ABBREVIATIONS

Whenever in this SOW the following abbreviations and terms or pronouns in place of them are used the intent and meaning shall be interpreted as follows:

A  amperes
AIC amperes interrupting capacity
ANSI American National Standards Institute
ASM American Society for Testing and Materials
AWG American Wire Gauge
C Centigrade
CPT control power transformer
CSA Canadian Standard Association
DIN Deutsche Industrial Normenausschuss
EASA Electrical Apparatus Service Association
EEMAC Electrical and Electronics Manufacturers Association of Canada
EUSERC Electrical Utility Service Equipment Requirements Committee
F Fahrenheit
HP horsepower
Hz hertz
ICEA Insulated Cable Engineers Association
IEC International Electro-technical Commission
IEE Institution of Electrical Engineers (London)
ISO International Organization for Standardization
ITC Independent Testing Company
kA kilo-amperes
kVA kilo-volt-amperes
MCC motor control center
mm millimeters
NEC National Electrical Code
NEMA National Electrical Manufacturers Association
NETA National Electrical Testing Association
O&M Operations and Maintenance
OSHA Occupational Safety and Health Act
PLC programmable logic controller
PSI pounds per square inch
PVC polyvinyl chloride
RMS root mean square
RTD Resistance Temperature Detector
TVSS Transient Voltage Surge Suppressor
UL Underwriters Laboratories
V volts
VA volt-ampere
VAC volts alternating current
VDC volts direct current
W watts

PART 1 GENERAL

1.01 SCOPE

A. Motor shop shall furnish all necessary labor, equipment and materials required for the complete testing, repair and refurbishment of one (1) existing wound rotor motor, Pump Motor # 3.

B. Qualifications
Within 8 weeks of Notice to Proceed, submit a sequence for the motor modifications for motor retrofitting. Submit schedule in Microsoft Project; Primavera; or approved equal. Schedule shall indicate starting dates, ending dates, durations, and milestones for all critical motor modification tasks including but not limited to:

1. Motor shop shall be a certified EASA shop.
2. Motor shop shall be located within a 750 miles’ radius of the Pacheco Pumping Plant and have the physical plant capability for handling the size and weight of the motors.
3. Motor shop shall have a minimum of ten years of experience in medium voltage motor modifications on machines of similar type and size. Motor shop shall have performed similar base bid and additive bid motor modifications on at least five projects with medium voltage centrifugal pump motors during these ten years’ period.
4. Submit minimum of three references with the bid documents for three similar projects that included similar rehabilitation of medium voltage motors. References shall include owner name, address, contact person, phone and email, and summary of services provided.

C. Work shall include removal, all transportation from the PPP to the motor retrofit facility, motor retrofitting, transportation back to the PPP, and reinstallation of the refurbished motor.

D. The existing 12 wound rotor motors are manufactured by Toshiba International Corporation, rated at 2000 hp, 4160 VAC, 712 RPM, 274 FLA. These motors were converted to induction motor rated for Pulse Width Modulation ASD control by Toshiba 300Mvi. Medium Voltage Drives. by shorting the slip rings. The motor weighs approximately 15,000 kg (16.5 ton) and the rotor weighs 3,900 kg (4.3 ton).

E. Provide additional services to perform complete motor stator rewinding on PPP motor #3 if authorized and approved by the District based on review of testing and performance data. Motor rewinding shall not be performed without written and explicit approval by the District as part of the project Additive Bid Item #3.17 listed in this scope of work.

F. Notify District Engineer of discrepancies within the Contract Documents and discrepancies between the Contract Documents and actual field conditions.

G. Motor shop shall use supporting blocks provided by the District for temporary setting of the motor where applicable. Supporting blocks required at the motor shop shall be furnished by the motor shop.

1.02 RELATED SECTIONS

A. Toshiba motor nameplate data and other information including weight, dimensions and motor outline drawing for a representative motor is included in Appendix A. Additional detailed technical motor data including motor data, serial numbers, etc. is available for inspection by bidders upon written request to the District and will be made available to the motor shop after award of Contract.

B. Schedule: Within 8 weeks of Notice to Proceed, submit a sequence for the motor modifications for motor retrofitting. Submit schedule in Microsoft Project; Primavera; or approved equal. Schedule shall indicate starting dates, ending dates, durations, and milestones for all critical motor modification tasks including but not limited to:

1. Dates and duration of the motor pretesting and removal
2. Dates and duration of shop modification including durations of modifications and testing.
3. Dates and duration of motor delivery to the PPP, re-installation, and on-site modifications.

