

# Addendum No. 5

## Attachments

## SECTION 16405

### AC INDUCTION MOTORS

#### PART 1 - GENERAL

##### 1.01 RELATED SECTIONS

- A. This section applies only when referenced by a motor-driven equipment specification. Application, horsepower, enclosure type, mounting, shaft type, synchronous speed, and any deviations from this section will be listed in the equipment specification. Where such deviations occur, they shall take precedence over this section.

##### 1.02 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
  - 1. Anti-Friction Bearing Manufacturers' Association (AFBMA):
    - a. 9, Load Ratings and Fatigue Life for Ball Bearings.
    - b. 11, Load Rating and Fatigue Life for Roller Bearings.
  - 2. American National Standards Institute (ANSI): C50.41, Polyphase Induction Motors for Power Generating Stations.
  - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. 85, Test Procedure for Airborne Sound Measurements on Rotating Machines.
    - b. 112, Standard Test Procedures for Polyphase Induction Motors and Generators.
    - c. 114, Standard Test Procedures for Single-Phase Induction Motors.
    - d. 620, Guide for Construction and Interpretation of Thermal Limit Curves for Squirrel-Cage Motors Over 500 Horsepower.
    - e. 841, Recommended Practice for Chemical Industry Severe-Duty Squirrel-Cage Induction Motors, 600V and Below.
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. MG 1, Motors and Generators.
    - b. MG 13, Frame Assignments for Alternating Current Integral Horsepower Induction Motors.

- c. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
- 5. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC)
- 6. Underwriters Laboratories (UL):
  - a. 547, Thermal Protectors for Electric Motors.
  - b. 674, Electric Motors and Generators Used in Hazardous (Classified) Locations.

### 1.03 DEFINITIONS

- A. CISD-TEFC: Chemical industry, severe-duty enclosure.
- B. TEFC: Totally enclosed, fan cooled enclosure.
- C. TENV: Totally enclosed, non-ventilated enclosure.
- D. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.

### 1.04 SUBMITTALS

- A. Shop Drawings:
  - 1. Descriptive information.
  - 2. Nameplate data in accordance with NEMA MG 1.
  - 3. Additional Rating Information:
    - a. Service factor.
    - b. Locked rotor current.
    - c. No load current.
    - d. Safe stall time for motors 200 horsepower and larger.
    - e. Multispeed load classification (e.g., variable torque).
    - f. Adjustable frequency drive motor load classification (e.g., variable torque) and minimum allowable motor speed for that load classification.
  - 4. Enclosure type and mounting (e.g. horizontal, vertical).
  - 5. Dimensions and total weight.
  - 6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
  - 7. Bearing type.
  - 8. Bearing lubrication.

9. Bearing life.
  10. Description and rating of motor thermal protection.
  11. Motor sound power level in accordance with NEMA MG 1.
  12. Maximum brake horsepower required by the equipment driven by the motor.
  13. Description and rating of submersible motor moisture sensing system.
- B. Quality Control Submittals:
1. Factory test reports, certified.
  2. Manufacturer's Certificate of Proper Installation, 100 horsepower and larger.
  3. Operation and Maintenance Manual.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. General Electric.
- B. U.S. Motors.
- C. Baldor.

### 2.02 GENERAL

- A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.
- B. In order to obtain single source responsibility, the contractor shall utilize a single supplier to provide a drive motor, its driven equipment, and specified motor accessories.
- C. Meet requirements of NEMA MG 1.
- D. Frame assignments in accordance with NEMA MG 13.
- E. Provide motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.
- F. Motors shall be specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.

G. Motors driven by variable frequency drives shall be inverter duty rated in compliance with NEMA MG1, Part 31.

H. Operating Conditions:

1. Maximum ambient temperature not greater than 50 degrees C.
2. Motors shall be suitable for operating conditions without any reduction being required in the nameplate rated horsepower or exceeding the rated temperature rise.
3. Overspeed in either direction in accordance with NEMA MG 1.

### 2.03 HORSEPOWER RATING

- A. As designated in motor-driven equipment specifications.
- B. Constant Speed Applications: Brake horsepower of the driven equipment at any head capacity point on the pump curve not to exceed motor nameplate horsepower rating, excluding any service factor.
- C. Adjustable Frequency, Adjustable Speed Applications: Driven equipment brake horsepower at any head capacity point on the pump curve not to exceed motor nameplate horsepower rating, excluding any service factor.

### 2.04 SERVICE FACTOR

- A. 1.15 minimum at rated ambient temperature, unless otherwise indicated.

### 2.05 VOLTAGE AND FREQUENCY RATING

- A. System Frequency: 60-Hz.
- B. Voltage Rating: 460V unless otherwise indicated in motor-driven equipment specifications.
- C. Suitable for full voltage starting.
- D. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.

### 2.06 EFFICIENCY AND POWER FACTOR

- A. For all motors except single-phase, under 1 horsepower, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:
  1. Efficiency:

- a. Tested in accordance with NEMA MG 1, paragraph 12.54.1.
  - b. Guaranteed minimum at full load in accordance with Table 1 or as indicated in motor-driven equipment specifications.
2. Power Factor: Guaranteed minimum at full load in accordance with Table 1 or as indicated in motor-driven equipment specifications.

#### 2.07 LOCKED ROTOR RATINGS

- A. Locked rotor kVA Code F or lower if motor horsepower not covered by NEMA MG 1 tables.
- B. Safe stall time 15 seconds or greater.

#### 2.08 INSULATION SYSTEMS

- A. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.
- B. Three-Phase and Integral Horsepower Motors, Unless Otherwise Indicated in Motor-Driven Equipment Specifications: Class F with Class B rise at nameplate horsepower and designated operating conditions, except EXP and DIP motors which must be Class B with Class B rise.

#### 2.09 ENCLOSURES

- A. All enclosures to conform to NEMA MG 1.
- B. TEFC and TENV: Furnish with a drain hole with porous drain/weather plug.

#### 2.10 TERMINAL (CONDUIT) BOXES

- A. Oversize main terminal boxes for all motors.
- B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.
- C. Except ODP, furnish gaskets between box halves and between box and motor frame.
- D. Terminal for connection of equipment grounding wire in each terminal box.

## 2.11 BEARINGS AND LUBRICATION

### A. Horizontal Motors:

1. 3/4 horsepower and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
2. 1 Through 400 horsepower: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
3. Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in AFBMA 9 and 11.

### B. Regreasable Antifriction Bearings:

1. Readily accessible, grease injection fittings.
2. Readily accessible, removable grease relief plugs.

## 2.12 NOISE

### A. Measured in accordance with IEEE 85 and NEMA MG 1.

### B. Motors controlled by adjustable frequency drive systems shall not exceed sound levels of 3 dBA higher than NEMA MG 1.

