

Resolution 2025-R-38

A Resolution accepting the Bid for Electrical Work at Well 7 and authorizing the Mayor to Execute Documents Related Thereto

WHEREAS, the invitation to bid for the Well 7 Electrical Work was prepared in compliance with the provisions of the Alabama Bid Law; and

WHEREAS, the City of Irondale publicly opened and read aloud the Project bids that were submitted, as shown in the table below:

COMPANY	TOTAL BID PRICE
Dexter Fortson Associates, Inc.	\$44,792.00

THEREFORE BE IT RESOLVED by the City Council of the City of Irondale, Alabama, in regular meeting duly assembled, a quorum being present as follows:

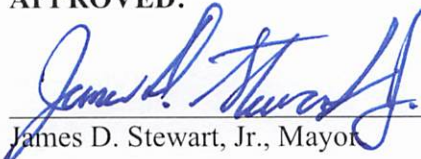
1. The bid for electrical work at well 7 in the total amount of Forty-Four Thousand Seven Hundred Ninety-Two and 00/100 Dollars (\$44,792.00) is hereby accepted.
2. Mayor James D. Stewart, Jr., or his designee, is hereby authorized to execute any necessary documents with Dexter Fortson Associates, Inc. for such amount not to exceed \$44,792.00 to effectuate this bid acceptance.

ADOPTED & APPROVED: This 18th day of February, 2025.



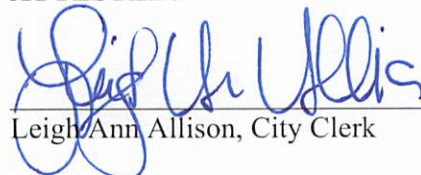
David Spivey, City Council President

APPROVED:



James D. Stewart, Jr., Mayor

ATTESTED:



Leigh Ann Allison, City Clerk

CERTIFICATION

I, Leigh Ann Allison, the City Clerk of the City of Irondale, Alabama, hereby certify that the above to be a true and correct copy of a resolution adopted by the City Council of the City of Irondale at its regular meeting held on February 18, 2025, as the same appears in the minutes of record of said meeting.

Leigh Ann Allison, City Clerk



Dexter Fortson Associates, Inc.

5511 Powder Plant Ln • Bessemer, AL 35022 • (205) 432-2700

DFA Alabama General Contractors License No. 15674U
UL508A Certified Panel Builder – E204430
"MADE IN THE USA"

DFA ALABAMA GENERAL CONTRACTORS LICENSE NO. 15674U
DFA FEDERAL TAX ID # 63-0835256

IRONDALE WATER DEPARTMENT
CITY OF IRONDALE, ALABAMA
CITY HALL
101 20TH ST SOUTH
IRONDALE, AL 35210



BID PACKAGE FOR:

WELL 7 ELECTRICAL

BID DATE: FEBRUARY 18, 2025
BID TIME: 10:15 A.M. LOCAL TIME

BID QUOTATION SHEET

City of Irondale, Alabama

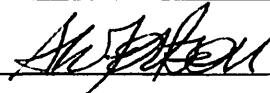
Item #	Quantity	Description	Total <i>Lump Sum</i>
1	1	Furnish and Install all Electrical Equipment and Labor for the above specifications.	\$ <u>44,792.00</u>
2	1	Delivery and Install Date	<u>MARCH 4, 2025</u>

THE AWARD OF THE BID WILL BE BASED ON THE TOTAL/SUM OF THE BASE BID PRICE AND THE DELIVERY DATE. ONCE THE CITY COUNCIL HAS APPROVED THE BID, THE SUCCESSFUL BIDDER WILL COORDINATE A DELIVERY/INSTALL DATE. THE PURCHASE ORDER WILL BE TRANSFERRED FROM THE OWNER TO THE SUCCESSFUL BIDDER. THE OWNER RESERVES THE RIGHT TO SELECT SUCCESSFUL BIDDER BASED ON THE DELIVERY AND INSTALL DATE.

THE UNDERSIGNED OFFERS THESE PRICES, TERMS, AND DELIVERY AS PER BID GENERAL CONDITIONS AND SPECIFICATIONS. BIDS SUBMITTED ARE FIRM AND NO CLAIMS FOR ERRORS WILL BE MADE AFTER BIDS ARE OPENED.

NAME OF COMPANY: **DEXTER FORTSON ASSOCIATES, INC.**

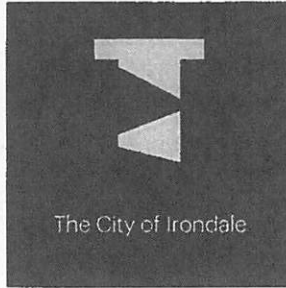
BY (Please Print): **ANDREW W. FORTSON**

SIGNATURE (Authorized Representative): 

COMPANY ADDRESS: **5511 POWDER PLANT LANE, BESSEMER, AL 35022**

PHONE: **205-432-2710**

E-MAIL: **JJONES@DFA-INC.COM**



Invitation to Bid

Well 7 Electrical

Sealed bids will be received by the City of Irondale, Alabama for the Irondale Water Department, City Hall, 101 20th Street South, Irondale, Alabama 35210 until 10:15 a.m. local time on February 18, 2025, at which time bids will be opened publicly and read in the City Council Chambers. The City reserves the right to reject any or all bids and to waive informalities in awarding this bid to the lowest responsive bidder. Bidders are to state that bids submitted are firm and that no claims for errors will be made after bids are opened and subsequent thereof. If you have questions concerning this bid, contact Jared Morris in writing at jmorris@cityofirondaleal.gov.

