**SPECIFICATION GUIDE**

Based on the application, one or more of the following Construction Specifications Institute (CSI) Master Format Sections should be used as the specification section for the iQpump Controller. Please note that in 1995, 1998, and 2004 the CSI Master Format database edition was updated. 1995 and 1998 utilize a 5-digit number while 2004 uses a 6-digit number. The section numbers do not always remain for the same title across the database updates. Equivalent 1998 and 2004 database section numbers are used in this document for easy cross-referencing. Note that not all 2004 edition sections have a 1998 equivalent section as the database was greatly expanded in 2004.

1998ed 15170 (Motors)

1998ed 15510 (Hydronic Pumping)

1998ed 15540 (HVAC Pumps)

2004ed 22 05 13 (Common Motor Requirements for Plumbing Equipment)

2004ed 23 05 13 (Common Motor Requirements for HVAC Systems)

2004ed 23 20 00 (HVAC Piping and Pumping)

2004ed 23 21 23 (Hydronic Pumps)

2004ed 26 29 23 (Variable-Frequency Motor Controllers)

**1. GENERAL OVERVIEW**

Product Scope:

The variable speed pump controller shall be ***iQpump*** by Yaskawa Electric America, Inc. The ***iQpump*** Controller is designed for use with AC induction pump motors incorporating true pump control system logic, and pump terminology embedded within the controller and displayed on the programming HOA Keypad interface.

***iQpump*** shall have a complete integrated pumping macro with pump-specific parameters allowing the operator to setup specific control values for a wide range of pumping applications such as constant pressure, constant flow, suction control, vacuum control and level control. ***iQpump*** will automatically adjust pump operating conditions as the process variables change within the defined programmable pump settings while still maintaining optimum pump performance and protection.

The ***iQpump*** Controller can be configured for Simplex, Duplex, Triplex and Multiplex pump systems using one master ***iQpump*** Controller with the ability to add up to an additional five lag pumps or control up to eight iQpump controllers in a Multiplex Network.

Standard variable frequency drives (VFD’s) NOT incorporating true pump control terminology, pump curve No Flow & Dead Head detection settings, System Pre-Charge Levels, Independent Thrust Bearing Control, Sleep Control, Feedback Loss Wire Break Detection, High and Low Pressure, Flow, and Level Detection, Anti-Jam, HOA Keypad, Real Time Clock, Single Phase Operation, Multiplex Operation, and Multiple pump alarm messages specific to the pump control system and motor shall not be considered equal or acceptable.

1.1 SECTION INCLUDES

Submit under provisions of the following section: 2004ed 26 29 23 (Variable-Frequency Motor Controllers)

1. ***iQpump*** Variable Frequency Drive (VFD) manufactured by Yaskawa America, Inc.

1.2 REFERENCES

Submit under provisions of the following section: 1998ed 01091 (Reference Standards)

 2004ed 01 42 19 (Reference Standards)

1. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Variable Frequency Drive Systems
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
3. UL and cUL approved for both Single Phase & Three Phase Input Voltage
4. IEEE Standard 444 (ANSI-C343)
5. IEEE Standard 519
6. IEC: 146A
7. UL 508A (Industrial Control Panel)
8. UL 508C (Power Conversion)
9. CSA 22.2 No. 14-95 (Industrial Control Equipment)
10. UL 1995 (Plenum rating)
11. EN 50178 (LVD)
12. EN 61800-5-1 (LVD)
13. IEC 529
14. FCC CFR 47 Part 15 Subpart B
15. EN 61800-3 First Environment Restricted
16. CE mark 2006/95/EC LVD
17. CE mark 2004/108/EC
18. RoHS
19. IBC 2006 Seismic – referencing ASC 7-05 and ICC AC-156

1.3 SUBMITTALS

Submit under provisions of the following sections: 1998ed 01340 (Shop Drawings, Product Data, and Samples)

 2004ed 01 33 23 (Shop Drawings, Product Data, and Samples)

 1998ed 01300 (Submittals)

 2004ed 01 33 00 (Submittal Procedures)

1. Shop Drawings shall include: Wiring diagrams, electrical schematics, front and side views of enclosures, overall dimensions, conduit entrance locations and requirements, nameplate legends, physical layout and enclosure details.
2. Product Data: Provide data sheets showing; voltage, ratings of customer use switching and over-current protective devices, short circuit ratings, and weights.
3. Manufacturer's Installation Instructions and Technical Manuals: Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of adjustable speed drive. Document the sequence of operation, cautions and warnings, troubleshooting procedures, spare parts lists and programming guidance.