## 2.13 BALANCE AND VIBRATION CONTROL

### A. In accordance with NEMA MG 1-12.06.

## 2.14 EQUIPMENT FINISH

### A. External Finish: Prime and finish coat manufacturer's standard. Field painting in accordance with Division 9.

### B. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

## 2.15 SPECIAL FEATURES AND ACCESSORIES

### B. Winding Thermal Protection:

1. Thermostats, unless otherwise noted in the pump specification:
  - a. Motors for constant speed and adjustable speed application 30 through 75 horsepower.
  - b. Bi-metal disk or rod type thermostats embedded in stator windings (normally closed contact).

- c. Automatic reset contacts rated 120 volts ac, 5 amps minimum, and opening on excessive temperature. (Manual reset will be provided at motor controller.)

C. Nameplates:

1. Raised or stamped letters on stainless steel or aluminum.
2. Display all motor data required by NEMA MG 1-10.37 and NEMA MG 1-10.38 in addition to bearing numbers for both bearings.
3. Premium efficiency motor nameplates to also display NEMA nominal efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.

## 2.16 FACTORY TESTING

A. Tests:

1. In accordance with IEEE 112 for polyphase motors and IEEE 114 for single-phase motors.
2. Routine (production) tests on all motors in accordance with NEMA MG 1, plus no load power at rated voltage and polyphase, rated voltage measurement of locked rotor current. Test multispeed motors at all speeds.
3. For energy efficient motors, test efficiency at 50, 75, and 100 percent of rated horsepower:
  - a. In accordance with IEEE 112, Test Method B, and NEMA MG 1, paragraphs 12.54 and 12.57.
4. Power factor:
  - a. Speed.
  - b. Current at rated horsepower.
  - c. kW input at rated horsepower.
  - d. On motors of 100 horsepower and smaller, furnish a certified copy of a motor efficiency test report on an identical motor.

B. Test Report Forms:

1. Routine Tests: IEEE 112, Form A-1.

## PART 3 - EXECUTION



3.01 INSTALLATION

- A. In accordance with manufacturer's instructions and recommendations.
- B. Align motor carefully and properly with driven equipment.
- C. Secure equipment to mounting surface with anchor bolts. Provide anchor bolts meeting manufacturer's recommendations and of sufficient size and number for the specified seismic conditions.

3.02 MANUFACTURER'S SERVICES

- A. Furnish manufacturer's representative at site in accordance with Section 01650, PUMP STATION START-UP AND TESTING for installation assistance, inspection, equipment testing, and startup assistance for motors larger than 75 horsepower.
- B. Manufacturer's Certificate of Proper Installation.

END OF SECTION

## SECTION 16485

### VARIABLE FREQUENCY DRIVES

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- A. Provide all labor, materials, equipment and incidentals required, and install, place in operation and field test variable frequency drive(s) (VFD's).
- B. The variable frequency drive shall be a space vector Pulse-Width Modulated (PWM) design. Modulation methods which incorporate "gear-changing" techniques are not acceptable. The final responsibility of distributor or packager modifications to a third-party standard product will reside with the VFD manufacturer. The VFD manufacturer shall have overall responsibility for the drives. All drives shall be supplied by one manufacturer. The VFD shall be manufactured within the United States of America to alleviate concerns of future serviceability and parts availability.
- C. VFD's shall be eighteen pulse units. Refer to 2.02A.8 for the power unit rating requirements of the VFD.

##### 1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Pumps, General
- B. Division 13 - Instrumentation

##### 1.03 QUALITY ASSURANCE

- A. The entire VFD system as described in section 2.01B shall be factory assembled and system tested by the VFD manufacturer to assure a properly coordinated system.
- B. Codes: Provide equipment in full accordance with the latest applicable rules, regulations, and standards of:
  - 1. Local Laws and Ordinances.
  - 2. State and Federal Laws.
  - 3. National Electric Code (NEC).
  - 4. Underwriters Laboratories (UL).
  - 5. American National Standards Institute (ANSI).
  - 6. National Electrical Manufacturers Association (NEMA).
  - 7. Institute of Electrical and Electronics Engineers (IEEE).
- C. The complete drive system shall be UL listed.

#### 1.04 SUBMITTALS

- A. Submittals shall conform in all respects to Section 01300 SUBMITTALS.
- B. Submittals shall be custom prepared by the VFD manufacturer for this specific application.
- C. Submittal information shall include, but not be limited to:
  - 1. Equipment dimensions, including stub-up locations, shipping splits and shipping weights.
  - 2. Catalog cuts of major components.
  - 3. Spare parts list, per Paragraph 3.03.
  - 4. Certifications, including:
    - a. Warranty, per section 1.04.
    - b. Efficiencies, per section 2.02.A.1.
  - 5. Harmonic Distortion Analysis, per section 2.01D.

#### 1.05 WARRANTY

- A. All equipment furnished under this section shall be warranted for on site parts and labor by the contractor and the equipment manufacturers for a period of five (5) years after substantial completion.

### PART 2 - PRODUCTS

#### 2.01 Material and Equipment

- A. All material supplied shall be one of the products specified in Appendix D “List of Approved Products” appended to these technical specifications.
- B. Any modifications to a standard product required to meet this specification shall be performed by the VFD manufacturer only. Distributor or system integrator changes to the VFD manufacturer's product are specifically disallowed.
- C. The VFD system shall consist of a power factor correction / harmonic filter unit, input rectifier-grade phase-shifting transformer, 18 pulse converter section, output inverter and control logic section, harmonic filtering unit and Solid State Soft Start (SSSS) bypass. All components listed including power factor correction / harmonic filter shall be integral to the VFD lineup, factory wired and tested as a complete system. The entire VFD system shall meet the requirements of NEC article 409 and IEEE 508A for fault current withstand ratings as indicated on the project electrical drawings.

- D. Input circuit breaker, interlocked with the enclosure door, with through-the-door handle to provide positive disconnect of incoming AC power and shall be capable of being locked in the open position.
- E. VFD system shall maintain a 0.95 minimum true power factor throughout the entire speed range.

## 2.02 VARIABLE FREQUENCY DRIVES

### A. Ratings

1. The drive system shall be 96% efficient at full load and full speed and 95.5% efficient at 51% load and 80% speed. Losses to be utilized in drive system efficiency calculation shall include input transformer, harmonic filter and power factor correction if applicable, VFD converter and output filter if applicable. Auxiliary controls, such as internal VFD control boards, cooling fans or pumps, shall be included in all loss calculations.
2. Rated Input Power: 460 Volts 60 Hz, +10%, -5% at rated load, 3-phase.
  - a. Voltage Dip Ride-Through: VFD shall be capable of sustaining continued operation with a 40% dip in nominal line voltage. Output speed may decline only if current limit rating of VFD is exceeded.
  - b. Power Loss Ride-through: VFD shall be capable of a minimum 3 cycle power loss ride-through without fault activation.
3. Output Power: As required by motors supplied.
4. Ambient Temperature Range: 0 to 40°C.
5. Elevation: Up to 3300 feet (1000 meters) above MSL without de-rating.
6. Atmosphere: Non-condensing relative humidity to 95%.
7. AC Line Frequency Variation: +/- 3 Hertz.
8. Power Unit Rating Basis: 115% rated current continuous, 150% rated current for one minute, at rated temperature. If the power unit rating of the VFD does not meet the above requirements, provide VFD with one standard size larger than the nameplate motor horsepower.
9. VFD shall be sized to serve 115% of motor load.

