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Specification – Eco-Flow-C

1. VARIABLE FREQUENCY DRIVES FOR SWIMMING POOL PUMPS & WATER FEATURES

PART 1 GENERAL

1.1 SCOPE

A. This specification defines the electrical, mechanical, environmental, agency and reliability requirements for three-phase, Variable Frequency Drives (VFD) as specified herein.

B. Specific consideration is provided within this specification toward the unique and harsh environmental conditions that are typically present within a swimming pool equipment room. Suppliers should note the specific warranty requirements relative to the VFD's ability to withstand this environment. Chlorine and other chemical gasses are often present within the pool equipment room and NEMA 1 Drives will not be permitted under any circumstances.

c. The specification also addresses the fact that users within this application field are often unfamiliar with VFD technology. A simple user interface to the VFD is essential. Setup and operation is required by intuitive menus that are written in a manner that the pool operator can understand.

1.2 RELATED SECTIONS

Schedule 1 – list of applications (Requires additional information relating to specific project)

1.3 REFERENCES

A. The Variable Frequency Drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards.

1. Institute of Electrical and Electronic Engineers (IEEE)
IEEE 519-1992: Guide for harmonic content and control
2. Underwriters Laboratories (UL508C: Power Conversion Equipment)
3. National Electrical Manufacturer's Association (NEMA)
ICS 7.0: Industrial Controls & Systems for VFD.
4. IEC 61800 –3 Fulfill all EMC immunity requirements

B. In case of any conflict between the requirements of this section and those of the listed documents, the requirements of this section shall take precedent.



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1.4 SUBMITTALS - REVIEW/APPROVAL

- A. The following information shall be submitted to the Customer's Engineer.
 - 1. Dimensional outline drawing
 - 2. Schematic diagram
 - 3. Power and control connection diagram(s)
- B. Submit four (4) copies of the above information per submittal guidelines.

1.5 SUBMITTALS- INFORMATION

- A. When requested by the Customer's Engineer the following product information shall be submitted:
 - 1. Descriptive bulletins
 - 2. Product sheets
 - 3. Harmonic Analysis

1.6 SUBMITTALS- PROJECT CLOSEOUT

- A. The following information shall be submitted for record purposes prior to final payment.
 - 1. Final as-built drawings and information for items listed section in 1.04.
 - 2. Installation information.

1.7 QUALIFICATIONS

- A. For the equipment specified, the VFD manufacturer shall be ISO 9001 certified.
- B. The supplier of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by the Engineer, a list of applications with similar equipment shall be provided to demonstrate compliance with this requirement.

1.8 REGULATORY REQUIREMENTS

None

1.9 DELIVERY, STORAGE, AND HANDLING

Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10 FIELD MEASUREMENTS

None



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1.11 OPERATION AND MAINTENANCE MANUALS

- A. Two (2) copies of the equipment operation and maintenance manuals shall be provided.
- B. Operation and maintenance manuals shall include the following information:
 - 1. Instruction books
 - 2. Recommended renewal parts list
 - 3. Drawings and information required by Section 1.06.

PART 2 PRODUCTS

2.1 MANUFACTURERS / PRODUCTS

- A. H2flow Controls, Inc. Sylvania, OH / Eco-Flow-C
- B. _____
- C. _____

D. Or pre-approved equal meeting the detailed requirements of this specification. All products and services proposed are obligated to meet the detailed requirements of this specification. Any proposed exceptions must be clearly stated with the bid, clearly citing the reason for non-compliance, and the cost for providing a conforming product. Failure to provide a detailed list of proposed exceptions may cause a bid to be deemed non-responsive. The Engineer will be the sole determiner of the acceptability of a proposed exception. In no case, will adjustments to the Contract Price be allowed later for conformance to the Specifications. In the event that a product is later found to be non-compliant, the supplier will be obligated to make changes to the product so as to be compliant or alternatively supply a product that does comply with this specification. Furthermore, the supplier will be required to pay any reasonable charges incurred by any third parties to achieve a compliant result.

2.2 GENERAL

- a) The VFD shall be rated at IP54 / NEMA 12 or higher. Exposed enclosure surfaces shall be corrosion resistant. VFD's installed within a supplementary panel shall not be vented or cooled from ambient external air. With the exception of the VFD's heatsink and water-resistant heatsink fan, the VFD's electronics shall be fully sealed within the NEMA 12 or higher enclosure. So called 'NEMA 12 or NEMA 4 Vented' enclosures are not permitted.



