SECTION 7500
WASTEWATER PUMPING SYSTEMS
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7510 GENERAL

A. DESIGN REQUIREMENTS

1. These Specifications apply to all pump stations and associated facilities that are to be owned, operated, and maintained by Cary. Designers of private pump stations and force mains and associated should look for guidance from the appropriate permitting agency (NCDEQ, NC Plumbing Code, etc.).

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

3. All aspects of the design of pump stations, and associated facilities shall be submitted for review and approval to Cary's Utilities Department. This review may be more extensive than the typical development site plan process. 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.

4. Prior to approval of any pump station plan, a detailed economic analysis consisting of minimum 20-year present worth evaluation shall be submitted by the Engineer-of-Record comparing the extension of gravity sewer service with the construction of a pump station and force main alternative. Gravity sewer systems shall always be preferred over pump station and force main construction. Cary reserves its right to consider economic evaluations, service area configuration, operating costs, and other external factors before approving pump station plan submittals in lieu of gravity sewer extensions.

5. All equipment, except for the generator, included in this Specification shall be designed for a sound rating of 55 dB (A) or less at a distance of 7 meters from the operating equipment. The generator shall include a sound attenuating enclosure and hospital grade silencer. The generator shall have a sound rating of less than 71 dbA for generators rated below 150KW and less than 73 dba for generators, rated between 150KW and 250KW, at a distance of 7 meters from the operating equipment. Warning horns and sirens have no sound restrictions.

   The pump station design shall incorporate ways to minimize the sound levels leaving the site property. Factors to consider include equipment layout, cumulative sound levels, and walls that reflect the sound. Equipment submittals that include the sound ratings for the major equipment to be installed at the pump station shall be supplied to and approved by the Utilities Department prior to ordering the equipment.

The pump station shall not be approved for routine operation until sound testing has demonstrated that the noise levels are in accordance with the requirements of this section. All sound testing shall be performed by reputable personnel and testing equipment to assure accuracy. The Director reserves the right to require certified sound engineers in cases when the accuracy of the testing equipment is uncertain. The Director may also require sound testing to be redone prior to the end of the corrections period to further demonstrate that the pump station, including the generator, is performing as designed.

Generator testing and operation other than for urgent necessity in the interest of public health and safety shall be during the time periods of Monday through Friday between the hours of 9:00 a.m. and 4:00 p.m., not including holidays which are observed by the state.

6. Pump station facility design plans shall evaluate surge and water hammer and incorporate sufficient surge suppression based on the range of flows, pressure and other variables included in the pump station design.

7. Pump station facility design plans shall include emergency pumping capabilities and permit sufficient space to accommodate equipment staging.

8. Pump station facility design plans shall include provisions for odor control/ chemical facilities in accordance with design guidance provided by Cary.

B. WARRANTY

1. All equipment, materials, and systems supplied under this Specification shall be provided in new and in unused condition with a warranty from the manufacturer to Cary 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 Cary (as Warrantee) at the time of acceptance for maintenance by Cary.

C. SUBMITTALS

1. Design Report

   a) A design report signed and sealed by a NCPE 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:

      i. Total dynamic head calculations for all applicable pumping situations.

ii. System curve and pump curve analysis used to determine pump selection and operating point. Pump family of curves shall be provided.
iii. Pump station cycle and pump run times covering the high, low, and average flows over the entire expected operating period of the pump station.
iv. 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).
v. Pump station flotation/buoyancy calculations.
vi. 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.
vii. Maximum detention times within the pump station and force main covering the low flows over the entire expected operating period of the pump station.
viii. 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.
ix. Airflow calculations and chemical dosing calculations for the odor control/ chemical facilities.
x. Flow capacity and headloss calculations for the grinder unit.
xi. Calculations for the sizing of the backup power generator.
xii. If jockey pumps are proposed, calculations must show how the pump can meet all design criteria.

2. Project Review Submittals

a) Project Review Submittals shall be submitted to Cary's Utilities 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 Cary to accepting designs or equipment that do not meet the specified standards or other Cary requirements.

b) 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 Specification 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 hydraulic schematics, electrical wiring diagrams, and control panel schematics. Additional detailed information that

may be required for submittal for specific equipment is listed in the appropriate equipment section.

3. Pre-Approved Equal Submittals

   a) Equipment and systems other than those listed in the Approved Manufacturers List must receive approval from the Director of Utilities prior to application for a permit for the pump station or force main, and prior to entering into construction contracts or purchasing any equipment or systems for the pump station or force main. Purchasing equipment in no way obligates Cary to accepting equipment that does not meet the specified standards or other Cary requirements.

   b) Pre-Approved Equal packages shall include the following information as a minimum:

      i. Current catalog data sheets and complete technical data to support Specification compliance.
      ii. A point-by-point list clearly stating all differences between the named item and the proposed alternate and a separate list clearly stating all exceptions to the Specifications. If no exceptions are listed, then no exceptions to the Specifications will be allowed.
      iii. Installation list with name, address and phone number of contact person for each of at least five (5) installations where the proposed equipment has been in similar service and satisfactory operation for at least two (2) years. The date of placing equipment in service at each listed installation shall be provided.
      iv. Three (3) copies of Pre-Approved Equal information shall be submitted.

   c) Equipment that meets the Pre-Approved Equal submittal requirements, the technical Specification requirements, and all other requirements of Cary, will be approved by the Director of Utilities via letter within 14 calendar days of receipt of a complete package. Approval of Equal equipment or systems in no way eliminates the requirement for complete submittals at a later date.