C. Procedure: Within 8 weeks of Notice to Proceed as described in the Special Provisions, motor modification procedure in a step-by-step process describing in detail the work to be performed. Procedure shall include but not be limited to:
1. Motor pre-testing procedure.

2. Motor and pump inspection, decoupling, and movement of motor to transporting vehicle.

3. Transportation procedure including sketch showing horizontal and vertical tie-down, strapping, and supporting requirements of the motor in conformance with Toshiba requirements. Indicate required road permits.

4. Motor unloading procedure, motor reinstallation, and motor coupling to pump.

5. Submit proposed process for motor rewinding (Additive bid item) should motor rewinding be required by the District.

6. Product data: Submit catalog data and submittal information for all materials provided under this Section including bearings, ground brush shorting hardware, grounding materials, motor terminations, RTDs as needed.

7. Submit test procedures for the motor to be followed during pretesting, testing at the motor shop, and at the site during Motor acceptance testing. Test procedure shall be submitted for review and approval prior to performing any testing. Test procedures shall follow EASA and NETA standards for medium voltage motor maintenance testing and as specified herein at a minimum. Test procedures shall include data forms, sequence of testing, test equipment, and sign-off sheets for testing witnessed by the motor shop technician and the District (or District’s representative).

8. Submit calibration program details indicating procedures for assuring that all applicable test instruments are maintained within rated accuracy. Submit instructions and procedures issued for calibration and maintenance of each instrument. Accuracy shall be shown to be directly traceable to the National Institute of Standards and Technology (NIST).

9. Submit completed testing forms for pretesting (at the Pacheco site) and tests performed at the motor shop and on site after reinstallation. Testing forms shall include the completed forms and witness signatures as specified.

10. Upon successful motor repair, refurbishment, installation, and testing, submit a letter certifying that the motor modification work has been completed in conformance with the requirements of the indicated standards and as specified herein. Certification shall also state that the motor is ready for operation as induction motors running under ASD control. Certification shall be written on corporate letterhead of the motor shop and be signed by the managing supervisor of the motor shop.

11. Should the District execute a motor rewind Additive Bid Item, submit a certification that the rewound motor conforms to the original motor nameplate Certification shall also state that the motor is ready for operation as induction motors running under ASD control Certification shall be written on corporate letterhead of the motor shop and be signed by the managing supervisor of the motor shop.

D. Removal & Reinstallation of Motor

1. Remove the motor from its mounting base, pump, and shaft, and drain the oil per the Toshiba Motor Installation Manual. The District’s crane may be used to place motors on a transportation truck provided by the motor shop. The motor shop shall provide the transportation between the District’s facility and the motor shop.

2. After the motor is modified and tested, the motor shop shall deliver the motor back to the PPP facility. The District’s crane may be used to offload the motor as specified herein. The motor shop will reinstall the motor onto its mounting base, make pump connections, fill all oil reservoirs with the recommended oil per the operations manual, provide conductors.
Scope of Work (SOW)
Pump Motor # 3 Testing and Repair/Refurbishment
Pacheco Pumping Plant

and terminations for new and reconnected motor/pump monitoring systems, and reconnect electrical sources of supply including medium voltage power connection to the ASD.

3. Prior to any transporting of the motor, the motor shop shall plastic wrap and otherwise protect the motors from moisture, dirt, and physical damage.

4. The motor shop shall coordinate with the District for the pickup and delivery of the motor in conformance with the motor shop's submitted schedule.

E. Normative References/Standards

This section is intended to be used and referenced by users of motors that need repair as well as by owners and operators of establishments that offer motor repair services. The work within this specification shall conform to the applicable sections of the following reference standards. The revision of each standard in effect on the date of bid opening shall apply.

1. State of California Administrative Code
   a. Title 24, Part 3

2. Department of Labor
   a. Occupational Safety and Health Standards

3. Electrical Apparatus Service Association (EASA):
   a. EASA AR100-2015, Recommended Practice for the Repair of Rotating Electrical Apparatus.
   b. Guidelines for Maintaining Motor Efficiency During Rebuilding (Tech Note 16)

4. Institute of Electrical and Electronic Engineers (IEEE):
   b. IEEE Std. 522, Guide for Testing Turn Insulation of Form-Wound Stator Coils for AC Machines.

