



CITY OF HOUSTON

INVITATION TO BID

Issued: May 7, 2010

Bid Opening:

Sealed bids, in duplicate, will be received by the City Secretary of the City of Houston, in the City Hall Annex, Public Level, 900 Bagby, Houston, Texas 77002 until **10:30 A.M. Thursday, May 27, 2010**, and all bids will be opened and publicly read in the City Council Chamber, City Hall Annex, Public Level, 900 Bagby at 11:00 A.M. on that date for the purchase of:

FURNISH AND INSTALL VARIABLE FREQUENCY DRIVES FOR THE PUBLIC WORKS AND ENGINEERING DEPARTMENT

Bid No. S50-C23649

NIGP Code: 691-29

Buyer:

Questions regarding this solicitation should be addressed to Arturo Lopez, Senior Procurement Specialist, at **822-292-8721** or e-mail to arturo.lopez@cityofhouston.net

Electronic Bidding:

In order to submit a bid for the items associated with this procurement, you must fill in the pricing information on the "PLACE BID" page.

Prebid Conference:

A Pre-Bid Conference will be held for all Prospective Bidders in the Strategic Purchasing Division, Concourse Level (Basement), Conference Room, #1 City Hall, 901 Bagby, at **10:00 a.m. on Wednesday, May 19, 2010**. **The site visit will be scheduled at the pre-bid conference.**

All Prospective Bidders are urged to be present. It is the bidder's responsibility to ensure that they have secured and thoroughly reviewed all aspects of the solicitation documents prior to the Pre-Bid Conference. Any revisions to be incorporated into this solicitation document arising from discussions before, during and subsequent to the Pre-Bid Conference will be confirmed in writing by Letter(s) of Clarification prior to the bid due date. Verbal responses will not otherwise alter the specifications, terms and conditions as stated herein.

Bidding forms, specifications, and all necessary information should be downloaded from the Internet at <http://purchasing.houstontx.gov>. By registering and downloading this solicitation document, all updates to this solicitation document will be automatically forwarded via e-mail to any registered bidders. This information may also be obtained from the Supplier Assistance Desk, Strategic Purchasing Division, 901 Bagby, Concourse Level, Houston, Texas 77002.

The place of the bid opening may be transferred in accordance with Paragraph (b), (5) of Section 15-2 of The Code of Ordinances, Houston, Texas. The bid-opening meeting may be rescheduled in accordance with Paragraph (b), (6) of said Section 15-2.

The City reserves the right to reject any or all bids, or to accept any bid or combination of bids deemed advantageous to it.

City employees are prohibited from bidding on this solicitation in accordance with the Code of Ordinances Section 15-1.

***CONTENTS:**

- A. OFFER
- B. SCOPE OF WORK/SPECIFICATIONS
- C. GENERAL, SUPPLEMENTARY CONDITIONS AND BOND FORMS

*NOTE 1: Actual page numbers for each section may change when the solicitation document is downloaded from the Internet or because of letters of clarification. Therefore, bidders must read the solicitation document in its entirety and comply with all the requirements set forth therein.

*NOTE 2: **To be considered for award please submit the electronic bid form and the forms listed in section A, including the signature page, which must be signed by a company official authorized to bind the company and a 10% Bid Bond.**

SECTION A



FORMAL ONE-TIME BID

FURNISH AND INSTALL VARIABLE FREQUENCY DRIVES FOR THE PUBLIC WORKS AND ENGINEERING DEPARTMENT

Bid No. S50-C23649

NIGP Code: 691-29

To The Honorable Mayor
and City Council Members
of the City of Houston, Texas (the "City"):

The undersigned hereby offers to provide services necessary to **Furnish and Install Variable Frequency Drives, at the Southwest Waste Water Treatment Plant, located at 4211 Beechnut and the 69th Street, Waste Water Treatment Plant, located at 2525 S/Sgt. Macario Garcia Drive, for the Public Works and Engineering Department**, F.O.B. destination point Houston, Texas, in accordance with the City's Scope of Work / Specifications and General Terms & Conditions and/or samples/drawings provided herein. When issued by the City of Houston, Letters of Clarification shall automatically become part of this bid document and shall supersede any previous specifications or provisions in conflict with Letters of Clarification. It is the responsibility of the bidder to ensure that it has obtained all such letters. By submitting a bid on this project, bidder shall be deemed to have received all Letters of Clarification and to have incorporated them into the bid.

The City may accept this bid offer by issuance of a Notice of Award Letter and/or a Purchase Order at any time on or before the 120th day following the day this Official Bid Form is opened by the City. This offer shall be irrevocable for 120 days after bid opening or for 90 days after City Council awards the bid, whichever comes last, but this period may be extended by written agreement of the parties.

The City reserves the right to INCREASE quantities during the twelve-month period following the issuance of the first purchase order subject to agreement in writing by the Prime Contractor/Supplier to honor the same bid price.

The City reserves the option, after bids are opened, to adjust the quantities listed on the electronic bid form upward or downward, subject to the availability of funds, and/or make award (s) on a line item basis.

SECTION A

Documents/forms must be downloaded from the City's Website

<http://purchasing.houstontx.gov>

Additional Required Forms to be Included with this bid:

In addition to the electronic Bid Form and the Official Signature Page, the Forms listed in Table 1 **must be completed and submitted to the Office of the City Secretary on or before the date and time the bid is due:**

Table 1
Affidavit of Ownership
Fair Campaign Ordinance
Statement of Residence
Conflict of Interest Questionnaire
10% Bid Bond
Contractor References
Pay or Play Form 1a / Acknowledgement Form

Table 2 lists other documents and forms that should be viewed/downloaded from the City's website, but are not required to be submitted with the bid. The City will request these forms, as applicable, to be completed and submitted to the City by the recommended/successful bidder:

Formal Instructions for Bid Terms
Sample Insurance Certificate / Over \$50,000
Sample Insurance Certificate / Construction OCP Policy
2010 Building Construction Wage Rate
2010 Engineering Construction Wage Rate
Bonds for Construction, (Performance, Maintenance and Statutory Payment)
Drug Forms
Pay or Play Form 2 / Certification of Participation

Questions concerning the Bid should be submitted in writing to: City of Houston, Strategic Purchasing Division, 901 Bagby, Room B405, Houston, TX 77002, Attn: Arturo Lopez or via fax: 822-292-8759 or via email (preferred method) to arturo.lopez@cityofhouston.net no later than **4:00 PM, Friday, May 21, 2010.**

PERMITS:

Successful Contractor shall be responsible for securing any and all permits for proposed work. Any fee charged for these permits should be the responsibility of the Contractor and not the City of Houston.