4. Testing Results Submittals

   a) The results of all testing shall be submitted to Cary's Utilities 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.

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

c) A final, compiled summary of all testing done on all equipment shall be provided to Cary 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 on approved media device.

5. Operation and Maintenance Manuals (O&M)

a) Operation and Maintenance (O&M) manuals are required for all equipment and systems furnished under this Specification section. **Three copies shall be supplied to Cary in printed format prior to startup of the subject equipment or systems.** The O&M manuals shall contain all 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:

i. Final approved shop drawings.
ii. Design data including certified pump curves and system curves.
iii. Wiring diagrams and control schematics.
iv. Detailed inventory of installed equipment, including its functional description, and manufacturer name, address, and phone number (and the same for a local representative of the manufacturer).
v. Operating instructions.
vi. Troubleshooting techniques.
vii. Spare parts list.
viii. Maintenance schedules.
ix. Assembly and disassembly instructions.
x. Instructions for start-up and shutdown, as well as calibration and adjustment.
xi. Annotated hard copy and downloadable electronic copy of application program for all field programmable equipment (eg PLCs, operator interfaces, etc.)

b) Final, Operation and Maintenance (O&M) manual covering all equipment and systems supplied shall be provided to Cary upon completion of the project prior to project closeout and final acceptance. This document shall consist of a single bound printed copy and an electronic copy in Cary approved format.

7520 PUMP STATION SITE AND STRUCTURES

A. GENERAL

1. Pump stations shall be located on a parcel or an easement that is dedicated to Cary. The site shall be directly connected to a dedicated public right-of-way or have a dedicated access easement to a public right-of-way.

2. Cary requires sewage grinders, on-site backup power, and odor control facilities at all pump stations. Sizing of these items will be based on expected flow volumes and characteristics.

3. All stations shall have a minimum of 2 pumps of equal capacity. The pumps shall be solids handling, submersible, centrifugal pumps each capable of pumping flows equal to the expected peak hourly flow. The allowable peak flow can be found in Section 7010 A.2. (c). The Director of Utilities may require that higher peaking factors be used. The Director of Utilities may require wet well/dry well pumping systems when peak flows exceed 1-MGD. Where 3 or more pumps are required, they should be of such capacity that with the largest unit out of service, the remaining units shall have capacity to handle the peak hourly flows. Pumps and force mains shall be sized to provide a minimum velocity in the force main of 2.5 fps and a maximum velocity of 10 fps.

4. Pump stations shall remain fully functional, operational, accessible and free from physical damage during a 100-year flood.

B. SITE WORK

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

2. 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. Visual screening and landscaping shall be provided in accordance with the approved site plan.

3. The site shall be secured by an 8-ft high vinyl coated chain link fence. It shall have 3-wire vinyl coated barb arms, set at an outward facing 45 degree angle and located at the top of each post. Each wire to be 3 strand barb wire class III galvanized or aluminized. The outer barb wire shall hold a load of 250-lbs.The 8-ft height does not include the barb arms. The vinyl coating shall be black and provided with UV resistant vinyl. All fencing shall be provided with a black vinyl coated polyester privacy screen across the entire surface area of the fence including gates. Minimum 9 gauge galvanized “easy twist” fence ties for binding fence and privacy screen shall be installed on each 2”, 3”, or 4” post at a minimum vertical spacing of 2 feet. The fence shall also be rated for a minimum life span of 12-years.

   Fencing shall be provided around the entire perimeter of the pump station property maintaining an offset of 10-12 feet from the property boundary. All fence posts shall also be vinyl coated over the galvanized steel in black color to match fencing and privacy screening. Smaller pump stations shall include manual slide gates for equipment access, a minimum width of 12-ft. Gates at

larger pump stations receiving chemical deliveries shall accommodate tractor trailer accessibility and be provided with electrically operated gates. Both small and large pump stations shall provide manual 180 degree opening pedestrian access gates separate from equipment access gates. All gate posts and corner posts shall be provided with minimum 4-inch diameter fence posts.

4. 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.

5. 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%. Sites shall be properly designed for the delivery of chemicals required for the station, in some cases larger than WB-40 vehicle. Additional turning radius may be required.

6. An **LED** light equivalent to a high-pressure sodium vapor light with a minimum 600-watt capacity in compliance with Cary standards, is required. The light shall be mounted on a suitable utility that retracts or pivots for bulb maintenance from ground level. The light shall be at a height of 30 feet and shall be controlled by an on/off switch mounted on the pole. All area lighting shall be provided in a downward projecting fixture, such as shoe box type light or approved equal. Open globe lighting shall be prohibited on all pump station sites.

7. Pump stations shall have a metered potable water supply from Cary's public water distribution system at minimum sizing of 1-inch service, but provided with sufficient volume and pressure for operations including wash downs, etc. For larger stations a 2-inch service shall be provided to accommodate larger wash down and service needs. The supply shall have an approved reduced pressure principle, RPZ, backflow prevention system. A minimum of one (1) freeze proof yard hydrant is required within the fenced area. Emergency shower and eye washing basin shall be provided in pump stations with chemical odor control facilities. Separate reduced pressure principle, RPZ, backflow preventers shall be required as necessary to protect eye wash and/or emergency shower stations from potential chemical contamination within the pump station site. As required by ANSI Z358.1, the shower and eye wash stations shall be provided with a tepid water system and be able to operate simultaneously.