1.4 QUALITY ASSURANCE

Submit under provisions of the following sections: 2004ed 01 43 00 (Quality Assurance)

 1998ed 01400 (Quality Requirements)

 2004ed 01 40 00 (Quality Requirements)

1. VFD shall have a minimum design life of 10 years. Must be part of the submitted documentation.

1.5 OPERATION AND MAINTENANCE DATA

Submit under provisions of the following section: 1998ed 01730 (Operation and Maintenance Data)

 2004ed 01 78 23 (Operation and Maintenance Data)

1. Include instructions for starting and operating VFD, and describe operating limits, which may result in hazardous or unsafe conditions.

1.6 QUALIFICATIONS

Submit under provisions of the following section: 2004ed 01 43 13 (Manufacturer Qualifications)

1. Manufacturer must have a minimum of 25 years of documented experience, specializing in variable frequency drives.

1.7 DELIVERY, STORAGE, INSPECTION, AND HANDLING

Submit under provisions of the following sections: 1998ed 01610 (Delivery, Storage, and Handling)

 2004ed 01 65 00 (Product Delivery Requirements)

 2004ed 01 66 00 (Product Storage and Handling Requirements)

 2004ed 01 71 00 (Examination and Preparation)

1. Deliver, inspect, store, handle and protect products to site.
2. Accept VFD on site in original packing. Inspect for damage.
3. Store in a clean, dry space. Maintain factory wrapping, or provide an additional heavy canvas or heavy plastic cover, to protect units from dirt, water, construction debris, and traffic.
4. Handle carefully, in accordance with manufacturer's written instructions, to avoid damage to components, enclosure, and finish.

1.8 WARRANTY

Submit under provisions of the following section: 1998ed 01740 (Warranties and Bonds)

 2004ed 01 78 36 (Warranties)]

1. Provide VFD warranty, for one year from date of startup, not to exceed 18 months from date of shipment. Warranty shall include parts, and labor allowance for repair hours.

**2. PRODUCTS**

Submit under provisions of the following sections: 1998ed 13400 (Controllers)

 2004ed 26 29 23 (Variable-Frequency Motor Controllers)

 2004ed 40 94 00 (Digital Process Controller)

2.1 MANUFACTURERS

Submit under provisions of the following section: 1995ed 01430 (Manufacturer Qualifications)

 2004ed 01 43 13 (Manufacturer Qualifications)

1. VFD shall be ***iQpump*** drive series, manufactured by Yaskawa America Inc.
2. Motors should be inverter duty rated, per NEMA MG1 parts 30 and 31, for motor-drive compatibility.

2.2 DESCRIPTION

Submit under provisions of the following section: 2004ed 01 60 00 (Product Requirements)

1. Provide enclosed variable frequency drives suitable for operation at the current, voltage, and horsepower indicated on the schedule. Conform to requirements of NEMA ICS 3.1.