### B. Construction

1. The controller shall produce an adjustable AC voltage/frequency output. It shall have an output voltage regulator to maintain correct output V/Hz ratio despite incoming voltage variations.
2. The controller shall have a continuous output current rating of 100% of motor nameplate current.
3. The converter section shall be 18 pulse utilizing diodes.
4. The inverter output shall be generated by IGBTs. Pulse Width Modulation strategy will be of the space vector type implemented to generate a sine-coded output voltage. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current

for pure sine wave operation. The inverters shall be able to sustain 1600 volt surges.

5. The controller(s) shall be suitable for use with any standard NEMA-B squirrel-cage induction motor(s) having a 1.15 Service Factor or with existing standard NEMA-B squirrel-cage induction motor(s) with nameplate data as shown on the plans. Provide drives with dV/dT output filters. At any time in the future, it shall be possible to substitute any standard motor (equivalent horsepower, voltage and RPM) in the field.
6. The control logic section shall be fully digital and not require analog adjustment pots or fixed selector resistors. A power failure will not necessitate a reload of any drive parameter or configuration.
7. Minimum Starting Speed: When called to operate, the VFD shall ramp to a minimum speed. The minimum speed shall be adjustable but initially set at 60% of maximum speed. The 4-20 mA speed signal from the PLC and potentiometer on the front of the drive shall modulate the signal between the minimum speed set point and the maximum output speed of the drive; i.e., at the 4 mA signal, the VFD shall run at the minimum speed. At the 20 mA signal, the VFD shall run at full speed. The potentiometer shall also adjust speed between the minimum speed set point and the maximum running speed. Below the minimum speed set point, the potentiometer shall have no effect.

#### C. Basic Features

1. The door of each power unit shall include: a keypad with a manual speed device, "HAND / OFF / REMOTE/BYPASS" mode selector switch, "POWER ON" light, "VFD FAIL" light, VFD "RUNNING" light, fault reset pushbutton, "MOTOR OVER TEMPERATURE" light, "MOTOR HEATER ON" light, "ENCLOSURE OVER TEMPERATURE" light, "DRIVE LOCKOUT" light, CONTROL POWER ON light, START and STOP pushbuttons and a TEST / NORMAL selector switch. All lights shall be LED type.
2. The VFD shall include a customer selectable automatic restart feature. When enabled, the VFD shall automatically attempt to restart after a trip condition resulting from instantaneous overcurrent, overvoltage, out of saturation or overload. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function (programmable for up to 3 attempts) is not successful within a customer programmable time period. Auto-Restart shall be programmable to allow for individual fault selection.
3. A door-mounted membrane keypad with integral 2-line minimum, 24-character LCD display shall be furnished, capable of controlling the VFD and setting drive parameters. The keypad shall include the following features:

- a. The digital display must present all diagnostic message and parameter values in English engineering units when accessed, without the use of codes.
  - b. The digital keypad shall allow the operator to enter exact numerical settings in English engineering units. A user menu written in plain English (rather than codes) shall be provided in software in nonvolatile memory as a guide to parameter setting and resettable in the field through the keypad. Multiple levels of password security shall be available to protect drive parameters from unauthorized personnel. The drive set up parameters must be able to be transferred to new boards to reprogram spare boards.
  - c. The following digital door-mounted keypad indications may be selectively displayed:
    - 1) Speed demand in percent.
    - 2) Output current in amperes.
    - 3) Output Frequency in hertz.
    - 4) Input voltage.
    - 5) Output voltage.
    - 6) Total 3-phase KW.
    - 7) Kilowatt hour meter
    - 8) Elapsed time running meter.
    - 9) RPM.
    - 10) DC bus voltage.
  - d. VFD shall have the capability of communicating via an RJ-45 Ethernet port with a Modicon PLC using MODBUS Ethernet protocol.
  - e. VFD parameters, fault log and diagnostic log shall be downloadable via a RJ-45 Ethernet port.
4. Refer to the VFD wiring diagram in the drawings for remote signals and alarms.

D. Enclosure

1. All VFD components shall be factory mounted and wired on a dead front, grounded, NEMA-1 enclosure. If a free-standing enclosure is provided, it shall be suitable for mounting on a concrete housekeeping pad.

E. Protective Features and Circuits: The controller shall include the following alarms and protective features:

1. Instantaneous overcurrent and overvoltage trip.
2. Undervoltage and power loss protection.
3. Power unit overtemperature alarm and protection. Upon sensing an overtemperature condition, the VFD is to automatically trip.
4. Electronic motor inverse time overload protection.

5. Responsive action to motor winding temperature detectors or thermostatic switches. A dry contact (NC) input to the VFD is required.
6. When power is restored after a complete power outage, the VFD shall be capable of catching the motor while it is still spinning and restoring it to proper operating speed without the use of an encoder.
7. The VFD shall be protected from damage due to the following, without requiring an output contactor:
  - a. Three-phase short circuit on VFD output terminals.
  - b. Loss of input power due to opening of VFD input disconnecting device or utility power failure during VFD operation.
  - c. Loss of one (1) phase of input power.
8. The VFD shall continue to operate at a reduced capacity under a single-phase fault condition.
9. The VFD shall be able to withstand the following fault conditions without damage to the power circuit components:
  - a. Failure to connect a motor to the VFD output.
  - b. VFD output open circuit that may occur during operation.
  - c. VFD output short circuit that may occur during operation.
10. Three phase lightning and surge protection across the line input at each VFD.
11. Provide 120V motor heater power that is active when the motor is off and is off when the motor is active.

#### F. Parameter Settings

1. The following system configuring settings shall be provided and field adjustable, without exception, through the keypad/display unit. Except for Motor Nameplate Data, all parameters must be adjustable while the processor is on-line and the drive is running.
  - a. Motor Nameplate Data.
    - 1) Motor frequency.
    - 2) Number of poles.
    - 3) Full load speed.
    - 4) Motor volts.
    - 5) Motor full load amps.
    - 6) Motor HP.
    - 7) Current limit, max.
  - b. VFD Configuration Parameters.
    - 1) Independent accelerate/decelerate rates.
    - 2) Max/Min speed (frequency)
    - 3) Catch-a spinning load selection.
    - 4) No load boost.
    - 5) Full load boost.
    - 6) Volts/Hertz ratio.
    - 7) Overspeed trip.
    - 8) Overload trip curve selection.

