NELHA Specifications for 250 HP Variable Frequency Drive (VFD) Unit Procurement

A) Standard Features:

1. Nominal Horsepower - Variable Torque / Variable Frequency Drive
2. Nominal Horsepower: 250
3. Input Voltage Rating: 480VAC
4. Rated Output Current 302 Amps
5. Frame Size R6
6. Wire Size Capacities of Power Terminals -Terminal Block: 350 MCM/ Ground Lug 3/0 AWG
7. Dimension and Weight: height 34.6" X width 11.8" X depth 15.8" / weight 152 lbs.
8. Heat Dissipation & Airflow Requirements:
   - Power Losses – 3850 watts, 13000 BTU/Hr.
   - Airflow – 405 CFM, CM/Hr. - 540
9. Input Impedance: 5% Equivalent impedance from dual DC reactors or AC Reactor
10. EMI/RFI onboard filters CE marked EN61800-3 for first environment restricted level
11. AC transient protection consisting of 4-120 joule MOV's (phase to phase, phase to ground)
12. Short Circuit Current Rating: 100 kA RMS Symmetrical
13. VFD keypad with built in time clock with battery back up with 10 year life span for time and date fault recording along with multiple operation functions
14. Enclosure rating shall be NEMA/UL Type 1 for indoor mounting
15. The VFD cooling fan shall turn off when not needed to increase fan life and be designed for removal without disconnecting any wiring both power or control
16. All VFD's shall have the same customer interface regardless of horsepower rating
17. The VFD keypad shall be backlit and removable to allow uploading and downloading parameter settings
18. The VFD shall be able to communicate via Ethernet without the use of a third-party gateway.
19. The keypad shall include hand-off-auto selections with bump less transfer between hand and auto
20. Internal PID functionality shall be supplied with the VFD for closed loop control.
21. The VFD shall be able to be programmed via laptop. All interconnecting communications cable, modems, and/or adapters shall be supplied along with a licensed copy of the software.
22. Data Display:
    - Output Frequency
    - Motor Current
    - Calculated % Motor Torque
    - Calculated Motor Power (kW)
    - DC Bus Voltage
    - Output Voltage
    - Heatsink Temperature
    - Elapsed Time Meter (reset-able)
    - KWh (reset-able)
    - Input / Output Terminal Monitor

- PID Actual Value (Feedback) & Error
- Fault Text
- Warning Text
- Three (3) Scalable Process Variable Displays
- User Definable Engineering Units
23. Two (2) Programmable Analog Inputs
24. Six (6) Programmable Digital Inputs
25. Two (2) Programmable Analog Outputs
26. Up to Six (6) Programmable Relay Outputs (Three (3) Standard)
27. Input Speed Signals
    - Current 0 (4) to 20 mA
    - Voltage 0 (2) to 10 VDC
    - Increase/Decrease Reference Contacts (Floating Point)
    - Serial Communications
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    - Increase/Decrease Reference Contacts (Floating Point)
    - Serial Communications
29. Start/Stop
    - 2 Wire (Dry Contact Closure)
    - 3 Wire (Momentary Contact)
    - Application of Input Power
    - Application of Reference Signal (PID Sleep/Wake-Up)
    - Serial Communications
30. Start Functions
    - Ramp
        Flying Start
        Pre-Magnetization (DC Brake) on Start
    - Automatic Torque Boost
    - Automatic Torque Boost with Flying Start
    - Auto Restart (Reset) – Customer Selectable and Adjustable
31. Stop Functions
    - Ramp or Coast Stop
    - Emergency Stop
    - DC Braking / Hold at Stop
    - Flux Braking
32. Timer Functions
    - Four (4) Daily Start/Stop Time Periods
    - Four (4) Weekly Start/Stop Time Periods
    - Four Timers for Collecting Time Periods and Overrides
33. Supervision Functions
34. Adjustable Current Limit

35. Automatic Extended Power Loss Ride Through (Selectable)
36. PIP Control
    - Two (2) Integral Independent Programmable PID Setpoint Controllers (Process & External)
    - External Selection between Two (2) Sets of Process PID Controller Parameters
    - PID Sleep/Wake Up
37. Motor Control Features
    - Scalar (V/Hz) and Vector Modes of Motor Control
    - V/Hz Shapes
      Linear
      Squared
    - Energy Optimization
    - IR Compensation
    - Slip Compensation
    - Three (3) Critical Frequency Lockout Bands
38. Pre-programmable Protection Circuits
    - Overcurrent
    - Short Circuit
    - Ground Fault
    - Over Voltage
    - Under Voltage
          Input Phase Loss
    - Output Device (IGBT) Over Temperature
    - Adjustable Current Limit Regulator
    - UL508C approved Electronic Motor Overload (l^2T)
39. Programmable Fault Functions for Protection Include
    - Loss of Analog Input
    - Panel Loss
    - External Fault
    - Motor Thermal Protection
    - Stall
    - Underload
    - Motor Phase Loss
    - Ground Fault
40. Input Impedance
    - 5% Equivalent Impedance with Internal Reactors(s)

41. Include Ethernet Card
    - A TCP/IP fieldbus module / FENA-11 (one port) shall be included (installed) with the specified VFD.