GENERAL INFORMATION

All bidders must use the form provided in the bid package for submitting their bids. All bids must be sealed and marked in the lower left corner "Well 7 Electrical". Late bids will not be opened.

Records showing successful bidder(s) and prices quoted will be placed on file and may be examined upon request.

Should there be a change in ownership or management, the contract may be canceled at the City's discretion unless a mutual agreement is reached with the new owner or manager to continue the contract with its present provisions and prices. The contract is not transferable by either party.

METHOD OF AWARD

The award will be made to the lowest bidder meeting specifications. It is not the policy of the City to purchase on the basis of low bid only. Quality, conformity with the specifications, terms of delivery and past service and experience are among the factors that may be considered in determining the responsive bidder.

COMPLETION DATE

Electrical work shall be installed within twenty (20) days of issuance of a purchase order by the City of Irondale.

INSURANCE AND BONDS

Prior to commencing any work, the successful bidder shall provide to the City written evidence of the minimum requirements for insurance set forth herein and include such costs in pricing to the City.

The successful bidder shall procure and maintain during the performance of and until the completion of the work at the successful bidder's expense the insurance coverages set forth in the Insurance Exhibit A attached hereto.

1. A cashier's check or bid bond payable to the City of Irondale, Alabama, in an amount not less than five percent (5%) of the amount of the bid, but in no event more than \$10,000.00, must accompany the bidder's proposal. Performance and statutory Labor and Material Payment Bonds will be required from the successful bidder prior to the

commencement of any work. All measurement devices shall be calibrated by a third party capable of certifying the accuracy of the devices being utilized in the repair process.

2. Company performing repairs shall have a repair shop located within 40 miles of utility. The shop shall grant access to the owners at any point during the repair process to inspect work being performed to date. The repair facility shall have the capability and equipment needed to remove, install and start -up repaired equipment if so needed.

LAWS and ORDINANCES

The supplier shall observe and comply with all federal, state, local and municipal laws, ordinances, rules and regulations that would apply to this contract.

Leigh Ann Allison
City Clerk



VARIABLE FREQUENCY DRIVE

1.1 SUMMARY

- A. Scope: Well Number 7 of the City of Irondale (“City” or “Owner”) shall have a new 150 HP Variable Speed Drive (“VFD”) installed. The Systems Integrator shall provide a new VFD, line reactor, load reactor, and upsize the wiring from the existing MCC through the proposed new reactors to the motor. The current wiring is 3/0 and will be increased to 4/0. Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for adjustable or variable frequency motor controllers (also identified as VFDs, AFDs, Variable Frequency Drives, or Adjustable Frequency Drives) as required for the complete performance of the Work, as specified herein. Well Number 7 is located at 108 22nd Street North, Irondale, Alabama 35210 (“Project Site”).
- B. Related Sections include, but shall not be limited to, the following:
1. General provisions of these bid specifications.
 2. Refer to the specification sections for the VFD driven equipment for additional requirements.

1.2 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of these bid specifications, unless otherwise specified.
1. American Society of Civil Engineers (“ASCE”)
 - a. ASCE/SEI 7, “Minimum Design Loads for Buildings and Other Structures.”
 2. Institute of Electrical and Electronics Engineers (“IEEE”)
 - a. IEEE 519, “IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems”
 3. International Code Council (“ICC”):
 - a. ICC IBC, “International Building Code”
 - b. ICC UBC, “Uniform Building Code”
 - c. AC156, “Acceptance criteria for Seismic Certification by Shake Table Testing of Nonstructural Components”
 4. International Electrotechnical Commission (“IEC”)
 - a. IEC 61000, “Electromagnetic Compatibility”
 - b. IEC 61800-5-1, “Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy”
 - c. IEC 60068 Part 2-3, “Basis Environmental Testing Procedures Part 2: Tests – Test Ca: Damp Heat”
 - d. IEC 60146-1-1, “Semiconductor converters - General requirements and line commutated converters - Part 1-1: Specification of basic requirements”
 - e. IEC 60664-1, “Insulation Coordination for Equipment Within Low-Voltage Systems”
 - f. IEC 60447, “Basic and safety principles for man-machine interface, marking and identification - Actuating principles”
 - g. IEC 61439-1, “Low-Voltage Switchgear and Controlgear Assemblies - Part 1: General Rules”
 - h. IEC 60364-1, “Low-Voltage Electrical Installations - Part 1: Fundamental Principles, Assessment of General Characteristics, Definitions”
 - i. IEC 60204-1, “Safety of machinery - Electrical equipment of machines - Part 1: General requirements”
 - j. IEC 106, “Guide for Specifying Environmental Conditions for Equipment Performance Rating”
 - k. IEC 529, “Degrees of protection provided by enclosure”
 - l. IEC 1000, “Electromagnetic Compatibility”

