CITY OF TAMPA

Bob Buckhorn, Mayor **CONTRACT ADMINISTRATION DEPARTMENT**

Michael W. Chucran, Director

ADDENDUM NO. 4

DATE: January 6, 2016

Contract 16-C-00019; University Pumping Station Pump #1 Replacement

Bidders on the above referenced project are hereby notified that the following addendum is made to the Contract Documents. BIDS TO BE SUBMITTED SHALL CONFORM TO THIS NOTICE.

Item 1: The Bid Date is hereby changed to January 17, 2017.

Item 2: Replace Workmanship and Materials Section 45-Electrical, with the attached Section 45 – Electrical.

Item 3: Replace Workmanship and Materials Section 46 –Variable Frequency Drives, with the attached Section 46 – Variable Frequency Drives.

All other provisions of the Contract Documents and Specifications not in conflict with this Addendum shall remain in full force and effect. Questions are to be e-mailed to Contract Administration@tampagov.net.

Jim Greiner

Jim Greiner, P.E., Contract Management Supervisor

SECTION 45 - ELECTRICAL

W-45.01 Scope of Electrical Work

The work in this section consists of furnishing all labor, materials, equipment, transportation, and performing all operations required to support the installation and commissioning of the electrical portion of the University Pumping Station, Pump No.1 Replacement. The work includes, but is not limited to, the following:

1. Submit working drawings, parts schedules and cut-sheets to the Engineer.

2. Furnish and install all equipment, controls and instrumentation as shown on the Plans and described in the Specifications.

   Specifically:

   a. The existing Allen Bradley variable frequency drive (VFD) and associated equipment mounted in section 3 of the existing Sewage Pumps Control Center shall be removed from the enclosure, and a new free-standing, 400 horsepower, true 12-pulse VFD shall be installed. The work shall be performed in such a way as to ensure maximum availability of the sewage pumps. Any necessary power outages shall be kept to a minimum, and coordinated with the Inspectors at least three days prior to the event.

   b. The proposed main circuit breaker and input fusing shall be installed in cubicle 3 as noted above, as shown on the drawings, and as specified. This work will require the electric utility company, TECO, to temporarily disconnect the electrical service to the pumping station at a low-flow period of the day (between midnight and 6AM). The Contractor shall coordinate this activity with City Personnel who will dictate the terms of the outage. The city will coordinate the outage with TECO and cover any associated costs.

   c. Provide a surge protection device (SPD) on the load side of the VFD main circuit breaker as shown, specified, and required.

   d. Verify existing Power / Instrumentation / Control connections in the field prior to commencing demolition work. Create a point-to-point wiring list and mark conductors to facilitate reconnection. Coordinate Instrumentation / Control connections with City personnel. City personnel will be responsible for any pump controller reprogramming, and making any final I/O connections, in the existing SCADA RTU enclosure, necessary for adding the proposed VFD system. The Contractor shall provide and route all wiring as required.

   e. All removed equipment shall remain the property of the City and shall be removed from the premises and disposed of properly as directed by the City.

f. Modify the pump controls located in section 4 of the existing Sewage Pumps Control Center as shown, specified and required. All added controls shall be of the same design and quality of the original controls.

g. Remove the existing sewage pump motor and associated local controls as shown, specified and required.

h. Install proposed sewage pump motor and local controls as shown, specified, and required.

i. Install vibration monitoring equipment as shown, specified, and required.

j. Provide and install Annunciator and associated PLC in order to provide alarm indication.

k. Provide and install conduit and electrical wiring as shown, specified and required. Note that concrete penetrations must be made to install new conduits.

l. Install the ground system as shown, specified and required.

m. Provide and install stainless steel channel erector systems to mount and support enclosures, boxes, conduits and other equipment.

n. All electrical work shall be performed in accordance with the 2011 National Electrical Code (NEC) and Chapter 5 of the City of Tampa Code.

W-45.02 General Requirements

1. Codes: Any conflicts between the Specifications and Drawings or with the regulations of local codes, public utility company, or the National Electrical Code or the National Electrical Safety Code shall be promptly brought to the attention of the Engineer for clarification. All materials and work shall be in accordance with said standards.

2. Contract Documents: The drawings are generally diagrammatic not necessarily showing in detail all of the minor items and it shall not be interpreted to mean that any minor item required may be omitted. The Contractor shall make use of all the data in all of the Contract Documents and shall verify all information at the site which may influence his proposal. The Contractor shall obtain all necessary shop drawings and shall consult manufacturer's representatives during installation startup as needed.