CITY BUILDING CODES:

All work performed or equipment installed shall be in strict accordance with the City of Houston Building Codes. The Contractor will immediately correct any deficiencies discovered during work or after completion. Failure to correct deficiencies will result in the City having corrections made at the Contractor's expense.

PERFORMANCE BOND and PAYMENT BOND:

The successful Contractor(s) shall be required to provide a Performance and Payment Bond in the total amount (100%) of the Contract if the award is in excess of \$25,000.00.

The Performance and/or Payment Bond shall be in the same form as that distributed by the City, and attached hereto, all duly executed by this bidder (as "Principal") and by an incorporated surety company licensed to do business in the State of Texas. If the amount of the bond is greater than \$100,000.00 the surety must hold a certificate of authority from the United States Secretary of the Treasury.

The Contractor(s) shall be required to provide a Performance and/or Payment Bond as outlined above, which will be delivered to the City Purchasing Agent of the City, on or before the tenth (10th) day following the day the bidder receives notice from the City.

BID BOND:

The Contractor shall be required to provide and submit with the bid a Bid Bond in the amount of 10% of the total amount bid by the Contractor. The Bid Bond shall be in the same form as that distributed by the City, and attached hereto, all duly executed by this Bidder (as "Principal") and by a corporate surety company licensed to do business in the State of Texas, and if the amount of the bond is greater than \$100,000.00 the surety must hold a certificate of authority from the United States Secretary of the Treasury, or a Cashier's or a Certified check in a like amount. Company or personal checks are not acceptable.

MAINTENANCE BOND:

The Contractor shall furnish a maintenance bond in the total (100%) bid amount in the form required by the City (samples attached). One bond, also referred to as the One Year Maintenance Bond, will be conditioned upon Contractor's repair, replacement or restoration of any work or any portion of the work which is found to be defective or fails in any way to comply strictly with this contract or the plans and specifications for such work within a period of one (1) year from the date of acceptance of such work by the City Council or after the date that the "CO", or his designee in writing, determines, in a written notice to the Contractor, to be the date upon which the project is both substantially complete and available for the full and beneficial occupancy or use of the City.

QUALITY AND WORKMANSHIP

The bidder must be able to demonstrate upon request that it has performed satisfactorily, services similar to the services specified herein. The bidder will provide records of warranty and repair services performed for others upon request. The City of Houston shall be the sole judge whether the services performed are similar to the scope of services specified herein.

CONTRACTOR'S QUESTIONNAIRE

In order to receive bid award consideration, the bidder must be able to demonstrate that they are currently providing or have had at least one contract, to **Furnish and Install Variable Frequency Drives** that is similar in size and scope to this contract. **Bidder must have references documenting that it has Furnished and Installed Variable Frequency Drives.** The reference(s) should be included in the space provided below. Please attach another piece of paper if necessary. If references are not included with the bid, the bidder shall be required to provide such references to the City of Houston within five working days from receipt of a written request from the City of Houston to do so. **Bidder's capability and experience shall be a factor in determining the Contractor's responsibility.**

1. Business Name: _____
Business Address: _____
City, State, Zip: _____
Name of Owner/Contact Person: _____
Phone: _____ Fax: _____ Email: _____
No. of Years providing Service to this business: _____

2. Business Name: _____
Business Address: _____
City, State, Zip: _____
Name of Owner/Contact Person: _____
Phone: _____ Fax: _____ Email: _____
No. of Years providing Service to this business: _____

2. Business Name: _____
Business Address: _____
City, State, Zip: _____
Name of Owner/Contact Person: _____
Phone: _____ Fax: _____ Email: _____
No. of Years providing Service to this business: _____

4. Business Name: _____
Business Address: _____
City, State, Zip: _____
Name of Owner/Contact Person: _____
Phone: _____ Fax: _____ Email: _____
No. of Years providing Service to this business: _____

SITE INSPECTION

The City of Houston reserves the right to inspect the bidder's current place of business to evaluate equipment condition and capabilities, staff experience, training and capabilities, and storage capabilities as they relate to the performance of this contract.

SECTION B
SCOPE OF WORK

- 1.0 General: Variable Frequency Drives for Wastewater Operations
 - 1.1 The Contractor shall be required to furnish all labor, supervision, transportation, permits, tools, consumables, safety equipment, testing and testing equipment necessary to furnish and install Variable Frequency Drives (VFDs) in strict accordance with the scope of work/specifications. The Contractor shall install two 150HP, 460 V/60HZ VFDs at Pump Station (PS) #11, 69th Street Wastewater Plant and two 100HP, 460 V/60HZ VFDs at the South West Wastewater Plant.

- 2.0 Performance Time:
 - 2.1 The contractor shall have **210 calendar days** to furnish, deliver and install the 100HP, 460V/60HZ, VFDs, in strict accordance with the scope of work/specifications after receipt of the City of Houston Purchase Order.

 - 2.2 The contractor shall have **170 calendar days** to furnish, deliver and install the 150 HP 460 V/60 Hz, VFDs, in strict accordance with the scope of work/specifications after receipt of the City of Houston Purchase Order.

- 2.0 Warranty: - (100HP & 150HP VFDs)
 - 2.1 The contractor shall warranty the VFDs and associated equipment for a period of two years. The warranty shall include all parts, labor, material and transportation cost associated either performing the warranty repairs on site or at the contractor's facility. The warranty shall subsequent to certification and acceptance of the equipment by the City.

TECHNICAL SPECIFICATIONS
Southwest Wastewater Plant
Variable Frequency Drives for Wastewater Operations

PART ONE - GENERAL

1.0 General:

- 1.1 Furnish and install two Variable Frequency Drives (VFD), 100HP, 460V/60HZ for Sludge Transfer Pumps at Southwest Wastewater Treatment Plant (SWWWTP)
- 1.2 Manufacturer: Toshiba HX7+C411KCD, NSNB, or City approved equal
- 1.3 The two-year equipment warranty period starts after the VFD is received, installed and certified by the City subsequent to start-up.
- 1.4 The total bid price must include start-up services for the motor drive units
 - 1.4.1 The total bid price must include a minimum of one-half day field service training. The training must cover the operation and maintenance of VFD units for plant operators, instrumentation, electricians and engineers. The instruction/training must include the theory of VFD unit operations, trouble shooting and maintenance requirements.
- 1.5 The contractor shall be ISO-9001 and 14001 certified.
- 1.6 The contractor shall manufacture both VFDs and, if applicable, motors at the same facility.
- 1.7 The VFD shall be capable of constant and variable torque applications.
- 1.8 The VFD shall utilize IGBTs (insulated gate bipolar transistors) in its power section.
- 1.9 The VFD shall have a common design for all horse power models 50 through 1500HP with input disconnect switch and input semiconductor fuses.
- 1.10 The VFD shall be designed for installation in outdoor corrosive conditions such as found in waste water treatment facilities.
- 1.11 The VFD shall be designed for outdoor IP56 enclosure non magnetic stainless steel
- 1.12 The VFD shall be designed to perform in ambient temperature -14°F to 122°F (518, 1400, & 1500kVA max 104°F)
- 1.12 The VFD shall be designed to perform at altitude - 4,500 feet maximum without derating
- 1.14 The VFD shall be designed to perform in relative humidity - 95% maximum no condensation allowed (100% with space heater option)

- 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.