5. International Electrotechnical Commission (IEC)
   a. IEC 60085, Electrical Insulation - Thermal Evaluation and Designation

   a. 2015 Maintenance Performance and Maintenance Testing

   a. ISO Std. 1940-1: Mechanical Vibration - Balance Quality requirements for Rotors in a constant (rigid) state - Part 1: Specification and Verification of Balance Tolerances
8. National Electrical Manufacturers Association (NEMA):
   a. 2016 NEMA, Std. MG-1, Motors and Generators

9. Toshiba
   a. TIC, Instruction Manual for Vertical Type Three-Phase Induction Motor. (Available for review upon request.)

10. NFPA 70B-2006 Recommended Practice for Electrical Equipment Maintenance
11. NFPA 70-2014, National Electrical Code

F. Quality Control

1. Calibration. All measuring instruments shall be calibrated regularly, including burn off oven temperature control. The calibration records shall be available for inspection by the District. Minimum frequency of calibration shall be annually. Calibration procedures shall conform to the applicable sections of EASA and NETA guidelines. Conduit, wire, and terminations to instruments furnished under other sections including process instrumentation primary elements, transmitters, local indicators, remote and local control panels.

2. Core Loss Test Equipment; shall be calibrated per manufacturer's instruction and documentation shall be on file and available for review by the District.

3. Provide shop and site testing as specified herein. District reserves the right to monitor and witness all testing specified herein. Provide a minimum of two weeks' notification to the District prior to any testing.

G. Warranty

1. The motor modification shall be guaranteed against workmanship defects for a period of three years following substantial completion. The motor shop shall be responsible for repairing any motor that fails within three years and provide all labor, travel, crane services, hauling fees, and materials. Additionally, any necessary repair(s) required to make the motor operational in the PPP application shall be performed by the motor shop at no additional cost.

H. Insurance Requirements

1. Motor shop shall have liability insurance and shall provide details in the proposal.

PART 2  PRODUCTS

2.01 MATERIALS

A. Should the RTDs need removal & replacement, provide & install one RTD each in the upper motor bearings and lower motor bearings. Provide 100 ohms’ platinum RTD sensors rated for 500 degrees F with size and mounting to match existing installations. Provide sufficient wire length for making final connections to conversion equipment as shown on the Drawings. Provide RTD model with features and options to match existing District installations.

B. Shaft grounding: Provide type of bearing protection system for modified motor. Provide rings, locking collars, mounting brackets, fasteners, grounding terminations, and components for a complete
grounding system. Grounding conductors for bearing protection rings shall be copper and sized as recommended by the bearing protection system manufacture. Provide shaft grounding/bearing protection system.

C. Motor terminations: Provide new motor leads and NEMA lugs as found on the existing leads. (See 3.06A)

PART 3 EXECUTION

3.01 GENERAL

A. The motor removal and reinstallation at the PPP shall be per the submitted and approved motor modification procedure and be monitored by motor shop personnel.

B. Motor shop may utilize District crane along with district personnel for moving motor as specified herein.

C. Conform to District lock out, tag out procedures for all disconnected conductors. Install suitable identification tags on all circuits, cables, raceways, and terminal blocks to facilitate correct reconnection.

D. Scheduling of the work shall include provisions for motor shutdown, operational constraints, and District personnel availability.

3.02 SAFETY AND PRECAUTIONS

A. Motor shop shall observe safe practices while performing tests in accordance with OSHA and accident prevention procedures by National Safety Council and applicable codes.

B. Tests shall be performed with apparatus de-energized, except as necessary for motor performance and functional tests.

3.03 EXAMINATION AT PPP PRIOR TO TRANSPORTATION

A. Verify that repair and testing is free from improper grounds, short circuits, and overloads.

B. Verify correctness of wiring by visual comparison of the conductor connections with connection diagrams.

C. Make individual circuit continuity checks by using electrical circuit testers.

D. Existing 480V motor space heating circuits are fed from a common circuit breaker and must be kept energized during the motor modification period. Provide suitable insulated terminators, barriers, and signage for any live circuits left in place following removal of the motor.

