## PART 1 - GENERAL

1.01 Electrical: All electrical components shall meet NEMA standards, and shall comply with NEC and UL as applicable to construction and installation of wiring and components. The electrical system inside the wet well shall comply with the National Electric Code for Hazardous Locations, Class I, Division 1, Group D.

An enclosure shall be provided to house all electrical equipment outlined in the following specifications. The enclosure shall be mounted on stainless steel unistruts on the wet well, in a location practical for future operation of the station. The mounting shall be completed in a manner that provides the necessary strength to adequately support the panel.

The enclosure and the electrical equipment which shall be supplied with each sewage pumping station are described in this section.

The utility company's electric meter, utility company's CT enclosure, service entrance-rated main breaker or fusible disconnect, and automatic transfer switch enclosure shall be mounted on a structure of three (3) inch stainless steel strut (square tubing and U-channel) to one (1) side of the main motor control panel enclosure. The control transformer shall be mounted either on the stainless steel strut or on the side or back of the main control panel enclosure. Where the utility company mounting requirements differ from the requirements herein, the utility company requirements shall govern for those items under their jurisdiction only.

1.02 Miscellaneous items: The contractor shall pay all service and permit fees required for the installation of the electrical service. Pickaway County electrical inspection shall be completed prior to start-up and acceptance. The District shall provide the generator for start-up and training.

## PART 2 - PRODUCTS

2.01 Enclosures: Enclosures supplied with each station shall be free-standing, double-door Hoffman #A-74H7224SSLP or equal (or appropriately sized equivalent) and shall be rated NEMA Type 4X. The enclosure shall be large enough to provide an unused space equal to at least thirty percent (30%) of the space required. This space shall be reserved for installation of future equipment by the District, and no wiring or controls shall intrude into this reserved space. The construction shall be equal to or better quality than 12-gauge 304 stainless, in accordance with ASTM A-167, and shall be supplied with a drip shield, a continuous hinge on the panel, and smooth seamless sides. All bolts, screws, pins, and other fasteners used on the enclosure shall be stainless steel.

The enclosure shall include add-on kits equal to the Hoffman Kits listed by catalog number below:

1. A-DSTOPK Door Stop Kit.
2. A-LF16M18 light with remote switch (provide two (2) lights if panel size or configuration dictates)
3. Design-air Electric Heater, 115 volt, with built-in thermostat, Model D-AH2001A, or other Hoffman Model sized properly to ensure proper air transfer and heating of entire enclosure (provide 20 degrees Fahrenheit temperature rise above ambient). Two (2) heaters will be necessary where the enclosure is divided into separate compartments.

Each enclosure shall have a door-in-door arrangement with interior swing-out panels on each side. The alternating on-off switch, circuit breakers, control switches, pilot lights, etc., shall be accessible to the operator from the inner panel without opening the inner doors. The outer panel shall be void of control devices.

The outer panel doors of the enclosure shall be secured as follows: Both the right-hand and left-hand doors shall be secured with pad-lockable Hoffman latch, Cat. # A-L1CR.

The sub panel in the back of the main enclosure shall be steel painted with white ceramic paint (Hoffman A-72P72 or equal). All other components of the enclosure shall be stainless steel.

Each sewage pumping station enclosure shall be provided with one (1) duplex service outlet of 120-volt, AC, 20-amp rating. This outlet shall be supplied from the control transformer and shall have GFCI circuit protection. The outlet shall be located in the motor control panel behind the inner door.

All enclosures, panels, etc., (including the motor control panel) shall be UL-listed and shall be fabricated by a UL-approved shop in accordance with the NFPA 79 Electrical Standards for Industrial Machinery.

A shop drawing of the control panel shall be provided, showing panel elevation, dimensions, and weight. Interconnecting wiring diagrams shall be provided, which show all electrical connections between field-installed equipment and the control panel. Schematic control wiring diagrams shall be provided, showing all control components, switches, pilot lights, relays, etc. The wiring diagrams shall indicate wire and terminal numbers. Each component shall be uniquely labeled. A copy of all as-built electrical/control/instrumentation drawings shall be laminated (or otherwise sealed in plastic) and permanently located in the main control panel enclosure.