2.0 QUALITY ASSURANCE STANDARDS:

- 2.1 Institute of Electrical and Electronic Engineers (IEEE) Standard 519-1992, IEEE Guide for Harmonic Content and Control.
- 2.2 Underwriters Laboratories UL 508.
- 2.3 National Electrical Manufacturer's Association (NEMA) (ISC6, Enclosures for Industrial Controls and Systems.
- 2.4 IEC 801-2, 801-4, 255.4.
- 2.5 NFPA 70, National Electrical Code.

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.
- 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 2 phase 460V/60 Hz and 146 amps.
- 4.3 Main drive output power 2 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 0⁰ to 122⁰ 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 $\pm 10\%$ and frequency of $\pm 2\text{Hz}$.
- 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 ($Z_{in}:500\Omega$) and ± 0 to ± 10 Vdc ($Z_{in}:67\Omega$) input signals and eight programmable digital inputs with analog input signal capable of being inverted such that the minimum reference corresponds to 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 2-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 $\pm 0.2\%$ of maximum frequency for the analog input (at $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$).
- 4.22 The drive shall have selectable input terminal priority.
- 4.24 The drive shall have drooping control capability to promote load sharing.
- 4.25 The drive shall contain three critical frequency jump points with individual bandwidth.
- 4.26 The drive shall be capable of setting both upper and lower limit frequencies.
- 4.27 The PWM carrier frequency is adjustable from .5 - 5khz or .5-15khz model dependent. Output current derating is required starting at 2.2, 5, or 8khz also model dependent.
- 4.28 The drive shall be capable of PID set point control and line speed trim.
- 4.29 Preset macros for machine tools, textiles, hoists, conveyors, fans, pumps, etc.
- 4.40 The drive shall have RS222C serial communications standard.
- 4.41 Automatic cooling fan control based on heat sink temperature for extended fan life.
- 4.42 The drive shall have the capability of special custom user setting.
- 4.42 The drive shall be able to act as a space heater for a motor when the system is not running.
- 4.44 The drive shall have adjustable input and output terminal response time selections to prevent noise effects and chattering.
- 4.45 The drive shall have a built-in control system for commercial power/inverter power switching.

- 4.46 The drive shall accept 4-20mA signal input that would allow the drives maximum frequency, acceleration/deceleration time multiplication factor, voltage boost, or current limit to be adjusted while running.
- 4.47 The drive shall have an adjustable retry function after a fault. Both number of attempts (at least 10) and time (1-10 sec).
- 4.48 The drive shall have an adjustable output short circuit detection selection for standard motor and low impedance motors.

5.0 OPERATIONAL FUNCTIONS:

- 5.1 The VFD shall contain two separate acceleration/deceleration times with auto tuning for optimum setting (0.1 to 6000 seconds) with choice of linear, S, or C curves.
- 5.2 The VFD shall have an optional dynamic braking circuit available.
- 5.3 The VFD shall operate the motor in the forward or reverse direction.
- 5.4 The VFD shall be capable of jogging the motor up to 20 Hz then stopping the motor by deceleration, DC injection, or coasting.
- 5.5 The VFD shall contain fifteen preset speeds that can be activated from the keypad, terminal inputs, and host computer.
- 5.6 The VFD shall restart into a rotating motor operating in either the forward or reverse direction and match that frequency.
- 5.7 The VFD shall have adjustable soft stall that reduces frequency and voltage of the inverter to sustain a run in a overload situation.
- 5.8 The VFD shall be capable of performing a time base pattern run using 4 groups of 8 patterns each using the 15 preset speed values for a maximum of 22 different patterns.
- 5.9 The VFD shall have adjustable UL listed electronic overload protection (10%-100%).
- 5.10 The VFD shall have a custom programmable volt/hertz pattern.
- 5.11 In True Torque Control mode the drive shall utilize auto tuning.

6.0 PROTECTIVE FEATURES:

- 6.1 The VFD shall have an external fault input.
- 6.2 The VFD shall be capable of re-setting faults remotely and locally.
- 6.3 The VFD shall be programmable to alert the following alarms:

- Over torque alarm
- Inverter overload pre-alarm
- Motor overload pre-alarm
- Braking resistor overload pre-alarm
- Inverter overheat pre-alarm
- Undercurrent alarm
- Over-current pre-alarm
- Communication error alarm
- Cumulative timer alarm
- Executing retry.

6.4 The VFD shall identify and display the following faults:

- Over-current during acceleration trip
- Over-current during deceleration trip
- Over-current during run trip
- Over-current on the DC Bus during acceleration trip
- Over-current on the DC Bus during deceleration trip
- Over-current on the DC Bus during run trip
- Load end over current trip detected at start-up
- U-phase short circuit trip detected at start-up
- V-phase short circuit trip detected at start-up
- W-phase short circuit trip detected at start-up
- Overvoltage during acceleration trip
- Overvoltage during deceleration trip
- Overvoltage during run trip
- Inverter overloaded trip
- Motor overloaded trip
- Inverter overheat trip
- Emergency off trip
- EEPROM failure during write cycle
- EEPROM abnormality during initial reading
- RAM error
- ROM error
- CPU error
- Communication interruption error
- Gate array error
- Output current detection circuit error
- Option PCB error trip
- Low operating current trip
- Main circuit under-voltage trip
- Over-torque trip
- Software detected earth fault trip
- Hardware detected earth fault trip
- Auto-tuning error
- Inverter type form mismatch error
- EEPROM type form mismatch error.

