessories. Doors shall also provide easy accessibility for maintenance. Doors shall have lock arm to prevent swinging when open.

160.11.03.08.05 The enclosure shall be "Sound Attenuated and Weatherproof" providing a maximum of 80 dBA at 50 feet when running at full load unless otherwise directed by the Director of Engineering.

160.11.03.08.06 The enclosure shall be provided pre-wired, requiring only external connection to the power panel.

160.11.03.08.07 Lube oil and coolant drains shall be extended to the exterior of the enclosure and terminated with drain valves.

160.11.03.08.08 All moving parts inside of enclosure, including cooling fan and charging alternator, shall be fully guarded to prevent injury.

160.11.03.08.09 Lifting points shall be provided on the base frame suitable for lifting the combined weight of the base tank, engine generator unit, and enclosure.

160.11.03.08.10 A floodlight shall be provided inside the enclosure to illuminate the generator equipment located within the interior of the enclosure. The floodlight shall be provided with a switch mounted on the generator control panel.

160.11.03.09 Control System.

160.11.03.09.01 Provide a generator set mounted control panel for complete control and monitoring of the engine and generator set functions. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged door secured with a twist lock latch. The panel door shall have a voltage shunt switch. The panel itself shall be mounted on a separate support stand which shall be mounted inside the enclosure such that the face of the panel faces outward and is isolated from vibrations of the engine/generator arrangement. Panel/breaker arrangements shall be mounted in such a manner as to not restrict access to the generator, engine, or other parts of the system that need periodic maintenance or repair.

160.11.03.09.02 The control panel shall be automatic and safety type and shall include at least all items required by NFPS 110 Level 1.

160.11.03.09.03 Panel shall include the following instrumentation and controls (at a minimum): voltmeter, ammeter, frequency/tachometer, engine running hours, coolant temperature gauge, lube oil pressure gauge, battery condition voltmeter,

run/off/auto switch, emergency stop pushbutton, lamp test pushbutton, 7 position voltmeter phase selector switch, 4 position ammeter phase selector switch, 3 attempt start timer, and cooldown timer.

160.11.03.09.04 Panel shall include the following emergency shutdowns with individual warning lamps (at a minimum): fail to start, high coolant temperature, low lube oil pressure, and overspeed.

160.11.03.09.05 Panel shall include the following alarms with individual warning lamps (at a minimum): approaching low oil pressure, approaching high engine temperature, low/high battery voltage, battery charger failure, control switch not in auto mode.

160.11.03.09.06 Panel shall have at least 2 spare shutdown channels and 1 spare alarm channel and 4 additional fault channels for shutdown or alarm programming.

160.11.03.09.07 Panel shall have the ability to send up to 8 channels back to the existing SCADA system at the pump station.

160.11.03.09.08 Engine generator unit shall be provided with a fuel level gauge indicating relative fuel tank level in percent values.

160.11.03.09.09 The panel shall be provided with a switched light that illuminates the panel face.

160.11.03.10 Circuit Breaker. Provide a generator mounted, molded case or insulated case construction, UL rated, 3 pole, circuit breaker, sized as required. Breaker shall utilize a thermal magnetic trip. Breaker shall be housed in a steel NEMA 1 enclosure mounted on a separate support stand vibration isolated from the engine/generator arrangement. Bus bars, sized for the cable type shown on drawing, shall be supplied on the load side of breaker.

160.11.03.11 Receptacles. The engine generator shall be supplied with two 120 VAC, 15 amp duplex receptacles and two 120 VAC, 20 amp twist lock receptacles. Receptacles shall have individual circuit breakers, and shall be placed inside the enclosure or shall have weatherproof covers.

160.11.03.12 Shop Painting.

160.11.03.12.01 All steel and iron surfaces shall be protected by suitable coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, engine, alternator, enclosure, piping, and valves shall be shop primed and finish painted prior to shipment to the site.

