City of Oak Ridge, Tennessee
* * * * REQUEST FOR QUOTATION * * * *

Page - 1
Date - 4/30/14
Order No. - 138873-000 OQ
Brn/Plt - 22145

Vendor Name:_____
Payment Terms:_____
F.O.B,:_____
Delivery Date:_____
Ship Via:_____
Signature:_____ _____

SHIP City of Oak Ridge - Materials Management
TO 100 Woodbury Lane / P.O. Box 1
Oak Ridge, TN 37830
(865) 425-1819 FAX (865) 482-8475
Lyn Majeski lmajeski@oakridgetn.gov

Ordered - 04/30/14 Freight - Default - Handling Code
Requested - 05/13/14 Taken By -
Delivery - Deliveries are accepted 8 a.m. TO 3 p.m.

Description / Supplier Item		UM	Unit Cost	Extension
LOW VOLTAGE MOTOR CONTROL CENTER-EAST PLANT PUMP STATION PER THE FOLLOWING SPECIFICATIONS	1	EA		EA

Total Order

CITY OF OAK RIDGE
RFQ #138873

LOW VOLTAGE MOTOR CONTROL CENTER ADJUSTABLE FREQUENCY DRIVE CONTROLLER

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. This section provides specification requirements for adjustable frequency, variable speed drives packaged as part of a complete MCC unit or herein identified as AC drive units for use with NEMA B design AC motors. The term AC Drive includes the controller unit.
B. The AC drive manufacturer shall furnish, field test, adjust and certify all installed AC drive units for satisfactory operation.
C. Any exceptions or deviations to this specification shall be indicated in writing and submitted with the quotation.

1.02 SUBMITTALS

A. Four (4) copies of approval drawings shall be furnished for Owner's approval prior to factory assembly of the AC drive units. These drawings shall consist of elementary power and control wiring diagrams, MCC electrical one line diagram, MCC unit schedule and MCC front elevation drawings.
B. Front elevation drawings shall include dimensions for MCC front view, top and bottom conduit entry locations, MCC enclosure description and ratings, overall MCC weight and anchoring points.
C. Elementary wiring diagrams shall include all power and control components packaged within the AC drive controller unit and documentation of any non-default settings programmed at the MCC factory.
D. Unit schedule shall indicate drive output horsepower, duty/torque type, pilot devices, disconnect ratings, and nameplate legends for each AC drive controller unit.
E. Submit with the delivery of the MCC an Installation and Maintenance Manual and one (1) copy of the manufacturer's drawings per shipping block.

1.03 REGULATORY REQUIREMENTS

A. ANSI/NFPA 70 – National Electrical Code (NEC)
B. ANSI C84.1 – Electric Power Systems and Equipment - Voltages Ratings (60Hz).
C. CSA C22.2 No. 14-M91 – Industrial Control Equipment
D. NEMA ICS 1 – Industrial Control and Systems General Requirements
E. NEMA ICS 2.3 – Instruction for Handling, Operation and Maintenance of Motor Control Centers.
F. NEMA ICS 18 – Motor Control Centers.
G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
H. UL 508 - UL Standard for Safety for Industrial Control Equipment.
I. UL 508C - UL Standard for Safety for Power Conversion Equipment.
J. UL 845 - UL Standard for Safety for Motor Control Centers.
K. UL 50 - UL Standard for Safety for Enclosures for Electrical Equipment.

1.04 WARRANTY

The AC drive units shall be warranted to be free from defects in materials and workmanship for a period of twelve (12) months from the start-up date.