- 9) Overload trip time selection
- 10) Adjustable Ramp Stop.
- c. Automatic VFD Control.
  - 1) PID utilizing an internal or external setpoint.
  - 2) Three selectable critical speed avoidance bands with programmable bandwidths.
  - 3) Auto start functions: On/Off, Delay On/Off. Operable from a 4-20mA signal or from the PID output, command, or feedback signal.
  - 4) Speed Profile: Programmable entry and exit points.
  - 5) Programmable loss of signal control: Stop, maintain last speed, or default to preselected setpoint.
2. All drive setting adjustments and operation parameters shall be stored in a parameter log which lists allowable maximum and minimum points as well as the present set values. This parameter log shall be accessible via a RJ-45 Ethernet port capable of communicating with a Modicon PLC using MODBUS Ethernet protocol as well as on the keypad display.

#### G. Input/Output Features

1. Two programmable analog inputs: VFD speed in, spare.
2. Three programmable analog outputs: VFD speed output, Drive (output) current in Amps, spare.
3. Two programmable digital inputs: Run, spare.
4. Ten programmable digital outputs: VFD fault, VFD running, VFD in remote, 6 spare.
5. One Pot input (three wire control, +10 V, wiper and common).
6. System Program providing built-in drive control or application specific configuration capability.

#### H. Diagnostic Features and Fault Handling

1. The VFD shall include a comprehensive microprocessor based digital diagnostic system that monitors its own control functions and displays faults and operating conditions.
2. A "Fault Log" shall be accessible via a RJ-45 Ethernet link capable of communicating with a Modicon PLC using MODBUS Ethernet protocol as well as line-by-line on the keypad display. The "FAULT LOG" shall record, store, display and output to a serial port upon demand, the following for the 64 most recent events:
  - a. Date and time of day.
  - b. Type of fault.
  - c. All faults and events shall be stored and displayed in English, not fault codes.
3. A "HISTORIC LOG" shall record, store, and output via a RJ-45 Ethernet link port capable of communicating with a Quantum PLC via MODBUS Ethernet protocol upon demand, the following selectable control variables at



1 msec. intervals for the 58 intervals immediately preceding and the 20 intervals immediately following a fault trip:

- a. Torque demand.
- b. Torque command.
- c. Torque feedback.
- d. Torque error.
- e. Torque maximum.
- f. Current demand.
- g. Peak current.
- h. Motor current.
- i. DC bus voltage.
- j. Line voltage.
- k. Velocity demand.
- l. Velocity reference.
- m. PI min/max limit.
- n. Boost.
- o. VFD mode (Auto/Manual).

## PART 3 - EXECUTION

### 3.01 FACTORY TESTING

- A. The VFD manufacturer shall provide as a minimum, the following quality assurance steps within his factory:
  1. Incoming inspection of components and raw materials based on strategic supplier base and experience. Sampling plans based on MIL STD 105E.
  2. MIL STD 45662 calibration system.
  3. All products subject to 100% testing and final inspection; no sampling plans permitted.

### 3.02 PRE-DELIVERY TESTING COORDINATION

- A. One VFD unit of each specified type and application shall be shipped to the pump manufacturer's test facility for complete operational testing. The VFD Manufacturer shall provide a qualified representative at the pump Manufacturer's test facility during testing. All costs incurred by the VFD Manufacturer to meet this requirement shall be included in the bid.
- B. Certified test reports shall be submitted to the ENGINEER before the equipment is shipped to the project site.

### 3.03 STARTUP AND TRAINING

- A. VFD manufacturer shall provide the services of a factory technician for startup assistance and training. Verification of VFD input harmonic voltage and current distortion limits specified must be verified as part of final startup and acceptance.

If harmonic distortion requirements are not met, it is the responsibility of the VFD supplier to meet the specification at the supplier's expense. A recording type Fluke 41 or equivalent harmonic analyzer displaying individual and total harmonic currents and voltages must be utilized.

- B. A 10% payment retainage will be released upon field test verification of harmonic specification requirements and final acceptance.
- C. Provide 2 8-hour days training for up to 8 personnel (each day).

### 3.04 SPARE PARTS

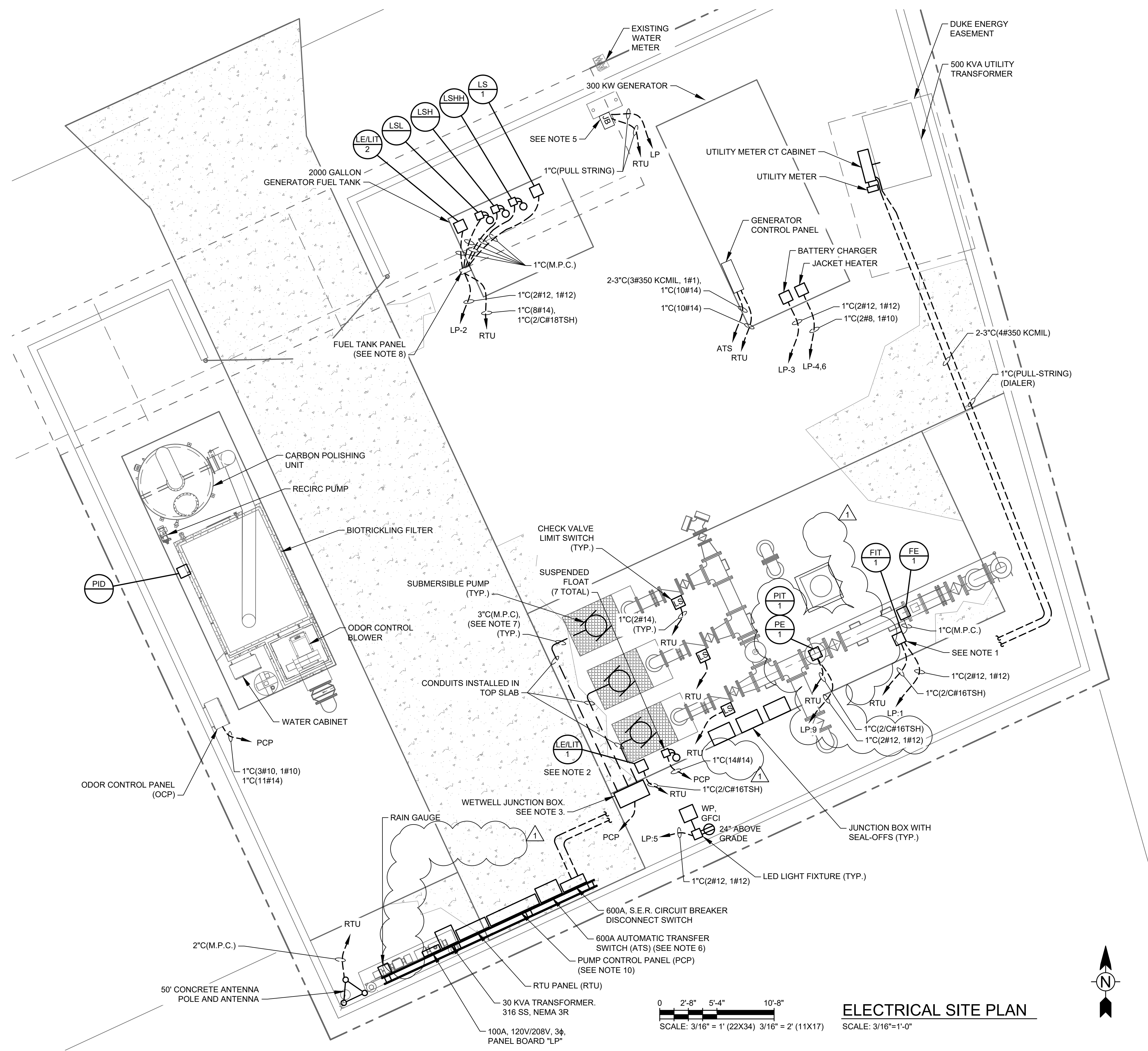
- A. The following spare parts shall be furnished:
  - 1. Three of each type of fuse rated 460V or less.
  - 2. Two of each type of converter power semiconductor.
  - 3. Two of each type of inverter power semiconductor.
  - 4. One of each type of type control printed circuit board and gate firing boards.
  - 5. (5) Five keypad assembly(s).
  - 6. (1) Spare VFD for each size provided on project.
  - 7. (1) Copy of software required with (1) copy of any program software with initial set points configured per initial plant setup.