E. If the decoupled motor is to be stored at the PPP or the motor shop for any period over 24 hours, provide temporary motor stator space heating circuit to avoid condensation on the motor windings.

F. Transport to and from the PPP to the motor shop shall be provided by the motor shop. Transportation of motors shall conform to recommendations of the TIC and the submitted motor modification plan.

G. All RTDs shall be sealed to prevent oil leakage.

H. Protect existing sensors and devices that are to be reused from damage during motor removal and reinstallation.
3.04 TESTING

A. The motor shop shall provide all material, equipment, labor, and technical supervision to perform all tests and inspections specified in this SOW.

B. The tests shall determine the following:

1. Assurance that motor and associated equipment is operational within industry and manufacturer's tolerances
2. Assurance that motor and auxiliary equipment are installed in accordance with the instruction manual
3. Suitability for motor energization

C. Test reports shall include the following:

1. Summary of project
2. Description of motor inspection and tests
3. List of test equipment used in calibration
4. Test equipment calibration date
5. Test results
6. Conclusions and recommendations
7. Appendix, including appropriate test forms

D. Test report shall be bound and certified. Three copies of each report shall be submitted to the District Engineer no later than fifteen (15) days after completion of tests.

E. Materials/installations found to be defective shall be reported directly to the District Engineer.

3.05 PRETESTING, DISASSEMBLY, AND INITIAL INSPECTION WHILE AT MOTOR SHOP

A. Prior to disassembly, perform pretesting of motor as specified herein and in conformance with EASA requirements for field performance testing of medium voltage motors. Submit test results for the motor and include a letter certifying the motors condition. Certification letter shall be written on motor shop's corporate letter head, signed by a corporate officer. Should pretesting reveal concerns regarding condition of the motors, notify the District immediately and do not proceed with disassembly or removal of motors. Pretesting shall include at a minimum:

1. Visual and mechanical inspections
2. Perform a megohm test per IEEE Std. 43 to test the winding insulation. Megohm testing shall be performed at DC voltages recommended by IEEE Standard 43 and NETA for existing maintenance testing of existing motors. The motor shall megger at 200 megaohm or greater.
3. Perform Polarization Index (PI) Test and develop Polarization Index ratio. Graph and submit the Mohm readings during the PI test to produce a Polarization Index profile. Submit PI
testing results and compare with the recommended minimum values for machine insulation classes per IEC 60085.

4. DC over potential tests in accordance with ANSI/IEEE Standard 95

5. Phase-to-phase stator resistance

B. Prior to disassembly make field measurements of critical equipment clearances, installation positions, and mounting hardware. Measurements shall be made as necessary to achieve conformance with TIO equipment data and existing installation tolerances. Field measurements shall be used by the motor shop on reassembly to verify the installation meets TIO requirements.

C. At the motor shop, disassemble motor and inspect all motor and machine surfaces in conformance with TIC recommended procedures and the submittal motor modification plan.

D. The motor shaft bearings, and auxiliary equipment, shall be inspected for any damages.

E. Notify the District immediately of any damage or concerns noted during the motor disassembly and inspection.

3.06 RELEADING THE MOTOR

A. Remove & replace all existing six (6) motor lead wires (1,2,3, 4,5,6). The length of each replacement lead wire shall be 9 feet longer than the removed old lead wires. These longer lead wires are required by another capital project that will install 3 core-balanced 50/5, Class C-20 differential protection CTs inside the existing Main MV Motor Terminal box

B. Polish thrust-bearings

C. Replace all RTD’ with motor shop furnished materials

3.07 ROTOR TEST

A. Testing: The winding within the rotor shall be tested using a surge test to verify the integrity of the rotor windings. A DC megger test shall be performed on the rotor to test for leakage currents. Apply a stable single-phase voltage to the stator of the assembled motor while the shaft is slowly turned through at least one revolution. Variation of stator current more than three percent shall be an indication of a rotor defect. When electrical or mechanical defects with the rotor are suspected, or if the stator winding is defective, other tests shall be used, including one or more of the following as recommended by the motor shop and original motor manufacturer and as directed by the District:

1. Growler tests

2. Current analysis or vibration analysis of a loaded motor

3. Physical examination

4. Ultrasonic or magnetic impression examination of the bars and end rings

5. Core loss tests (axial current thorough shaft)

B. Repair. If the rotor is identified as being defective the District shall be notified at once. No additional testing or repairs shall be permitted until the District has been notified and has approved the work proposed.
3.08 SHAFT AND BEARING FITS

A. Bearing fits at both shaft and end bracket contact points shall be measured and verified to be within bearing manufacturer tolerance. If dimensional tolerances are unavailable ANSI/EASA AR100-2015, Tables 2-13 and 2-14. Notify the District of any discrepancies.