B) Optional Features:

1. 3 Relay Extension Module (OREL-01)
2. 115/230 V Digital input interface Card (OHDl-01)
3. Fieldbus Adapter Modules
   - LonWorks
   - BACnet IP to MS/TP Router
   - Profibus
   - DeviceNet
   - required Ethernet
   - ControlNet
4. DriveWindow Light Start-up, Operation, Programming and Diagnostic Tool
5. Fan Replacement Kit

C) Specifications:

1. Input Connection
   - Input Voltage   480 VAC 3-Phase (+/- 30%)
   - Frequency   48 – 63 Hz
   - Line limitations   Max +/13% of nominal phase to phase Input voltage
   - Fundamental Power Factor   0.98 at nominal load
2. Output (Motor) Connection
   - Continuous Output Current / Variable Torque: $1.0 * l_{2N}$ (Nominal rated output current)
   - Base Motor Frequency Range: 10 – 500 Hz
   - Switching Frequency   1, 4, 8 or 12 kHz
   - Short Circuit Withstand Rating: 100,000 AIC (UL) w/o fuses
3. Agency Approval / Listing & Compliance: UL, cUL, CE
4. Ambient Conditions, Operation
   - Air Temperature: 15° to 40°C
   - Relative Humidity: 5 – 95%, no condensation allowed
   - Vibration: Max 3.0 mm – 2-9 Hz, Max 10 m/s^2 90-200 Hz
5. Analog Input Quality   Two (2) programmable analog inputs
6. Analog Output Quality   Two (2) programmable analog outputs
7. Digital Inputs   (Six 6) programmable digital inputs
8. Internal Power Supply
   - Primary Use   Internal power supply for digital inputs
   - Voltage   + 24 VDC, max 250 mA
   - Maximum Current: 250 mA
   - Protection   Short circuit protected
9. Relay Outputs

- Quantity	Three (3) programmable relay (Form C) Outputs
- Switching Capacity:	+24 VDC or 250 VAC, 0.4 A at 120 VDC

10. Protections
- Single Phase   Protected (input & output)
- Overcurrent Trip Limit: $3.5 \times l_{2N}$ instantaneous
- Adjustable Current Regulation Limit: $1.1 \times l_{2N}$ (RMA) max
- Under Voltage Trip Limit $1.30 \times Un$
- Over Temperature (Heatsink)   +115°C (+239°F)
- Auxiliary Voltage   Short circuit protected
- Ground Fault: Protected
- Short Circuit: Protected
- Microprocessor Fault: Protected
- Motor Stall Protection: Protected
- Motor Over Temperature Protection: Protected
- Input Power Loss of Phase: Protected
- Loss of Reference: Protected
- Short Circuit Current Rating: 100,000 RMS symmetrical Amperes
- Input Line Impedance: 5% equivalent

D) General Specifications and Requirements

1. Any changes to these features, specifications and requirements shall be put in writing by the vendor and approved by the NELHA Officer-in-Charge OIC). For the sake of this solicitation and installation of the equipment, the NELHA OIC will be Jan War, Operations Manager or his designated representative.
2. Manufacturer/Vendor shall provide on-line (Zoom or Teams) start up assistance by a factory authorized and trained technician.
3. Warranty: 1 year on site parts and labor from date of shipment with factory certified start up.
4. **The VFD shall be ABB ACH580 Series VFD's for HVAC Application, Drive Only; model ABB ACH580-01-302A-4 or Equal VFD in strict accordance with the above features, specifications and services**.

New VFD will be required to communicate with, take a lead or following roles in the PID controls with client's current ABB drives. VFD manufacturer shall demonstrate that they can integrate seamlessly with client's current inventory of ABB, ACH 550-UH drives when in PID lead or following roles.

Proposed Additions:

The VFD should include a Pump and Fan Alteration (PFA) mode of operation. The PFA function should contains the following major features:

- The VFD controls the motor of pump no. 1, varying the motor speed to control the pump capacity. This motor is the speed regulated motor.

- Direct line connections power the motor of pump no. 2 and pump no.3, etc. The ACH550 switches pump no. 2 (and then pump no. 3, etc.) on and off as needed. These motors are auxiliary motors.

- The VFD PID control uses two signals: a process reference and an actual value feedback. The PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference.

  - When demand (defined by the process reference) exceeds the first motor's capacity (user defined as a frequency limit), the PFA control automatically starts an auxiliary pump. The PFA also reduces the speed of the first pump to account for the auxiliary pump's addition to total output. Then, as before, the PID controller adjusts the speed (frequency) of the first pump such that the actual value follows the process reference. If demand continues to increase, PFA adds additional auxiliary pumps, using the same process.

- When demand drops, such that the first pump speed falls below a minimum limit, the PFA control automatically stops an auxiliary pump. The PFA also increases the speed of the first pump to account for the auxiliary pump's missing output.

- An Interlock function (when enabled) identifies off-line (out of service) motors, and the PFA control skips to the next available motor in the sequence

- An Autochange function (when enabled and with the appropriate switchgear) equalizes duty time between the pump motors. Autochange periodically increments the position of each motor in the rotation – the speed regulated motor becomes the last auxiliary motor, the first auxiliary motor becomes the speed regulated motor, etc.

- The VFD's programmable relays are capable of interfacing with the PFA function.

The VFD's Modbus Register must contain the following:

- A Control Word capable of receiving and writing a 16-bit Word from NELHA's current SCADA system for Command/Control purposes.
- A Reference 1 parameter capable of receiving and writing data from NELHA's current SCADA system with a range of 0 to 20000 for speed control purposes.
- A Reference 2 parameter capable of receiving and writing data from NELHA's current SCADA system with a range of 0 to 10000 for speed control purposes.
- A read only STATUS WORD capable writing data to NELHA's current SCADA system for the purpose of monitoring the current status of the VFD.

- A read only FAULT WORD capable of writing data to NELHA's current SCADA system for the purposing of monitoring active VFD faults.