1.05 QUALITY ASSURANCE

A. The AC Drive and MCC shall be manufactured by one supplier in an ISO 9001 certified facility.
B. The AC drive unit and all associated optional equipment shall be UL listed according to the Standard for Safety for Motor Control Centers UL 845. A UL label shall be attached inside each AC drive unit as verification.
C. The AC drive unit shall be designed, constructed and tested in accordance with UL, CSA, NEMA & NEC standards and shall be third party certified by UL, CSA and NOM.
D. Each AC Drive shall be tested with an AC induction motor under load conditions. The final AC Drive unit shall be hi-pot tested with all power and control components before shipment.
E. The manufacturer of the AC drive controller unit shall have been specialized in the design and production of AC drive units for a period of at least 10 years.
F. All factory supplied options shall be completely tested for successful operation before shipment.
G. Quality Assurance documentation shall be furnished to verify successful completion of the above tests upon written request of the Owner.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The AC drive unit shall be provided by Square D (Brand of Schneider Electric).
B. Alternate control techniques other than pulse width modulated technology (PWM), are not acceptable.
C. The AC drive unit shall be Square D Altivar Model #61 or 71.

2.02 GENERAL DESCRIPTION

A. The AC drive unit shall convert the input AC main power to an adjustable frequency and voltage as defined in the following sections.
B. The input power section shall utilize a 6-Pulse bridge rectifier design with line reactors for effective harmonic mitigation incorporating diode rectifiers. The diode rectifiers shall convert fixed voltage and frequency, AC line power to fixed DC voltage. This power section shall be insensitive to phase rotation of the AC line.
C. The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall utilize insulated gate bipolar transistors (IGBTs) or intelligent power modules (IPMs) as required by the current rating of the motor.

2.03 CONSTRUCTION

A. The AC drive unit shall be a combination disconnect-drive MCC style unit. The input fusible switch shall provide NEC required branch circuit protection. The fusible switch shall have an external operator. Wiring between the AC Drive and the disconnect shall not be disturbed when removing or installing the AC drive unit from the MCC.
B. Units should be of modular construction so that it is possible to readily interchange units of the same size without modifications to the MCC structure.

2.03 CONSTRUCTION, continued

C. All conducting parts on the line side of the unit disconnect shall be isolated to prevent accidental contact with those parts.

D. AC drive units larger than 50 hp variable torque shall be connected directly to the main horizontal bus with appropriately sized cable or riser bus.

E. All AC drive units shall be enclosed in a structure which contains a 12" (305mm) high horizontal wireway at the top of each section, and a 6" (152mm) high horizontal wireway at the bottom of each section. These wireways should be unobstructed the full length of the MCC to allow room for power and control cable to connect between units in different sections.

F. AC drive units which require a full section are not required to have vertical wireways.

G. All AC drive unit interior mounting panels shall be white for better visibility inside.

H. A cast metal handle operator shall be provided on each AC drive unit disconnect. With the AC drive unit connected to the MCC bus and the AC drive unit door closed, the handle mechanism shall allow complete on/off control of the unit disconnect with clear indication of the disconnect's status. All circuit breaker operators shall include a separate tripped position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door.

   1. A mechanical interlock shall prevent an operator from opening the AC drive unit door when the disconnect is in the on position. Another mechanical interlock shall prevent an operator from placing the disconnect in the on position while the AC drive controller unit door is open. It shall be possible for authorized personnel to defeat these interlocks.
   2. A non-defeatable interlock shall be provided between the handle operator and the structure to prevent installing or removing a plug-on AC drive controller unit unless the disconnect in the off position.

I. Provisions shall be provided for locking all disconnects in the off position with up to three padlocks.

J. Handle mechanisms shall be located on the left side to encourage operators to stand to the left of the unit being switched.

K. Unit construction shall combine with the vertical wireway isolation barrier to provide a fully compartmentalized design.

L. All AC drive units shall be provided with unit control terminal blocks for use in terminating field wiring. Terminal blocks shall be pull-apart type, 250 V, and rated for 10 amperes. All current-carrying parts shall be tin-plated. Terminals shall be accessible from inside the unit when the unit door is opened. The stationary portion of the terminal block shall be used for factory connections and will remain attached to the unit when the portion used for field connections is removed. The terminals used for field connections shall be accessible so they can be wired without removing the unit or any of its components.