- m. IEC 1800, "Adjustable speed Electrical power drive systems"
- n. IEC 60721-3-3, "Classification of Environmental Conditions"
- o. IEC 60255-8, "Overload Relays"
- p. IEC 60801-2,-3,-4,-5, "Immunity Tests"
- q. IEC 60947-2, "Low-voltage switchgear and controlgear - Part 2: Circuit-breakers"
- 5. International Organization for Standardization ("ISO"):
 - a. ISO 9001, "Quality Management Systems – Requirements"
 - b. ISO 14001, "Environmental management systems -- Requirements with guidance for use"
- 6. National Electrical Manufacture Association ("NEMA")
 - a. NEMA 250, "Enclosures for Electrical Equipment"
 - b. NEMA ICS Part 4, "Overload Relays"
 - c. NEMA ICS7, "Industrial Control and Systems Adjustable Speed Drives"
 - d. NEMA ICS 7.1, "Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Speed Drives"
- 7. National Fire Protection Association
 - a. NFPA 70, "National Electrical Code ("NEC")"
 - b. NFPA 79, "Electrical Standard for Industrial Machinery"
 - c. NFPA 5000, "Building Construction and Safety Code"
- 8. Occupational Health and Safety Administration ("OHSA")
 - a. OSHA 1910.95, "AC Drive Controller Acoustical Noise"
- 9. Semiconductor Equipment and Materials International ("SEMI")
 - a. SEMI F47, "Industry Standard for Voltage Sag Immunity"
- 10. Underwriters Laboratories, Inc. ("UL"):
 - a. UL 50, "Enclosures for Electrical Equipment"
 - b. UL 98, "Disconnect Switches"
 - c. UL 507, "Electric Fans"
 - d. UL 508, "Industrial Control Equipment"
 - e. UL 508A, "Standard for Industrial Control Panels"
 - f. UL 991, "Safety Tests for Safety Related Controls Employing Solid State Devices"
 - g. UL 508C, UL 61800-5-1, "UL Standard for Safety Power Conversion Equipment"

1.3 DEFINITIONS

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.
 - 1. LV: Low voltage
 - 2. VFD: Variable frequency drive
 - 3. VSI: Voltage source inverter
 - 4. AFE: Active front end
 - 5. DFE: Diode front end
 - 6. MTBF: Mean time between failure
 - 7. MTTR: Mean time to repair
 - 8. NPC: Neutral point clamped
 - 9. IGBT: Insulated gate bipolar transistor
 - 10. PWM: Pulse width modulation

1.4 SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of, in addition to those specified herein.
 - 1. Submit sufficient information to determine compliance with the bid specifications. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.

2. Deviations from the bid specifications shall be indicated within the submittal. Each deviation shall reference the corresponding drawing or specification number, show the bid specification requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.
3. Submit required product data and shop drawings specific to each product and accessory proposed. In addition, include the following information:
 - a. Manufacturer, supplier, and proposal specific contact information.
 - b. Manufacturer's catalog data indicating model numbers, equipment specifications and construction features including all furnished options, and accessories.
 - c. VFD assembly rated input KVA and output KVA, percent efficiency, operating characteristics, and electrical characteristics.
 - d. Maximum Btu heat release data and ambient cooling requirements.
 - e. Enclosure type, NEMA rating, material and finishes.
 - f. Certification of UL conformity
 - g. Equipment assembly. Indicate dimensions, shipping section dimensions. weights, foundation requirements. required clearances, location and size of each field connection, and mounting and installation instructions.
 - h. Include elementary and interconnection diagrams for power, signal, control. and communications wiring. Diagrams shall provide the minimum detail as shown for drawings in the appendix of NFPA 79. All field terminals shall be identified and updated later within the O&M data to include actual field connection information. Drawings shall not be typical. but be provided for each VFD furnished.
 - i. Electronic 2D dimensional drawing and 3D model CAD files for standard units shall be provided upon request if not available from the manufacturer's website.

- B. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which, the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Required working clearances and required area above and around VFDs.
 2. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements.
 3. Show support locations, type of support, and weight on each support.
 4. Indicate field measurements.