160.11.03.12.02 Stainless steel, nonferrous, and nonmetallic surfaces shall not be painted.

160.11.03.13 Power Transformer. An externally mounted power transformer shall be supplied to provide required 240 VAC single phase power to the coolant heater and anti-condensation heater for each engine generator unit. The amp load shall be calculated by a Design Professional or the generator manufacturer.

160.12 AUTOMATIC TRANSFER SWITCHES

160.12.01 An automatic transfer switch (ATS) shall be provided on all pump stations for switching power to the onsite backup generator when normal grid power fails. The ATS shall be provided by the same manufacturer as the generator, and included under the same warranty as the generator.

160.12.02 General

160.12.02.01 The ATS shall be rated for the voltage and ampacity as shown on the plans and shall have 600 volt insulation on all parts in accordance with NEMA standards.

160.12.02.02 The current rating shall be a continuous rating when the switch is installed in an unventilated enclosure, and shall conform to NEMA temperature rise standards. Designs which require cabinet ventilation are unacceptable and do not meet this specification.

160.12.02.03 The unit shall be rated based on all classes of loads, i.e., resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less shall be UL listed for 100% tungsten lamp load.

160.12.02.04 As a precondition for approval, all transfer switches complete with accessories shall be listed by Underwriters Laboratories, under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems.

160.12.02.05 The withstand current capacity of the main contacts shall not be less than 20 times the continuous duty rating when coordinated with any molded case circuit breaker established by certified test data. Refer to required withstand and close ratings as shown in Table 160.01.

160.12.02.06 Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.

160.12.02.07 Transfer switches shall comply with the applicable standards of UL, CSA, ANSI, NFPA, IEEE, NEMA, and IEC.

160.12.02.08 The transfer switches shall be supplied with a microprocessor based control panel as detailed further in these specifications.

160.12.02.09 The transfer switch shall be capable of detecting if the source switch was successful and if the pump station is receiving power. It shall also be capable of transmitting a failure signal if it was not successful in switching sources and the pump station is not receiving power.

160.12.03 Sequence of Operation

160.12.03.01 The ATS shall incorporate adjustable three phase under-voltage sensing of the normal source.

160.12.03.02 When the voltage of any phase of the normal source is reduced to 80% of nominal voltage, for a period of 0-10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.

160.12.03.03 The ATS shall incorporate adjustable single phase under-voltage sensing of the emergency source.

160.12.03.04 When the emergency source has reached a voltage value within 10% of nominal voltage and achieved frequency within 5% of the rated value, the load shall be transferred to the emergency source after a programmable time delay.

160.12.03.05 When the normal source has been restored to not less than 90% of rated voltage on all phases, the load shall be re-transferred to the normal source after a time delay of 0-30 minutes (programmable). The generator shall run unloaded for 5 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.

160.12.03.06 If the engine generator should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.

160.12.03.07 The transfer switch shall be equipped with a microprocessor based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability.

160.12.03.08 The front panel display shall include indicators for timing functions, capability to bypass the time delay on transfer or retransfer, an ATS test switch, and afford on-board diagnostic capability.

160.12.03.09 The control panel shall be provided with calibrated pots (accessible only by first opening the lockable cabinet door) to set time delays, voltage and frequency sensors. Designs which make use of DIP switches to render such adjustments are not acceptable. The ATS shall be capable of being adjusted while the controls are energized and the unit in automatic mode. Designs which force a "programming mode" or require the controls be de-energized during adjustment are unacceptable.

160.12.03.10 The control panel shall be opto-isolated from its inputs to reduce susceptibility to electrical noise and provided with the following inherent control functions and capabilities:

160.12.03.10.01 An LED display for continuous monitoring of the ATS functions.

160.12.03.10.02 Built-in diagnostic display.

160.12.03.10.03 Capability to support external communication and network interface through an optional RS 485 port.

160.12.03.10.04 Mechanical test switch to simulate a normal source failure.

160.12.03.10.05 Time delay to override momentary normal source failure prior to engine start. Field programmable 0-10 seconds (continuously adjustable via a calibrated potentiometer factory set at 3 seconds).

160.12.03.10.06 Time delay on retransfer to normal source, continuously adjustable 0-30 minutes, factory set at 30 minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.