B. If needed repairs to end bracket bearing housings shall be by building up the metal and machining to size concentric and parallel to rabbet. Welding, plating, and sleeving are the accepted methods. Wear resistant high strength epoxy products designed for use on bearing journals shall be acceptable. General epoxies or other compounds, knurl, and/or peen shall not be used to lock or seat bearings.

3.09 FANS

A. Fans shall be checked for cracks and fit to the shaft or rotor. If required, fans shall be firmly fixed to the shaft or rotor by the original factory method. Welding to the shaft is not permitted. Repairs to fans shall only be made as directed by the District. Replacement fans shall have the same number of blades, be dimensionally, and structurally equivalent to the original manufacturer supplied fan. It is preferred to replace fans with an original equipment component supplied by the manufacturer specifically designed for the applicable motor. If the fan is replaced the air velocity and/or quantity shall remain the same as the original fan.

3.10 PAINTING AND CLEANING

A. Some of the existing coatings on the motors and related conduits are likely to contain lead.

B. The motor shop shall paint all exterior motor parts at the motor shop following motor modification and testing.

C. The motor shop shall apply one coat of primer and two coats of base paint to the motor. All paint shall be a 2 parts epoxy. Paint shall be Dunn Edwards or approved equal. Paint colors shall match existing.

3.11 BALANCING

A. The motor rotor shall be checked for balance. In the event rotor unbalance exceeds manufacturer's original specifications it shall be dynamically balanced and meet the following criteria:

1. Half key. It shall be balanced with a half key in the keyway.

B. Tolerance shall conform to ISO 1940-1, G2.5: the permitted total imbalance shall be 7.5W/N = oz in/plane where W is weight of rotor in pounds and N is operating speed in RPM. (213 W/N gm. in/plane)

C. Material removal; if material is removed, electrical and structural integrity and fan capacity shall be maintained.

D. Added material; added material including ground shaft protection ring shall withstand the rotating motor centrifugal forces and be positioned either in the manufacturer’s designated positions and locked in place or positioned in a location where the centrifugal force will tend to keep the material in place. Weights may be attached to metallic parts only.

3.12 REASSEMBLY

A. The assembly of the motor is the reverse of the disassembly process and the following points shall be observed:

1. Match marks shall line up.
2. On reinsertion of the rotor, take care not to damage the journals or the stator windings and laminations.

3. Dowels and fitted bolts shall go back into the same holes that they came from.

4. New bearings shall be used unless directed otherwise by the District. Bearing internal fit and lubricant shall be equivalent to the original. Original bearings shall be returned to the District for inspection.

5. The endplay shall be the same as the original manufacturer's setting.

3.13 SHOP TESTING

A. The District shall witness all tests. All specified shop tests shall be performed at the same time. Provide two weeks' notice to the District of each motor shop test. Submit all completed test reports to the District for review. The District will not make any financial payments until all test reports have been submitted to the District and the motor has passed all tests as defined below.

B. All oil reservoirs shall be filled with oil prior to any testing using oil conforming to TIC motor maintenance requirements.

C. Equipment used for testing shall adequately and accurately reproduce rated voltages and conditions without causing damage to the motor or motor insulation.

D. The motor shop shall perform a megohm test per IEEE Std. 43 to test the winding insulation. Megohm testing shall be performed at DC voltages recommended by IEEE Standard 43 and NETA for existing maintenance testing of existing motors. The motor shall megger at 200 M ohm or greater.

E. DC over potential tests in accordance with ANSI/IEEE Standard 95

F. Perform surge test per IEEE Std. 522 on the stator and rotor. This test shall be performed prior to the disassembly and prior to the motor rotor refurbishment. In addition, this test shall be performed during the run test. Perform surge test at 5000 V minimum for rotor and 9000 V minimum for stator or as recommended by the Toshiba Instruction Manual and EASA guidelines.

G. Perform Polarization Index (PI) Test and develop Polarization Index ratio. Graph and submit the M ohm readings during the PI test to produce a Polarization Index profile. Submit PI testing results and compare with the recommended minimum values for machine insulation classes per IEC 60085.