A minimum 24”x24”x8” stainless steel NEMA 4X junction box shall be mounted over the wet well on two (2) vented stainless steel feed-through wireways (Hoffman F-66W24SS or equal) over two (2) five (5) inch holes through the wet well top slab. The door of this

junction box shall open in a direction away from any access hatches in the wet well, and the door shall be pad lockable. All wires entering the wet well (pump power and control wires, float wires, etc.) shall be connected to terminal strips inside this junction box with corresponding wires extending to the main control panel. Terminals shall be labeled as "Pump 1," "Pump 2," etc. Cord grip connectors or other appropriate components shall be glued at the bottom of this junction box for all wires entering the wet well to seal the opening and provide strain relief for the wires. Stainless steel braided wire sleeved with attachment tails shall also be provided for large pump cords.

2.02 Circuit Breakers: All circuit breakers shall be of the thermal magnetic type, with molded case breakers. Breakers shall be UL-listed and CSA certified, and shall meet Federal Specification W-C-375B/GEN.

Three-pole breakers shall be manufactured by Square D or approved equal, and shall have a short circuit rating equal to 125% of the available fault current. Regardless of the available fault rating, circuit breakers shall not be less than Style FA for applications under 100 amps, or Style KA for applications between 100 and 250 amps.

Single-pole breakers shall be Square D-QOU series or approved equal, and shall be used for control circuitry and peripheral devices.

A main circuit breaker shall be provided inside the main enclosure for the control panel, with separate circuit breakers for each motor and transformer primary, as well as single-pole circuit breakers for control circuitry, RTU, lighting, outlets, flow meter and chart recorder, generator block heater, generator battery charger, etc. Another service entrance circuit breaker or fusible disconnect shall be provided in a NEMA 4X stainless steel enclosure outside the main enclosure on the line side of the automatic transfer switch, lightning arrester, etc.

Circuit breakers shall be accessible to the operator through the inner panel door without having to come in contact with the open wiring. The main and motor branch circuit breakers shall be lockable.

A minimum of two (2) spare 120-volt AC, 15 amp circuit breakers shall be provided and mounted on the panel.

2.03 Starters: Motor starters shall be soft start, electronic overload starters with adjustable trip phase loss, ground fault, and phase reversal protection. They shall be equipped with three (3) poles and shall be provided with auxiliary contacts for use in the control circuit and for status inputs to the SCADA system. Starters shall be Allen Bradley Bulletin 509 type with SMP-2 adjustable overload relay, Square D Class 8536 Full voltage NEMA starters with optional solid state motor logic overload relay (Class 9065 if ordered separately), or Furnas ESP 100 series, Class 14 with Class 20 trip overload, with solid state adjustable thermal overloads. No other starters will be considered equal or allowed. All starter coils must be 110 volt.

Starters shall conform to all NEMA ratings. The minimum size starter shall be NEMA 1.

Starters shall have at least one (1) set of auxiliary dry N.O. contacts rated at 10 amps for future SCADA use.

Electronic soft-starters, as manufactured by Allen-Bradley, shall be supplied for all motors twenty (20) horsepower or larger or where otherwise required by a local power company or EHRWSD. Soft-start starters shall also be provided with a soft-stop feature.

Provisions for sequential pump starting shall be made in the controls to prevent more than one (1) pump from starting simultaneously.

2.04 Control Transformers: Control transformers shall be dry type, stainless steel enclosed (NEMA 3R), mounted external to the main control panel. Primary voltage shall be 120 volt AC.

The transformer should be sized for the proposed power requirements of the pumping station plus an additional 25% capacity for future loads, with a minimum output current rating of 30 amps. The transformer shall be protected by circuit breakers on the primary and secondary sides.

2.05 Control Relays & Pump Controller: All control relays shall be of the illuminated 8 or 11-pin octal plug-type, Allen Bradley, Square D or approval equal. Relays may be either direct panel-mounted or DIN rail-mounted. Control relays shall be of at least DPDT configuration.