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- b)** The VFD shall convert incoming fixed frequency three phase AC power into a variable voltage and variable frequency three phase output utilizing pulse width modulation. Advanced Space Vector Control will be utilized to reduce motor heating and provide precise control of the AC motor.
- c)** The VFD shall include a built-in Category C3 EMC Filter to mitigate harmonic distortions being transmitted back through the supply lines.
- d)** The VFD shall utilize DC capacitors to filter out bus ripple and provide smooth DC power to the transistor section.
- e)** The VFD shall utilize IGBT transistors to produce a pulse width modulated output. SCR output stages are not acceptable.
- f)** The VFD shall have a full load amp rating which exceeds or meets NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, and shall be able to provide 110% of its variable torque rating and 150% of its constant torque rating for one minute.
- g)** The VFD shall utilize space vector control to reduce motor harmonics and torque ripple.
- h)** The VFD shall include the ability to reliably protect the pump from any of the following abnormal pump conditions: Run Dry/Loss of Prime; Cavitation; Dead head/Closed Valve; Worn impeller; Blocked Filter; Bearing Failure/Wear Detection. Protection using measured current (Amps), as a method for these protective features shall not be acceptable.
- i)** Auto Reset of certain fault conditions. If VFD goes into a fault condition, it will make 5 attempts to Automatically Reset itself in a 20 minute period. If after the 5 attempts the fault still stands the VFD will shut down the pump and display a fault message that will require a manual reset. If less than 5 faults occur in the 20 minutes the 20 minute timer resets to zero.
- j)** The VFD shall provide a display with selectable readout of parameters, including: Speed; Torque; Electrical Power; Current; Output Voltage; Frequency; Heatsink Temperature; Motor Temperature; Run Time; Energy Consumed; Mains Time.
- k)** The VFD shall be capable of interfacing to an analog output signal from a Flow Transducer and be commissioned to achieve a 'constant flow' condition.
- l)** The VFD shall have remote run / stop capability, as well as, E-Stop integration.
- m)** The VFD shall include the capability for copying of settings when multiple similar pumps are involved. Settings established in one VFD shall be transferred to the others via a removable keypad.
- n)** Each VFD shall be provided with a bypass function, either internal to the VFD panel or in a separate bypass control panel. If in a separate enclosure to the VFD, the Bypass Controls



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shall be mounted in a NEMA 12 or higher rating enclosure. NEMA 12 'vented' panels are not acceptable.

1. Three Motor Contactors shall be included. Contactor A is required to be in series with the Line Power supply and the VFD, Contactor C is required to be in series with the VFD and the motor and Contactor B is required to bypass the VFD. In 'VFD' operation, contactors A and C are engaged and contactor B is open. When in 'Bypass' mode, contactors A and C are open and contactor B is engaged.
 2. All contactors shall be appropriately rated for the supply voltage and pump motor specified and shall be in accordance with NEC standards.
 3. Contactor B shall include an appropriately rated Motor Overload.
 4. A Control Power Transformer shall be included so as to provide the necessary control voltage required to operate the Motor Contactors. The VFD panel or separate Bypass panel, shall include a door mounted 3-position lockable selector switch. The switch shall be labeled: VFD-OFF-BYPASS. The switch is to require a key to move from one position to another. Two keys shall be provided to the customer. The Bypass panel shall be manufactured in accordance with and approved to UL508.
 5. Installations in locations where a Power Disconnect is not within 'line of sight' of the VFD Control Panel, or where deemed necessary by local electrical codes, a suitably rated Circuit Breaker Disconnect or 'Knife' disconnect shall be included in the bypass control panel.
- o)** All applications shall require the inclusion of an appropriately rated Line Reactor. The Line Reactor shall be housed in an enclosure according to the manufacturer's instructions, taking careful note of the devices radiated heat and the chemical environment in which it may be installed.
- p)** All applications that will have a cable length between the VFD and the Pump Motor that exceeds 300 feet shall require the inclusion of an appropriately rated Load Reactor. When included, the Load Reactor shall be housed in an enclosure according to the manufacturer's instructions, taking careful note of the devices radiated heat and the chemical environment in which it may be installed.
- q)** In geographical areas where there is a high incidence of Lightning storms, the VFD Control Panel shall include a Lightning Arrestor.
- r)** The VFD shall accept a supply voltage of -15% / + 10% of its stated supply rating
- s)** The VFD shall be electronically lockable in order to prevent unauthorized or unintended program changes.