7.0 MONITOR FUNCTIONS:

- 7.1 The VFD shall have a graphical backlit LCD digital display.
- 7.2 The VFD digital display shall be capable of displaying:
 - Frequency
 - % current and amps
 - % voltage and volts input & output
 - RPM
 - GPM
 - Input & output watts
 - Torque
 - Input reference signal.
- 7.3 The VFD shall have 220 programmable parameters that can be changed while the drive is operating.
- 7.4 The VFD's 222 parameters shall be adjustable from the touchpad or computer link.
- 7.5 The VFD's 8-button keypad shall be NEMA 12 rated,
- 7.6 The VFD's keypad shall be capable of being extended 15 feet from the VFD.
- 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 2R 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 through-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 2R 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 specified.
- 9.0 POWER UNIT:
- 9.1 The VFD shall employ diode bridge rectification to convert AC to DC. SCRs and other switching power devices are not used in the converter section of the drive to minimize line notching and RFI.
 - 9.2 The Converter Section shall be unaffected by phase rotation/phase sequence.
 - 9.3 Semiconductors on all ratings shall be sized (current) to allow full operation and overload capabilities at minimum input voltage.
 - 9.4 PIV Ratings of the rectifier will be as follows:
 - 9.4.1 460V drives—rectifier minimum PIV rating of 1600V.
 - 9.5 The VFD shall have MOVs mounted phase-to-phase for surge protection.
- 10.0 EIGHTEEN PULSE MODELS:
- 10.1 The converter section shall employ three sets of 6-pulse rectifiers which are connected in parallel to the same DC bus.
 - 10.2 Rectifiers shall be protected by fast acting "semiconductor" fuses.
 - 10.3 An input phase shifting autotransformer shall be used to achieve proper harmonic cancelation.
 - 10.4 The phase shifting transformer shall have multiple secondary's rated at full

voltage and phase shifted for maximum harmonic attenuation.

- 10.5 The converter section shall be usable on 50Hz and 60Hz distribution systems.
- 11.0 INSTALLATION:
- 11.1 The Contractor shall be responsible for unbolting, removal, and disposal of the pre-existing VFD support platform and VFD unit on site.
- 11.2 Contractor shall be responsible for any necessary permits, permit fees, and inspections to meet City building and electrical code requirements.
- 11.3 Contractor to include in his proposal the cost of a crane to lift and position the new VFDs.
- 11.4 Field splices shall be reinforced with an internal sleeve and all joints shall be tightly fitted.
- 11.5 The Contractor shall submit a wiring drawing for review and approval by electrical group prior to commencing construction showing all the wiring that will be between the existing panels to the new VFD enclosure.
- 11.6 The contractor shall install and complete all necessary power and control wiring. All wiring shall be enclosed in plastic coated rigid conduits.
- 11.7 The contractor shall install a stiff leg support(s) for the rigid conduits between the existing panels and the new VFD spaced as required by code. The support shall be constructed from stainless steel Unistrut and shall include all necessary associated stainless steel hardware for support and strapping.
- 11.8 All cabinet penetrations must be water tight.
- 11.9 The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual and in accordance with quality assurance section 2.0.
- 11.10 The contractor shall provide and install an electrical by-pass for the VFDs to the existing starters feeding excess sludge pumps #1 & #2 such that, in the event of a VFD failure the excess sludge pumps can remain operational.
- 11.11 New conductors will be spliced from the incoming power to the input circuit breakers of the new VFDs.
- 11.12 New conductors will be provided from each VFD output terminal block and spliced to the existing motor leads to the motor starters.
- 11.12 The electrician(s) shall follow all applicable NEC regulations and rules when wiring the new VFDs.
- 11.14 The 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.
- 11.15 The contractor shall label each VFD cabinet with the corresponding pump

and motor identifications (pump #1 and pump#2).

PART TWO – NUMBER SYSTEM CONFIGURATION

1.0 HX7 PLUS PACK VFD:

1.1 Use the following part numbering system to configure the HX7 Plus Pack. The example below illustrates a 100HP 460V integrated 18 pulse drive in NEMA 2R stainless steel enclosure, with stainless steel I-beam base.

H	X	7	+	C	4	1	1	K	C	D	NS	NB
SERIES					VAC	RATING			STYLE		OPTION 1	OPTION 2**
2						660			CB-NEMA 2R with input circuit breaker		AE = Isolated Three-Contactor Bypass	
						820			CB1-NEMA 1 with input circuit breaker		NS = Stainless Steel Enclosure	
4	■					11K			CD-NEMA 2R with 18-Pulse input, circuit breaker		NB = Stainless Steel I-Beam Base (Only available with NS Option)	
C						16K						
						20K						
						26K						
						29K						
						45K						
						*51K40						
						60K						
						70K						
						81K						
						92K						
						10L						
						12L						
						*14L40						
						*15L40						
						*500, 1400, & 1500 ratings are 40 deg. 1 C Celsius maximum						

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 2R enclosures feature air-to-air heat exchangers.

PART THREE - SKETCHES

1.0 Installation of the new VFDs shall be on an existing concrete pad. **Note: for approximate location see sketch below.**

SPECIFICATIONS FOR: VARIABLE FREQUENCY DRIVE (Two Drive Units)
FOR THE PUBLIC WORKS AND ENGINEERING DEPARTMENT WASTEWATER
OPERATIONS DIVISION

Photo with sketch showing the proposed location of the VFD cabinet support pad that will be constructed by the City for the VFD units.

Sketch showing Proposed Concrete Pad Location for new VFD Units



Figure 1.0

SPECIFICATIONS FOR: VARIABLE FREQUENCY DRIVE (Two Drive Units)
FOR THE PUBLIC WORKS AND ENGINEERING DEPARTMENT WASTEWATER
OPERATIONS DIVISION