2.3 RATINGS

Submit under provisions of the following sections: 1998ed 01360 (Design Data)

 2004ed 01 33 16 (Design Data)

 2004ed 01 60 00 (Product Requirements)

 2004ed 26 29 23 (Variable-Frequency Motor Controllers)

1. VFD must have the minimum range of horsepower ratings: 0.75 to 175 HP at 240 VAC; 0.75 to 1000 HP at 480 VAC; 1 to 250 HP at 600 VAC.
2. VFD must have Normal Duty ratings and to optimize the VFD size for fan and pump applications.
3. VFD must operate, without fault or failure, when voltage varies plus 10% or minus 15% from rating, and frequency varies plus or minus 5% from rating.
4. VFD shall be \_\_\_\_\_\_\_\_\_\_ volts, \_\_\_\_\_\_\_ Hz, 3 Phase or Single Phase.
5. Displacement Power Factor: 0.98 over entire range of operating speed and load.
6. Service factor: 1.0
7. Operating Ambient Temperature: NEMA 1 (IP20): -10°C to 40°C (14°F to 104°F); Open Chassis: -10°C to 50°C (14°F to 122°F).
8. Ambient storage temperature: -20°C to 60°C (-4°F to 140°F).
9. Humidity: 0% to 95%, non-condensing.
10. Altitude: Up to 3,300 feet (1000m), higher altitudes achieved by derating.
11. Vibration: 9.81m/s2 (1 G) from10 to 20 Hz; 2.0 m/s2 (0.2 G) from 20 Hz to 55 Hz.
12. Minimum Efficiency: 96% at half speed; 98% at full speed.
13. Starting Torque: 100% starting torque shall be available from 0.5 Hz to 3 Hz; 150% starting torque shall be available from 3 Hz to 60 Hz.
14. Overload capability: 120% of rated FLA for 60 seconds; 170% of rated FLA peak.
15. Controlled speed range: 40:1.
16. The VFD’s shall have optional external EMI/RFI filters. The RFI filters shall allow the entire VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted. No Exceptions.
17. Total Harmonic Distortion (THD) compliance: Given the information provided by the customer’s electric power single line diagram and distribution transformer data, the VFD manufacturer shall carry out an analysis of the system. The analysis reviews the potential for the proposed equipment, and any existing equipment, to meet IEEE 519 (tables 10.2 and 10.3) recommendations at the Point of Common Coupling (PCC). The result of the analysis shall determine if additional power quality improvement measures should be included in the proposal to meet the THD recommendations of IEEE 519. The PCC shall be at the primary side of the main distribution transformer.
18. VFDs must be suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes.
19. The VFD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.

2.4 DESIGN

Submit under provisions of the following sections: 1998ed 01360 (Design Data)

 1998ed 13400 (Controllers)

 2004ed 01 33 16 (Design Data)

 2004ed 01 60 00 (Product Requirements)

 2004ed 26 29 23 (Variable-Frequency Motor Controllers)

 2004ed 40 94 00 (Digital Process Controller)

1. VFD shall employ microprocessor based inverter logic, isolated from all power circuits.
2. VFD shall include surface mount technology with protective coating.
3. VFD shall be able to be mounted with the heatsink out the back of the enclosure.
4. VFD shall employ a PWM (Pulse Width Modulated) power electronic system, consisting of:
5. Input Section:

VFD input power stage shall convert three-phase AC line power into a fixed DC voltage via a solid-state full wave diode rectifier, with MOV (Metal Oxide Varistor) surge protection.