- C. Operation & Maintenance ("O&M") manuals shall be provided in accordance with the minimum requirements specified in and additional requirements specified herein.
1. Submit required Operations & Maintenance data specific to each product and accessory proposed. In addition, include the following information:
 - a. Manufacturer, supplier, support, and repair center specific contact information.
 - b. Manufacturer's standard operation and maintenance data assembled for each size and type of equipment furnished.
 - c. All construction, installation, schematic, and wiring diagrams updated to an as-installed and commissioned state.
 - d. All configured settings/parameters for adjustable components updated to an as-installed and commissioned stated if different from the factory default. Electronic copies of configuration files shall be provided, on media acceptable to the Owner (e.g. CD, USB stick, etc.), where these configurations can be saved as an electronic file for future upload into replaced or repaired components.
 - e. List of furnished and recommended spare parts.
 - f. Statement of standard Warranty.
 2. O&M manuals shall be submitted with equipment arrival on site.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products

of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of ten (10) years.

1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.
2. The manufacturer or their representative shall have service, repair, and technical support services available 24 hours 7 days a week basis.

B. All work performed, and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Equipment assemblies, materials, and equipment shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prior to delivery to the Project Site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in a clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.
- B. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the bid specifications.
- C. Inspect and report any concealed damage or violation of delivery, storage, and handling requirements to the Owner.

1.7 WARRANTY

- A. The manufacturer shall warrant products against defects in material and workmanship for twelve (12) months. The warranty shall exclude normal wear and tear under normal usage and any damage caused by abuse, modification, or improper maintenance by entities other than the manufacturer or its approved representative.

1.8 SPECIAL TOOLS AND SPARE PARTS

- A. The successful bidder shall provide a recommended spare parts list with the following information provided as a minimum:
 1. Contact information for the closest parts stocking location to the Owner.
 2. Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.
 3. Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the VFD equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D Altivar Process Variable Speed Drive, Altivar 600 Series.
- B. Acceptable Products: VFDs specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Products shall be modified as necessary by the manufacturer for compliance with requirements. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the bid specifications prior to the bid date:
 - 1. Square D Altivar Process Variable Speed Drive by Schneider Electric.
- C. The VFD manufacturer shall provide for repair and service of the drive components with worldwide support. The VFD manufacturer shall provide remote diagnostic services in conjunction with the VFD's user interface to provide QR code, or equivalent, linked access to worldwide web based enhanced diagnostics, documentation, and customer service.

2.2 GENERAL REQUIREMENTS

- A. The VFDs shall be built to comply with the UL standard and shall be marked in accordance with to UL 508, UL508C or UL 61800-5-1.
- B. Without limiting the generality of other requirements of this Section, all work specified herein shall conform to or exceed the applicable requirements of the following standards; provided, that wherever the provisions of listed publications conflict with the requirements specified herein, the more stringent requirements shall apply:
 - 1. ANSI/NFPA 70: National Electrical Code;
 - 2. EN61800-5: Electronic equipment for use in power installation;
 - 3. CSA C22.2 No. 274 – Adjustable Speed Drives;
 - 4. IEC 60068 Part 2-3: Basis Environmental Testing Procedures Part 2: Tests – Test Ca: Damp Heat;
 - 5. IEC 60146-1-1: Semiconductor converters - General requirements and line commutated converters - Part 1-1: Specification of basic requirements;
 - 6. IEC 60664-1: Insulation Coordination for Equipment Within Low-Voltage Systems;
 - 7. IEC 60447: Basic and safety principles for man-machine interface, marking and identification - Actuating principles;
 - 8. IEC 61439-1: Low-Voltage Switchgear and Controlgear Assemblies - Part 1: General Rules;
 - 9. IEC 60364-1: Low-Voltage Electrical Installations - Part 1: Fundamental Principles, Assessment of General Characteristics, Definitions;
 - 10. IEC 60204-1: Safety of machinery - Electrical equipment of machines - Part 1: General requirements;
 - 11. IEC 106: Guide for Specifying Environmental Conditions for Equipment Performance Rating;
 - 12. IEC 529: Degrees of protection provided by enclosure;
 - 13. IEC 1000: Electromagnetic Compatibility;
 - 14. IEC 1800: Adjustable speed Electrical power drive systems;
 - 15. IEC 60721-3-3: Classification of Environmental Conditions;
 - 16. IEC 60255-8: Overload Relays;
 - 17. IEC 60801-2,-3,-4,-5: Immunity Tests;
 - 18. NEMA ICS Part 4: Overload Relays;
 - 19. NEMA ICS7: Industrial Control and Systems Variable Speed Drives; and
 - 20. UL 508C, UL 61800-5-1: UL Standard for Safety Power Conversion Equipment.
- C. Variable Frequency Drives shall provide for the starting and speed control of standard NEMA A or NEMA B, design AC inverter duty asynchronous motors and synchronous motors with permanent magnets by the

adjustment of output voltage and frequency. The VFD shall be a digitally controlled drive, using Pulse Width Modulation ("PWM").