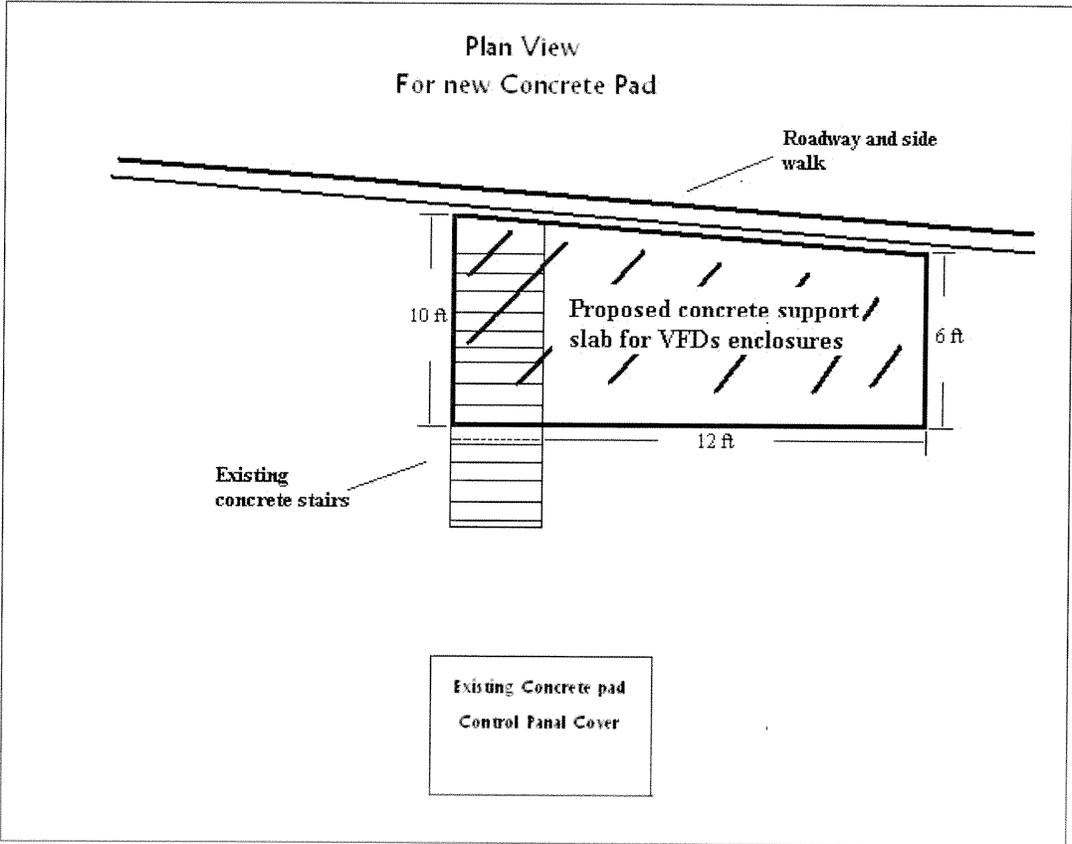


Figure 2.0

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 W& 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.

- 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.

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.

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 or cycled 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.

- 3.1.4.1 Compliance to IEEE 519 – Harmonic analysis for particular jobsite including total voltage harmonic distortion and total current distortion.
 - 3.1.4.2 The VFD manufacturer shall provide calculations specific to this installation, showing total harmonic voltage distortion is less than 5%. Input 2% line reactors shall be sized and provided if necessary to ensure compliance with IEEE standard 519-1992, Guide for Harmonic Control and Reactive Compensation for Static Power Converters. The acceptance of this calculation must be completed prior to VFD installation.
 - 3.1.4.3 Prior to installation, the VFD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the VFDs . The results shall be based on a computer aided circuit simulation of the total actual system, with information obtained from the power provided and the user.
 - 3.1.4.4 If the voltage THD exceeds 5%, the VFD manufacturer is to recommend the additional equipment required to reduce the voltage THD to an acceptable level.
 - 3.1.4.5 The VFDs shall have an 18-pulse or greater transformer-rectifier input section.
- 3.1.4 Complete electrical power and control diagrams showing the control, and protection system, illustrating the protection, control, trip and alarm functions at the different locations, reference signals and commands, and the auxiliary supplies (i.e. air, electrical auxiliary supplies, etc.). Wiring diagrams shall be fully explicit 2-line diagrams showing all power and control point-to-point connections.

4.0 WARRANTY:

- 4.1 Note: Reference Scope of Work, “Warranty”, Page 6, Section 2.0

PART 2 PRODUCTS:

1.0 ACCEPTABLE MANUFACTURERS:

- 1.1 Toshiba, ABB, Robicon, Siemens.
- 1.2 The VFD manufacturer shall:
 - 1.2.1 Have an existing sales representative for Wastewater Plant applications, with expertise in Wastewater Plant systems and controls.
 - 1.2.2 Have an independent service organization.

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. The drive efficiency shall be 97% or better at full speed and full load. 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 outdoor 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 characters/line) LCD display. The LCD shall be backlit to provide to provide easy viewing in any light condition. The contrast 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.

- 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-through 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 1 minute.
- 2.2.11 The VFD shall have input circuit breaker motor circuit protector standard in the drive enclosure, 60,000 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.

- 2.2.15 The VFD shall not contribute any short-circuit current to an upstream short-circuit fault.
 - 2.2.16 The VFD shall be provided with an integrally-mounted Siemens S7-215-DP programmable logic controller with expansion modules as required to facilitate the remote monitoring and control of the VFD system through the existing and proposed PLC-based control system.
 - 2.2.17 The VFD shall be high-efficiency (≥ 0.95), high power factors (≥ 0.95), low – harmonic type, see Item 1.04, A.5.
 - 2.2.18 The VED shall not interfere with power factor correction capacitors on the switchgear bus. If there is potential conflict, the VFD manufacturer shall be responsible for de-tuning of any affected capacitor per Specification Section 16412.
- 2.4 All VFDs shall have the following adjustments:
- 2.4.1 Interposing power blocks ahead of the main circuit breaker input terminals to facilitate connection of the power feeders sized as shown on the drawings.
 - 2.4.2 Three (2) programmable critical frequency lockout ranges to prevent the VFD from continuously operating at an unstable speed.
 - 2.4.3 PI set-point controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control; thus eliminating the need for external controllers.
 - 2.4.4 Adjustable within the range of 0-20mA and 0-10 Volts. Additionally, the reference must be able to be scaled so that maximum reference can represent a frequency less than 60 Hz, without lowering the drive maximum frequency below 60 Hz.
 - 2.4.5 Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices.
 - 2.4.6 One analog output proportional to Frequency.
 - 2.4.7 Outputs must be true form C type contacts; open collector outputs are not acceptable.
 - 2.4.8 Seven (7) programmable present speeds.
 - 2.4.9 Two independently adjustable acceleration and deceleration and deceleration ramps. These ramp times shall be adjustable from 0.2 to 1200 seconds.
 - 2.4.10 The VFD shall Ramp or Coast to a stop, as selected by the user.

2.5 The Following operating information display shall be standard on the VFD digital display. The display shall be in complete English words (alpha-numeric codes are not acceptable):

1. Output Frequency
2. Motor Speed (RPM, % or Engineering units)
3. Output Current
4. Output Voltage
5. Heatsink Over-temperature
6. Analog Input Values
7. Keypad Reference Values
8. Elapsed Time Meter
9. KWH meter

2.6 The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop, and announce the fault condition in complete words (alphanumeric codes are not acceptable).