1. Intermediate Section:
2. DC bus as a supply to the VFD output Section shall maintain a fixed voltage with filtering and short circuit protection.
3. DC bus shall be interfaced with the VFD diagnostic logic circuit, for continuous monitoring and protection of the power components.
4. A minimum of 3% DC bus impedance to minimize reflected current (40 HP and larger).
5. Output Section
6. Insulated Gate Bipolar Transistors (IGBTs) shall convert DC bus voltage to variable frequency and voltage.
7. The VFD shall employ PWM sine coded output technology to power the motor.
8. VFD shall offer a low noise, low carrier frequency settings.
9. VFD shall employ a common main control board from 0.5HP to 1000HP with a common control connection diagram for all ratings.
10. VFD shall employ a switching logic power supply operating from the DC bus.
11. VFD shall be designed to shut down with no component failure in the event of an output phase to phase or phase to ground short circuit and provide annunciation of the fault condition.
12. VFD must have plated bus bar to resist corrosion.
13. VFD shall have an adjustable carrier frequency, from 1 kHz to 15 kHz below 100 HP; 1 kHz to 10 kHz from 100 HP to 300 HP; 1 kHz to 5 kHz 350 HP and larger. (480 V Class).
14. VFD must have a motor noise control function that monitors the load at all times and reduces the output voltage automatically, reducing motor audible noise.
15. VFD shall be able to be mounted next to each other with zero clearance for ratings up to 30 HP.
16. VFD shall have embedded Modbus RTU/Memobus accessible via a RS-422/485 communication port. The termination resistor shall be built-in.
17. VFD shall include three independent multi-function analog inputs, individually selectable for 0-10 VDC, -10 to +10 VDC, 0-20 mA or 4-20 mA. Each input shall have a programmable bias and gain. The inputs shall be individually programmed for, but not limited to:
18. PID Set Point
19. PID Feedback
20. Pressure Level
21. Flow Level
22. Depth Level
23. VFD shall include eight independent multi-function digital input terminals that can be set for sinking/sourcing and internal/external power supplies. The inputs shall be individually programmed for, but not limited to:
24. Hand – Off – Auto operation Selection
25. Detection of External Fault Condition
26. Remote Reset
27. Multi-step Speed Commands
28. Run Permissive
29. Floating Control
30. Check Valve input alarm/fault
31. High or low level Alarm/fault
32. High or Low input pressure Alarm/fault
33. High pressure alarm/fault
34. Pump pre-charge
35. VFD shall include one multi-function 32 kHz pulse train input that shall be programmed for, but not limited to:
36. PID Set Point
37. PID Feedback
38. VFD shall include two individually selectable 0-10 VDC, -10 to +10 VDC, or 4-20 mA analog outputs. The outputs shall be individually programmed for, but not limited to:
39. Output Frequency
40. Output Current
41. Output Power
42. PID Feedback
43. VFD shall include one fixed form "C" fault contact, two programmable multi-function form "A" contacts, and one programmable form “C” contact. These output relay contacts shall all be rated for 1A at 250 VAC and shall be programmed for, but not limited to:
44. Pump Fault
45. Low and High Pressure Detection
46. Pump Over Cycling Detection
47. Loss of Prime Detection.
48. Drive Fault
49. Over/Under Torque Detection
50. Not Maintaining Set Point Detection
51. No Flow Detection
52. Thrust Bearing Start
53. Low Input Pressure
54. Low/high Flow Level
55. Anti-Jam Protection
56. De-scale Operation
57. VFD shall provide terminals for remote input contact closure, to allow starting in the automatic mode.
58. VFD shall provide 24 VDC, 150ma transmitter power supply for powering transducer feedback devices.
59. VFD shall include an external fault input function to be programmed a digital input, which shall be programmable for a normally open or normally closed contact. These terminals can be used for the connection of firestats, freezestats, or similar safety devices.
60. VFD shall include a control power loss ride through capable of 2 seconds.
61. VFD shall have DC injection braking capability that is adjustable and current limited.
62. VFD shall have a bidirectional speed search function to catch a spinning motor, regardless of its direction.
63. VFD unit shall include the following meters to estimate use of energy:
64. Elapsed Time Meter
65. Kilowatt Meter
66. Kilowatt Hour Meter
67. VFD shall have a fault trace function to capture relevant monitor values at the time of the most recent fault. This is includes a time/date stamp of when the fault occurred.
68. VFD shall have a motor preheat function to prevent moisture accumulation in an idle motor.
69. VFD shall have a motor auto-tuning function capable of automatically determining the motor's electrical characteristics for maximum torque production and minimum energy usage.
70. VFD shall include diagnostic fault history with the last 10 fault indications in the selected keypad language and time/date stamp as well as heatsink cooling fan operation hours.
71. VFD shall have preventative maintenance monitors for predicting the remaining life of the IGBTs, cooling fans, bus capacitors and pre-charge relay.
72. VFD shall turn off its cooling fans when not running to increase fan life.
73. VFD shall have the following minimum protective functions: Overheat, motor overload, VFD overload, short circuit, overvoltage, undervoltage, input phase loss, output phase loss, output ground fault and overcurrent.
74. VFD shall have a USB port for easy connection to a computer (PC) for startup and troubleshooting.
75. VFD manufacture shall provide free PC software that includes online and offline parameter management, application wizards, oscilloscope function, network configurator for Ethernet, parameter conversion tool and diagnostic functions.