3. Tests: The Contractor shall provide all necessary instruments and special apparatus to conduct any test that may be required to ensure that the system is free of all

improper grounds and short circuits. These tests shall be conducted in the presence of the Engineer prior to final acceptance.

4. Guarantee: The Contractor shall submit a written guarantee to the City that all electrical work and material provided under this Contract is free from defects for a period of two (2) years after final acceptance of the job. There will be no additional charge to the City to repair or replace any such work which is found to be defective within the guarantee period.

5. Materials and Equipment: All materials and equipment shall be new and shall bear the manufacturer's name, date of manufacture, trade name, and the UL label. Equipment and materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, but readily accessible for inspection.

6. Operation and Maintenance Manuals: Supply nine sets of operational and maintenance manuals and one complete set of blue line Contract Drawings marked in red reflecting all as-built information.

7. Test Documentation: Test all equipment and document tests.

W-45.03 Execution of Work

All work shall be executed in a neat and workmanlike manner by experienced and capable electricians so as to present a neat installation upon completion.

The execution of work on one drive system shall not interfere with the normal operation of the remaining pumps and drives.

Electrical work shall be coordinated so as not to interfere with or delay other construction operations.

The ends of all conduits shall be carefully reamed free from burrs after threading and before installation. All cuts shall be made square. All joints shall be made up tight. Care shall be taken to see that all control and power conduits are grounded as required by the NEC and Chapter 5 of the City of Tampa Code, Building and Construction Regulations.

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SECTION 46 - VARIABLE FREQUENCY DRIVES

W-46.01 General

This section includes the requirements for the Variable Frequency Drive (VFD) equipment.

Provide all labor, materials, equipment and incidentals required; and install, place in operation and field-test the Variable frequency drive equipment.

One (1) 400 HP, 12-pulse VFD unit shall be provided and installed. The VFD unit shall be mounted in a NEMA Type 12 filtered and gasketed enclosure with full rear cover plates. The VFD shall also include an externally operated disconnect device.

The VFD system shall be designed to operate as specified hereinafter when powered by either the utility electrical service, or by the existing standby power facilities. Operational testing shall be performed under both normal and emergency power.

The AFD shall be designed with a rectifier input designed for 12-pulse minimum operation. Phase shifting transformers shall be housed in the AFD enclosure. Active harmonic filters and inductor-capacitor filters are not acceptable.

W-46.02 Acceptable Manufacturers

The Variable Frequency Drive (VFD) shall be a Yaskawa, Model iQ1000, provided by Icon Technologies. The Wastewater Department has officially standardized on this name brand and no alternates will be considered. The Standardization Certificate of Conditions and Circumstances is included hereinafter.

Alternate control techniques other than pulse width modulated (PWM) are not acceptable.

W-46.03 General Provisions

Governing Standards: The drive shall be designed to meet the following specifications:

1. NFPA 70 - National Electrical Code.
2. NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Variable Speed Drive Systems.
3. NEMA 250 - Enclosures for Electrical Equipment.
4. UL 508C - Underwriters Laboratories.
5. CAN/CSA - C22 No. 14-M91 - Canadian Standards Association.
6. IEC 146 - International Electrical Code.

The drive shall conform to the following requirements:

1. NFPA 70
2. IEC 146

3. EN/CE
4. IEC 801
5. C-UL marking to provide an approved listing for both United States and Canadian users.
6. The Manufacturer shall furnish the product as listed and classified by Underwriters Laboratories as suitable for the purpose specified and indicated.

Warranty: All equipment furnished under this section shall be warranted by the Contractor and the equipment manufacturers for a period of two (2) years after final acceptance of the job. Warranty shall include all labor and material.

W-46.04 Submittals

Submittals shall be custom prepared by the VFD manufacturer for this specific application.

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/subassemblies showing all relevant electrical information.

