CITY OF HOUSTON

Administration and Regulatory Affairs Department
Strategic Purchasing Division

Annise D. Parker
Mayor

Calvin D. Wells, Deputy Director
City Purchasing Agent
P.O. Box 1562
Houston, Texas 77251-1562

F. 832.393.8755
https://purchasing.houstontx.gov

June 2, 2010

Subject: Letter of Clarification No. 1 to Invitation to Bid No. S50-C23649 to Furnish and Install Variable Frequency Drives (VFD's), for the Public Works and Engineering Department

To: All Prospective Contractors:

This letter of Clarification is being issued for the following reasons:

- **Revise the above referenced solicitation, SECTION "B" - SCOPE OF WORK, as follows:**

  Delete pages 8, 9, 10, 14, 17, 18, 21, 22, 23, 25 & 26 of 42, and replace with the revised pages 8, 9, 10, 14, 17, 18, 21, 22, 23, 25 & 26 of 42, marked, Revised 05/21, 5/26, 2010.

- **The following questions and City of Houston responses are hereby incorporated and made a part of the Invitation to Bid:**

Question #1 What size are the breakers at 69th street that feed the VFD's that are inside the motor starters?

Answer: The breakers are 400 Amp Breaker with 300 Amp fuses.

Question #2 In section 1.2 for Southwest Water Plant and section 1.1 for 69th Street the term "or city approved equal" is used as an alternate to the Toshiba drive specified - what is the process and paperwork required to submit and have approved an alternative to Toshiba?

Answer: Acceptable manufacturers are Toshiba, ABB, Robicon and Siemens; the contractor shall provide the specifications of any other alternate brands to the project manger for review and approval prior to bid response date.

Question #3 Would the City prefer to also have a VFD input contactor to allow total isolation of the VFD from the power source and the motor?

Answer: The City's electrical group's preference is to isolate the VFDs using the breaker, thus shutting off all power to the unit.

Question #4 May any motor run wires be reused?

Answer: They must be either megger tested or megged to insure they are in good condition.

Question #5 For the cable tray support that will run from the VFDs to the control panel, does the pole support have to be stainless steel (SS)?

Answer: The cable tray support at the Southwest Wastewater Treatment Plant can be a galvanized pole with the stainless steel unistrut attached at the top. The plastic coated conduit or plastabond ® is required to be attached to the stainless steel unistrut, but the support pole does not have to be stainless steel.

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FURNISH & INSTALL VARIABLE FREQUENCY DRIVES (VFD'S)
FOR THE PUBLIC WORKS AND ENGINEERING DEPARTMENT

Question #6 Can the existing contractors be used as part of the bypass contactors?

Answer: No.

Note: No further questions will be accepted after the publication of this Letter of Clarification.

When issued, Letter(s) of Clarification shall automatically become a part of the bid documents and shall supersede any previous specification(s) and/or provision(s) in conflict with the Letter(s) of Clarification. It is the responsibility of the bidders to ensure that it has obtained all such letter(s). By submitting a bid on this project, bidders shall be deemed to have received all Letter(s) of Clarification and to have incorporated them into this solicitation.

Furthermore, it is the responsibility of each Contractor to obtain any previous Letter of Clarification associated with this solicitation.

Arturo Lopez

Arturo Lopez
Senior Procurement Specialist
832-393-8731

Attachments:

Revised pages 8, 9, 10, 14, 17, 18, 21, 22, 23, 25 & 26 of 42, marked, Revised 05/21, 5/26, 2010.

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1.15 The VFD shall be designed to perform at vibration - 0.6G maximum

1.16 The drives shall be manufactured in the United States

1.17 The VFD must be IEEE 519 compliant and a recommended list of spare parts shall be provided.

1.18 The VFD shall be equipped with a long lead filter or instantaneous rate of voltage change over time, (DV/DT) filter.

1.19 The VFD shall have a bypass contactor.

1.20 The VFD shall have an output filter.

2.0 QUALITY ASSURANCE

2.1 Reference Standards:

2.1.1 Institute of Electrical and Electronic Engineers (IEEE) Standard 519-1992, IEEE Guide for Harmonic Content and Control.

2.1.2 Underwriters Laboratories UL 508.

2.1.3 National Electrical Manufacturer's Association (NEMA (ISC6, Enclosures for Industrial Controls and Systems.

2.1.4 IEC 801-2, 801-4, 255.4.

2.1.5 NFPA 70, National Electrical Code.

2.2 Testing. All printed circuit boards shall be completely tested and burned –in before being assembled into the completed VFD. The VFD shall then be subjected to a preliminary functional test, minimum 8-hour burn-in, and computerized final test. ***The burn-in shall be at full current under reactor load.***

2.3 Failure Analysis. VFD manufacturer shall have available and analysis laboratory to evaluate the failure of any component.