### 3.05 FIELD QUALITY CONTROL

- A. Functional Test:
  - 1. Conduct on each VFD.
  - 2. Inspect controller for electrical supply termination connections, interconnections, proper installation, and quiet operation.
  - 3. Vibration Test: Complete assembly, consisting of motor, load, and flexible shafting, connected and in normal operation, shall not develop amplitudes of vibration exceeding limits recommended by current edition of Hydraulic Institute Standards. Where pumps and motors are separated by intermediate flexible shafting, measure vibration both at top motor bearing and at two points on top pump bearing, 90 degrees apart.
  - 4. Record test data for report.
- B. Performance Test:
  - 1. Conduct on each VFD.
  - 2. Perform under actual or approved simulated operating conditions.
  - 3. Test for continuous 7-day period without malfunction.
  - 4. Demonstrate performance by operating the continuous period while varying the application load, as the input conditions allow, in order to verify system performance.
  - 5. Record test data for report.

END OF SECTION

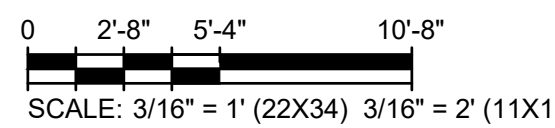
8/6/2019 3:28:18 PM - \\TTS181\FS1\PROJECTS\IER10034200-10034-16004\CAD\SHEETFILES\TOWN CENTER - PS 3497\52 E-102.DWG - REINEFELD, AURORA



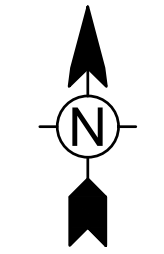
- GENERAL NOTES:**
1. THE AREA WITHIN 10 FEET OF ALL HATCHES AND 18 INCHES ABOVE ALL HATCHES IS A HAZARDOUS CLASS 1 DIV. 1 LOCATION. ALL ELECTRICAL EQUIPMENT WITHIN THIS AREA MUST HAVE NEMA 7 RATING.
  2. NOT USED.

3. ALL EQUIPMENT OUTSIDE OF HAZARDOUS AREAS AS STATED ABOVE SHALL HAVE NEMA 4X RATING.
4. CONDUITS ABOVE WET WELL SHALL BE INSTALLED IN CONCRETE SLAB.

- NOTES:**
1. PROVIDE SUNSHIELD OVER FLOW METER TRANSMITTER AND PRESSURE TRANSMITTER.
  2. PROVIDE STAINLESS STEEL CAGE OVER RADAR LEVEL TRANSMITTER.
  3. WET WELL JUNCTION BOX SHALL HAVE SPLIT TYPE EYSR SEAL-OFF'S ON ALL CONDUITS ENTERING AND EXITING JUNCTION BOX. PROVIDE TERMINAL STRIP IN JUNCTION BOX FOR TERMINATING CONDUCTORS.
  4. CONDUIT SHALL NOT BE RUN ON TOP OF SLAB.
  5. FOR FUTURE PRESSURE TRANSMITTER AT WATER METER. RUSS ELECTRIC AT'S-NO EXCEPTIONS.
  7. CONDUITS FEEDING PUMPS SHALL BE ROUTED AND INSTALLED IN TOP SLAB.
  8. PNEUMERATOR LC1003 GENERATOR FUEL TANK PANEL. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DUKE ENERGY CONNECTION AND INSTALLATION FEES.
  9. SEAL-OFF'S SHALL NOT BE LOCATED DIRECTLY BELOW CONTROL PANEL. PROVIDE SEAL-OFF'S BELOW WET WELL JUNCTION BOXES. SEE NOTE 3.



**ELECTRICAL SITE PLAN**  
SCALE: 3/16"=1'-0"



REV	DATE	DESCRIPTION
1	08/05/2019	ADDENDUM NO. 5

LINE IS 2 INCHES AT FULL SIZE (IF NOT SCALE ACCORDINGLY)