76. VFD shall have an eight-language removable HOA Keypad with an illuminated LCD display. The operator shall have program copy and storage functions to simplify the set up of multiple drives. The HOA Keypad shall be interchangeable for all drive ratings. The operator will provide complete programming, operating, monitoring, and diagnostic capabilities.
77. VFD shall have a keypad with dedicated Hand-Off-Auto keys. The keys shall include industry standard commands for Hand, Off, and Auto functions.
78. VFD shall have an internal real time clock. The internal time clock shall include a back up via battery. The time clock will be used to date and time stamp faults and record operating parameters at the time of fault. The internal time clock can be programmable to control start/stop functions, running speeds, PID parameter sets and digital output relays.
79. VFD keypad shall provide plain language display readouts of output frequency in hertz, PI feedback in percent, pump speed in RPM, set point and feedback level in programmable engineering units (PSI, GPM, etc.), output voltage in volts, output current in amps, output power in kilowatts, D.C. bus voltage in volts, control terminal status, heatsink temperature in degrees and fault conditions in the selected keypad language.
80. VFD parameter settings shall be stored in non-volatile memory that does not require a battery backup.
81. VFD shall be designed to allow all parameter adjustments to be made with the door closed.
82. VFD shall have selectable and user-customizable engineering units for easy configuration of keypad displays to match process and feedback labels in units such as PSI, GPM, and Feet.
83. VFD shall include a user selectable PID control loop, to provide closed loop set point control capability, from a feedback signal, eliminating the need for closed loop output signals from a building automation system. The PID controller shall have a differential feedback capability for closed loop control of pumps for pressure, flow or temperature regulation in response to dual feedback signals.
84. VFD shall have an independent, PID loop that can be used with an analog input that will vary a VFD analog output and maintain a set point of an independent process (valves, dampers….).
85. VFD shall include pump-specific application presets. The parameter presets can be used to help facilitate start-up. The presets will program all parameters and customer interfaces for a particular application (Pump Down Level, Geothermal, Vertical Turbine) to reduce programming time.
86. VFD shall include an energy saving “sleep” function shall be available, providing significant energy savings while minimizing operating hours on driven equipment. When the sleep function senses minimal deviation of a feedback signal from set point or low demand, the system reacts by stopping the driven equipment. Upon receiving an increase in speed command signal deviation, the drive and equipment resume normal operation.
87. VFD shall include loss of input signal protection, with a selectable response strategy including running at a preset speed or a percentage of the most recent speed.
88. VFD shall have an underload detection function that monitors the load and will stop the system in the event of a pump shaft failure.
89. VFD shall include electronic thermal overload protection for both the drive and motor. The electronic thermal motor overload shall be approved by UL.
90. VFD shall have a quick disconnect, removable control wiring terminal board that stores the drive’s parameter settings. The terminal board can be installed into a new drive and transfer all settings to the new drive. The control wiring shall not need to be removed.
91. VFD shall use 24 VDC cooling fans for all ratings. Fans shall be mounted at the top of the drive for easier access. No tools shall be required to replace the fans.
92. VFD shall include the following additional program functions:
93. Capability to reset all parameters back to the factory settings.
94. Capability to reset all parameters back to a user-defined set of parameters.
95. Capability to see only the parameters that have been modified.
96. Ability to set the motor speed (PI set point) in Hertz, RPM, percent or custom units with units label.
97. Critical frequency rejection capability: 3 selectable, adjustable dead bands to lock out continuous operation at frequencies that may product mechanical resonance.
98. Auto restart capability: 0 to 10 attempts with adjustable delay between attempts.
99. Ability to close fault contact after the completion of all fault restart attempts.
100. Kinetic Energy Braking (KEB) function for stopping at power loss.
101. Overvoltage suppression function for cyclic regenerative loads.
102. Stall prevention capability.
103. "S" curve soft start / soft stop capability with four programmable corners.
104. Four sets of acceleration/deceleration times, selectable via digital input.
105. Acceleration/deceleration adjustment from 0.00 to 6000 seconds while running.
106. Fourteen preset and 1 custom volts per hertz patterns.
107. Programmable security code to prevent parameter setting changes.
108. Heatsink over temperature speed fold back capability.
109. Control I/O Terminal status indication.
110. Motor thermistor input.
111. Reverse direction lockout.
112. Current limit adjustment from 30% to 200% of rated current of the motor.
113. Input signal or serial communication loss detection and response strategy.
114. Automatic energy saving function.
115. Undertorque/Overtorque Detection.
116. Overexcitation braking function to quickly stop the motor.
117. Cooling fan failure detection and selectable drive action.
118. Select any of seventeen preset speeds while running.
119. Ability to remove of HOA Keypad during VFD operation.