Intrinsically safe relays (Warrick Series 27A1Do Intrinsic Barrier or approved equal) shall be provided with the wet well float switches. Wiring associated with the intrinsically safe relays shall be segregated from other power and control wiring.

The submersible transducer shall control pump on and off functions via an Essex Engineering Corporation, Inc. Model 2410 Pump Controller or approved equal. The controller shall accept the signal from the transducer and control the pump on and off functions with adjustable set points. The controller shall be supplied with an LED indicator and the appropriate alarm functions.

2.06 Duplex Alternator: The alternating relay shall be rated for 120-600 Volts and shall be Furnas, Cat. No. AB10A*, Class 47, Square D Class 8501 or approved equal.

An alternating on-off switch shall be provided in the panel. For duplex stations this shall consist of a selector switch with the following options: PUMP 1 - ALTERNATE – PUMP 2.

The above describes a duplex alternator. Pumping stations with three (3) or more pumps shall have an alternator capable of equalizing operating hours among the pumps.

For maintenance purposes, the pump station shall be capable of being set on pump one (1) or two (2) only and have that be the lead pump for the duration of time the second pump is out of service

2.07 Phase Conversion: If phase conversion is required due to power constraints, a variable frequency drive shall be utilized. Drive shall be TOSHEBA, Allen Bradley or approved equal. No add- a-phase units will be allowed.

2.08 Submersible Electronic Pressure Transducer: Transducer shall be KPSI Model 700-6PSI or equal. Watertight flexible fifty (50) foot cord to junction box. Contractor shall provide schedule 80 PVC conduit to route the cord to wet well lid.

High level float shall be molded plastic, with N.O. potted mercury switch. Flygt or approved equal.

There shall be a minimum of one (1) float switch and one (1) pressure transducer supplied with each station. They shall be used as follows:

1. Pumps off
2. Lead pump on
3. High level
4. Lag pump on
5. High- Level Alarm

The High-Level Alarm float shall be wired to the local alarm, SCADA alarm and attempt to start both pumps (with a thirty (30) second lag). All items shall be integrated with the SCADA system.

All floats shall be provided with enough extra cable to permit installation of at least ten (10) feet lower than the elevation shown on the plans or at the level of the top of the pump volute, whichever is higher. Excess cable shall be neatly looped at the float hanger. Cable support shall be provided for each float cable and shall consist of a stainless steel braided wire sleeve with attachment tails for connection to the float hanger(s). Float hanger(s) shall be located at the edge of the pump hatch opening, unless otherwise shown on the plans or directed by the Engineer.

2.09 Switches and Pilot Lamps: All lamps shall be of the transformer type.

Switches and pilot lamps shall be oil-tight and shall meet NEMA standards for A600 heavy duty contacts. Each pump shall have a separate selector switch with the following settings:
HAND-OFF-AUTO (HOA). Each pump shall also have a green pilot lamp connected to auxiliary contacts on the starter to indicate when the pump is running. These switches

and lights should be located inside the control panel in non-secured locations and on the control panel door in secure (fenced) locations.

All HOA switches and pilot lamps shall be Allen-Bradley 800 series or approved equal. Switches and pilot lamps shall be oil-tight and shall meet NEMA standards for A600 heavy-duty contacts. All pilot lamps shall have the push-to-test feature.

2.10 Over-Current Relays: Adjustable over-current relays shall be provided and shall be wired so that every motor lead passes through a separate current loop (i.e. one (1) current loop for each phase of each pump).

Output contacts for a remote alarm shall be provided.

The over-current relays shall be SSAC Model No. ECS41BC or equivalent for pumps with full-load current up to 20 amps or SSAC Model No. ECSH4HBD for pumps with current rating between 20 and 50 amps.

When rated motor current exceeds 50 amps, current transformers shall be provided to satisfy the current requirements (i.e. current shall be reduced below 50 amps for monitoring purposes). This shall be accomplished by running the motor leads through appropriately sized current transformer "donuts" and running the leads from the current transformers through the current loops of appropriately sized over-current relays.