160.12.03.10.07 Time delay on transfer to emergency, continuously adjustable 0-15 seconds, factory set at 1 second.

160.12.03.10.08 An in-phase monitor shall be provided. The monitor shall compare the phase angle difference between the normal and emergency sources and be programmed to anticipate the zero crossing point to minimize switching transients.

160.12.03.10.09 An interval-type automatic clock exerciser shall be incorporated within the microprocessor.

160.12.03.10.10 Provide a momentary pushbutton to bypass the time delays on transfer and retransfer.

160.12.04 Construction and Performance

160.12.04.01 The automatic transfer switch shall be of double throw construction operated by a reliable electrical mechanism momentarily energized. There shall be a direct mechanical coupling to facilitate transfer in 6 cycles or less.

160.12.04.02 The normal and emergency contacts shall be mechanically interlocked such that failure of any coil or disarrangement of any part shall not permit a neutral position.

160.12.04.03 For switches installed in systems having ground fault protective devices, and/or wired so as to be designated a separately derived system by the NEC, a 4th pole shall be provided. This additional pole shall isolate the normal and emergency neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability are not acceptable.

160.12.04.04 The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400 Amps.

160.12.04.05 The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Minimum UL listed withstand and close into fault ratings shall be as shown in Table 160.01.

160.12.04.06 A dielectric test at the conclusion of the withstand and closing tests shall be performed.

160.12.04.07 The automatic transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at 0.50 power factor. This certification is to ensure that there shall be no current flow between the two isolated sources during switching.

160.12.04.08 All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.

160.12.04.09 Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.

160.12.04.10 A manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection, or manual operation.

160.12.04.11 The switch shall be mounted in a NEMA 3R enclosure unless otherwise indicated on the plans.

160.12.04.12 Switches composed of molded case breakers, contactors or components thereof not specifically designed as an automatic transfer switch shall not be acceptable.

160.13 ODOR CONTROL / CHEMICAL FACILITIES

160.13.01 Odor control measures shall be evaluated for all possible sources of odor related to wastewater pumping systems. Source locations to be analyzed shall include, but not be limited to, the wet well at the pump station, the force main discharge location, and force main air release valves. Odor control measures to be analyzed shall include, but not be limited to, oxidizing agent added to the wastewater, odor masking agents added to the air, activated carbon treatment, biofilter treatment, and wet scrubber treatment. Final determination of the need and type of appropriate odor control measures shall be made by the Director of Engineering and Public Utilities Director.

160.13.02 Solutions that include chemical feed shall consider the feasibility of chemical delivery to the site, provide appropriate chemical storage facilities including secondary containment, and shall incorporate chemical feed systems as listed in the Approved Manufacturers List.

160.13.03 Odor control facilities not located on the pump station site (air release valves and discharge points for instance) shall be constructed in underground vaults outside of the roadway; or if necessary to be above ground, shall be housed inside a structure. Appropriate consideration shall be given to changing media or supplying chemical at the remote locations, as well as the safety of the maintenance staff while servicing the systems.

160.14 FORCE MAINS

160.14.01 Design

160.14.01.01 Force mains shall be installed in dedicated public ROW or in dedicated utility easements.

160.14.01.02 Force mains smaller than 4 inches in diameter shall be PVC, while force mains 4 inches or larger shall be PVC or epoxy coated DIP as specified in Section 100. HDPE is also allowable with approval from the Director of Engineering.

160.14.01.03 PVC pipe for force mains with a diameter of 3 inches or less shall be a minimum of SDR21 or Schedule 40 in accordance with ASTM D1785.

160.14.01.04 PVC pipe greater than 3” diameter shall meet the requirements of AWWA C900, minimum DR 18 with integral bell with strength equal to the pipe wall, cast iron O.D., 18-foot length, with a solid elastomeric ring.

160.14.01.05 Force mains shall be installed with a minimum cover of 4 feet measured from the top of the pipe to the finished subgrade. Where force mains are proposed along roadways which will be widened in the future, the depth of cover shall be increased to provide a minimum of 4-feet of cover after the future widening.