- D. Unless otherwise specified or shown within the bid specifications, the successful bidder shall be responsible for matching the VFD to the load (variable or constant torque) as well as the speed and current of the actual motor being controlled. This sizing shall match the KVA and inrush characteristics of the motors provided.
- E. Environmental Requirements
 - 1. The VFD shall be rated to withstand the following environmental conditions while able to give a 100% output current continuously. Where derating is necessary to meet on site environmental conditions, the manufacturer shall submit the VFDs derated performance. The derating factor shall be specified so that neither the lifetime of the VFD nor the unit's performance, overload capability included, nor the reliability of the VFD shall suffer.
 - a. Storage Temperature: -40°C to 70°C;
 - b. Operating Temperature for UL Type 1 VFDs: -15°C to 50°C without derating, up to 60°C with derating of power stage (UL Type 1);
 - c. Operating Temperature for enclosed VFDs: -10°C to 40°C without derating, down to -10°C with enclosure heater, up to 55°C with derating of power stage;
 - d. Relative Humidity: ≤95% relative humidity without condensation per IEC 60068-2-3;
 - e. Operating Altitude: ≤1000m without derating, up to 4800m with derating;
 - f. Corrosion Protection Level: Class 3C3 according to IEC 60721-3-3 for cooling air and chemical gases;
 - g. Biological Protection Level: Class 3B1 according IEC 60721-3-3;
 - h. Dust Protection Level: Class 3S3 according to IEC 60721-3-3; and
 - i. Vibration and Shock Protection Level: Class 3M3 according to IEC 60721-3-3.
 - 2. The VFDs shall have an integral enclosure that shall protect from ingress of dirt and water in accordance with UL Type 3R. The user interface terminal shall be rated UL Type 12, mounted on front face of enclosure, and accessible for programming and controls with the main door closed.
 - 3. VFD enclosures shall be front cabinet accessible and constructed in conformance with IEC 60439-1. Conduit entry shall be bottom entry as standard to allow for top mounted cooling components. The VFD enclosure shall have a forced air and heat sink cooling system that does not require liquid or air condition cooling components for ambient temperatures within the drives stated ambient temperature operating range.

2.3 PERFORMANCE REQUIREMENTS

- A. The VFD shall be rated for the nominal input voltage specified or shown on the drawings. The VFD shall have a three-phase input voltage tolerance within the following range of the corresponding nominal input voltage:
 - 1. 380V -15% 480V +10%
- B. The VFD shall meet the following minimum operating requirements:
 - 1. Rated Frequency: 50 Hz -5% to 60 Hz + 5%. The VFD shall operate from 40 to 72 Hz when powered by standby or emergency generators.
 - 2. Displacement Power Factor: ≥0.97
 - 3. Efficiency:
 - a. >98 % at nominal load for VFD (IP 21 / UL Type 1).
 - b. >97.5 % at nominal load for enclosed VFD systems.
 - c. >96 % at nominal load for low harmonic VFD (IP 21 / UL Type 1).
 - d. >95.5 % at nominal load for low harmonic enclosed VFD systems.
 - 4. Overload Capability: Heavy Duty at 150% nominal current for 1 min
 - 5. Harmonics Mitigation: <48% THDi according to IEC/EN 61000-3-12 at 80-100% load
 - 6. Surge immunity according to IEC/EN 61000-4-5 Level 3

7. The VFD shall be compliant with SEMI F47: degraded running operation during undervoltage conditions.
 - a. 50% undervoltage for up to 200 ms
 - b. 30% undervoltage for up to 500 ms
 - c. 20% undervoltage for up to 1 s
- C. The VFD shall provide a speed range in the motor quadrant 1:100 in sensor less vector control and in the generator quadrant 1:50 in sensor less vector control.
- D. The VFD shall provide an over torque capability better than 150% of the rated motor torque for heavy duty applications during 60s, every 10 minutes.
- E. The VFD shall provide a speed accuracy $\pm 10\%$ of the nominal slip of the motor in sensor less vector control.
- F. The VFD shall provide a torque control accuracy $\pm 15\%$ in sensor less vector control for AC motors.

2.4 APPLICATION REQUIREMENTS

- A. The VFD shall be able to control motors using the following motor control types in accordance with the applications needs and energy savings: Volts per hertz VC Standard, Volts per hertz VC 5pts, Volts per hertz VC Quad., Volts per hertz VC Energy Saving.
- B. The VFD shall provide a Real Time Clock management with battery backup.
- C. The VFD shall be capable of automatic tuning of motor parameters through measurement of the motor without rotation, and without the need to disconnect the load from the motor.
- D. The VFD shall provide functionality adjustable within the drive parameters to reduce voltage surges on motor cables.
- E. The successful bidder shall provide AC chokes and filters to fit installation and motor requirements per the following guidelines:
 - a. A line reactor shall be required.
 - b. A load reactor shall be required.
- F. Protection:
 1. The VFD shall be UL 508 or UL61800-5-1 listed for use on distribution systems.
 2. The VFD shall have coordinated short circuit rating designed to UL 508C or UL 61800-5-1 and NEMA ICS 7.1 Short Circuit Rating: 35kAIC.
 3. Micro-short voltage sag immunity per SEMI F47.
 4. Upon power-up the VFD shall automatically test for valid operation of memory, option module, loss of analogue reference input, loss of communication, DC to DC power supply, control power and the pre-charge circuit.
 5. The VFD shall be protected against short circuits, between output phases and ground and the logic and analogue outputs.
 6. The VFD shall have a selectable ride through function that shall allow the logic to maintain control for a minimum of one second without tripping.
 7. The deceleration mode of the VFD shall be programmable for normal and trip conditions. The stop modes shall include freewheel stop, fast stop.
 8. Upon loss of the analog process follower reference signal, the VFD shall trip and/or operate at a user-defined speed set by a software programmed speed settings or last speed.
 9. The VFD shall integrate a protection against IGBT and heat sink over temperature.
 10. The VFD shall have solid state thermal protection that is UL Listed and meets UL 508C as a Class 10 overload protection and meets IEC 60947-2.
 11. The VFD shall have a motor thermal memory retention function per UL requirements.