H. Running Test. After the insulation tests, the motor shall be run at no load at rated terminal voltage. The test shall determine that:

1. No Load Amps; no load current unbalance should not exceed 6 to 10 % of the voltage unbalance.

2. Vibration; Horizontal, vertical, and axial readings shall be taken at each bearing and results recorded. Tolerance shall not exceed ANSI/EASA AR100-2006, Table 4-5.

I. The motor shall be test run at the shop for one hour at full voltage under no load. Testing shall conform to EASA recommendations for verifying motor operating characteristics.

J. Compare test data of the modified motor with test data from the motor made prior to disassembly. Prepare a written description of any significant changes in the motor test data and submit with the test data report.

K. If the motor fails any of these tests, determine the cause of the failure and notify the District immediately. Perform additional motor modifications as an Additive Bid Item if specifically directed by the District as specified herein.
3.14 SITE INSTALLATION

A. Transport the motor to the Pacheco facility and off load as specified herein. Motor shop may use the District’s crane for movement of the motor with district personnel present.

B. Reassemble motor and pump combination at the PPP per TIC Instructions Manual 2D- S7470, and as directed by the District in conformance with submitted motor modification plan. Monitor reassembly and verify key measurements made during disassembly and tolerances are met.

1. Recouple motor to pump shaft.

2. Reconnect bearing water cooling piping.

3. Refill oil in conformance with the Special Provisions and to TIC motor maintenance requirements.

4. Perform megohm test of motor prior to termination of power conductors. Perform a megohm test per IEEE Std. 43 to test the winding insulation. Megaohm testing shall be performed at DC voltages recommended by IEEE Standard 43 and NETA for existing maintenance testing of existing motors. Each motor shall megger at 200 M ohm or greater.

5. Connect new power, instrumentation, and control circuits from motor terminal boxes.

6. Provide grounding conductor from the shaft grounding protection brush to the grounding grid terminal located at the motor base. Provide grounding conductor termination at the grounding ring per requirements of the grounding ring manufacturer. Field locate grounding grid termination point and bond using exothermic weld.

3.15 STARTUP TESTING

A. Field startup testing shall be performed and monitored by the motor shop technicians with district present.

B. The motor shall operate on the medium voltage ASD after the motor has been reinstalled at the PPP. When the motors are connected to the medium voltage ASDs they shall slowly increase operating speed until the motor reaches its rated RPM of 712 RPM. The motor shall be slowly ramped up in speed at the following increments: 25%, 50%, 75% and 100% of the rated RPM of 712 RPM. Once achieving rated RPM, the motors shall continue to operate for a minimum of 60 minutes at the rated RPM speed of 712 RPM. After 60 minutes of operating at rated speed, the motor speed will be slowly decreased in the following increments: 100%, 75%, 50%, and 25% of rated RPM of 712 RPM. Ramp up and ramp down shall each take place over 30 minute intervals.

C. If the motor fails any of these tests, determine the cause of the failure and notify the District immediately. Perform additional motor modifications as an Additive Bid Item if specifically directed by the District as specified herein.

3.16 SITE ACCEPTANCE TESTING

A. If the motor fails any of these tests, determine the cause of the failure and notify the District immediately. Perform additional motor modifications as an Additive Bid Item if specifically directed by the District as specified herein.

B. After 30 days (720 hour) operating period motor shop shall perform confirmation testing of motor including:

1. Megohm test per IEEE Std. 43 to test the winding insulation. Megaohm testing shall be performed at DC voltages recommended by IEEE Standard 43 and NETA for existing maintenance testing of existing motors. The motor shall megger at 200 megohm or greater.

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2. Perform Polarization Index (Pl) Test and develop Polarization Index ratio. Graph and submit the megohm readings during the Pl test to produce a Polarization Index profile. Submit PI testing results and compare with the recommended minimum values for machine insulation classes per IEC 60085.

3. Note any significant discrepancies of the site acceptance test results from the shop test results as specified herein.

3.17 MOTOR REWINDING (ADDITIVE BID ITEM)

A. Motor rewinding has been included in the Contract Documents as an Additive Bid item. If specifically authorized by the District, perform stator rewinding as specified herein. All work associated with motor repair shall also be performed as required but shall be included in the motor shop's Base Bid of work.