160.14.01.06 Sewage combination air valves shall be installed at all the high points where the difference between high and low points is greater than 5 feet, and the distance between sewage combination air valves shall not exceed 3000 feet.

160.14.01.07 A plug valve shall be installed every 3000 feet of force main length, unless otherwise directed by the Director of Engineering.

160.14.01.08 All air release valves, plug valves, or other fittings or appurtenances that have moving or operating parts and require maintenance and routine access shall have a manhole placed over them or over the operating portion of the device, or a valve box, as directed by the Director of Engineering.

160.14.01.09 Force mains shall discharge at the invert of the receiving manhole and shall be as close as possible to 180 degrees from the outlet pipe.

160.14.01.10 All manholes installed along a force main and the discharge manhole shall be installed according to Section 100 and coated with an approved epoxy coating.

160.14.01.11 Refer to Section 100 for more details on easements, separation distances, bedding requirements, installation requirements, etc.

160.14.02 Valves and Appurtenances

160.14.02.01 Check Valve: Check valves shall be iron bodied, fully bronze mounted with bronze clapper disc and bronze seat ring, and shall have a spring loaded lever arm capable of being mounted on either side of the valve.

160.14.02.02 Plug Valve: Plug valves shall be eccentric action and resilient plug facing with heavy duty stainless steel bearings and welded-in corrosion resistant nickel seat. Force main plug valves shall provide clean passage for a solid sphere of at least 67% of the adjoining pipe diameter to facilitate pigging of the force main. Force main plug valves shall be "full-port" cross-sectional area perpendicular to the flow of at least 100% of the adjoining pipe.

160.14.02.03 Air Release Valve/Vacuum Breaker: The valve shall be sized by a Design Professional and approved by the Town. Information on the manufacturer's recommended sizing, along with the Design Professional's recommendation, shall be submitted to the Director of Engineering for review when applying for approval of the sizing. Combination air valves shall be of the single housing style that combines the operation of both an air/vacuum and air release valve. The valve shall have a minimum 2-inch NPT inlet and 150 PSI working pressure. The air release valve shall be supplied by a manufacturer listed on the Approved Manufacturer's List. The valve shall meet the requirements of AWWA C512. Assembly shall be housed in a flat top manhole per Detail 160.03.

160.15 TESTING AND INSPECTIONS

160.15.01 Inspections

160.15.01.01 All materials and equipment used in the construction of wastewater pumping systems shall be verified for compliance with the specifications by the Construction Inspector prior to installation. Non-conforming materials or equipment shall be immediately removed from the job site.

160.15.01.02 Compliance with plans and specifications shall be verified on a regular basis by the Construction Inspector.

160.15.02 Testing

160.15.02.01 General

160.15.02.01.01 The Contractor shall furnish all materials, labor, and equipment to perform all testing. Water for testing purposes may be obtained from the Town. The Contractor shall reimburse the Town for all water used at normal Utility Rates.

160.15.02.01.02 All water or wastewater used during testing of the pump station, force main, or any of the systems described in this section, shall be returned to the Town sanitary sewer system after proper coordination with the Public Utility Director.

160.15.02.01.03 Before the operational tests are conducted, the required copies of the Operation and Maintenance Manuals shall be delivered to the Town.

160.15.02.01.04 The Town reserves the right to require further testing, as necessary, to assure that all components and infrastructure are performing in accordance with the manufacturer recommendations and Town specifications. All testing, repairs and/or readjustments, and necessary re-testing, shall be at the expense of the Owner/Developer.

160.15.02.01.05 All on-site testing and/or installation verification shall be performed in the presence of the Construction Inspector, Public Utilities Director, and Pump Station Mechanic, as well as any other personnel the Town determines should be present.

160.15.02.01.06 All testing, installation verification, and training, shall be performed in the presence of, or by, an experienced, competent, and authorized manufacturer's representative.