2.4 Qualifications. VFDs shall be UL Listed.

2.4.1 The contractor must provide an ISO9001 certified manufacturing facility.

2.4.2 After Sales Support: The contractor must provide support direct from a network of factory-trained distributors and certified service centers located throughout North America and Canada.

3.0 SUBMITTALS:

3.1 Certificate of Unit Responsibility: attesting that the VFD manufacturer has accepted unit responsibility for the proper functioning of each VFD in conjunction with its respective motor and pump.

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3.2 Prior to installation, the contractor shall provide an estimated total harmonic distortion (TDH) caused by the VFDs. The results shall be based on a computer aided circuit simulation of the total actual system using information obtained from the power provided and the user.

3.2 The contractor shall provide calculations specific to the installation showing total harmonic voltage distortion is less than 5%.

4.0 VARIABLE FREQUENCY DRIVE (VFD***):***

4.1 Drive design for continuous use 100 hp motor, 120 full load amps and F class insulation.

4.2 Main drive input power 3 phase 460V/60 Hz and 146 amps.

4.3 Main drive output power 3 phase 0 to 460V/0 to 90 Hz, 122 amps.

4.4 Main drive output frequency of 0.01Hz to 400Hz.

4.5 Drive speed regulation shall be 2% and 0.1 to 0.5% in true torque control mode.

4.6 Drive designed for ambient temperature operating range 0^0 to 122^0 F.

4.7 Drive capable of operating in relative humidity 100%.

4.8 Drive shall be supplied with cooling fan and/or optional heat sink unit

4.9 Drive tolerance for voltage ±10% and frequency of ±2Hz.

4.10 The drive shall have the following volts/hertz characteristics:

4.10.1 Drive shall have constant V/Hz second order non-linear automatic torque boost and true torque control plus automatic energy-saving control/torque boost adjustment, end frequency adjustment (0 to 20 Hz), maximum voltage frequency adjustable from 25Hz to 400Hz, voltage boost adjustable from 0 to 20%, a minimum of 150% torque at 1 Hz and starting frequency adjustable from 0 to 10 Hz.

4.11 Drive shall be capable of setting both upper and lower limit frequencies.

4.12 Drive to include preset macros for pumps.

4.12 Drive shall have capability of taking custom user settings.

4.14 Drive overload current capability shall be 100% continuous and 120% for one minute.

4.15 Drive shall have RS-222 and RS-485 ports for communication.

4.16 Drive shall accept 4 to 20 mA (Zin:500Ω) and ± 0 to ±10 Vdc (Zin:67Ω) input signals and eight programmable digital inputs with analog input signal capable of being inverted such that the minimum reference corresponds to maximum speed.

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maximum speed.

4.17 Drive shall contain separate acceleration/deceleration times with auto tuning ability.

4.18 Drive shall be capable of jogging the motor up to 20 Hz then stopping.

4.19 Drive shall be capable of running 4 groups of 8 patterns using 15 preset speed values for a maximum of 22 different patterns.

4.20 Control ability shall be activated from keypad, terminal inputs and host computer/PLC.

4.21 Digital display shall be plain English and not code number(s) and letter(s).

4.22 Drive shall be capable of re-setting faults remotely and locally.

4.22 Drive shall have programmable trip alarms that shall include; over current, voltage and motor overload, low current, communication error, and short circuit trip detect.

4.24 Drive shall have two programmable 4-20 mA analog outputs and three programmable relay outputs.

4.25 Drive shall have ability for automatically restart after an over current, overload etc. trip out and this capability should be adjustable by operator.

4.26 Drive communication options shall include remote I/O, Profibus, RS484, Toshiba F10/S20, Ethernet, Modbus, Modbus+ and Metasys N2.

4.27 Drive shall be equipped with an elapsed run time meter which can be displayed.

4.28 Drive shall be wired with 3-position Hand-Off-Auto switch and speed potentiometer. When in "Hand", the VFD will be started and the speed controlled from the speed potentiometer which shall have a control limit from 25 Hz to 60 Hz. When in "Auto", the VFD shall be equipped with capability to be started via an external contact closure with the motor speed controlled via an external speed reference input.

4.29 Drive must use 18 pulse technologies.

4.20 VFDs shall be UL listed.

4.21 The drive shall have frequency resolution of 0.01 Hz digital and 0.1 Hz analog.

4.22 The drive shall have frequency accuracy of ± 0.01 % of maximum frequency for the digital input and ± 0.2% of maximum frequency for the analog input (at 25°C ± 10°C).