2.5 PRODUCT OPTIONS

Submit under provisions of the following sections: 2004ed 01 62 00 (Product Options)

 2004ed 01 60 00 (Product Requirements)

1. VFD shall have the following optional accessories:
2. Industrial Network Communication Option Cards: DeviceNet, EtherNet/IP, Modbus TCP/IP, PROFIBUS-DP, PROFINET.
3. Building Automation Network Communication Option Cards: BACnet, Lonworks, Metasys (N2), Apogee (P1).
4. Auxiliary Control Power Unit: VFD control circuit can be powered using separate 24 VDC supply.
5. Digital Output Relay Option Card: Allows control of two additional lag pumps via contact closure.
6. Remote HOA Keypad Mounting Kit: VFD’s HOA Keypad can be mounted in the control cabinet behind a UL Type 4X membrane.
7. Outdoor HOA Keypad: HOA Keypad with Real Time Clock with special LCD capable of being seen outside in bright sun at high ambient temperatures.

2.6 ***iQpump*** SOFTWARE FEATURES

Submit under provisions of the following sections: 1998ed 01360 (Design Data)

 1998ed 13400 (Controllers)

 2004ed 01 33 16 (Design Data)

 2004ed 01 60 00 (Product Requirements)

 2004ed 40 94 00 (Digital Process Controller)

Pump-specificfirmware shall be embedded within the ***iQpump*** controller. These pump-specific software functions and settings shall be standard as minimum. All control features, Alarms, and Faults shall be displayed in intuitive system pump terminology on the HOA Keypad. Parameter codes with abbreviations are not acceptable.