160.15.02.01.07 Factory testing shall consist of testing all operating functions of the equipment under varying operating conditions to assure that it shall perform as specified. Any specific testing that may be required is discussed under the individual equipment items below. Results of factory testing shall be presented to the Town prior to delivery of the equipment.

160.15.02.01.08 Installation Verification shall consist of a visit to the site by a manufacturer's representative to inspect, check, adjust if necessary, and approve the equipment installation. The manufacturer's representative shall certify that the equipment has been properly installed and lubricated, is in accurate alignment, and is free from any undue stress imposed by connecting piping or anchor bolts. Any specific verification requirements are discussed under the individual equipment items below. Results of the installation verification shall be presented to the Town prior to start-up of the equipment.

160.15.02.01.09 On-site testing shall consist of all manual and automatic operating functions under various operating conditions, including full load conditions. The equipment shall also be tested under adverse or emergency conditions. All alarms and remote signals shall also be tested. Any specific testing that may be required is discussed under the individual equipment items below. Results of the on-site testing shall be presented to the Town prior to final acceptance of the project.

160.15.02.01.10 All functions and systems of the pump station, even those not specifically listed below, shall be tested to ensure proper operation under normal and emergency situations.

160.15.02.01.11 All defective equipment or malfunctioning systems shall be replaced or corrected, and the full system placed in a fully operational condition to the satisfaction of the Construction Inspector and Public Utilities Director.

160.15.02.01.12 Results of all factory testing, installation certifications, and on-site operational testing shall be provided to the Town in the final construction documents as described in the Submittals portion of this specification section.

160.15.02.02 Pump Testing

160.15.02.02.01 Each pump shall be tested at the factory for capacity, power requirements, and efficiency at specified rated head, shutoff head, operating head extremes, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall conform to the requirements and recommendations of the Hydraulic Institute Standards. Acceptance testing shall be Level A, with no minus tolerance or margin allowed. The test result report shall include data and test information as stipulated in the Hydraulic Institute Standards, copies of the test log originals, test reading to curve conversion equations, and certified performance curves. The curves shall include head, brake-horsepower (brake kW), pump efficiency, and shop test NPSH available, plotted against capacity. The curves shall be easily read and plotted to scales consistent with performance requirements. All test points shall be clearly shown.

160.15.02.02.02 All pumps shall receive installation verification.

160.15.02.02.03 On-site testing shall be performed to the maximum extent possible.

160.15.02.03 Grinder Testing

160.15.02.03.01 Each grinder unit shall be factory tested.

160.15.02.03.02 Each grinder unit shall receive installation verification.

160.15.02.03.03 Each grinder unit shall receive on-site testing.

160.15.02.04 Generator Testing

160.15.02.04.01 Each engine-generator set shall be fully assembled with its control panel and factory tested to demonstrate that the equipment conforms to specified requirements for load capacity. The tests shall consist of repeated starts and stops operation under a load bank at specified capacity for a minimum of 4 continuous hours, and tests to demonstrate that each safety shutdown device is working properly.

160.15.02.04.02 Each engine-generator set shall receive installation verification.

160.15.02.04.03 Each engine-generator set shall receive on-site testing to demonstrate that the equipment conforms to specified requirements for load capacity, and starting duty. The complete system (engine, generator, control panel, and automatic transfer switch) shall be field tested together by the manufacturer or manufacturer's representative as a complete system to assure compatibility. A resistive load bank with temporary connections shall be provided to complete the field testing. Each unit shall be mechanically checked for proper operation. Each alarm and safety shutdown shall be checked by artificially simulating an alarm condition. The testing shall consist of repeated starts and stops, a "cold start", normal operation under full load conditions at the specified power rating for a minimum of four continuous hours, and a one-step rated load pickup test in accordance with NFPA 110. The following items shall be measured,

recorded, and submitted in a field test report: outdoor ambient temperature, barometric pressure, kW output, engine speed (RPM), engine jacket water temperature, engine oil pressure, start time, completion time. Test reports shall verify that the specified tests have been performed and shall state results.