4.22 The drive shall have selectable input terminal priority.

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7.7 The VFD shall contain a reset of all parameters to factory default settings or user defaults.

7.8 The VFD shall have 2 programmable 4-20 mA analog outputs programmable to 17 choices.

7.9 The VFD shall have 2 programmable relay outputs programmable to 64 choices.

7.10 The VFD shall have 8 programmable digital inputs programmable to 54 choices.

7.11 The VFD shall have a pulse train output proportional to frequency (48, 96, and 260 times frequency).

7.12 The VFD shall have an elapsed time meter.

8.0 ENCLOSURE & SUPPORT PLATFORMS

8.1 Enclosure to be included and rated NEMA 3R or better for outdoor installation.

8.2 Enclosure shall have locking key entry.

8.3 Enclosure shall be of 12-gauge Stainless Steel construction or City approved better and shall utilize stainless steel U-type clamps on the door to prevent water intrusion.

8.4 Enclosure dimensions are anticipated to be approximately 81"H X 70"W X 29"D.

8.5 Grounding posts are to be provided inside the enclosures.

8.6 The contractor shall clearly label each cabinet so as to be able to easily identify which wasting pump the cabinet is connected.

8.7 A single fault red light beacon will be provided on the top of each enclosure and wired to VFD to indicate system failure.

8.8 A door interlock disconnect switch which will disconnect all input power shall be included. The disconnect handle shall be though-the-door type and it shall be padlock capable in the "Off" position.

8.9 The VFD shall use air to air heat exchanger for cabinet. Air conditioners that use compressors and/or refrigerants will not be acceptable. A Nema 3R enclosure using ventilation to achieve cooling will not be acceptable.

8.10 The VFD enclosure shall be floor mount with lifting eyes as well as fork lift provisions on the bottom.

8.11 The VFD shall use air to air heat exchangers where necessary for cabinet

8.12 The VFD shall have an optional external junction box for connections if

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C = 440V	16K = 150 HP 20K = 200 HP 26K = 250 HP 29K = 250 HP 45K = 400 HP *51K40 = 500HP 60K = 600 HP 70K = 700 HP 81K = 800HP 92K = 900 HP 10L= 1000 HP 12L = 1200 HP *14L40 = 1400 HP *15L40= 1500 HP *500, 1400,& 1500 ratings are 40 deg. 1 C Celsius maximum	CD-NEMA 2R with 18-Pulse input, circuit breaker	NB = Stainless Steel I-Beam Base (Only available with NS Option)

1.2 *500, 1400, and 1500 HP drives are rated 40 degrees Celsius maximum.

1.3 **For additional options, add "-1" to the part number and list the additional options.

1.4 NEMA 3R enclosures feature air-to-air heat exchangers.

PART THREE - INSTALLATION

1.0 INSTALLATION:

1.1 Contractor shall be responsible for any necessary permits, permit fees, and inspections to meet City building and electrical code requirements.

1.2 Installation is to include a concrete pad for the VFD enclosure – see attached sketch (figure 1.0 and figure 2.0) for location and dimensions.

1.3 The Contractor shall be responsible for the concrete support pad design and installation (see sketch below for location and approximate dimensions).

1.4 The Contractor shall obtain and submit a signed and licensed professional engineer sealed drawing of the concrete support pad to the city for approval prior to commencing construction.

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1.5 The concrete pad surface shall be sloped from the front to the back with a 3% slope to keep it clear of any standing water.

1.6 The front elevation of the slab shall be two inches above the sidewalk elevation and it shall slope back at a 3% downward grade.

1.7 The Contractor shall submit a signed and sealed wiring drawing for review and approval prior to commencing construction showing all the wiring that will be between the existing panels to the new VFD enclosure.

1.8 All cabinet penetrations must be water tight.

1.9 Contractor shall maintain a clean work site and he/she is responsible for removal and disposal of any construction related waste generate on the site.

2.0 SKETCHES

2.1 See sketches below.

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69TH Street Waste Water Treatment Plant
Drives for Pump Station #11 Pumps

TWO (2) VFDs rated for 150 HP 460V/60 Hz - Variable Torque Application

PART ONE - SPECIFICATIONS FOR VARIABLE FREQUENCY DRIVE (VFD) INSTALLATION

1.0 The requirements listed below are to cover the installation requirements for the frequency motor drive (VFD) in Pump Station (PS) #11 at the 69th Street Waste Water Treatment Plant.