C. STRUCTURES

1. General

   a) 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. Electric motor operated grinders will be required at all stations. Pump station structures other than the wet well shall be provided with a means to remove accumulated water and wastewater from the structure. Hinged and corrosion resistant access hatches with metal grate style fall protection for equipment and personnel shall be provided for all structures, shall be certified for H-20 loading, traffic rated, and sized appropriately. Stations where projected flows are .5MGD are required to install mechanical Barscreen units. Bar spacing to be ½" wide

b) 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.

2. Wet Well

a) 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 must be between two and eight times per hour at design daily flow (without being excessively deep.

b) 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 4000 psi. The Director of Utilities may require a higher strength concrete.

c) Precast concrete manhole wet wells shall conform to ASTM C-478. Manhole section joints shall be of a durable mastic sealing material. The exterior of manhole wet wells shall have a factory applied bitumastic or asphaltic coating. The exterior of wetwell joints shall be overlapped by an approved material. The interior side of the joints shall be plastered smooth with portland hydraulic cement grout.

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

e) At a minimum, wet wells shall have a 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 will be required on individual pump

stations in conjunction with odor control measures, depending on circumstances.

f) Wet wells and wet well piping shall be coated with at least 80-mils of an approved monolithic epoxy coating system consisting of a 100% solids, solvent-free, two-component epoxy resin for up to 100 mils of coating with a manufacturer approved set time of 6-hours or less. The epoxy coating system shall be installed in no more than 2 applications with no runs and no holidays. High voltage holiday testing shall be utilized to verify there are no voids in the coating. Epoxy coatings shall only be applied to adequately cured concrete structures that have been sufficiently washed and prepared for epoxy coating installation. Properly applied coating shall provide a smooth finish at 80-mils or greater and fill all pores in concrete substrate.

g) Care will 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.

3. Valve/Meter Vaults

a) The valve/meter 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/meter vault shall be complete with a drain that goes to the wet well or where a gravity drain cannot be included, a sump with a minimum ½ hp mercury float switch activated sump pump discharging to the wet well. The drainpipe between the valve vault and the wet well shall have a back water valve at the wet well end. The access cover for the valve vault shall be from a manufacturer listed on Cary's Approved Products List and shall be a square hatch of 1/4 inch aluminum diamond pattern plate with steel hinges on an aluminum frame cast in place in the cover slab. All access covers shall be centered over all equipment to accommodate service and removal and shall include removable metal grate style fall protection guards. Pipe stands shall be Stainless Steel to support valves and other appurtenances requiring support.

4. Manholes

a) Any manholes installed on the pump station site need to meet the standards described in Section 7000 of Cary's Standard Specifications. All manholes installed on the pump station site shall receive an interior coating of an approved epoxy resin, as previously specified for the pump station wet well. All manholes located within the 100-year flood elevation shall receive an exterior coating as specified in Section 7000.

5. Buildings

a) Building systems to house chemical feed facilities shall be adequate to provide sufficient storage, clearance, and 100% containment of chemicals in the event of a chemical tank or other failure. In addition to providing the required spill containment, chemical tanks shall be double wall, crosslinked polyethylene tanks. 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 NC Professional Engineer. Chemical feed delivery lines will be chemical resistant and of a flexible material routed through oversized schedule 80 conduit.

b) 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.

c) 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.

d) Buildings shall be heated to avoid the freezing of chemicals.

D. PIPING AND VALVES

1. Piping: Suction and discharge piping shall be 304 stainless steel Class 50 ductile iron flanged pipe in accordance with AWWA C 115. 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.

2. Pump piping: 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 wetwell. A stainless-steel chain shall be provided for lifting each pump from the wet well. All hardware used shall be 316 stainless-steel.

3. Check Valve: An external weight spring loaded, or air-cushioned or hydraulic loop 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). Check valves shall be ductile 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.

4. Plug Valve: 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.

5. 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. An approved transition coupling mechanical joint sleeve shall be installed on each discharge main between the wet well and the valve vault to allow for differential settlement and transition from stainless steel to ductile iron pipe. An isolation full port plug valve shall be installed downstream no greater than 50-feet from the valve/meter vault to isolate the force main from the vault and equipment. The plug valve shall be capable of passing a foam pig of equivalent size to the adjoining pipe.

6. Pressure gauge: A +/- 2% accuracy pressure gauge with a 3 inch or larger liquid filled dial, stainless steel case, and graduated to 150% of force main static pressure 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 force main. The gauge shall be oriented so that it is easily visible and legible from the valve vault hatch opening. The gauge shall also be capable of delivering an electronic remote signal compatible with SCADA. A separate manual read pressure gauge shall also be provided.

7. Anchor Bolts.

   a) 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. Anchor bolts and associated hardware shall be 316 stainless steel.

   b) 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.

   c) 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 or wedge and epoxy anchoring system securing them into the concrete.

d) Anti-seize compound will be applied to the threads of all stainless-steel bolts before assembly.

E. ELECTRICAL - GENERAL

1. 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.

2. Electrical service to all pump stations shall be appropriately sized three phase power, 240 VAC with automatic transfer switches to 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, and fusible safety switch. This shall be followed by a heavy-duty automatic transfer switch that transfers between the utility power and the on-site generator. 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 male receptacle assembly as manufactured by Crouse-Hinds or other approved equal from the other side. There shall be a NEMA 3R heavy duty single throw fusible safety switch between the generator and the automatic transfer switch.

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

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

5. All electrical components, including panels, shall be sealed off from the wet well in accordance with the N.C. Electrical Code requirements for electrical service to class 1 division 1.

6. The use of rigid conduits is required. Generally, PVC shall be used below ground and PVC coated galvanized steel shall be used above ground. Conduits that lead to a control panel shall be air gapped a minimum of 3-feet from the panel or seal-offs shall be provided.