12. The VFD shall be able to protect the motor when temperature probes are connected.
13. The VFD shall be able to limit the motor surge ($I dv/dt$) at twice the DC bus voltage
14. The VFD shall provide IGBT protection:
 - a. IGBT overcurrent protection;
 - b. IGBT checkup sequence;
 - c. IGBT checkup sequence before PWM enable sequence; and
 - d. IGBT over-heat protection.
15. The VFD shall provide VFD Current protection:
 - a. Phase short circuit protection;
 - b. Ground protection; and
 - c. Over-current protection.
16. The VFD shall provide VFD Voltage error protection:
 - a. Mains over-voltage protection;
 - b. Mains under-voltage protection;
 - c. DC Bus over-voltage protection; and
 - d. DC Bus pre-charge protection.
17. The VFD shall provide VFD Thermal protection:
 - a. VFD over-temperature protection;
 - b. FAN management; and
 - c. Switching Frequency management.
18. The VFD shall provide internal error detection.
19. The VFD shall provide Motor protection functions:
 - a. Motor output phase detection;
 - b. Motor surge voltage;
 - c. Motor overload detection; and
 - d. Motor stall protection.
20. The VFD shall provide Application protection functions:
 - a. Catch on fly function;
 - b. Mains input phase lost protection;
 - c. Motor over-speed input protection;
 - d. Current limitation;
 - e. Power limitation;
 - f. Reverse inhibition;
 - g. Under-load protection;
 - h. Over-load protection;
 - i. External error management;
 - j. Loss of follower signal;
 - k. Thermal Sensor management;
 - l. PID Feedback; and
 - m. Customer defined input.

2.5 CONTROL AND INTERFACE REQUIREMENTS

- A. Indicators:
 1. The VFD shall display a signal by LED near the connection point of the device when a hazardous voltage is present.
 2. The VFD shall have 3 LEDs for local diagnostics.
 3. The VFD shall have 3 dual color LEDs for embedded communication status.
 4. The VFD shall have 4 dual color LEDs for optional communication status.
- B. User Interface:
 1. A detachable UL Type 12/IP65 rated bi-color backlit graphical user interface terminal with keypad and capacitive wheel shall be provided for monitoring, annunciation, and configuration. The graphical display shall change to a red backlit color when an alarm occurs. The door mounting for

the user interface shall be done with a 22 mm hole.

2. A "Simply Start" menu for fast and easy commissioning shall be provided and parameter setting shall be easily accessible and user friendly with plain text messaging and actual setting range.
3. The keypad shall be capable of providing password protection.
4. The user interface shall be capable of saving and downloading configurations of the VFDs, as well as porting them to other VFDs.
5. The user interface shall offer a Mini-USB port for mass storage or PC device connection.
6. The mechanical mounting for the user interface on the cabinet shall be done with a 22 mm hole.
7. The VFD shall have self-diagnostic capabilities to display alarms, errors, and warnings as they occur and be able to store at least 15 of the last messages into the memory. These shall be accessible by PC maintenance tools or web server with flash record for data logging expertise.
8. The user interface shall be identical throughout the power range to avoid confusion amongst the users and need for training in several different units.
9. The displayed messages shall be in plain text English.