* 1. Hand/Off/Auto Run operation from HOA Keypad without stopping (bumpless transfer). HOA Keypad to display current operational mode. Example: Off Mode, Hand Mode, Hand Mode Reference, and Automatic Mode.
	2. HOA Keypad can be configured to lock out “Hand” with only off and auto run enabled.
	3. Application Presets that automatically set all critical drive settings. Applications include Water Level Control, Geothermal Well Control, Vertical Turbine Control, and General Purpose Mode.
	4. Full use of Real Time clock to time/date stamp faults and alarms and to provide for time/date based on/off control.
	5. Auto Restart on complete power loss. If in Auto Mode without external run control for start/stop, the pump system will automatically restart to maintain set point and cycle through all safety & restart conditions.
	6. Programmable Engineering units (PSI, GPM, LPH) for set point, feedback, and parameter scaling. It is not acceptable to use percent of VFD parameters for pump level settings.
	7. Programmable start levels, sleep levels, stop levels with engineering units specific to pump application. Example: PSI, GPM, LPH, etc.
	8. Programmable scaling for feedback levels with feedback transducer loss protection based on level and delay time. Both of these functions shall be independent.
	9. Pump Quick Setup Menu for pump settings and startup.
	10. System Pre-Charge: Programmable settings in pump engineering units that allows for charging of the pump system prior to automatic mode. Dedicated pre-charge system level settings with programmable timers. PI control is turned off and will enable automatically once operation is completed.
	11. Thrust Bearing: Programmable operation that will allow the pump motor to rapidly accelerate to a fixed speed with independent timers. PI control is turned off and will enable automatically once operation is completed.
	12. Programmable Low and High Pressure feedback settings with timers.
	13. Programmable pump over-cycling timer.
	14. Programmable Anti-Jam feature with cycle count and timer.
	15. Programmable Low City Pressure switch that will prohibit the drive from running when low incoming pressure is indicated by a pressure switch.
	16. Programmable Output Current Limit to protect the motor-pump system.
	17. Programmable parameter lockout feature to prevent parameter and set point changes.
	18. Programmable drive input Single Phase protection feature.
	19. Programmable Remote Drive Disable function that can put the system to sleep via a remote contact closure.
	20. Programmable Stop with Timer function to prevent starting into a back-spinning pump.
	21. Programmable alarms and faults for High and Low Water Level switches.
	22. Programmable Geothermal mode. A geothermal well facilitates heat transfer between the earth and a known system, such as space heating, electric power generation and food processing. The geothermal function has the ability to regulate the speed of the iQpump Controller based on an external temperature signal following a preset temperature-speed curve.
	23. Programmable Suction Pressure Control that will deviate from output pressure control when the pump inlet suction pressure drops beyond a settable point and control suction pressure.
	24. Programmable Vacuum Pressure Control that will deviate from output pressure control when the pump inlet vacuum increases beyond a settable point and regulate the vacuum pressure.
	25. Programmable Water Level Control Pressure Control that will deviate from output pressure control when the well level drops below a settable point and regulate the well level.
	26. Programmable Feedback Wire Break detection function with selectable response.
	27. Programmable Lube Pump control to enable pre-lubricating the pump seals prior to starting.
	28. Programmable Pre-Charge function to fill piping or storage tank before turning on the PI controller.
	29. Programmable Thrust Bearing function to protect the bearings of submersible motors.
	30. Programmable Flow Meter Control that can measure flow over time and store the data in non-volatile memory put the drive to sleep, control the drive to a flow set point, and check for high/low flow faults and alarms.
	31. Programmable Utility Start function to prevent all drives in a system from starting at the same time to reduce peak currents.
	32. Programmable low water & high water input settings.
	33. Programmable Minimum Pump Speed to prevent pump damage caused by cavitation.
	34. Programmable Alarm and Fault specifically for a thermostat placed on the pump housing (volute) or inside of the pump motor.
	35. Programmable Pump Motor heating level when stopped to control motor condensation.
	36. Programmable No Flow or Dead Head Pump Curve protection allowing for either settings in Hz, Engineering units (PSI, GPM, etc) or motor RPM.
	37. Embedded Pump Controller Capability: In addition to the ability to follow an analog input related for speed control, the drive shall be able to operate in the following control modes:
1. Simplex controller: The drive shall accept an input proportional to the process variable (flow, pressure, etc.). The drive shall accept direct keypad entry or analog input entry of the desired set point. The Drive shall utilize PI set point control to continuously modulate the output speed to maintain set point.
2. Multiplex controller: The drive shall be capable of being operated as a multiplex controller operating as in simplex mode with same system inputs but provide lead-lag control of up to 6 pumps such that the set point is controlled via operation of one or more pumps while alternating pumps to evenly distribute operation time. System master controller to have independent control settings in engineering units for pump system to turn on and off. System stabilization to also be included.
	1. Dedicated English Pump Alarms & Messages: Flashing LED or abbreviated codes are not acceptable:
3. Low Feedback
4. High Feedback
5. Low Water
6. Pump Over Cycling Detection
7. No Flow Detection
8. Loss of Prime Detection
9. Pump Fault
10. Motor Thermostat Fault
11. Pre-Charge Mode Active
12. Thrust Bearing Active
13. Start Mode Active
14. Sleep Mode Active
15. Anti-Jam Active
16. Feedback Loss Detection
	1. ***iQpump*** as standard is supplied with a pump controller SCADA PC program that allows the users to program pump parameter settings, drive commissioning, and diagnose system conditions. As standard, the PC program should have the following functions:
17. Online PID turner with graphical representation
18. System trending recorder (Oscilloscope) that allows a minimum of 6 signals to be graphed with a playback mode.
19. Run Status Page with pump visual graphics allowing for all pump functions such as, set points, feedback levels, faults, alarms, and Multiplex operation to be displayed with actual running data.
20. Programming parameter page for all pump specific parameters allowing for pre-setup, online changes, and complete upload/download of settings.
21. Pump Setup Wizard to be a graphical interface configured to ask questions to the operator for pump parameter settings based on pump application.
22. Pump Simulator with graphical interface allowing for training of engineers, service and start up technicians that will emulate the actual pump running conditions based on pump parameters settings, set point and feedback levels.
23. Program shall be able to communicate to pump controller via RS232/485, and Ethernet TCP/IP.
24. PC tool shall be automatically updated via the Internet.