7. Pump station electrical and control equipment shall be 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 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 light and GFI protected 120V outlet.

8. 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. Weatherhoods shall be installed to eliminate runoff to the front side. All electrical enclosures shall have hinged doors/covers.

9. An intermediate terminating explosion proof junction box is to be supplied and installed mid-way from the wet well and the pump control panel. This box shall be NEMA type 4X suitably sized to house all pump power and control wiring. Rigid metal conduit shall be utilized with the necessary seal-off fittings. Terminal strips shall be provided to properly split the power termination to facilitate pump removal from the junction box and not the pump control panel.

   Exposed outlet boxes for outdoor and indoor wet process areas used for lighting fixtures, switches, and receptacles shall be aluminum provided with rubber neoprene gasketed covers of similar metal. Junction and pull boxes shall be NEMA 4X construction and of ample size to house the required devices. Boxes shall be provided with hasps.

   The minimum size of boxes shall be according to the NEC. No box shall be filled to more than 40% of capacity.

   Where control wires must be interconnected in a junction box, terminal strips consisting of an adequate number of screw terminals shall be installed. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected. Approximately 20 % of the terminals provided shall consist of spare terminals. Terminals shall be lettered and/or numbered to conform to the wiring diagram.

7530 PUMP STATION EQUIPMENT

A. PUMPS

1. General

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

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

c) 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.

d) Each pumping unit including motor and all integral controls shall be rated and labeled for use in a Class 1, Division 1, Group C/D area as defined by the National Electric Code.

e) 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.

f) Abbreviations. Reference to standards and organizations herein shall be as indicated by the following designations.

i.	AFBMA	Antifriction Bearing Manufacturers Association
ii.	AGMA	American Gear Manufacturers Association
iii.	AISI	American Iron and Steel Institute
iv.	ANSI	American National Standards Institute
v.	ASME	American Society of Mechanical Engineers
vi.	ASTM	American Society of Testing and Materials
vii.	NPT	National Pipe Thread
viii.	SAE	Society of Automotive Engineers

2. Submittals

a) Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittals section. The data and specifications for each unit shall include, but not be limited to, the following:

i. Pumps
   - Name of Manufacturer
   - Type and model
   - Rotating speed
   - Direction of rotation
   - Size of suction elbow inlet
   - Size of discharge elbow outlet or nozzle
   - Net weight (mass) of pump and motor only
   - Complete performance curves showing capacity versus head, bhp (brake kW), NPSH required, and efficiency
   - Data on shop painting

ii. Motors
   - Name of manufacturer

- Type and model
- Type of bearings and method of lubrication
- Rated size of motor, hp (kW), and service factor
- Insulation class and temperature rise
- Full load rotative speed
- Net weight
- Efficiency at full load and rated pump condition
- Full load current
- Locked rotor current

b) Operation and Maintenance Manuals shall include, at a minimum, the following information:

i. Equipment function, normal operating characteristics, and limiting conditions.
ii. Assembly, installation, alignment, adjustment, and checking instructions.
iii. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
iv. Lubrication and maintenance instructions.
v. Guide to troubleshooting.
vi. Parts lists and predicted life of parts subject to wear.
vii. Outline, cross-section, and assembly drawings; engineering data; and wiring diagrams.
viii. Test data and performance curves.

3. Quality Assurance

a) Performance and Balance Requirements

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

ii. 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.

iii. The minimum hydrostatic test pressure shall be 1.5 times shutoff head plus max suction pressure.

iv. 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.

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

vi. 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.

4. Materials

a) Stator housing, oil chamber housing, impeller casing, and impeller shall be cast iron, ASTM A48.

b) Casing wearing ring shall be bronze, ASTM B62, rubber, or martensitic stainless steel, Brinell 300+.

c) Bottom wearing plate shall be cast iron, ASTM A48 with spiral grooves.

d) Impeller wearing plate shall be martensitic stainless steel, Brinell 200-250.

e) Shaft shall be alloy steel, hard chrome plated, or martensitic stainless steel, AISI type 416.

f) Mechanical seals shall be 2 tandem single type, oil lubricated with silicon or tungsten carbide seal rings at all points, except the upper rotating seal, which shall be carbon.

g) Discharge base shall be cast iron or fabricated steel.

h) Guiderails shall be stainless steel pipe, ASTM A312, Schedule 40S.

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

j) Pedestal base shall be cast iron or fabricated steel.

5. Pumps

a) 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.

b) 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.

c) The impeller shall be a semi-open and enclosed recessed one-piece casting with not more than two nonclog 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.

d) For pumping units 20 hp 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 hp 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.

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

f) 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, will 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.

g) 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 will not be acceptable. The use of secondary sealing compounds, gasket cement, grease, or other devices to obtain watertight joints will not be acceptable.

6. Pump Motors

a) The pump motors shall be sealed submersible type, and shall be appropriately sized three phase power, 60 Hertz motors with a maximum speed of 1800 RPM. The motors shall meet the U.S. requirements of Class I, Division I, and Group C/D for hazardous locations, and shall be sized to non-overloading throughout the entire operating range of the pump.

b) A heat sensor thermostat shall be attached to and embedded in the winding and be connected in series with the motor starter contactor coil to stop motor if temperature of winding is more than 220 degrees F. Thermostat shall reset automatically when motor cools to safe operating temperature. The common pump motor shaft shall be of 416 stainless-steel. (See 4E)

c) 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.