C. Control Interface:

1. VFD shall interface with automation systems to monitor, control, display, and record data for use in processing reports. VFD settings shall be retained within VFD's nonvolatile memory.
2. The speed command and reference may come from different control sources:
 - a. I/O terminals;
 - b. Communication network;
 - c. Web server;
 - d. Remote graphic display terminal;
3. A minimum of the following standard inputs / outputs shall be provided to interface with control systems and instrumentation:
 - a. Analog Inputs: 3 programmable 0(4)-20 mA or 0-10 vdc
 - 1) 2 analog inputs shall also be programmable for temperature sensors (PTC, PT100, PT1000, KTY84).
 - b. Analog Outputs: 2 programmable 0(4)-20 mA or 0-10 vdc.
 - c. Discrete Inputs: 6 programmable isolated logic inputs as either sink or source
 - 1) 2 discrete inputs shall also be programmable as 0-30 kHz pulse inputs
 - 2) 2 discrete inputs shall be dedicated Safe Torque Off safety function in accordance with IEC/EN 61508-1 SIL3
 - d. Discrete Outputs: 3 programmable relay contacts
 - 1) 1 discrete output shall be dedicated to product watchdog logic.
4. Programmable analog inputs shall be able to be assigned the following parameters:
 - a. Speed reference;
 - b. Summing reference;
 - c. Subtracting reference;
 - d. Multiplying reference;
 - e. Torque reference;
 - f. Torque limitation;
 - g. PID feedback;
 - h. Manual PID reference;
 - i. PID speed reference; and
 - j. Forced local reference.
5. Programmable analog outputs shall be able to be assigned the following parameters:
 - a. Motor current; and
 - b. Motor frequency.
6. Programmable discrete inputs shall be able to be assigned the following parameters:
 - a. Run;
 - b. Forward;
 - c. Reference switching;
 - d. Error reset; and

- e. Command switching.
- 7. Programmable discrete outputs shall be able to be assigned the following parameters:
 - a. Ready; and
 - b. Drive running.
- 8. Safety Inputs:
 - a. The VFD shall provide 2 inputs dedicated to Safe Torque Off (STO) safety function, which prohibits unintended equipment operation, in accordance with IEC/EN 61508-1 SIL3.
 - b. The VFD shall be compliant with EN13849 (PL e).
 - c. The VFD shall be compliant with safety of machinery EN 954-1.
 - d. The VFD manufacturer shall provide the certified schematics and the list of devices in order to comply with IEC/EN 60204-1 stopping category 0 and 1.
 - e. The VFD shall integrate the safety contacts in compliance with EN-81 13.2.2.3.

D. Communications:

- 1. The VFD shall provide at a minimum 1 Modbus and 1 Ethernet Modbus TCP communications ports.
- 2. VFD Ethernet ports shall be IPv6 compliant, allow for web server access and provide network management via SNMP and clock synchronization.
- 3. The VFD shall provide an embedded web server for enhanced diagnostic, mini usb, parameter access, and energy management. There shall be the capability to create a user-defined custom dashboard for viewing drive and process status through tables, charts, and graphical views. It shall be possible to export data in standard table format using the webserver, for information around energy consumption as well as error and warning history.
- 4. The VFD shall be compliant with the Cyber Security Management ISA Secure /Achilles.
- 5. The VFD shall be capable of providing Wi-Fi connectivity via option for wireless diagnostic, configuration, and parameter access.
- 6. The VFD shall provide integration connectivity via:
 - a. DHCP protocol for Fast Device Replacement; and
 - b. DTM library in compliance with standard FDT technology.

E. Configuration:

- 1. The VFD shall be capable of accepting independent command and speed reference signals from:
 - a. Terminals;
 - b. Modbus port;
 - c. Ethernet port;
 - d. Communication option card; and
 - e. Keypad display.
- 2. The VFD shall provide a speed set-point function capable of:
 - a. Maximum output frequency function;
 - b. Low and high speed scaling and limitation function;
 - c. Jump frequency;
 - d. Speed summing references function;
 - e. Preset-speed references function;
 - f. Jog function; and
 - g. Up-Down speed references.
- 3. The VFD shall provide a Stop function capable of:
 - a. Deceleration ramp on power loss;
 - b. Freewheel stop; and
 - c. Stop by DC injection at motor stop detection.
- d. Stop by DC injection by Logic Input.
- e. Stop on deceleration ramp adaptation.
- 4. The VFD shall have an acceleration/deceleration, time adjustable ramp function capable of:
 - a. Ramp type: linear ramp, S shape ramp, with U or customized profile;
 - b. Ramp Deceleration adaptation; and