1. Over-current trip.
2. Over-voltage trip.
3. Under-voltage trip.
4. Over-temperature.
5. Ground Fault either running or at start.
6. Adaptable Electronic Motor Overload (I^2t). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuit which are not speed dependant are unacceptable. The electronic motor overload protection shall be UL Listed for this function

2.7 Speed Command Input shall be via:

2.7.1 Keypad.

2.7.2 Two Analog inputs, each capable of accepting a 0-20mA, 0-10V, 2-10V signal. Input shall be isolated from ground. The analog input should be able to be inverted, so that minimum reference corresponds to maximum speed, and maximum reference corresponds to minimum speed. The minimum and maximum values (gain and offset) shall be adjustable within the range of 0-20 mA and 0-10 Volts.

2.8 Serial Communications.

2.8.1 The VFD shall have RS-222 and RS-485 ports as standard.

2.8.2 The VFD shall be able to communicate with programmable logic controllers (PLC's), distributed control systems (DCS), and direct controls (DDC).

2.8.3 Serial communication capabilities shall include, but not be limited to, run-stop control, speed set adjustment, proportional/integral PI controller adjustments, current limits, and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as

output speed/frequency, current (in amps), power (in kwh), relay outputs, and diagnostic fault information.

2.8.4 The VFD shall provide communication [PROFIBUS or ETHERNET] protocol, either built-in or on an integrated communication boards.

2.9 Accessories to be furnished and mounted by the drive manufacturer.

2.9.1 Customer Interlock Terminal Strip-Provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external interlocks and start/stop contacts shall remain fully functional whether the drive is in Hand or auto.

2.9.2 All wires to be individually numbered at both ends for ease of troubleshooting.

2.9.3 Door interlocked disconnect switch which will disconnect all input power from the drive and all input power from the drive and all internally mounted options. The disconnect handle shall be through- the- door type, and be padlockable in the "Off" position.

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

PART 2 EXECUTIONS

2.0 INSTALLATION:

2.1 Power and control wiring shall be completed by the Contractor. The Contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

2.2 Programming of the PLC integral with the VFD, and reprogramming of the plant PLC, shall be coordinated with the City of Houston.

3.0 START – UP:

3.1 Certified factory start-up shall be provided for each drive by a factory authorized service center.

3.2 A certified start-up form shall be filled out for each drive with a copy provided to the Owner, and a copy kept on file at the manufacturer.

3.3 The VFD must provide the "Start-up Wizard"

3.3.1 The 'Start-up Wizard' shall allow the user to program the drive by supplying fundamental application information such as:

- Motor ratings
- Acceleration/deceleration times and type, etc.
- Minimum and or maximum speeds
- V/Hz pattern
- Control logic/control topology

3.3.2 In addition to the 'Start-Up Wizard', all parameters may be accessed by menu tree navigation, direct access, communications, or Windows based programming software.

PART THREE - APPLICATION CONSIDERATION

1.1 Long Lead Length

1.1.1 All VFDs shall have software and hardware to limit reflected wave caused by long motor cable lengths. When applied to motors with insulation systems that are compliant with NEMA MG-1 -1998 Section IV Part 21, output filters shall not be required when motor lead length are within those recommended below.

MODEL	PWM CARRIER FREQUENCY	Suggested Maximum Lead Length
460V	<= 5kHz	600 feet
	>5kHz	200 feet

**PRODUCT RATINGS (Overview)
VFD STANDARD SPECIFICATIONS**

Model Range	4600 - 440K
Nominal Horsepower Range	60-400 (500 - 800HP available in 2006 - Contact Factory)
Input Voltage Rating (AC)	460VAC
Input Voltage	-10/+10%
Input Frequency	50/60Hz
Input Semiconductors	Three phase, full wave bridge diode
PWM Carrier	User adjustable between 0.5kHz to 15kHz. Current derate above
Output Type	Sinusoidal Coded PWM three phase output
Output Voltage	Automatic regulation, 'fixed', or floating with input.
Output Frequency	0.02 to 400.0HZ. Maximum output user adjustable from 20.00 to
Output Transistors	IGBT Power Switching Transistors, latest design generation. Integral hardware to limit DV/DT
Frequency Precision (speed control mode)	Analog input +/-0.2% of maximum output frequency. Digital input +/-0.01% of maximum output frequency.

Speed Regulation (speed control mode)	Closed Loop - 0.01 % from 0.02Hz to 120Hz. Open Loop Up to 0.1 % from 0.6Hz to 80Hz
Torque Limiting (speed control mode)	User adjustable from -250% to +250%
Torque Regulation (torque control mode)	Closed Loop +/-10% -100 to +100% torque Open Loop +/-10%, +50 to 100% torque
Torque Ripple (torque control mode)	Closed Loop <2%, -100 to +100% torque Open Loop <2%, 20% to 100% torque
Torque Response (torque control mode)	Closed Loop 200 radians per second. Open Loop 150 radians per second
Position Regulation (position control mode)	2/1024 of shaft revolution
Position Response (position control mode)	200 radians per second
Discrete (digital) Inputs	Eight independently configurable terminals programmable for any of 67 functions. Reaction software reversible (normally open, normally closed) Sink/Source selectable
Discrete (digital) Outputs	One Form 'C, two Form 'A' contact outputs. Contacts rated 250V, 2A. Independently programmable for any of 56 functions. Reaction software reversible (normally open, normally closed)
Analog Inputs	One input configurable for either 4-20ma or 0-10VDC, One input rated 0-10VDC or 1K to 10K. Ohm Potentiometer, One bi-polar input rated +/- 10VDC. All analog inputs scalable with independently adjustable gain and bias. Analog inputs configurable to any of 26 different functions.
Analog Outputs	Two scalable analog outputs, selectable to 4-20mA or 0-1mA. Programmable for any of 22 different functions.
Communication Ports	One TTL (5V Transistor-Transistor Logic), One RS222/RS485 smart port. One microprocessor communication bus port. TTL and RS222/485 ports scan for baud rate and parity setting.
Signal Isolation	Three channel analog isolation available (option ASD-ISO-1) 750VDC true analog isolation
Power Terminations	Input (LI/R, L2/S, L2/T), Output (TI/U, T2/V, T2/W), DC Bus (PA, PC), DCL (PO, PA), DBR -not used (PA, PB)
Environmental Ambient	Temperature: -10 to 40 Degrees C, Humidity: 95% non-condensing, Altitude: -1000 to +1000 meters (of sea level)
Protective Functions	Forty-seven fully monitored fault and alarm conditions displayed on Electronic Operator Interface and available via communication functions.
Speed Search (Restart)	Smoothly starts a freewheeling (spinning) motor regardless of direction of rotation or operating mode
Electronic Operator Interface	Graphical Backlit LCD display with flash upgradeable memory. Full operation, monitoring, and programming functionality. User configurable with complete password protection function. Remote mountable up to 1000' feet from drive. Dual communication ports, TTL and RS222/RS485. Optional real time clock with data logging capabilities.