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

e) 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 Celcius. 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.

f) Each motor housing shall be provided with a moisture detection system provided by the motor manufacturer and per the manufacturer's requirements, complete with all sensors, control power transformer, intrinsically safe control modules, and relays. The moisture detection system shall be rated for a 120V AC supply. The moisture detection system shall provide two normally open dry output contacts rated 5 amps at 120 volts AC. The contacts shall close when moisture is detected in the motor housing and an alarm relay energized. The pump shall not 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.

g) 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.

h) Thrust bearings shall be protected by bearing temperature switches. The switches shall be normally closed automatic reset type rated 5 amps at 120V AC.

i) 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.

j) Each pump 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 shall conform to NEC requirements.

k) All cables shall be of sufficient length to terminate in a junction box outside the wetwell as indicated on the drawings, with 10 feet of slack that shall be coiled on a cable hook at the top of the wetwell. Each cable shall be supported by AISI Series 300 corrosion-resistant PVC Style woven Kellem Grips type woven grips to prevent damage to the cable insulation. Mounting of cable supports in the wetwell shall be coordinated to prevent damage to the cable.

l) 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.

m) 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.

n) Adjustable Speed Drives: Adjustable frequency drives shall be provided as specified by the Director of Utilities or if the projected flow is .5MGD or higher.

o) Station pumps between 15-30 hp shall have a 30 hp rated RVSS. Stations with pumps greater than 30 hp shall utilize variable frequency drives with appropriately sized RVSS.

7. Appurtenances

a) 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 316 stainless steel.

b) Guiderail Mounted Base. A discharge base and discharge elbow shall be furnished by the pump manufacturer. The base shall be sufficiently rigid to firmly support the guiderails, 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 wetwell. 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 guiderails so that the unit can be removed from the wetwell and replaced without the need for operating personnel to enter the wetwell.

c) Sliding Bracket. 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.

d) Guiderails. Each guide rail mounted pumping unit shall be equipped with one or more guiderails. Guiderails 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. Guiderails shall be made of stainless steel.

e) Lifting Chain. Each guide rail mounted pumping unit shall be provided with a chain suitable for removing and installing. The chain shall be 316 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 wetwell. A stainless-steel cable is not an acceptable alternative to a lifting chain.

f) Special Tools and Accessories. 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.

8. Shop Painting

a) 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.

b) 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 filed with a universal primer and aliphatic polyurethane system.

c) 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.

B. PUMP CONTROL SYSTEMS

1. 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.

2. Submittals: Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittals section. The data and specifications for the Control Panel and Components shall include, but not be limited to, the following:

    - Name of manufacturer
    - Type and model
    - Enclosure rating
    - Dimensions of complete panel
    - Electrical schematics and wiring diagram
    - Liquid level sensors with mounting details and cable lengths, and pump controls
    - Published descriptive data on each item of equipment and all accessories, indicating all specific characteristics and options.

3. Enclosure: The Control Equipment Enclosure shall be a NEMA type 4X fiberglass and be of suitable size to house all components. A locking hasp shall be provided with no screw clamp type latches. Enclosure shall be fabricated from fiberglass. The top of the enclosure shall serve as a drip shield and the seam free sides shall prevent rain and sleet from entering. Inner panel shall be made of fiberglass.

4. Hinged Inner Door: An inner door shall be furnished. Overload reset push buttons, circuit breakers, switches pilot lights, and hr. meters shall be the only components accessible with door closed. Door shall be hinged and may be opened when service is required.

5. 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.

6. Motor Circuit Breaker (440-480 VAC): A properly sized, molded case, thermal hydraulic-magnetic circuit breaker or motor protector 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 motor(s). The interrupting rating shall be 5,000 RMS symmetrical amps.

7. Transformer Primary Circuit Breaker: A properly sized, two pole, molded case 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 breaker(s).

8. Control Power Transformer: An industrial quality control transformer shall be furnished to provide control voltage. The transformer shall be furnished to provide more than adequate KVA rating to provide 120-VAC power for all items required in the control and alarm circuits. Transformer shall be protected in its secondary by properly sized supplemental circuit breaker(s).

9. Magnetic Contactors and Overload Relays: A magnetic contactor shall be furnished for each motor. A separate, panel mounted, 3 leg (three phase) overload relay or motor protector shall be supplied for each motor. Each leg of the overload relay shall be equipped with a properly sized overload heater. Electronic overloads are not acceptable. Contactor and overload relay shall be properly sized for the required horsepower, voltage and phase.

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

11. 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.

12. 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. The phase and voltage monitor shall be adjustable.

13. Lightning and Surge Arrestor: Suitable lightning and surge arrestors shall be provided to protect motors and control equipment from lightning induced or other line surges. Surge arrestor shall meet current UL standards.

14. 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 inner door closed, overload relays may be reset without entering high voltage compartment.

15. Switches: Heavy-duty industrial grade oil-tight 22mm switches shall be provided for each pump for "Hand/Off/Automatic" operation selection. 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. The switches required shall be as follows:

Switch Function (Name Plate)	Voltage
HOA	120 VAC

16. Pilot Lights: Full voltage, push to test, heavy-duty industrial grade oil-tight pilot lights shall be provided. 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. Bulb change shall not require removal of the socket. Bulbs shall be "super bright" LED type. Lens shall be 22mm and made of lexan. The pilot lights required shall be as follows:

Pilot Light Function (Name Plate)	Voltage	Lens Color
PUMP 1	120 VAC	GREEN
PUMP 2	120 VAC	GREEN

17. 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. Relay contacts shall be rated at 10 amps minimum. All molded structural parts shall be of high mechanical and dielectric strength, structural dimensionally stable, arc resistant, thermosetting plastic. Base plate shall be high strength, diecast aluminum alloy. Solid state type relays shall not be considered acceptable for seal fail monitoring applications. An amber alarm pilot light shall illuminate upon alarm condition. Each pilot light shall include contacts that shall allow testing of the seal failure circuit and pilot light bulb by pushing. Bulb change shall not require removal of the socket. Bulbs shall be "super bright" LED type.