1.1 Manufacturer: Toshiba W7B415KAADW-1 W7 460 V 150 HP 18 pulse, or City approved equal

1.1.1 The two VFDs shall be installed on the north wall of the ground level control room in pump station #11 at the 69th street WWTP. Allowances must be made to permit the installation of a third VFD at some future date.

1.1.2 At a minimum the electrical system shall be constructed in accordance with American National Standards Institute/National Fire Protection Association (ANSI/NFPA) and the National Electrical Code (NEC) and the City of Houston Building Code. Note: all foreign manufactured equipment must meet U.S. codes and standards.

1.1.3 The contractor shall remove and dispose of the following equipment and related materials; three damaged VFDs and related abandon cabinets from PS #11 plus one abandon TI cabinet located on the north wall in PS #11 control room. The work shall include all necessary disconnections of electrical systems in walls, floor, and ceilings for scheduled removal.

1.1.4 Equipment and materials shall be of the latest proven design and no obsolete components or components to be phased out of production will be permitted.

1.1.5 Contractor shall furnish all equipment, materials and labor necessary to furnish and install new VFDs. The materials and equipment shall include all contactors, wiring, conduit, junction boxes, etc.

1.1.6 All wires shall be clearly identified via heat shrink labels and all contactors shall be labeled with etched metal or plastic tags. The tags are to be attached via screws, rivets, or an optional preapproved means.

1.1.7 The contractor shall review installation and provide all necessary ventilation so as to insure that all equipment installed on this project can be maintained within its design operating temperature range.

1.1.8 The VFDs shall be installed in a manner that will enable each VFD to operate a single pump.

1.1.9 The motor/control panel shall be equipped with a HAND –OFF- AUTO, (HOA) switch to permit local control of the pump motors.

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1.1.10 The installation shall include wiring for the INPUT / OUTPUT, (I/O to the PROGRAM LOGIC CONTROLLER, (PLC) for; analog speed control and speed feedback plus discrete signals run command, running feedback, and run fault feedback.

1.1.11 The contractor shall provide and install all necessary isolation relays, terminal blocks, and fuses matched to existing equipment.

1.1.12 The contractor shall be responsible for check-out and start-up of the complete electrical system, i.e. the contractor shall demonstrate the VFDs and the motor operation, the switching between automatic and manual modes, and the ramping up and down of the pump motors.

1.1.13 All conduit shall be Plastabond® plastic covered rigid conduit unless a request for alternate is otherwise granted

1.1.14 Enclosure must be NEMA one rated wall/panel mounted type cabinet with panel mounted interface such that the VFD/motors can be locally controlled and ramped up and down in a manual mode by the plant operator.

1.1.15 The contractor will coordinate with operations to maintain at least one pump and motor in operation at all times during demolition and installation to facilitate station operations.

1.1.16 The contractor shall remove abandoned wiring to source of supply.

1.1.17 The contractor shall remove exposed abandoned conduits and cut conduits flush with walls and floors and patch surfaces for all abandoned equipment.

1.1.18 The contractor shall provide and install blank covers for any abandoned outlets which are not removed.

1.1.19 The contractor shall maintain open access to existing installations as pumps are to remain in active status.

1.1.20 The contractor shall repair and finish any incidental damage created during demolition work and installation as part of bid price.

1.1.21 The VFD shall have a bypass contactor.

PART TWO - SECTION 106482 VFD SPECIFICATIONS

Two (2) VFDs rated for 150 HP 460V/60 Hz - variable torque application

PART 1 – GENERAL:

1.0 SECTION INCLUDES:

1.1 This specification is to cover a complete adjustable frequency motor drive (VFD) consisting of a pulse width modulated (PWM) inverter for use on a standard induction motor.

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2.0 QUALITY ASSURANCE:

2.1 Referenced Standards.

2.1.1 Institute of Electrical and Electronic Engineers (IEEE). Standard 519-1992, IEEE Guide for Harmonic Content and Control

2.1.2 Underwriters Laboratories UL 508.

2.1.3 National Electrical Manufacturer's Association (NEMA). ISC 6, Enclosures for Industrial Controls and Systems.

2.1.4 IEC 801-2, 801-4, 255.4.

2.1.5 NFPA 70, National Electrical Code.

2.2 Testing. All printed circuit boards shall be completely tested and burned –in before being assembled into the completed VFD. The VFD shall then be subjected to a preliminary functional test, minimum 8-hour burn-in, and computerized final test. ***The burn-in shall be at full current under reactor load.***

2.3 Failure Analysis. VFD manufacturer shall have available and analysis laboratory to evaluate the failure of any component.