W7 ASD 18 pulse

W7 ASD 18 PULSE PART NUMBERING CONVENTION

The W7 series ASD is available with commonly used options like manual bypass and input circuit breakers in an easy to install package.

AADW – Input Circuit Breaker

AEDW - Input Circuit Breaker, Isolated Manual (3) Contactor Bypass, Overload.

ASDW - Input Circuit Breaker, Isolated Manual Solid State Starter Bypass, Overload.

Use the following part numbering system to configure the W7. This example is for a 100HP 460V "AA" style integrated 18 pulse assembly with circuit breaker.

W	7	4	1	0	K	A	A	D	W			
Series	VAC	Rating #	Style			Option 1	Option 2					
4 = 460V		600 = 60HP	AA- Circuit Breaker									
		750 = 75HP	AE- Circuit Breaker, Isolated Bypass, Overload									
		10K=100HP	AS- Circuit Breaker, Isolated Solid State Bypass, Overload									
		12K=125HP										
		15K=150HP										
		20K=200HP										
		25K=250HP										
		30K=300HP										
		35K=350HP										
		40K=400HP										
		50K=500HP										
		60K=600HP										
		70K=700HP										
		80K=800HP										

**SECTION C
GENERAL TERMS AND CONDITIONS AND BOND FORMS**

BUILDING WAGE SCALE

A PDF version of this Building Wage Scale
can be viewed on the following web link

<https://purchasing.houstontx.gov/buyer/BidDocumentManager.aspx?id=C23649>

ENGINEERING WAGE SCALE

A PDF version of this Engineering Wage Scale
can be viewed on the following web link

<https://purchasing.houstontx.gov/buyer/BidDocumentManager.aspx?id=C23649>

**Document 00700
GENERAL CONDITIONS**

A PDF version of the General Conditions can be viewed on the following web link:

<https://purchasing.houstontx.gov/buyer/BidDocumentManager.aspx?id=C23580>

**Document 00800
SUPPLEMENTARY CONDITIONS**

The following Paragraphs amend and supplement the 2005 edition of General Conditions. Unaltered portions of General Conditions remain in effect.

ARTICLE 2 - THE CONTRACTOR

2.5 *LABOR: Insert the following Paragraph 2.5.2.1.1.*

2.5.2.1.1 Contractor shall make good faith efforts to comply with the City ordinances regarding Minority and Women Business Enterprises (MWBE) and Persons with Disabilities Business Enterprises (PDDBE) participation goals which are as follows:

- .1 the MWBE goal is 0 percent, and
- .2 the PDDBE goal is 0 percent.

3.28 CONTRACTOR DEBT

3.28.1 IF CONTRACTOR, AT ANY TIME DURING THE TERM OF THIS AGREEMENT, INCURS A DEBT, AS THE WORD IS DEFINED IN SECTION 15-122 OF THE HOUSTON CITY CODE OF ORDINANCES, IT SHALL IMMEDIATELY NOTIFY CITY CONTROLLER IN WRITING. IF CITY CONTROLLER BECOMES AWARE THAT CONTRACTOR HAS INCURRED A DEBT, IT SHALL IMMEDIATELY NOTIFY CONTRACTOR IN WRITING. IF CONTRACTOR DOES NOT PAY THE DEBT WITHIN 20 DAYS OF EITHER SUCH NOTIFICATION, CITY CONTROLLER MAY DEDUCT FUNDS IN AN AMOUNT EQUAL TO THE DEBT FROM ANY PAYMENTS OWED TO CONTRACTOR UNDER THIS AGREEMENT, AND CONTRACTOR WAIVES ANY RECOURSE THEREFORE.

3.28.2

ARTICLE 8 - TIME

8.1 *PROGRESS AND COMPLETION: Delete Paragraph 8.1.6. and replace with the following 8.1.6.*

8.1.6.1 Contractor shall credit the City by Change Order for inspection services for overtime work or work performed on Sundays or Legal Holidays. The amount Contractor credits the City will be **\$50.00 per hour** per inspector for inspection services.

ARTICLE 9 - PAYMENTS AND COMPLETION

9.1 *UNIT PRICE WORK: Delete Section 9.1 in its entirety and insert the following Section 9.1.*

9.1 References to Unit Prices in individual Specification sections are not applicable to the Contract. Include payment for portions of the Work required by these sections in the Stipulated Price for the Contract.

9.12 ***LIQUIDATED DAMAGES:*** *Insert the following Paragraph 9.12.1.1.*

9.12.1.1 The amount of liquidated damages provided in General Conditions Paragraph 9.12.1 payable by Contractor or Surety for each and every day of delay beyond Contract Time, are **\$500.00 per day.**

ARTICLE 11 - INSURANCE AND BONDS

11.2 *INSURANCE TO BE PROVIDED BY CONTRACTOR: Delete Paragraph 11.2.8. and replace with the following 11.2.8.*

11.2.1.4 Contractor shall provide Owners and Contractor's Protective Liability Insurance only if the contractor's bid price is equal to or greater than \$100,000.00.

11.2.8 *Endorsement of Primary Insurance:* Each policy except Workers' Compensation Insurance must contain an endorsement that the policy is primary insurance to any other insurance available to additional insured with respect to claims arising under the Contract.

**FURNISH & INSTALL VARIABLE FREQUENCY DRIVES
FOR THE PUBLIC WORKS AND ENGINEERING DEPARTMENT
ONE-YEAR MAINTENANCE BOND**

BID NUMBER C23649

THAT WE, _____, as Principal, hereinafter called Contractor, and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston, a municipal corporation, in the sum of \$_____, for the payment of which sum well and truly to be made to the City of Houston and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a Contract in writing with the City of Houston for _____, _____, all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein.