2.04 THERMAL MANAGEMENT

A. If required for proper operation in the specified conditions the AC drive controller unit controller unit shall incorporate a self contained air-based cooling system. Any air exhaust vents shall be louvered to help direct air flow away from personnel operating the AC drive unit. Fans, ductwork, and filters (required on all air intakes) shall be easily accessible for maintenance.

2.04 THERMAL MANAGEMENT, continued

B. An internal overtemperature trip shall be provided to detect cooling system failure or blockage. Upon occurrence of an overtemperature trip the cooling system fans shall continue running to provide a rapid cool down.
C. Power for the cooling system shall be provided internal to the AC drive unit by use of a control power transformer which includes two primary fuses and one secondary fuse (in the non-ground secondary conductor).

2.05 MOTOR DATA

A. The AC drive unit shall be sized to operate the following AC motors and shall be defined to match the load schedules and the type of connections used between the motor and the load, such as a direct connection or a power transmission connection:
    1. Motor horsepower: 2@200 and 1@100
    2. Motor Full Load Ampere: TO BE PROVIDED BY OWNER
    3. Motor rpm: 1800
    4. Motor voltage: 460 VAC
    5. Motor service factor: TO BE PROVIDED BY OWNER

2.06 APPLICATION DATA

A. The AC drive unit shall be sized to operate a Variable Torque load.
B. The speed range shall be from a minimum speed of 0.1 Hz to a maximum speed of 60 Hz.

2.07 ENVIRONMENTAL RATINGS

A. The AC drive unit shall be designed for operation in a NEMA Type 12 Motor Control Center enclosure as specified elsewhere.
B. The AC drive unit shall be designed to operate while mounted in a MCC structure with an ambient temperature from 0°C to +40°C (32°F to 104°F).
C. The storage temperature range shall be -25°C to +65°C (-13°F to 149°F).
D. The maximum relative humidity shall be 95% at 40°C (104°F), non-condensing or no dripping water
E. The AC drive unit shall be rated to operate at altitudes less than or equal to 3,300 feet (1000 m).

2.08 ELECTRICAL RATINGS

A. The AC drive unit shall be designed to operate from an input voltage of 480 VAC + or -10%.
B. The AC drive unit shall operate from an input voltage frequency range from 57 to 63 Hz. By configuration, it shall be capable of operation at a supply line frequency that can vary by +/- 20% during steady state operation
C. The displacement power factor shall not be less than 0.95 lagging under any speed or load condition.
D. The efficiency of the AC drive controller unit controller unit at 100% speed and load shall not be less than 96%.
E. The constant torque over torque capacity shall be 170% for 1 minute.
F. The output carrier frequency of the AC drive unit shall be selectable between 1 kHz and 16 kHz depending on inverter rating for low noise operation. The output carrier frequency of the AC drive unit shall be randomly modulated to avoid resonance.
G. The output frequency shall be from 0.1–200 Hz.

2.08 ELECTRICAL RATINGS, continued

H. All AC drive unit feeder equipment including conductors, lugs, disconnects, contactors, etc. shall be sized per NEC Article 430 for the AC drive input current rating. An impedance range corresponding to a 22,000 to 100,000 Amp fault availability level shall be assumed for the input current rating.