3. Spare parts list.

4. Manufacturers installation instructions.

5. Shop drawings including wiring diagrams, panel layouts, nameplate legends, etc.

6. Warranty.

7. Efficiencies.

8. Power factor.

9. Harmonic Distortion Analysis.

10. Certification letter stating VFD has a documented Mean Time Between Failure (MTBF) rating of at least 28 years.

11. Certification that VFD is true 12-pulse with integral dual bridge rectifier.

W-46.05 Performance and Design Requirements

Performance: The Variable frequency drive (VFD) controller shall be of sufficient capacity and shall provide a quality output waveform for stepless motor control from 10% to 100% of base speed. The VFD controller shall be suitable for variable torque (VT) loads as required for the driven load. Requirements of the driven equipment are covered in the driven equipment specification. The VFD controller shall include the following ratings and parameters:

1. Input Voltage and Frequency: 480 VAC (±10%), 3-phase, 60 Hertz (±2 Hertz).

2. Displacement Power Factor: Between 0.96 and 1.0, lagging, over the entire speed range.

3. Minimum VFD Efficiency: 95% at half speed; 97% at full speed.

4. Ambient Temperature: -10°C to 40°C.

5. Humidity: Non-condensing to 95%.

6. Output Power: Output voltage adjustable from 0 to rated input voltage. Output frequency range adjustable from 1 to 66 Hertz. The inverter section shall produce a pulse width modulated (PWM) waveform using third generation IGBT's.

7. VFD Service Factor: 1.0.

8. Starting Torque: 100% starting torque from 0.5 Hertz to 60 Hertz.

9. Overcurrent Capability: 120% of rated FLA for one minute (variable torque); 180% of rated FLA-instantaneous.

10. Volts per Hertz Ratio: Constant over entire range of the unit except under voltage boost condition and at frequencies over 60 Hertz.

11. Frequency Regulation: 0.2% steady state.

12. Frequency Resolution: 0.1 Hertz

13. Radio Frequency Interference (RFI): Must meet FCC requirements for RFI above 7 MHz as specified in part 15, subpart J, Class A devices.

14. Harmonic Distortion: VFD power input harmonic attenuation shall be provided by the installation of true 12-pulse VFD units and associated 12-pulse isolation transformers.

15. Minimum carrier frequency of 2kHz without derating.

Hardware: The drive hardware shall employ the following components/technology:

1. Diode or fully gated bridge input with phase to phase and phase to ground metal oxide varistor (MOV) protection.

2. Input 12-pulse phase shifting transformer with DC bus reactor to bring reflected harmonics to IEEE 519 levels. Phase shifting transformers shall be an integral part of the VFD package.

3. Critical VFD logic circuits shall be powered by the DC bus to facilitate an orderly shutdown and provide diagnostics during an AC power loss.

4. Gas tight plug-in connections on printed circuit boards to inhibit electrode corrosion.

5. Printed circuit boards shall have a conformal coating to help protect them from the effects of hydrogen sulfide gas.

6. Microprocessor-based inverter logic isolated from power circuits.

7. State-of-the-art insulated gate bipolar transistors (IGBT) inverter section. Inverter section shall not require commutation capacitors. Inverter section shall provide sine-coded PWM output to the motor.

8. Operator interface shall include an LCD digital display, programming keypad and operator keys option.

9. Internal communications bus to enable attaching common options.

Adjustment: Front panel facilities to adjust the following VFD parameters shall be provided:

Maximum Speed
Minimum Speed
Acceleration Time
Deceleration Time
Volts/Hertz Ratio
IR Compensation (DC BOOST)
Current Limit
Skip Frequencies

Fault Protection: Power circuit design shall provide for protection of power circuit components from fault conditions as follows:

1. Overload Protection: The drive shall provide NEC motor overload protection tested in accordance with UL Standard 991. Overload protection is speed sensitive and shall be adjustable for motors with speed ranges of 2:1, 4:1, and 10:1.

2. Fault Reset/Run: The drive shall provide multiple (as programmed) automatic fault reset and restarts following a fault condition before locking out and requiring manual restart. The automatic mode is not applicable to a ground fault or shorted output faults. The time between restarts shall be adjustable from 0.5 seconds to 30 seconds.

   A. Fault Memory: Data for at least the last four (4) faults shall be stored sequentially at the time of the fault. Information shall be maintained in non-volatile memory for later recall to aid in fault diagnosis.

3. Drive Circuit Breaker: An input thermal-magnetic circuit breaker, with lockable operator handle, shall be provided (operable with VFD door closed). The breaker

shall meet the disconnect switch, short circuit and ground fault NEC requirements for motor branch circuits. The breaker shall be rated for 65,000 amperes short circuit interrupting capacity and be rated as shown on the Drawings or required. The drive circuit breaker shall be Square D model MJL36800, or equal.