NOW THEREFORE, if the said Contractor shall comply with the provisions of Paragraph 11.5.1 of the General Conditions, and correct work not in accordance with the Contract documents discovered within the established one-year period, then this obligation shall become null and void, and shall be of no further force and effect; otherwise, the same is to remain in full force and effect.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other party at the address prescribed in the Contract documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

IN WITNESS THEREOF, the said Contractor and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

**FURNISH & INSTALL VARIABLE FREQUENCY DRIVES
FOR THE PUBLIC WORKS AND ENGINEERING DEPARTMENT**

BID NUMBER C23649

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:

(SEAL)

Full Name of Surety

Address of Surety for Notice

Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

Legal Assistant

Date

PERFORMANCE BOND

THAT WE, _____, as Principal, (the "Contractor"), and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound to the City of Houston (the "City"), a municipal corporation, in the penal sum of \$ _____ for the payment of which sum, well and truly to be made to the City, its successors and assigns, Contractor and Surety do bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a Contract in writing with the City for _____, all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein.

NOW THEREFORE, if the said Contractor shall faithfully and strictly perform the Contract in all its terms, provisions, and stipulations in accordance with its true meaning and effect, and in accordance with the Contract documents referred to therein and shall comply strictly with each and every provision of the Contract and with this Bond, then this obligation shall become null and void and shall have no further force and effect; otherwise the same is to remain in full force and effect. Should the Contractor fail to faithfully and strictly perform the Contract in all its terms, including but not limited to the indemnifications thereunder, the Surety shall be liable for all damages, losses, expenses and liabilities that the City may suffer in consequence thereof, as more fully set forth herein.

It is further understood and agreed that the Surety does hereby relieve the City or its representatives from the exercise of any diligence whatever in securing compliance on the part of the Contractor with the terms of the Contract, and the Surety agrees that it shall be bound to take notice of and shall be held to have knowledge of all acts or omissions of the Contractor in all matters pertaining to the Contract. The Surety understands and agrees that the provision in the Contract that the City will retain certain amounts due the Contractor until the expiration of 20 days from the acceptance of the Work is intended for the City's benefit, and the City will have the right to pay or withhold such retained amounts or any other amount owing under the Contract without changing or affecting the liability of the Surety hereon in any degree.

It is further expressly agreed by Surety that the City or its representatives are at liberty at any time, without notice to the Surety, to make any change in the Contract documents and in the Work to be done hereunder, as provided in the Contract, and in the terms and conditions thereof, or to make any change in, addition to, or deduction from the Work to be done hereunder; and that such changes, if made, shall not in any way vitiate the obligation in this Bond and undertaking or release the Surety there from.

It is further expressly agreed and understood that the Contractor and Surety will fully

indemnify and save harmless the City from any liability, loss, cost, expense, or damage arising out of Contractor's performance of the Contract.

If the City gives Surety notice of Contractor's default, Surety shall, within 45 days, take one of the following actions:

1. Arrange for Contractor, with consent of the City, to perform and complete the Contract;
or
2. Take over and assume completion of the Contract itself, through its agents or through independent contractors, and become entitled to the payment of the balance of the Contract Price.

If the Surety fails to take either of the actions set out above, it shall be deemed to have waived its right to perform and complete the Contract and receive payment of the balance of the Contract Price and the City shall be entitled to enforce any remedies available at law, including but not limited to completing the Contract itself and recovering any cost in excess of the Original Contract Price from the Surety.

This Bond and all obligations created hereunder shall be performable in Harris County, Texas. This Bond is given in compliance with the provisions of Chapter 2252, Texas Government Code, as amended, which is incorporated herein by this reference.

Notices required or permitted hereunder shall be in writing and shall be deemed delivered when actually received or, if earlier, on the third day following deposit in a United States Postal Service post office or receptacle, with proper postage affixed (certified mail, return receipt requested), addressed to the respective other Party at the address prescribed in the Contract documents, or at such other address as the receiving party may hereafter prescribe by written notice to the sending party.

**FURNISH & INSTALL VARIABLE FREQUENCY DRIVES
FOR THE PUBLIC WORKS AND ENGINEERING DEPARTMENT**

BID NUMBER C23649

EXECUTED in multiple originals this _____ day of _____, 20____.

ATTEST/SEAL: (if a corporation)

WITNESS: (if not corporation)

(Name of Principal)

(Address of Principal)

By: _____

Name:

Title:

Date:

By: _____

Name:

Title:

Date:

ATTEST/SEAL

SURETY WITNESS:

(Name of Surety)

(Address of Surety)

By: _____

Name:

Title:

Date:

By: _____

Name:

Title:

Date:

REVIEWED:

This Bond has been reviewed as to form by the undersigned Paralegal and has been found to meet established Legal Department criteria.

Date

Paralegal

STATUTORY PAYMENT BOND

THAT WE, _____, as Principal, hereinafter called Contractor and the other subscriber hereto, _____, as Surety, do hereby acknowledge ourselves to be held and firmly bound unto the City of Houston, a municipal corporation, in the sum of \$_____ for the payment of which sum, well and truly to be made to the City of Houston, and its successors, the said Contractor and Surety do bind themselves, their heirs, executors, administrators, successors, jointly and severally.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH THAT:

WHEREAS, the Contractor has on or about this day executed a contract in writing with the City of Houston for _____, _____, all of such work to be done as set out in full in said Contract documents therein referred to and adopted by the City Council, all of which are made a part of this instrument as fully and completely as if set out in full herein;

NOW, THEREFORE, if the said Contractor shall pay all claimants supplying labor and materials to him or a Subcontractor in the prosecution of the Work provided for in the Contract, then, this obligation shall be void; otherwise the same is to remain in full force and effect;

PROVIDED HOWEVER, that this Bond is executed pursuant to the provisions of Chapter 2252, Texas Government Code, as amended, and all liabilities on this Bond shall be determined in accordance with the provisions of said Article to the same extent as if it were copied at length herein.

IN WITNESS THEREOF, the said Contractor and Surety have signed and sealed this instrument on the respective dates written below their signatures and have attached current Power of Attorney.

**FURNISH & INSTALL VARIABLE FREQUENCY DRIVES
FOR THE PUBLIC WORKS AND ENGINEERING DEPARTMENT**

BID NUMBER C23649

ATTEST, SEAL: (if a corporation)
WITNESS: (if not a corporation)

Name of Contractor

By: _____
Name:
Title:

By: _____
Name:
Title:
Date:

ATTEST/SURETY WITNESS:
(SEAL)

Full Name of Surety

Address of Surety for Notice

Telephone Number of Surety

By: _____
Name:
Title:
Date:

By: _____
Name:
Title: Attorney-in-Fact
Date:

This Ordinance or Contract has been reviewed as to form by the undersigned legal assistant and have been found to meet established Legal Department criteria. The Legal Department has not reviewed the content of these documents.

Legal Assistant

Date