**ORANGE COUNTY UTILITIES DEPARTMENT ENGINEERING DIVISION**  
9150 CURRY FORD ROAD ORLANDO, FL. 32825

BID SET

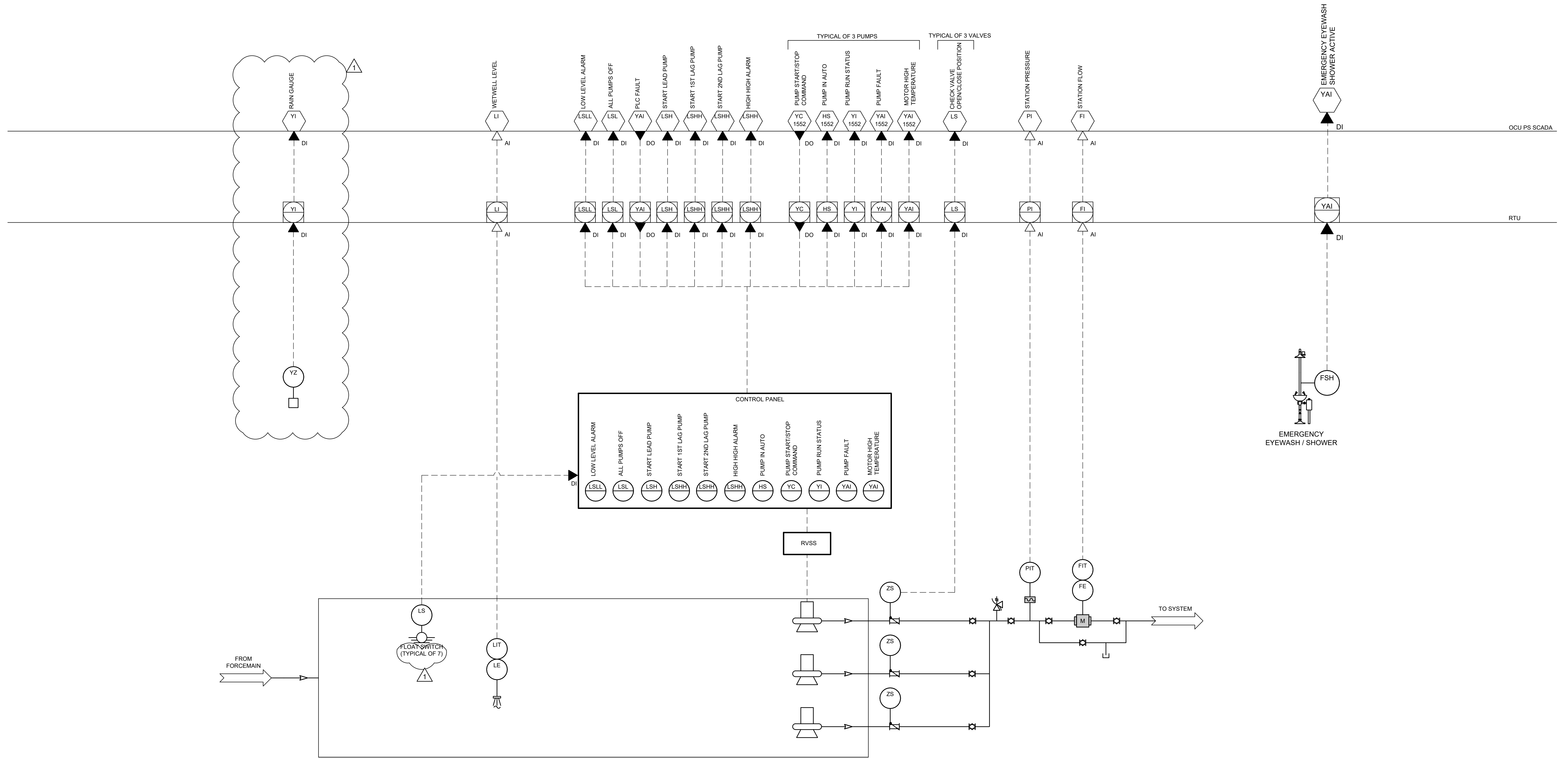
**TETRA TECH**  
ENGINEERING BUSINESS NO. 2429  
201 EAST PINE STREET SUITE 1000 ORLANDO, FL 32801  
PHONE: (407) 839-3955 FAX: (407) 839-3790

**ORANGE COUNTY UTILITIES**  
TOWN CENTER BOULEVARD 3497 AND SOUTH CENTRAL 3499  
MASTER PUMP STATION IMPROVEMENTS  
PS3497 ELECTRICAL  
SITE PLAN

BANKS R. WASON  
PROFESSIONAL ENGINEER  
FLORIDA LICENSE #73973

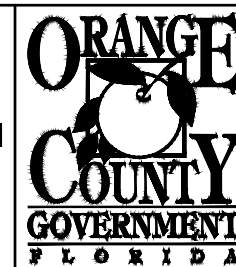
OCU FILE NO.: 75985	SCALE: AS-NOTED
DESIGNED BY: JAS	DRAWING NO.:
DRAWN BY: JAS	<b>E-102</b>
CHECKED BY: BRW	SHEET: 63 OF 85
CADD FILE: 52 E-102	

8/6/2019 3:28:19 PM - P:\N10034200-10034-16004\CAD\SHEETFILES\101.DWG - REINEFELD, AURORA



REV	DATE	DESCRIPTION
1	08/05/2019	ADDENDUM NO. 5

LINE IS 2 INCHES  
AT FULL SIZE  
(IF NOT SCALE ACCORDINGLY)



**ORANGE COUNTY UTILITIES DEPARTMENT**  
ENGINEERING DIVISION  
9150 CURRY FORD ROAD ORLANDO, FL. 32825

BID SET



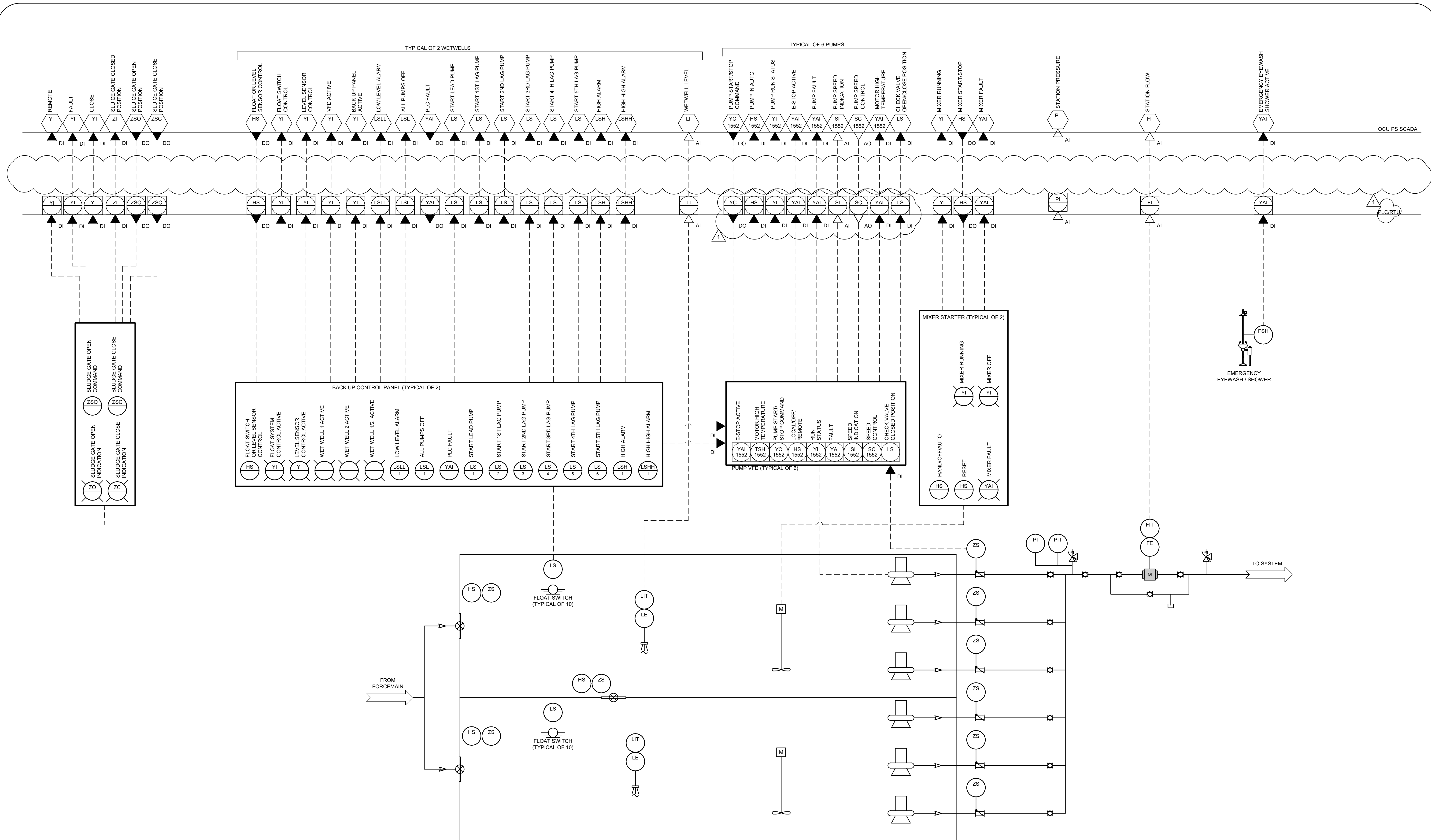
**ORANGE COUNTY UTILITIES**  
TOWN CENTER BOULEVARD 3497 AND SOUTH CENTRAL 3499  
MASTER PUMP STATION IMPROVEMENTS  
PS 3497 P&ID