4. Load Protection: The following features shall be provided to protect the drive motor:

   A. Inverse-time overload protection
   B. Overvoltage protection
   C. Overfrequency protection
   D. Short circuit protection
   E. Ground fault protection

Power Conditioning: The drive shall be designed to operate on an AC line which may contain line notching and up to 10% harmonic distortion. An input isolation transformer shall not be required for protection from normal line transients.

Operation: The VFD output waveform shall be suitable for operating a NEMA Design B squirrel cage induction motor without derating or requiring additional service factor. VFD output current and voltage waveform shall be inherently sinusoidal at all speeds, regardless of loading, with a total harmonic distortion not exceeding 10% at full load. The VFD output shall produce no pulsating torques to the output shaft or the mechanical system (therefore eliminating the chance of exciting a resonance caused by VFD induced torque pulsations). The VFD shall have an adjustable carrier frequency with a minimum of five field selectable settings.

The suppliers of the VFD equipment shall evaluate the proposed motor load and provide a product best matching this load characteristic. The sewage pump is a very critical load; therefore, all drive components must be fully compatible, reliable, and of the highest quality. The VFD shall have a minimum 590 amp continuous rating and 640 amp rating for 60 seconds.

Provide and install the following VFD controls as shown on the Drawings:

1. "MOTOR RUN" pilot light
2. "VALVE OPEN" pilot light
3. "VALVE CLOSED" pilot light
4. " PUMP OPERABLE" pilot light
5. "PUMP OFF" pilot light
6. "PUMP OVERTEMP" pilot light
7. Mushroom Head Push Button for Emergency stop
8. Push Button for Stop
9. Push Button for Drive Reset
10. "OFF-AUTO-HAND (OAH) switch (with overlapping auto-hand contacts)
11. "MANUAL SPEED ADJUST" potentiometer
12. "DIGITAL OPERATOR INTERFACE"

W-46.06 Construction

Small wiring, necessary fuse blocks, and terminal blocks within the VFD equipment shall be furnished as required. All control wires leaving the VFD shall be provided with terminal blocks with suitable numbering strips. All control wiring shall be durably marked at each end. Control components mounted within the assembly; such as fuse blocks, relays, push buttons, switches, etc.; shall be Specification grade, and be suitably marked for identification corresponding to appropriate designations on the manufacturer's wiring diagrams. All printed circuit boards shall be given a conformal coating, at the factory, to protect the circuitry from contamination.

The VFD shall be provided with adequate lifting means and shall be capable of being rolled or moved into the installation position and bolted to the proposed housekeeping pad.

W-46.07 Controls

Features: The VFD shall include the following features, in addition to all features indicated on the drawings:

1. IR Compensation (DC Boost): Digital programming shall provide a selectable range for offsetting motor losses at low frequency operation. DC Boost shall be current regulated and automatically adjusted, on each start, to motor temperature and load changes. DC Boost shall be adjustable from 15% to 120% of the drive current rating.

2. Volts Per Hertz Adjustments: Programming shall provide the ability to fully configure the volts per hertz for squared, cubed, straight line, pre-programmed or full custom patterns.

3. Current Limit: Programmable current limit from 30% to 200% of VFD rated full load current.

4. Acceleration/Deceleration: Acceleration and deceleration times shall be independently adjustable from 0 seconds to 3600 seconds. Provisions for a second set of remotely selectable acceleration/deceleration settings shall be provided.

5. Skip Frequencies: No less than two selectable, adjustable frequency bands shall be provided to lock out continuous operation at frequencies which may produce mechanical resonance.

6. Speed Regulation: The programmable speed regulation modes shall include the following:

    a. Open loop.
    b. Slip compensation with 0.5% speed regulation.
    c. Closed loop encoder feedback with 0.1% speed regulation (PID).

7. Control Logic: The drive shall be programmable or self adjusting for operation under the following conditions.

    a. Operate drive with motor disconnected.

b. Controlled shut down with no component failure in the event of an output phase to phase or phase to ground short circuit and annunciation of the fault condition.
c. Adjustable PWM carrier frequency within a range of 2.5kHz-5kHz.
d. Multiple programmable stop modes including -ramp, coast, DC injection braking.
e. Multiple acceleration and deceleration rates.
f. All adjustments to be made with the door closed.
g. Adjustable output frequency up to 400 Hertz.