- c. Ramp switching.
- 5. Application programming dedicated to pumps:
 - a. The VFD shall provide Pump Control & Monitoring Functions:
 - 1) Centrifugal pump characteristics and configurations.
 - 2) Pump monitoring function to define data relevant for pump (acceleration, low speed, high speed, etc.)
 - 3) Application Units function to define units used in applications.
 - 4) Pump Cyclic Start Protection to protect the pump against too many restarts in a dedicated time period.
 - 5) Multi-pump functions.
 - b. The VFD shall provide Pump Protection Functions:
 - 1) Anti-Jam function to remove automatically clogging substances from the pump impellers.
 - 2) Pipe Cleaning function to start pump regularly to avoid sedimentation in pump impeller.
 - 3) Cavitation Pump Protection.
 - 4) Inlet protection to avoid system dry running.
 - c. The VFD shall provide Application control functions:
 - 1) Stop and Go function to reduce consumption when VFD is in standby mode.
 - 2) Pulse input in order to connect a flow meter.
 - 3) Process control (PID) function to maintain a process at a given pressure or flow reference.
 - 4) Flow limitation function to allow limiting the consumption of water.
 - 5) Friction loss compensation function to compensate pressure losses in pipes due to friction.
 - 6) Pipe Fill function to manage a smooth control during pipe filling and to lessen the effects of water hammer.
 - 7) Sleep wake-up function to manage periods of the application when process demand is low and when it is not needed.
 - 8) Low demand function to define periods of the application when process demand is low to save energy.
 - 9) Jockey pump control function to start / jockey pump, during sleep period, to maintain emergency service pressure or demand such as low water.
 - 10) Sensor management to define how it will be used to drive inputs to manage pressure sensor or flow sensor.
 - d. The VFD shall provide Application protection functions:
 - 1) High flow protection function to detect pipe burst or detect running outside normal working area; and
 - 2) Outlet pressure protection function to fix minimum and maximum pressure.
 - e. The VFD shall provide Pump curve input to help optimize pump performance:
 - 1) Input and storage of the pump characteristics including 5 points of the pump curve.
 - 2) A best efficiency point ("BEP") function to run in optimum conditions and detect deviation from this point.
- F. Diagnostics and Configuration:
 - 1. The VFD Supplier shall have Windows based PC software for configuring and diagnosing the VFD. It shall be possible to set and modify parameters, control the drive, read actual values and make trend analysis using the software. The PC-tools may be connected to the VFD by wired or wireless connection.
 - 2. The VFD shall display all faults in plain text and help screens shall be available to guide the user in the troubleshooting. Codes are not acceptable.
 - 3. The VFD shall provide a Real Time Clock management for time stamping of detected errors.
 - 4. The VFD shall display detected errors with QR codes to guide the user in the troubleshooting.
 - 5. The VFDs must provide LED lights to indicate the status of the VFD.
 - 6. The VFD must have the ability to dynamically display I/O status.
- G. Energy Management:
 - 1. The VFD shall provide a data logging function to keep files ready for maintenance or user.

2. The VFD shall provide information related to Energy management through different ways such as: web server, keypad, facet for SCADA, communication networks.
3. The user interface shall be able to display a chart relative to energy efficiency and energy management.
 - a. Report in KW;
 - b. Display energy history for instant, weekly, monthly, and yearly;
 - c. Trend base on variation /time; and
 - d. Power measurement accuracy shall be less than 5 %.
4. The user interface shall be able to display the "efficient" set point for pump based on pump characteristics.
5. The user interface shall be able to display the "efficiency board" including CO2 savings, Savings viewer, and Return of Investment.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.
- B. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the successful bidder in writing, with a copy to the Owner, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- C. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the successful bidder.
- E. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.
- F. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion as determined by Owner.

3.2 FIELD QUALITY CONTROL

- A. Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory-trained manufacturer's field service representative. This manufacturer's field service technician shall provide all material, equipment, labor and technical supervision to perform inspection, testing and adjustments to ensure equipment is installed, adjusted, and tested in accordance with the manufacturer's recommendations and is ready for operation. The manufacturer's field service technician shall replace damaged or malfunctioning equipment and report to the Owner any discrepancies or issues with the installation.
- B. The manufacturer's representative shall, upon satisfactory completion of inspection and testing, attach a label to all serviced devices indicating the date serviced and testing company responsible.

3.3 FIELD TESTING AND COMMISSIONING

- A. Operational Readiness Testing:
 1. The successful bidder shall inspect and test furnished equipment and associated systems for conformance to the bid specifications, including equipment manufacture's recommendations, and readiness for operation. The test shall include the following as a minimum:
 - a. Visually inspect for physical damage and proper installation;

- b. Perform tests in accordance with manufacturer's instructions;
 - c. Perform tests to ensure compliance with bid specifications;
 - d. Perform tests that equipment is ready for operation; and
 - e. Touch-up paint all chips and scratches with manufacturer-supplied paint and transfer remaining paint to Owner.
2. Following completion of the work described herein, the successful bidder shall submit an operational readiness test report documenting all test results, including all assumptions, conditions, allowances and corrections made during the test. The report shall provide a listing of all modifications and adjustments made onsite to include any settings / parameters not identified as factory defaults within the equipment's O&M documentation. The test report shall include a signed statement from the successful bidder, installer(s) and the factory-trained manufacturer's representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations, completely conforms to the requirements of the bid specifications and is ready for operation.

B. Functional Demonstration Testing

- 1. Prior to scheduling functional demonstration testing the successful bidder shall submit a signed statement from the successful bidder, installer(s) and the factory-trained manufacturer's representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations, completely conforms to the requirements of the bid specifications and is ready for operation.
- 2. Following completion of the work, the successful bidder shall completely demonstrate the functionality and performance of the equipment and associated systems in the presence of Owner, observing and documenting complete compliance with the bid specifications.
- 3. Following completion of the work, the successful bidder shall submit a written report documenting successful completion of functional demonstrating testing including all assumptions, conditions, allowances and corrections made during the test.