BANKS R. WASON  
PROFESSIONAL ENGINEER  
FLORIDA LICENSE #73973

OCU FILE NO.: 75985  
DESIGNED BY: AMR  
DRAWN BY: AMR  
CHECKED BY: BRW  
CADD FILE: I-101

SCALE: AS-NOTED  
DRAWING NO.:  
**I-101**  
SHEET: 82 OF 85

8/6/2019 3:28:20 PM - P:\IER1\0034\200-10034-16004\CAD\SHEETFILES\201.DWG - REINEFELD, AURORA



REV	DATE	ADDENDUM NO. 5	DESCRIPTION
1	08/05/2019		

LINE IS 2 INCHES  
AT FULL SIZE  
(IF NOT SCALE ACCORDINGLY)

**ORANGE COUNTY GOVERNMENT FLORIDA**

*ORANGE COUNTY UTILITIES DEPARTMENT ENGINEERING DIVISION*

9150 CURRY FORD ROAD ORLANDO, FL. 32825

BID SET

**TETRA TECH**  
ENGINEERING BUSINESS NO. 2429

www.tetra-tech.com  
201 EAST PINE STREET SUITE 1000  
ORLANDO, FL 32801  
PHONE: (407) 839-3955 FAX: (407) 839-3790

**ORANGE COUNTY UTILITIES**  
TOWN CENTER BOULEVARD 3497 AND SOUTH CENTRAL 3499  
MASTER PUMP STATION IMPROVEMENTS  
PS 3499 P&ID

BANKS R. WASON  
PROFESSIONAL ENGINEER  
FLORIDA LICENSE #73973

OCU FILE NO.: 75985  
DESIGNED BY: KC  
DRAWN BY: KC  
CHECKED BY: BRW  
CADD FILE: I-201

SCALE: AS-NOTED  
DRAWING NO.:  
**I-201**  
SHEET: 84 OF 85



# Florida Department of Environmental Protection

Rick Scott  
Governor

Carlos Lopez-Cantera  
Lt. Governor

Central District  
3319 Maguire Boulevard, Suite 232  
Orlando, Florida 32803-3767

Noah Valenstein  
Secretary

## NOTIFICATION OF ACCEPTANCE OF USE OF A GENERAL PERMIT

**PERMITTEE:**

Orange County Utilities  
9150 Curry Ford Road  
Orlando, FL 32825  
Mark Ikeler, Chief Engineer

Email: [mark.ikeler@ocfl.net](mailto:mark.ikeler@ocfl.net)

**PERMIT NUMBER:**

0368602-001-DWC/CG

**ISSUE DATE:**

September 28, 2018

**EXPIRATION DATE:**

September 28, 2023

**COUNTY:**

Orange

**PROJECT NAME:**

Orange County Mater Pump  
Station PS3499

**CONNECTED TO:**

OCUD South WRF

**FACILITY ID:**

FLA107972

Dear Mr. Ikeler:

This letter acknowledges receipt of your Notification/Application for Constructing a Domestic Wastewater Collection/Transmission System for the subject project. Our office received the Notice on September 12, 2018.

*This is to advise you that the Department does not object to your use of such General Permit.*

Please note the attached requirements apply to your use of this General Permit for constructing the proposed domestic wastewater collection/transmission system.

You are further advised that the construction activity must conform to the description contained in your Notification/Application for Constructing a Domestic Wastewater Collection/Transmission System and that any deviation will subject the permittee to enforcement action and possible penalties.

Sincerely,

A handwritten signature in black ink that reads "OHM".

Osama Mahmoud  
Engineer  
Permitting and Waste Cleanup Program - Wastewater

OHM/ohm

cc: Daniel Allen, PE, Tetra Tech, [Daniel.allen@tetrattech.com](mailto:Daniel.allen@tetrattech.com)  
Charles LeGros, DEP, [Charles.LeGros@dep.state.fl.us](mailto:Charles.LeGros@dep.state.fl.us)  
Osama Mahmoud, DEP, [osama.mahmoud@dep.state.fl.us](mailto:osama.mahmoud@dep.state.fl.us)

## REQUIREMENTS FOR USE OF THE GENERAL PERMIT FOR DOMESTIC WASTEWATER COLLECTION/TRANSMISSION SYSTEMS:

1. This general permit is subject to the general permit conditions of Rule 62-4.540, F.A.C., as applicable. This rule is available at the Department's Internet site at:  
<http://www.dep.state.fl.us/legal/Rules/shared/62-4/62-4.pdf> [62-4.540]
2. This general permit does not relieve the permittee of the responsibility for obtaining a dredge and fill permit where it is required. [62-604.600(6)(b)1]
3. This general permit cannot be revised, except to transfer the permit. [62-604.600(6)(b)2]
4. This general permit will expire five years from the date of issuance. If the project has been started and not completed by that time, a new permit must be obtained before the expiration date in order to continue work on the project. [62-4.030]
5. Upon completion of construction of the collection/transmission system project, and before placing the facilities into operation for any purpose other than testing for leaks or testing equipment operation, the permittee shall submit to the Department's Central District Office Form 62-604.300(8)(b), Request for Approval to Place a Domestic Wastewater Collection/Transmission System into Operation. This form is available at the Department's Internet site at: <http://www.dep.state.fl.us/water/wastewater/dom/dw-forms.htm>. [62-604.700(2)]

**Please submit the entire clearance document package in electronic format to [DEP\\_CD@dep.state.fl.us](mailto:DEP_CD@dep.state.fl.us), with a copy to [osama.mahmoud@dep.state.fl.us](mailto:osama.mahmoud@dep.state.fl.us) , and [Charles.LeGros@dep.state.fl.us](mailto:Charles.LeGros@dep.state.fl.us). If the file is very large, you may post it to the Wastewater Electronic Applications folder on the following ftp site at:**

<ftp://ftp.dep.state.fl.us/pub/wastewater/>

After posting the document, send an e-mail to [DEP\\_CD@dep.state.fl.us](mailto:DEP_CD@dep.state.fl.us), with a copy to [osama.mahmoud@dep.state.fl.us](mailto:osama.mahmoud@dep.state.fl.us) , and [Charles.LeGros@dep.state.fl.us](mailto:Charles.LeGros@dep.state.fl.us), alerting us that it has been posted. Any submitted drawings (should be sized 11" x 17") and the engineer of record's signed seal and dates on the required document must be legible for acceptance.