8. Control Inputs: Control interface cards shall provide input terminals for access to fixed drive functions that include start, stop, remote auxiliary, speed, and enable. Four additional inputs shall be available for functions such as reverse, preset speed access, jog, second acceleration/deceleration time access and local control selection. Inputs shall be programmable to configure the drive for standard 3-wire, 2-wire, and serial operation.

   The control terminals shall be rated for either 24 VDC or 115 VAC and shall be immune to the deleterious effects of surrounding electromagnetic radiation/noise. Each input shall be optically isolated from the drive control logic.

9. Ride Through: The drive shall have a minimum two (2) second carry-over during a utility power outage.

10. Analog Output: An output signal shall be jumper selectable for 0-10 VDC or 0-20 mA and be user programmable such that it is proportional to output frequency, output current, output voltage reference, or output power. A programmable offset shall be provided to allow modification of the analog output to obtain 2-10 VDC or 4-20 mA.

11. Reference Signals: The drive shall be capable of using the following inputs as a speed control:

    a. Remote potentiometer.
    b. 0-10 VDC
    c. 4-20 mA

12. Loss Of Reference: In the event of loss of the 4-20 mA reference signal, the drive shall be user programmable to either run at minimum speed, or at 80% of the most recent speed.

13. Digital I/O:

    Inputs: The VFD shall include a forward “run” input and a minimum of five (5) programmable multi-function inputs. The functions shall include, but are not limited to, the following:

    a. External fault (NO)/(NC)

b. Fault reset
c. Remote/local selection
d. Stop command using deceleration timer
e. Jog command
f. Inertia ride-through command

Outputs: Contact output ratings shall be 250 VAC/30 VDC, minimum 1.0 ampere, and shall be provided as follows:

a. (1)- Form A run contact.
b. (1)- Form C contact programmable as follows:

1) Drive fault
2) Zero speed
3) @ frequency
4) Drive ready

14. Interface: The drive shall provide a removable Operator Interface Module with integral display to show drive operating conditions, adjustments, and fault indications. The display shall be removable under power without causing a fault and shall be visible and operable without opening the enclosure door. The display shall use either LED or backlit LCD technology; and be alpha numeric, or numeric only with an active cross-reference to facilitate intuitive use by a tyro. Units shall be user scalable. The display shall be capable of remote mounting by means of cable connection up to 10 meters (33 feet) from the drive and be capable of being used as a hand-held terminal.

15. Operator's Devices: The drive shall provide an option for Start, Stop, Jog, Reverse and Speed Control as an integral part of the Operator Interface Module.

16. Adjustments: The digital interface shall be used for all set-up, operation and adjustment settings. All adjustments shall be stored in non-volatile memory (EEPROM). No potentiometer adjustments shall be required. The drive shall provide EEPROM memory for factory default values.

17. Speed Profiles: Programming capability to produce speed profiles with linear acceleration/deceleration or "S-Curve" profiles that provide changing acceleration/deceleration rates. S-Curve profiles shall be selectable for fixed or adjustable values.

18. Run On Power Up: A user selectable restart function shall be provided to automatically restart the equipment after restoration of power after an outage.

19. Flying Start: The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick-up" the motor at the rotating speed. The flying start feature shall be operable with or without encoder feedback.

Diagnostics: Diagnostic indicators located on the drive face shall show the type of fault responsible for drive shutdown, warning or failure. On occurrence of more than one condition, each condition shall be recorded or indicated by the diagnostic segment.

Testing: Drive manufacturer shall conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to specified requirements. All power switching components shall be pre-run under temperature and load conditions. Tests shall include:

1. Factory testing.
2. Field acceptance testing.

W-46.08 Installation

Install and interconnect equipment as shown on the Drawings.

Contractor shall provide a factory-trained technician for on-site start-up and debugging at no additional cost.

W-46.09 Spare Parts

The following spare parts shall be furnished:

1. Three (3) each of each type of fuse used.

2. Four (4) of each type of converter power semiconductor.

3. Four (4) of each type of inverter power semiconductor.

4. One (1) of each type of printed circuit board, including diagnostic systems.

A spare parts list including original device manufacturer's part numbers for cross-referencing purposes shall be furnished. Lists containing only the VFD manufacturer's part numbers are not acceptable.

W-46.10 Training

A minimum period of one 8-hour day of on-site training by a factory-trained engineer or technician shall be provided for City technicians and operating personnel. This training shall include component level troubleshooting and software. This training shall be provided at no additional cost to the City.

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