2.4 Qualifications. VFDs shall be UL Listed.

2.4.1 The contractor must provide an ISO9001 certified manufacturing facility.

2.4.2 After Sales Support: The contractor must provide support direct from a network of factory-trained distributors and certified service centers located throughout North America and Canada.

3.0 SUBMITTALS:

3.1 Submittals shall include the following information:

3.1.1 Certificate of Unit Responsibility, attesting that the VFD manufacturer has accepted unit responsibility for the proper functioning of each VFD in conjunction with its respective motor and pump. No other submittal will be received until the certificate has been received and found to be in conformance with this requirement.

3.1.2 Outline dimensions.

3.1.3 Weight.

3.1.4 Typical efficiency vs. speed graph for variable torque load.

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1.2.3 Provide the drive and all necessary controls, as herein specified. Manufacturer shall have been engaged in the production of this type of equipment for a minimum of 10 years.

1.2.4 Design the VFD specifically for variable torque applications.

2.0 VARIABLE FREQUENCY DRIVES:

2.1 The variable frequency drives (VFDs) shall be solid state, with a Pulse Width Modulated (PWM) output waveform. Fundamental power factor shall be 95% at all speeds and loads.

2.2 All VFDs shall have the following specifications:

2.2.1 Input: 460 VAC +/-10%, 2 phase, 60 Hz.
2.2.2 Output: 2 phase, 0 to 120 Hz. Operation above 60 Hz. shall require programming changes to prevent inadvertent high-speed operation.

2.2.3 Environmental operating conditions: 0 to 40 °C @ 2 kHz. switching frequency, 0 To 2200 feet above sea level, less than 95% humidity, non-condensing.

2.2.4 Enclosure shall be rated Type 1 for indoor use.

2.2 All VFDs shall have the following standard features:

2.2.1 All VFDs shall have the same customer interface, including digital display, keypad and customer connections; regardless of horsepower rating. The keypad is to be used for local control, for stepping through the display and menus.

2.2.2 The VFDs shall give the user the option to either display a fault or run at a programmable preset speed.

2.2.3 The VFDs shall utilize a plain English digital (code numbers and letters are not acceptable). The digital display shall be a 40-character (2 line x 20 charters/line) LCD display. The LCD shall be backlit to provide to provide easy viewing in any light condition. The contact should be adjustable to optimize viewing at any angle. All set-up parameters, indications, faults, warnings and other information must be displayed in word to allow the user to understand what is being displayed without the use of a manual or cross-reference table.

2.2.4 The VFDs shall have the ability to automatically restart after an over current, over voltage, under voltage, or loss of input signal protective trip. The number of restart attempts shall be a minimum of four, adjustable by the operator.

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2.2.5 The VFDs shall have the ability to automatically restart after an over-current, overvoltage, or decelerate to set-point without safety tripping or component damage (flying start).

2.2.6 The VFDs shall be equipped with an automatic extended power loss ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-though shall be one-cycle, based on full load and no inertia. Removing power from the motor is not an acceptable method of increasing power loss ride-through.

2.2.7 The customer terminal strip shall be isolated from the line and ground.

2.2.8 Rewired 2-position Hand-Off-Auto switch and speed potentiometer. When in "Hand ", the VFD will be started, and the speed will be controlled from the speed potentiometer. When in "Auto ", the VFD will start via an external contact closure, and its speed will be controlled via an external speed reference.

2.3.9 The drive shall employ three current limit circuit to prove trip free operation:

2.2.9.1 The Slow Current Regulation limits circuit shall be adjustable to 115% (minimum) of the VFD's variable torque current rating. This adjustment shall be made via the keypad, and shall be displayed in actual amps, and not as percent of full load.

2.2.9.2 The Current Switch-off limit shall be fixed at 180% (minimum, instantaneous) of the VFD's variable torque current rating.

2.2.10 The overload rating of the drive shall be 110% of its variable torque current rating for I minute.

2.2.11 The VFD shall have input circuit breaker motor circuit protector standard in the drive enclosure, 65,000 amps interrupting capacity. Circuit breaker shall be padlockable in the "Off " position.

2.2.12 The VFD shall have an optional DC Link Reactor to reduce the harmonics to the power line and to increase the fundamental power factor.

2.2.13 The VFD shall be optimized for a 2 kHz carrier frequency to reduce motor noise and provide high system efficiency. The carrier frequency shall be adjustable by the start-up engineer.

2.2.14 The VFD shall have a manual speed potentiometer in addition to using the keypad as a means of controlling speed manually

END OF DOCUMENT