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- t) Motors to which the VFD is to be installed shall have a minimum insulation of “Class F”.

2.3 Multiple Motors with one VFD

- a) **Pump A or Pump B** For applications where a redundant pump is to be installed, the VFD control panel is required to include a Pump A / Pump B selector switch. The control panel shall be configured so that only pump A or pump B can be selected, i.e., both pumps must not be allowed to run simultaneously. This control is to be incorporated into the Bypass configuration detailed in Section 2.02 (n) of this specification.
- b) **Pump A and Pump B** For applications where two pumps are to be run simultaneously from a single VFD, the control panel shall be configured so that each pump is provided with an appropriately rated motor overload. The motor overload protection of the VFD shall not be relied on for protection of each individual motor. This control is to be incorporated into the Bypass configuration detailed in Section 2.02 (n) of this specification.

2.4 User Interface for initial programming and day to day operation

The VFD shall include a programmable Controller with an operator backlit LCD Graphical / Alpha / Numerical Display. The Controller shall comprise the following features:

- a) Real Time Clock
- b) Password protection
- c) Hard-wired tamper protection feature
- d) Custom software to control the VFD via a Modbus communication network
- e) Automatic Flow Control. The Controller and VFD are to automatically adjust the pump's speed in order to compensate for a filter becoming dirty. The system is to maintain a minimum flow (GPM) required to meet State mandated turnover rates.
- f) Programmable speeds for daytime and nighttime turnover rates.
- g) Non-volatile memory. All programmed parameters as well as the real time clock settings shall be maintained in the event of a power outage.
- h) Manual Backwash Control. Single button control that will ramp the pump's speed to a higher level for backwashing.
- i) Programmable time duration for backwash speed
- j) Automatic Backwashing. The Controller shall accept an input from an Automatic Backwashing system. The Controller's program shall be written so that such a signal will automatically initiate a higher speed for the pump until the signal is removed.
- k) The Controller shall be capable of interfacing to an analog output signal from a Flow Transducer and displaying measured flow in GPM
- l) Automatic reset of alarms caused by power brown outs / power loss
- m) External input for seasonal / unoccupied speed



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2.5 Interfacing to a Chemical Controller

The VFD control panel may also interface to the chemical control system if it is able to provide the functionality and control detailed in Section 2.04.

2.6 SYSTEM COMMISSIONING

- A. Provide the services of a qualified manufacturer's employed Field Service Engineer to assist the Customer the start-up and commissioning of the equipment specified under this section. Field Service personnel shall reside within the State in which the specified equipment is being installed and be factory trained with periodic updates and have experience with the same model of VFD on the job site. Sales representatives will not be permitted to perform this work. The manufacturer's service representative shall provide technical direction and assistance to the Customer in general assembly of the equipment, installation as specified in manufacturer's installation instructions, wiring, application dependant adjustments, and verification of proper VFD operation.
- B. The manufacturer's service representative shall perform the following minimum work.
 - 1. Inspection and final adjustments.
 - 2. Operational and functional checks of VFD
- C. The Field Service Engineer shall provide two (2) copies of the manufacturer's field start-up report before final payment is made.

2.7 MAINTENANCE / WARRANTY SERVICE

- A. Warranty of (3) three years to commence from the date of start-up, not to exceed 3 months from the date of shipment. Warranty shall include all parts but not labor or travel. On-site warranty repairs or troubleshooting shall be billed on a time and cost basis. Supplier must provide written confirmation that on-site service can be provided within 5 hours of such a request.

2.8 TRAINING

- A. The Field Service Engineer shall provide a training session for up to 5 Customer's staff. Training and instruction time shall be in addition to that required for start-up service.
- B. The manufacturer's Field Service Engineer shall conduct the training.
- C. The training program shall consist of the following:
 - 1. Instructions on the proper operation of the equipment.
 - 2. Instructions on the proper maintenance of the equipment.

2.9 POST COMMISSIONING SUPPORT

For the warranty period, the VFD manufacturer / supplier shall maintain a factory trained technical engineer within 5 hours travel distance from the Customer's facility. Sales Representatives shall not be permitted to provide technical support.

-SECTION END-