160.15.02.05 Automatic Transfer Switch Testing

160.15.02.05.01 Each automatic transfer switch shall receive field verification.

160.15.02.05.02 Each automatic transfer switch shall receive on-site testing in conjunction with the engine generator. At a minimum, the main power supply from the commercial power grid shall be cut and the switch shall automatically properly transfer the power feed to the standby generator.

160.15.02.06 Control System Testing

160.15.02.06.01 All electrical, instrumentation, control, and telemetry systems shall receive on-site testing to ensure complete operation of all systems. At a minimum the testing shall include the following:

160.15.02.06.01.01 Pump automatic control and operation

160.15.02.06.01.02 Level-sensing equipment operation

160.15.02.06.01.03 Alarm and telemetry system automatic operation

160.15.02.06.01.04 Backup power generation automatic control and operation

160.15.02.07 Structure Testing

160.15.02.07.01 Wet wells and other wastewater containing structures at the pump station shall be inspected and tested for watertightness. Structures shall be thoroughly cleared of dirt, mud, gravel and other foreign debris prior to testing.

160.15.02.07.02 The watertightness test shall be performed in accordance with ACI 350.1R "Testing Reinforced Concrete Structures for Watertightness". If the structure is a small diameter precast manhole, a vacuum test in accordance with ASTM C1244 "Standard Test Method for Concrete Sewer Manholes by Negative Test Pressure (Vacuum) Test" may be used in lieu of the hydrostatic test.

160.15.02.07.03 Watertightness testing shall not commence until the structure is fully assembled and backfilled.

160.15.02.07.04 Any structure that fails to meet the requirements of the watertightness test shall be inspected, made watertight, and retested until the structure passes.

160.15.02.08 Force main Testing

160.15.02.08.01 The force main shall be hydrostatically tested in accordance with Section 120.06.02 except that the test pressure will be 150 PSI.

160.16 TRAINING

160.16.01 Suppliers of major equipment packages shall provide training to Town staff as to the proper operation and maintenance of their equipment.

160.16.02 Training shall be performed by an experienced, competent, and authorized manufacturer's representative.

160.16.03 Training shall be at no additional cost to the Town.

160.16.04 Operation and maintenance training shall be provided for all equipment supplied as part of the pump station. The extent of detail and time required for training on each piece of equipment shall be determined by the Public Utilities Director, based on factors such as new Town maintenance employees and how familiar the Town maintenance employees are with the equipment.

160.16.05 Operational training shall include, but not be limited to, the following procedures or information: normal startup of the unit, normal shutdown of the unit, emergency shutdown of the unit, normal operation of the unit (typical temperature, pressures, signals, rpm, etc., for gages and instruments which are displayed on the panel), a presentation of all operational features (alternative run modes, bypasses, other features not typically used in day-to-day operation, etc.), presentation of all alarm signals, etc.

160.16.06 Maintenance training shall include, but not be limited to, the following procedures or information: standard lubrication procedures and schedules, removal and replacement of equipment, disassembly and re-assembly, replacement of wear parts or common replacement parts, standard troubleshooting procedures, etc.

160.16.07 Simplified operation instructions shall be submitted for review in accordance with the submittals section of this specification. When the review is complete, the instruction sheets shall be printed on heavy paper or cardboard stock and laminated with clear plastic. Two copies of the laminated instructions shall be furnished with the unit. One copy shall be located or displayed at the control panel for the unit. The reserve copy shall be delivered to the Town. The instructions specified here are in addition to the required operation and maintenance manuals.

Table 160.01 - Minimum UL Listed Withstand and Close Into Fault Ratings		
	Size (Amps)	(RMS Symmetrical)
Any molded case breaker:		
	Up to 200	10,000
	201-260	35,000
	261-400	35,000
	401-1200	50,000
	1201-4000	100,000
Specific coordinated breakers:		
	Up to 150	30,000
	151-260	42,000
	261-400	50,000
	401-800	65,000
	801-1200	85,000
	1201-4000	100,000
Current limiting fuse:		
	Up to 4000	200,000
Note: All values 480 volt, RMS symmetrical, less than 20% power factor.		