2.06 SOURCE QUALITY CONTROL

Submit under provisions of the following sections: 1998ed 01400 (Quality Control)

 2004ed 01 43 00 (Quality Assurance)

 2004ed 01 45 00 (Quality Control)

1. Inspect and test, under load, each completed VFD at the completion of production using a computerized, automated testing fixture. All test results shall be stored as detailed quality assurance data.
2. All fully assembled controls shall be functionally tested, with fully loaded induction motors. The combined test data shall then be analyzed, to insure adherence to quality assurance specifications.
3. Inspect and production test, under load, each completed VFD assembly.

**3. EXECUTION**

3.1 EXAMINATION

Submit under provisions of the following sections: 2004ed 01 71 00 (Examination and Preparation)

 2004ed 02 22 00 (Existing Conditions Assessment)

1. Verify that surface is suitable for VFD installation.
2. Do not install VFD until the installation environment can be maintained within the service conditions required by the manufacturer.

3.2 INSTALLATION

Submit under provisions of the following sections: 1998ed 01620 (Installation Standards)

 2004ed 01 73 19 (Installation)

A. Install VFD where indicated, in accordance with manufacturer's written instructions, NEMA ICS 3, and complying with recognized industry practices to ensure that system complies with requirements and services intended purposes.

Submit under provisions of the following sections: 1998ed 16160 (Enclosure)

 2004ed 26 27 16 (Electrical Cabinets and Enclosures)

B. Drives located outdoors shall be provided in a NEMA 3R (Marine grade aluminum, powder-coated white) enclosure. Drives located indoors shall be provided in a ventilated type 12 enclosure.

C. Provide access space around drives for service as indicated, but in no case less than that recommended by the manufacturer.

Submit under provisions of the following sections: 2004ed 26 27 26 (Wiring Devices)

D. Tighten accessible connections and mechanical fasteners after placing VFD.

Submit under provisions of the following sections: 1998ed 16195 (Electrical Identification)

 2004ed 26 05 53 (Identification for Electrical Systems)

E. Provide a nameplate label on each VFD, identifying rated horsepower, full load amperes, model number, service factor and voltage/phase rating.

3.3 FIELD QUALITY CONTROL

Submit under provisions of the following section: 2004ed 01 45 16 (Field Quality Control Procedures)

1. Field inspection and testing.
2. Inspect completed installation for physical damage, proper alignment, anchorage and grounding.

3.4 MANUFACTURER'S FIELD SERVICES

Submit under provisions of the following section: 1998ed 01445 (Manufacture’s Field Services)

 2004ed 01 43 33 (Manufacture’s Field Services)

1. Prepare and start to installed VFD system.

3.5 ADJUSTING

Submit under provisions of the following section: 2004ed 01 75 00 (Starting and Adjusting)

1. Carry out adjusting work. Make final adjustments to installed VFD, to assure proper operation of the system.

END OF SECTION