B. Motor rewinding shall conform to the EASA guidelines and recommended practices for repair of electric motors.

C. Winding Removal
   1. Winding Removal. All windings within the stator shall be removed and the stator shall be inspected for any damage. Then the stator shall be cleaned.
   2. Winding Data shall be recorded and submitted to the Engineer to permit replicating precisely the original configuration. Replacing concentric with a lap winding configuration is preferred when appropriate and based on the following: Changes that do not affect the magnetic densities or current densities by more than 2% are permissible, as well as changes that reduce the current density (increase cross sectional area per turn). Otherwise, the total cross section area of a turn, the turns per coil, the end turn extension, the span, and connection of the coils shall not be changed.
   3. Perform a core loss test on the stator both before and after stripping and iron repair, to check for damaged interlaminar insulation. The tests shall be done at a flux density that matches the original flux density (measured in lines per square inch) of the original motors before rewinding. Excitation current and watts loss shall be recorded each time, as well as a physical check carried out for hot spots. If hot spots exceed 15°C above the average temperature after 15 minutes, or losses are excessive overall either before or after stripping, the situation shall be discussed with the District before proceeding further. For a core without any hot spots, the losses after stripping shall not be more than 10% higher than the pre-strip losses. To avoid misleading results, the second core loss test should not be done until the core has been cleaned and dried.
   4. The winding shall be burned out in a controlled temperature burnout oven where the part is monitored by attaching a sensing probe to the stator core and temperature is limited by means of fuel control and supplementary (water spray) cooling to 360°C (680°F) for organic (C3) or 400°C (750°F) for inorganic (C5) interlaminar insulation. If a higher temperature is deemed necessary, submit reference documentation from the original motor manufacturer indicating that the core iron can safely withstand the temperature and confirmed by the core loss test.
   5. Winding Extraction. Lamination damage due to coil cutoff or splaying of teeth shall not be permitted.

D. Core preparation
   1. All obvious iron damage and significant frame damage, plus any defects indicated by a core loss test, shall be corrected, and/or reported to the District before proceeding further.
2. If required, method of repair shall be chosen from the following upon direction from the District:
   a. Grinding of the lamination is not permitted, however limited de-burring is acceptable and allowed upon receiving approval from the District.

3. Removal of individual lamination(s) is not permitted. However, restacking part or all the assembly with the same number of de-burred laminations that have the same material composition, dimensions, and interlaminar insulation characteristics as the original lamination assembly is permitted.
   a. Inserting split mica between the laminations shall be permitted if specifically approved by the District provided lamination assembly dimensions remain unchanged.

4. The air gap of the rewound motor shall match the original motor air gap before rewinding.

E. Stator winding

1. All windings shall use form coils. The stator shall be rewound with inverter rated turn insulation copper wire at the nominal motor voltage. After rewinding, the stator shall be Vacuum Pressure Impregnated (VPI) in Class H epoxy resin to eliminate any air pockets in the windings. Before impregnation, the windings shall be tested to verify there are no incorrect terminations or shorted turns.

2. Insulation system shall be equal to or better than the original materials supplied by the manufacturer. Individual insulation system components shall be compatible as a group and suitable for the environment intended.

3. Rewinding conductors and conductor cross sectional area shall be equal to or greater than the original materials supplied by the original manufacturer.

4. Stator coil(s) extension shall not be greater than original. Minimize crossed slot conductors.

5. Coil connections or splices shall be equal to or greater than the conductivity of the winding conductors. Compounds or chemicals used in the connection process shall be neutralized.

6. Provide six new stator RTD’s, two per phase, matching the RTD’s presently installed in the existing stator.

7. Acceptable impregnation methods include preheating, treatment, and curing of the stator with materials suitable for the operating temperature and physical environment.

F. Perform all other motor modifications in addition to the rewinding operation to achieve motors that conform to NEMA MG-1 for inverter duty operation. Upon completion of the rewinding process, the rewound motor shall be certified and nameplated by the manufacturer or motor shop as suitable for inverter duty operation at 1.00 service factor.

G. During the rewinding process, perform all other motor modifications as specified herein including, installation of vibration and other assessment sensors, and ground brushes.

H. After rewinding is completed, perform all testing of the rewound motor as specified above for Factory Testing, startup testing, and site acceptance testing.