2.11 Voltage Monitors: A voltage monitor shall be supplied to monitor the incoming voltage. This unit shall be manufactured by SSAC, Model No. WVM911AL (480 volt), WVM611AL (240 volt) or equal. The monitor shall be rated at either 480 volt AC or 240 volt AC, according to the incoming voltage source. The restart delay shall be adjustable from 0.25 to 64 seconds. Voltage monitor shall monitor all incoming phases. Protection of the voltage monitor, on the incoming voltage, shall be through 2-amp fast-blow fuses (Bussman KTK-R2 or equal). Voltage and current monitoring shall be provided for all legs ($L_1$, $L_2$, $L_3$). Monitor shall be push button type.

When an under-voltage condition occurs, an alarm shall be sent via the SCADA system after an adjustable time delay.

2.12 Wire and Cable: All wiring and cable installation shall conform to NEC regulations and shall comply with local codes. All conductors shall be copper. Wiring shall not be operated above 75 degrees Celsius.

For electrical equipment feeders (motor control center, motor branch circuits, etc.), located below grade or for exterior control and motor circuits, wiring shall be type THHN through #2 AWG and type RHH for larger than #2 AWG.

For branch circuits for lighting and receptacles, wiring shall be type THHN in conduit. For branch circuits for interior, wiring shall be type MTW.

Power wiring shall be 12 AWG minimum, and control wiring shall be 14 AWG minimum.

For instrumentation (i.e. 4-20 mA signals), cables shall be 16 AWG copper, NEC-type TC rated at 600 volts (Belden No. 1118A or equal) individually shielded twisted pair cable. All digital signal wires may be of the type of wire specified above.

All SCADA and signal wires shall be in conduit separate from any AC power lines. All motor circuits must be in separate conduits from any lighting, receptacle, or control wiring.

All conductors shall be sized such that voltage drop does not exceed three percent (3%) for branch circuits or five percent (5%) for feeder branch circuit combinations.

The use of pulling compound shall be required in all installation of wire pulled in conduit as needed. All conduits shall be sized in accordance with NEC regulations and/or local codes.

All terminal blocks shall be Allen Bradley Terminals Model # 1492-CA1 for wire sizes #22 - #8 with mounting channel Model #1492-N1, end barriers Model # 1492-N16, and end anchors Model #1492-N23, or approved equal. At least ten percent (10%) spare terminals shall be provided on all terminal strips. Bare wire ends shall be connected into the recessed terminals. No-fork-tongue compression terminals shall be used unless approved by the District for specific applications. A UL-listed anti-oxidation compound shall be used on any wires connected with wire nuts. All ground connections shall have one (1) wire per lug.

All wiring and components shall be tag-numbered and clearly marked at each termination in accordance with the drawings and as directed by the Engineer. Wire tags shall be heat shrink type wire markers with permanent legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.

2.13 Raceways and Conduit: All conduits shall be one (1) of the following types:

1. Rigid galvanized steel, which shall comply with NEC and local codes. Rigid galvanized steel conduit shall be used for all above-grade installations and shall not be used for buried conduits.

2. PVC plastic, which shall be Schedule 80. All PVC conduit shall comply with NEC and local codes and have glued joints. PVC conduit shall be used for interior conduits or above-grade exterior conduits, but shall be used for all buried conduits.

3. Liquid-tight, which shall be flexible steel conduit with a high tensile strength galvanized steel core and continuous copper ground built into the core. This conduit shall have a smooth non-wrinkling PVC jacket that will not pull away from fittings. This conduit shall be type LA Liquatite as manufactured by Electri-flex, or

approved equal. Liquid-tight conduit shall be used for any final runs into instrumentation equipment, and shall not exceed 18 inches in length.

Conduits between the wet well and control panel shall have a minimum size of 2", shall be sealed gas-tight, and shall be as follows, unless otherwise approved by the District:

1 conduit for each pump
1 conduit for future mixer or influent grinder (spare)
1 conduit for high-high level float
1 conduit for level transducer

All conduits shall be tagged and identified with brass tags held on by copper wire at both ends.