18. Seal Failure Circuit Test Push Button (Illuminated): Heavy-duty industrial grade oil-tight push buttons shall be provided for each submersible pump motor. All push button 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. Bulb change shall not require removal of the socket. Bulbs shall be "super bright" LED type. Lens shall be 22mm and made of lexan. The push buttons required shall be as follows:

Push Button Function (Name Plate)	Voltage	Lens Color
P1 SEAL FAIL	120 VAC	AMBER
P2 SEAL FAIL	120 VAC	AMBER

19. Pump Alternator Circuit (For Duplex Pump Operation): The electro-mechanical 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 inner door. The switch shall have a position for: Pump 1, Pump 2, or Both.

20. 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 from sliding out of the socket. Relays shall have indicator lights showing when they are engaged.

21. High Wet Well Level Alarm: The control panel shall be provided with a suitable alarm circuit, activated by a separate level control. This alarm shall signal a high-water condition in the wetwell. Terminals shall be furnished in the control panel for connection of externally mounted alarm devices. A red flashing light shall be provided as a visual alarm of the high water in the wet well condition. A continuous sounding alarm shall also be provided as an audible alarm of the high water in the wet well condition.

22. Liquid Level Controls: Level control will be achieved by means of a corrosion resistant level sensing **Pressure Transducer**. Float-actuated mercury level control switches shall serve as a backup for low level alarm 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 wetwell. 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 will be allowed in the wet well.

23. 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.

24. 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 sized per table 250-95 of the N.E.C. In all cases, the enclosure must be adequately grounded per article 250 of the N.E.C. except for fiberglass enclosures, where a grounding bus shall be provided.

25. 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 volts use and accept a wire range of #22-8. All live parts shall have insulating walls on all sides of the lug. Blocks must be U.S. recognized.

26. Construction Standards: Subpanel 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 applicable standards. Power (motor) shall be in accordance with the current National Electrical Code. Major groups of wires shall be contained in plastic wiring trough equal to Panduit type E.

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

C. ALARM DIALER/SCADA/TELEMETRY

1. The pump station shall be provided with an alarm dialer in a lockable NEMA 4 enclosure. Hard line dialer units shall have a minimum of eight inputs and capable of additional expansion with battery backup and be the ANTX Dialer Scout or approved equal. The operating environment shall withstand from –5° Fahrenheit to 130° 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 monitor high water conditions and grinder jams through normally open/normally closed contacts, 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 Cary's Approved Manufacturers List. Seal failure and high temperature signals from all pumps shall be combined into a common "pump trouble" alarm to be transmitted from the dialer.

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

D. GRINDERS

1. General

a) 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.

b) 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 Cary's Approved Manufacturers List.

c) The wastewater grinder shall be placed in a separate manhole or other influent structure prior to the wetwell, but still within the pump station site. The grinder shall be able to be removed from the influent structure without entering the influent structure by means of a stainless-steel guide rail and stainless-steel lifting chain with 4x6 lifting eyes at 10ft intervals starting at the top assembly. Another means of solids removal such as a trash basket or bar rack must be provided for installation when the grinder unit is out of service for extended periods.

d) The wastewater grinder shall be electrically driven. The electric motor shall be a minimum 5 hp, 60 Hz, appropriately sized immersible motor. The motor shall be NEMA Design "B" and TEFC.

e) The wastewater grinder unit will 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.

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

g) The grinder unit power supply shall match the pump station power supply. Standard pump station power supply is 3 phase AC power.

h) Identification. 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.

2. Submittals

Submittals shall include electrical wiring diagrams complete for field wiring, terminal identifications, and control panel schematics. Electrical and control information shall be provided to allow coordination of field wiring to place the system in the desired operation. Submittals shall also include complete mounting and installation instructions,

including size, length and spacing of all supports and anchor bolts. Submittals shall include painting instructions.

3. Quality Assurance

a) All equipment shall meet the requirements of the following standards:

i. ASTM A536-84 - Standard Specifications for Ductile Iron Castings
ii. ASTM A36 - Standard Specifications for Carbon Steel Plate
iii. AISI 304 - Stainless Steel
iv. AISI 4140 - Heat Treated Hexagon Steel
v. AISI 4130 - Heat Treated Alloy Steel
vi. AISI 1018 - Carbon Steel
vii. 45-50 Rockwell C
viii. National Electrical Manufacturers Association (NEMA)
ix. National Electrical Code (NEC)
x. Underwriters Laboratory (UL and cUL)

b) 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 Cary's Utilities Department.

c) System Controls.

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

ii. A programmable controller shall be included in the panel. The programmable logic controller shall talk directly with the SCADA PLC without a third-party communication device. 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.

iii. 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.

iv. 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. Grinder control panel shall be positioned either under the weather shield at the electrical riser or in the control building if included. A standalone control panel will not be accepted.

v. 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.

vi. The controller shall indicate each of the following statuses with an indicator light on the panel face:
   - Power On
   - Grinder Overload
   - Motor Overload
   - Run

vii. 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.

viii. The controller shall be properly rated three phase power, 60 Hertz.

ix. 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 a NEMA 4X fiberglass reinforced polymer equipped with full hinged door, suitable for exterior mounting as shown on the drawings.