2.09 PROTECTION

A. The AC drive unit shall be protected against fault currents up to and including 100,000 Amps rms symmetrical at 480VAC and shall be UL 845 listed as verification.
B. Upon power-up the AC Drive shall automatically test for valid operation of memory, option module, loss of analog reference input, loss of communication, dynamic brake failure, DC to DC power supply, control power, and the pre-charge circuit.
C. The AC drive unit shall be protected against short circuits between output phases, between output phases and ground, on the internal power supplies, and on the logic and analog outputs.
D. The AC drive unit shall have a minimum AC under voltage power loss ride-through of 200 milliseconds (12 cycles). The AC Drive shall have the user-defined option of frequency fold-back to increase the duration of the power-loss ride-through.
E. The AC Drive will have a selectable ride through function which will allow the logic to maintain control for a minimum of one (1) second (60 cycles) without faulting.
F. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function shall provide restart attempts for a period of five (5) minutes and up to an unlimited amount time depending on setting. The restart attempts shall be separated by increasingly longer waiting periods to allow the condition to be cleared.
G. The deceleration mode of the AC Drive unit shall be programmable. The stop modes shall include free-wheel stop, ramp stop, fast stop and DC injection braking.
H. Upon loss of the analog process follower reference signal, the AC Drive unit shall be programmable to fault and freewheel stop, ramp stop, fast stop, stop without trip, automatically restart, run at last speed or maintain a user defined low speed setting.
I. The AC Drive unit shall have solid-state I^2t protection that is UL Listed and meets UL 508C as a Class 10 overload protection and meets IEC 60947. The minimum adjustment range shall be from 25 to 150 % of the nominal current rating of the AC drive controller unit.
J. The AC Drive unit shall three skip frequency ranges with hysteresis adjustment that can each be programmed independently, back to back or overlapping.
K. The AC Drive unit shall be include an adjustable thermal alarm which can be assigned to a relay or logic output to indicate the drive temperature has reached the thermal alarm setting.

2.10 ADJUSTMENTS & CONFIGURATIONS

A. The AC Drive unit shall have a user selectable Auto Tune feature. The Auto Tune will automatically send motor rated current to the connected motor and store the resulting resistance data into memory. The AC Drive unit will automatically optimize the operating characteristics according to the stored data.
B. The AC Drive unit motor and control parameters will be factory preset to operate most common applications. Necessary adjustments for factory supplied unit operator controls and sequencing shall be pre-programmed and tested by the manufacturer.

2.10 ADJUSTMENTS & CONFIGURATIONS, continued

C. A choice of three types of acceleration and deceleration ramps will be available in the AC Drive unit software; linear, S curve, U curve and custom.
D. The acceleration and deceleration ramp times shall be adjustable from 0.01 to 6,000 seconds.
E. The volts per frequency ratios shall be user selectable to meet variable torque loads, normal and high torque machine applications.
F. The memory shall retain and record run status and fault type of the past eight faults for operator review.
G. The software shall have an Energy Saving function that will optimize the energy consumed. A constant volts/Hz ratio will be maintained during acceleration. The output voltage will then automatically adjust to meet the torque requirement of the load.
H. Slip compensations shall be a software-enabled function.
I. The AC Drive unit shall offer programmable DC injection braking that will brake the AC motor by injecting DC current and creating a stationary magnetic pole in the stator. The level of current will be adjustable between 10-110% of rated current and available from 0.1-30 seconds continuously. For continuous operation after thirty (30) seconds, the current shall be automatically reduced to 50% of the nameplate current of the motor.
J. Sequencing logic will coordinate the engage and release thresholds and time delays for the sequencing of the AC Drive unit output, mechanical actuation and DC injection braking in order to accomplish smooth starting and stopping of a mechanical process.

2.11 GRAPHIC DISPLAY TERMINAL INTERFACE

A. The graphic display terminal shall provide eight (8) lines of 240 by 160 pixels in plain English to control, adjust and configure the AC Drive including all electrical values, bar charts, configuration parameters, I/O assignment, application and activity function access, faults, local control, adjustment storage, self-test and diagnostics. There will be a standard selection of six additional languages built-in to the operating software as standard.
B. The AC Drive unit model number, torque type, software revision number, horsepower, output current, motor frequency and motor voltage shall all be listed on the drive identification display as viewed on the graphic display terminal.
C. The graphic display shall be able to indicate one, two or 5 digital values or, up to two values by bar graph. As a minimum the selectable display values shall consist of speed reference, output frequency, output current, motor torque, output power, output voltage, line voltage, DC voltage, motor thermal state, drive thermal state, elapsed time, motor speed, machine speed reference and machine speed.
D. The graphic display terminal will consist of programmable function keys. The functions will allow both operating commands and programming options to be preset by the operator.
E. The graphic display terminal shall offer levels of settings from simple start-up to advanced user menus consisting of parameter setting, I/O map, fault history, and drive configuration. Password protection shall be available to limit unauthorized access to various levels of the menus.
F. The navigation wheel shall provide the ability to scroll through menus and screens, select or activate functions or increase the value of a selected parameter.