Conduit routing and wire pulling schedules shall be submitted with shop drawings.

Conduits for three phase wire between the main transformer and the transfer switch, as well as between the generator and the transfer switch, shall be encased in a minimum of three (3) inches of concrete on all sides. Other conduits shall be encased in concrete when shown on the plans. Other buried conduits may be encased at the discretion of the Contractor. Concrete encasement shall be colored as required by electrical codes.

Plastic conduit spacers shall be used for all buried conduits, whether encased in concrete or not.

2.14 Grounding: All submitted sire plans shall show a grounding scheme. Grounding shall comply with NEC requirements.

2.15 Nameplates: Engraved nameplates shall be provided for every circuit breaker, control switch, pilot, etc. Nameplates shall be white-faced tags with engraved black letters. Letters shall be at least 3/16-inch in height.

Nameplates shall be attached to the panel by means of stainless steel machine screws.

2.16 Line-Surge Protection: A lightning arrestor and line-surge capacitor shall be provided on the incoming power lines. The lightning arrestor shall be Current Technology Transgaurd, Model TG80. The lightning arrestor and line-surge capacitor shall be mounted outside the control panel.

2.17 Local Alarm: An audible and visual alarm shall be mounted in the enclosure. Mounting the alarm on the top or front of the panel shall not be acceptable. Specific site conditions shall dictate the orientation of the alarm and panel.

The alarm light shall be visible from 360 degrees. The local alarm shall be connected to the high level float, as described in Section 2.08, Submersible Electronic Pressure Transducer.

2.18 Elapsed-Time Meters: An elapsed-time meter connected to auxiliary contacts on the pump starter shall be furnished for each pump. A separate elapsed-time meter shall also be furnished to indicate when two (2) pumps run simultaneously. Elapsed-time meters shall have an increment of 1/100 hour. Elapsed-time meters shall be non-resettable.

2.19 Service Disconnect: After the electric meter, a fused disconnect shall be provided. The fused disconnect shall be service entrance rated (per Artical 230-66 NEC), NEMA 3R, fused disconnect. Provide one (1) additional class KR-5 fuse for each fuse needed. A surge arrester shall be provided on the load side of the disconnect. The disconnect shall be padlockable in the on and off position.

2.20 Manual Transfer Switch: Provide a double throw, NEMA 3R, manual transfer switch for the generator receptacle. The transfer switch shall be rated for the same electrical load as the Service Disconnect. The manual transfer switch shall be located outside of the control panel as shown on the Districts Standard Pump Station Drawing. Lug nuts shall be provided for the connection of a emergency generator.

2.21 Flow Meter: A Badger mag meter shall be provided on the discharge force main. The meter shall be mounted in the valve vault or a separate vault at the discretion of the contractor. Separate vault shall have aluminum hatch and drain line if provided. The meter shall be rated for continual submergence, have a digital display in the control panel and have a connection to the SCADA System.

2.22 SCADA Equipment: Adequate space shall be provided for the installation of a NEMA 4 Fiberglass panel 36” H x 24”W x 12”D. The panel will be supplied and installed by the District. The SCADA Remote Terminal Unit is to be installed by the District and shall be manufactured by RUGID Computer, 6305 Elizan Drive NW, Olympia WA 98502. All necessary contacts and power connections for the proper operation of the SCADA system shall be provided. Contacts shall be provided for the following:

1. Each Pump On/Off
2. Flow
3. Wet Well Level
4. High Water Alarm
5. Intrusion Alarm
6. Entry Alarm
7. Power Fail
8. Pump Fail
9. Seal Fail

## PART 3 – EXECUTION

3.01 Installation: All electrical devices, conduit, wiring, and grounding must be installed and connected by a licensed electrical contractor. All electrical work shall comply with all

local, state and federal electrical codes. Contractor shall pay for all applicable permits and provide the District with proof of permits and inspection approvals.

END OF SECTION