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

xi. 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.

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

xiii. 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).

xiv. Control panel shall incorporate a manual momentary or spring return reversing switch for grinder control.

d) Spare Parts

i. The following spare parts shall be provided for each grinder as a minimum:
- Three (3) of each type of fuse found in the system
- Three (3) of each type of lamp bulb found in the system

ii. 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.

E. GENERATORS

1. General

a) 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.

b) 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 Cary's Approved Manufacturers List.

c) 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.

d) 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.) should be verified for the particular site. The kW rating needed for a particular pump station shall be calculated by a licensed professional engineer by the generator manufacturer.

e) The voltage, amps, phase, etc., shall be coordinated with the design of the electrical equipment for the particular site. Generators will be 3 phase, 60 hertz, and capable of multiple voltages through re-strapping.

f) The engine generator set will 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.

g) 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.

h) Reference Sound section above

2. Submittals

a) The Contractor shall submit to Cary's Utilities Department, complete shop drawings for assembly and installation, together with detailed specification and data covering materials, drive unit, parts, devices and accessories forming a part of the equipment furnished, with the submittals section. The data and specifications for each unit shall include, but shall not be limited to, the following:

- Manufacturer, model, and type: engine, alternator, enclosure, battery charger and battery, silencer, switchgear, transformer, etc.
- Listing of standard and optional accessories.
- Engine output horsepower and efficiency curves at specified conditions.
- Engine mechanical data including heat rejection, exhaust gas emission data (maximum values at loads of 1/4, 1/2, 3/4, and full for: carbon monoxide (CO) (lb/hr), nitrogen oxides (NOx)(lb/hr),

temperature (F), flow (ACFM)), combustion air and ventilation air flows, and fuel consumption at specified conditions.

- Generator electrical data including temperature and insulation data, winding pitch, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
- Ratings at specified conditions: engine (net horsepower), engine (maximum performance horsepower bare engine), generator kW at specified power factor, volts, amperes.
- Overall dimensions (length, width, height) and net weight.
- Concrete pad recommendation (including size, length, and spacing of all necessary supports and anchor bolts) and layout/stub-up locations for electrical conduits.
- Wiring diagrams and schematics for the entire system, including the engine control panel, generator breaker, automatic transfer switch, auxiliary transformer, and remote alarm indicators.
- Calculations or test results showing compliance with specified motor starting and voltage dip requirements.
- Line circuit breaker rating.
- Control panel layout, identifying location of all instrumentation being supplied.
- Operation instructions.
- Letter from the engine-generator manufacturer confirming that the unit will provide the specified minimum kW rating at the specified design conditions and time duration.
- Battery sizing calculations.
- Battery charger sizing calculations.
- Maximum output short circuit kvA available.
- A certificate of compliance, when required.
- Manufacturer's and dealer's written warranty.

3. Quality Control

a) 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.

4. Generator Equipment

a) Engine.

i. Engine shall be compression ignition type diesel powered, 4 stroke, liquid cooled, American made, with a minimum of 130 HP, or equal.

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

iii. The engine will be equipped with an electronic governor to maintain 4% droop 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.

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

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

b) Generator.

i. 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.

ii. 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.

iii. 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.

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

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

vi. The generator shall be supplied with a 240V single phase anti-condensation heater protected by a circuit breaker inside the main control panel. When the generator set is not running the heater is automatically connected to the AC supply through a power relay mounted in the control panel. Upon receiving a start signal the AC supply is automatically disconnected by the power relay and automatically reconnected when the start signal is removed, and the engine has stopped. A temperature set point shall determine the start and stop signal.

c) Fuel System.

i. 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.

ii. The fuel tank shall have the capacity to provide fuel for a minimum run time of 48 continuous hours at 100% prime load.

iii. 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 gauge, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided. The fuel system shall require a polishing/filtration system for larger units to be determined by Utilities Department. Any drain lines associated with the generator shall include brass plugs. Plastic plugs will not be accepted.

d) Lubrication.

i. 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.

ii. 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 will not be acceptable.

iii. 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.

e) Exhaust System.

i. 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.

ii. A rain cap 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 tops. The cap shall be stainless steel counterbalancing with vertical discharge.

f) Starting System.

i. 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.

ii. The engine starter shall be a 12-volt DC or 24-volt DC, solenoid shaft, electric starting system with positive engagement.

iii. 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 F and a battery end voltage of 70 percent of system voltage.

iv. 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 120 volts or 240 volts, single phase.

v. 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.

vi. 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.

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

g) Cooling System.

i. 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 F and taking into account the enclosure static pressure restriction. The fan shall draw air over the engine and discharge through the radiator.

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

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

h) Enclosure.

i. 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.

ii. 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.

iii. The enclosure shall be constructed of 12 gauge or heavier metal panels that can be easily removed, or doors.

iv. 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.

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

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

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

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

ix. An LED 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.

i) Control System.

i. 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 will have a voltage shunt switch. The panel itself shall be mounted on a separate support stand 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.

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

iii. 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 push-button, lamp test pushbutton, 7 position voltmeter phase selector switch, 4 position ammeter phase selector switch, 3 attempt start timer, and cool down timer.

iv. 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.

v. 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.

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

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

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

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

j) Circuit Breaker. Provide a generator mounted, molded case or insulated case construction, UL rated, 3 pole, and 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.

k) Receptacles. The engine generator will be supplied with two 120V, 20-amp duplex receptacles and two 120V, 20-amp twist lock receptacles. Receptacles will have individual circuit breakers and will be placed inside the enclosure or will have weatherproof covers.

l) Shop Painting.

i. 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.