3.18 ELECTRICAL CONNECTIONS
   A. The motor shop shall be responsible for making all medium (4160 Volts) & low voltage power, control, signal, and instrumentation connections and disconnection unless indicated or specified otherwise, as specified in this SOW.

3.19 ACCEPTANCE TESTING
   A. The motor shop shall perform factory acceptance testing of the motor at the shop and test run after reinstalling the repaired motor.

3.20 INSPECTIONS
   A. Electrical and Mechanical inspection shall be by the District Staff. Motor shop shall provide minimum of two (2) weeks notifications prior to inspection.

3.21 DISASSEMBLY AND REASSEMBLY POWER
   A. 480 VAC three-phase and 120 VAC single-phase power will be available to the motor shop including space heating of the motor during storage required at the plant.

3.22 LETTER OF CLARIFICATION
   A. District will provide, if any, addendum or letter of clarification to this specification before March 15, i.e. two (2) weeks prior to the propose submittal date.

3.23 PROPOSAL SUBMITTAL DATE
   A. Complete proposal shall be submitted on or before March 30, 2019
   B. Proposal shall include a detailed description of the transportation procedure to be implemented by the motor shop to prevent motor damage during transport and indicate a road permit requirement. Include transport sketch showing strapping and supporting of motor in the conveyance to eliminate vertical and horizontal movement.
   C. Proposal shall include methods and plan to seal all RTDs to prevent possible oil leakage.

3.24 SUBMITTALS
   The motor shop shall submit to the District Engineer for review, the following information categories:
   A. Complete descriptive literature
   B. Certification documentation
   C. Preliminary schedule with each major- and sub-task
   D. Work plan for motor and associated component disassembly, inspection, modification, and testing
   E. Rotor bar connection and insulation impregnation
   F. Inspection report
3.25 PAYMENT

A. Full compensation for furnishing labor, materials, tools, equipment, and performing the work required for electrical requirements shall be included in the lump sum price bid.
VERTICAL-TYPE THREE-PHASE 2000HP INDUCTION MOTOR

MOTOR SPECIFICATIONS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type-Form:</td>
<td>TIM-RCAT-D</td>
</tr>
<tr>
<td></td>
<td>Vertical-wound rotor-type induction motor with totally enclosed, water-cooled heat exchanger and drip-proof collector housing.</td>
</tr>
<tr>
<td>Number of poles:</td>
<td>10</td>
</tr>
<tr>
<td>Capacity:</td>
<td>2000 HP</td>
</tr>
<tr>
<td>Duty:</td>
<td>Continuous</td>
</tr>
<tr>
<td>Revolution:</td>
<td>712</td>
</tr>
<tr>
<td>Primary Voltage:</td>
<td>4000V</td>
</tr>
<tr>
<td>Current:</td>
<td>274A</td>
</tr>
<tr>
<td>Secondary Voltage:</td>
<td>1720V</td>
</tr>
<tr>
<td>Current:</td>
<td>515A</td>
</tr>
<tr>
<td>Herz (Cycle):</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Insulation Class:</td>
<td>F Class</td>
</tr>
<tr>
<td>Ambient Temperature:</td>
<td>40°C max.</td>
</tr>
<tr>
<td>Applicable standards:</td>
<td>NEMA MG-1</td>
</tr>
<tr>
<td>Direction of Rotation:</td>
<td>Right, viewed from motor top</td>
</tr>
<tr>
<td>Bearing (Upper):</td>
<td>Water-cooled thrust and guide bearings</td>
</tr>
<tr>
<td>(Lower):</td>
<td>Water-cooled guide bearing</td>
</tr>
<tr>
<td>Required water for cooler:</td>
<td>150 l/min (40 GAPI/min)</td>
</tr>
<tr>
<td>Required water for bearing:</td>
<td>40 l/min (11 GAPI/min)</td>
</tr>
<tr>
<td>Lubrication:</td>
<td>Turbine oil No. 140 (ISO GRADE 56)</td>
</tr>
<tr>
<td>Oil quantity (Upper):</td>
<td>80 l (21.1 GAPI)</td>
</tr>
<tr>
<td>Oil quantity (Lower):</td>
<td>40 l (11.4 GAPI)</td>
</tr>
<tr>
<td>Quantity:</td>
<td>12 sets</td>
</tr>
</tbody>
</table>