2.11 GRAPHIC DISPLAY TERMINAL INTERFACE, continued

G. An escape key shall allow a parameter to return the existing value if adjustment is not required and the value is displayed. The escape function will also return to a previous menu display.
H. A RUN key and a STOP key shall command a normal starting and stopping as programmed when the AC Drive is in keypad control mode. The STOP key shall be active in all control modes.
I. A user interface shall be available that is a WINDOWS® based personal computer, serial communication link or detachable graphic terminal display.
J. The keypad shall store in nonvolatile memory up to four user configuration programs. An operator shall have the ability to download a stored configuration to multiple AC Drive units.
K. The operator interface shall be MCC door mounted on the AC drive unit for ease of access and increased visibility.
L. All door-mounted controls shall be NEMA Type 12 rated.

2.12 CONTROL

A. Door mounted pilot devices shall be industrial rated 22mm type control operators and used independently of the keypad display. Software assignments for control inputs and outputs to operate factory-supplied controls shall be pre-configured from the factory. The following basic controls shall be provided. Additional controls can be found on the equipment electrical diagrams.
    1. POWER On pilot light, red
    2. FAULT pilot light, yellow, push-to-test
    3. RUN pilot light, green, push-to-test
B. 2-wire or 3-wire control strategy shall be defined within the software.
C. The control power for the digital inputs and outputs shall be 120 VAC.
D. The internal power supply incorporates an automatic current fold-back that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs shall be current limited and not be damaged if shorted or excess current is pulled.
E. All logic connections shall be furnished on pull apart terminal strips.
F. There will be (2) two software assignable analog inputs with interference filtering. The analog inputs will be software selectable and consisting of user defined configurations: x-y mA or x-y V.
G. There will be five software assignable logic inputs that will be selected and assigned in the software. The selection of assignments shall consist of forward, reverse, jog, plus/minus speed (2 inputs required), setpoint memory, preset speeds (up to 8 inputs), auto/manual control, controlled stop, terminal or keypad control, output contactor (2 inputs required), motor switching, and fault reset.
H. There will be two (2) software assignable analog outputs with interference filtering. The analog outputs can be selected and assigned in the software. The analog output assignments shall be proportional to the following motor characteristics: frequency, current, power, torque, voltage and thermal state. The output signal will be user defined configurations: x-y mA or x-y V.
I. Two (2) voltage-free Form C relay output contacts will be provided. One (1) of the contacts will indicate AC Drive unit fault status. The other contact will be user assignable.

2.12 CONTROL, continued

J. Drives shall include Modbus ports. One RJ45 Modbus HMI connector port, located on the drive front panel. One RJ45 Modbus network port, located on the drive control terminals.

K. Drive control and speed control via FUTURE PLC hardwired I/O shall include:
   1. PLC Analog output (4-20 mA) speed reference signal
   2. PLC Analog input (4-20mA) speed feedback signal
   3. PLC digital output drive start control
   4. PLC digital input drive run (Run =1)
   5. PLC digital input drive fault (Fault = 1)

PART 3 – EXECUTION COR-333 SE 06SC12 16492 - 11

3.01 INSPECTION

Owner to verify that the location is ready to receive work and the dimensions are as indicated.

3.02 PROTECTION

Before and during the installation, the AC Drive unit shall be protected from site contaminants.

3.03 INSTALLATION

A. Installation shall be in compliance with manufacturer's instructions, drawings and recommendations.

B. The AC Drive unit manufacturer shall provide a factory certified representative to supervise the start-up of the units in conjunction with the MCC and ATS. An eight (8) hour day shall be included for these services.

3.04 TRAINING

An on-site training course of one (1) training day shall be provided by a representative of the AC Drive unit manufacturer to plant and/or maintenance personnel.