For further clarification contact:  
(Osama Mahmoud), (407) 897-4125  
3319 Maguire Blvd, Suite 232  
Orlando, Florida 32803-3767

6. The new or modified collection/transmission facilities shall not be placed into service until the Department clears the project for use. [62-604.700(3)]
7. Abnormal events shall be reported to the Department's Central District Office in accordance with Rule 62-604.550, F.A.C. For unauthorized spills of wastewater in excess of 1000 gallons per incident, or where information indicates that public health or the environment may be endangered, oral reports shall be provided to the STATE WATCH OFFICE TOLL FREE NUMBER (800)320-0519 as soon as practical, but no later than 24 hours from the time the permittee or other designee becomes aware of the circumstances. Unauthorized releases or spills less than 1000 gallons per incident are to be reported orally to the Department's Central District Office within 24 hours from the time the permittee, or other designee becomes aware of the circumstances. [62-604.550]



# Florida Department of Environmental Protection

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Noah Valenstein  
Secretary

## NOTIFICATION OF ACCEPTANCE OF USE OF A GENERAL PERMIT

<b>PERMITTEE:</b> Orange County Utilities 9150 Curry Ford Road Orlando, FL 32825 Mark Ikeler, Chief Engineer	<b>PERMIT NUMBER:</b> <b>ISSUE DATE:</b> <b>EXPIRATION DATE:</b> <b>COUNTY:</b> <b>PROJECT NAME:</b>	0368614-001-DWC/CG October 4, 2018 October 4, 2023 Orange Orange County Pump Station 3497
Email: <a href="mailto:mark.ikeler@ocfl.net">mark.ikeler@ocfl.net</a>	<b>CONNECTED TO:</b> <b>FACILITY ID:</b>	OCUD South WRF FLA107972

Dear Mr. Ikeler:

This letter acknowledges receipt of your Notification/Application for Constructing a Domestic Wastewater Collection/Transmission System for the subject project. Our office received the Notice on September 12, 2018.

*This is to advise you that the Department does not object to your use of such General Permit.*

Please note the attached requirements apply to your use of this General Permit for constructing the proposed domestic wastewater collection/transmission system.

You are further advised that the construction activity must conform to the description contained in your Notification/Application for Constructing a Domestic Wastewater Collection/Transmission System and that any deviation will subject the permittee to enforcement action and possible penalties.

Sincerely,

A handwritten signature in black ink that reads "OHM".

Osama Mahmoud  
Engineer  
Permitting and Waste Cleanup Program - Wastewater

OHM/ohm

cc: Richard Wilson, PE, Epic Group, [rick@epicgroupllc.com](mailto:rick@epicgroupllc.com)  
Charles LeGros, DEP, [Charles.LeGros@dep.state.fl.us](mailto:Charles.LeGros@dep.state.fl.us)  
Osama Mahmoud, DEP, [osama.mahmoud@dep.state.fl.us](mailto:osama.mahmoud@dep.state.fl.us)



## REQUIREMENTS FOR USE OF THE GENERAL PERMIT FOR DOMESTIC WASTEWATER COLLECTION/TRANSMISSION SYSTEMS:

1. This general permit is subject to the general permit conditions of Rule 62-4.540, F.A.C., as applicable. This rule is available at the Department's Internet site at:  
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**Please submit the entire clearance document package in electronic format to [DEP\\_CD@dep.state.fl.us](mailto:DEP_CD@dep.state.fl.us), with a copy to [osama.mahmoud@dep.state.fl.us](mailto:osama.mahmoud@dep.state.fl.us) , and [Charles.LeGros@dep.state.fl.us](mailto:Charles.LeGros@dep.state.fl.us). If the file is very large, you may post it to the Wastewater Electronic Applications folder on the following ftp site at:**

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For further clarification contact:  
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Orlando, Florida 32803-3767

6. The new or modified collection/transmission facilities shall not be placed into service until the Department clears the project for use. [62-604.700(3)]
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# Florida Department of Environmental Protection

Rick Scott  
Governor

Carlos Lopez-Cantera  
Lt. Governor

Central District  
3319 Maguire Boulevard, Suite 232  
Orlando, Florida 32803-3767

Noah Valenstein  
Secretary

October 24, 2018

Orange County Utilities Engineering Division  
Mark Ikeler, Chief Engineer  
[Mark.Ikeler@ocfl.net](mailto:Mark.Ikeler@ocfl.net)  
9150 Curry Ford Road  
Orlando, Florida 32825-7600

File No.: 369210-001-EE, Orange County

Dear Mr. Ikeler:

On October 1, 2018, the Department received your request for verification of exemption to construct improvements to an existing sanitary sewer master pump station, as depicted on Exhibit 1 attached. The sewer pump station is located at 2710 Town Center Boulevard in Section 28, Township 24 South, Range 29 East in Orlando, Orange County. The parcel identification number is 27-24-29-8723-00-009.

Your request has been reviewed to determine whether it qualifies for (1) regulatory exemption, (2) proprietary authorization (related to state-owned submerged lands), and (3) federal approval that may be necessary for work in wetlands or waters of the United States.

**Additional authorization must be obtained prior to commencement of the proposed activity.** This letter does not relieve you from the responsibility of obtaining other federal, state, or local authorizations that may be required for the activity. Please refer to the specific section(s) dealing with that portion of the review below for advice on how to proceed.

If you change the project from what you submitted, the authorization(s) granted may no longer be valid at the time of commencement of the project. Please contact us prior to beginning your project if you wish to make any changes.

If you have any questions regarding this matter, please contact Leo Angleró at the letterhead address or at 407-897-2953 and email [Leo.Anglero@dep.state.fl.us](mailto:Leo.Anglero@dep.state.fl.us).

## 1. Regulatory Review – Verified

Based on the information submitted, the Department has verified proposed activity is not a regulated activity under Chapter 62-330.051(2), Florida Administrative Code. Consequently, a regulatory permit is not needed under Part IV of Chapter 373 of the Florida Statutes.