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

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

F. AUTOMATIC TRANSFER SWITCH (ATS)

1. 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.

2. General

a) 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.

b) 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.

c) 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.

d) 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.

e) 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 detailed in this Specification.

f) 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.

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

h) The transfer switches shall be supplied with a microprocessor-based control panel as detailed further in these Specifications.

i) 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.

3. Sequence of Operation

a) The ATS shall incorporate adjustable three phase under-voltage sensing of the normal source and emergency source.

b) 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.

c) 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.

d) 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.

e) 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.

f) 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.

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

h) 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.

i) 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:

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

    ii. Built-in diagnostic display.

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

iv. Mechanical test switch to simulate a normal source failure.

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

vi. Time delay on retransfer to normal source, continuously adjustable 0-30 minutes, factory set at 15 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.

vii. Time delay on transfer to emergency, continuously adjustable 0–15-minute, factory set at 1 minute.

viii. 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.

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

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

4. Construction and Performance

a) 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.

b) 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.

c) For switches installed in systems having ground fault protective devices, and/or wired 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.

d) 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.

e) 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 follows:

Any molded case breaker:

Size (Amps)	(RMS Symmetrical)
Up to 200	10,000
201-260	35,000
261-400	35,000
401-1200	50,000
1201-4000	100,000

Specific coordinated breakers:

Size (Amps)	(RMS Symmetrical)
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:

Size (Amps)	(RMS Symmetrical)
Up to 4000	200,000

*All values 480 volt, RMS symmetrical, less than 20% power factor.

f) A dielectric test at the conclusion of the closing tests shall be performed.

g) 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 will be no current flow between the two isolated sources during switching.

h) All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils,

fuses, 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.

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

j) 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.

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

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

7540 ODOR/CHEMICAL FACILITIES

1. 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 wetwell 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 appropriate odor control measures shall be made by the Director of Utilities.

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

3. Odor control facilities not located on the pump station site (air release valves and discharge points, for instance) shall be constructed in underground vaults or if necessary to be above ground, shall be house 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.

7550 INSPECTIONS, TESTING, AND TRAINING

A. INSPECTIONS

1. All materials and equipment used in the construction of the wastewater pumping system must be verified for compliance with the Specifications (or other approval granted by Cary) by Cary personnel prior to installation. Non-conforming materials or equipment shall be immediately removed from the job site.

2. Compliance with plans and Specifications shall be verified on a regular basis by the Cary personnel.

B. TESTING

1. General

a) The Contractor shall furnish all materials, labor, and equipment to perform all testing. Water for testing purposes may be obtained from Cary. The Contractor shall reimburse Cary for all water used at Inside Utility Rates.

b) All water or wastewater used during testing of the pump station, force main, or any of the systems described in this section, must be returned to Cary's sanitary sewer system after proper coordination with Cary's Department of Public Works and Utilities.

c) Before the operational tests are conducted, the required copies of the Operation and Maintenance Manuals shall be delivered to Cary.

d) Before the operational tests are conducted, the startup/testing procedures shall be reviewed with all involved parties and approved by Cary Utilities Department. Doing so may help reduce operational testing/acceptance durations.

e) Cary 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 Cary Specifications. All testing, repairs and/or readjustments, and necessary re-testing, shall be at no additional cost to Cary.

f) All on-site testing and/or installation verification shall be performed in the presence of the Cary personnel or other representative authorized by Cary.

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

h) Factory testing shall consist of testing all operating functions of the equipment under varying operating conditions to assure that it will 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 Cary prior to delivery of the equipment.

i) 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 Cary prior to start-up of the equipment.

j) 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 Cary prior to final acceptance of the project.

k) 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.

l) 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 Infrastructure Field Technician.

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

2. Pump Testing

a) 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, bhp (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.

b) All pumps shall receive installation verification.

c) On-site testing shall be performed to the maximum extent possible (flow availability could limit the range of testing conditions).

3. Grinder Testing

a) Each grinder unit shall be factory tested.
b) Each grinder unit shall receive installation verification.
c) Each grinder unit shall receive on-site testing.

4. Generator Testing

a) 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.

b) Each engine generator set shall receive installation verification.

c) 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.

5. Automatic Transfer Switch Testing

a) Each automatic transfer switch shall receive field verification.

b) 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.

6. Control System Testing

a) 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:

i. Pump automatic control and operation
ii. Level-sensing equipment operation
iii. Alarm and telemetry system automatic operation
iv. Backup power generation automatic control and operation
v. Vibration testing of all rotating equipment

7. Structure Testing

a) Wetwells 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.

b) 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.

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

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

C. OPERATOR TRAINING

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

2. Training shall be performed by an experienced, competent, and authorized manufacturer’s representative.

3. Training shall be at no additional cost to Cary.

4. Training shall be provided for, but not limited to, the equipment listed in the table below. The training times presented below for Operation Training and Maintenance Training are the minimum required. Complicated systems can require more than the minimum requirements.

Equipment System	Operation Training (hours)	Maintenance Training (hours)
Pumps and Pump Control Systems	2	4
Grinder System	1	2
Engine Generator and Automatic Transfer Switch	2	4
Chemical on/or Odor Control Systems	1	2
Alarm Dialer/ SCADA/Telemetry	1	0

5. 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 gauges 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.

6. 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.

7. 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 Cary. The instructions specified here are in addition to the required operation and maintenance manuals.

END OF SECTION 7500