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LARGE ELECTRIC MOTORS - DISASSEMBLY & ASSEMBLY

1.0 PURPOSE

To provide general instructions to station personnel for the disassembly and assembly of large (4,160 volt) electric motors.

2.0 RESPONSIBILITY

The Maintenance Engineer shall be responsible for ensuring the proper implementation of this procedure.

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3.1 Large electric motors have to be disassembled from time to time to replace worn bearings, to clean dirty windings and/or to dry the insulation.

3.2 This procedure provides generic procedures for the disassembly, assembly and cleaning of 4160V motors. However, the specific vendor instruction manual should be checked before doing any maintenance work on the motors. Appendix 12.1 lists all large motors and gives the reference to the proper instruction manuals.

3.3 The following topics are contained in this procedure:

4.0 PRECAUTIONS

4.1 If the rotor fan blades are changed, rebalancing the motor may be necessary.

4.2 If drying insulation, carefully control the temperature, avoid hot spots.

4.3 Replacement bearings may be from a different manufacturer. Verify that they are equal to the originals used in the motor.

4.4 Whenever a bearing is replaced, rigid cleanliness shall be observed through every step of the operation.

4.5 When pulling a ball bearing, exert the force of the bearing puller only on the inner race to remove the bearing from the shaft.

4.6 If the motor shaft has been seriously scored, it should be put between centers and reground.

4.7 Before starting to disassemble or assemble a motor, check the respective vendor manual for specific precautions.

4.8 When using a bearing puller, protect the shaft end.

4.9 Before cleaning a motor, except when cleaning the outer surface, verify that all power to the motor and control power is disconnected and the breakers are tagged out.

4.10 When drying stator windings insulation resistance should be measured before heat is applied, and every six to eight hours thereafter until resistance readings are steady.

4.11 Maintain a uniform temperature in the machine to obtain constant resistance readings.

4.12 When using a lifting rig, verify that the rig is installed correctly and that its capacity is big enough to lift the motor safely.

5.0 PREREQUISITES

5.1 Station Equipment Clearance Permit.

5.2 Radiation Work Permit (if applicable).

5.3 Horizontal or Vertical Motor Equipment History Form, as applicable.

6.0 LIMITATIONS AND ACTIONS

6.1 When drying insulation, do not exceed 200°F unless otherwise specified in the instructions for the respective motor.

7.0 MATERIAL AND TEST EQUIPMENT

7.1 Dial Indicator to align the motor and drive shafts.

7.2 Rigging to remove end shield and rotor.

8.0 PROCEDURE

8.1 Horizontal Motor Disassembly

8.1.1 Ensure that the prerequisites of Section 5.0 have been met.

8.1.2 Remove the electrical leads and tag for identification. Megger the motor in accordance with Reference 11.13.

8.1.3 Disconnect, if necessary, the motor from the drive. Mark the position of both coupling halves before disconnecting if not already done.

8.1.4 Measure and record the coupling alignment on the Equipment History Form.

8.1.5 Remove air inlet louvers and dust covers if any.

8.1.6 Remove leads of stator RTD's and/or bearing thermocouples if any.

8.1.7 Drain oil from bearings.

8.1.8 Clean end shields and/or bearing caps before removal.

8.1.9 Remove upper end shields and/or bearing caps.

8.1.10 Measure and record the air gap as specified on Equipment History Form.

8.1.11 Remove bearing temperature devices if any.

8.1.12 Ball bearing replacement.

1. Remove bearing using a bearing puller, exert force only on inner race.

2. Check shaft diameter for proper size of replacement bearing.

3. Heat the new bearing in an oven to 200°F. While it is hot, slide bearing on shaft, make certain that the inner race makes a firm, even contact with shaft shoulder.

8.1.13 Split sleeve bearing replacement.

1. Remove the top half of the bearing.

2. Raise motor shaft a few mils to remove load from bearing.

3. Rotate the lower half of the bearing 180° and remove.

NOTE: When replacing a sleeve bearing, always inspect the bearing journal surfaces. They must be smooth and polished, slight scoring can be removed with crocus cloth.

4. Fit the new bearing and adjust end play.

8.1.14 Measure and record the bearing dimensions specified on the Equipment History Form.

8.1.15 Using a jack or chain hoist to support the rotor, remove the lower end bells and slowly lower rotor onto stator.

8.1.16 Protect shaft bearing journals against dirt and scratching.

8.1.17 Using chain hoists, remove the rotor with the help of an appropriate shaft extension. (Check with manufacturers instructions as to which end the rotor has to be removed.)

8.2 Horizontal Motor Reassembly

8.2.1 Clean all motor parts, especially stator and rotor ventilating passages and machine mating surfaces such as bearing brackets, stator support seats and stator support bars before reassembling.

8.2.2 Check for wear on bearing parts including journals, bearings, seals, oil rings and guides.

8.2.3 Replace rotor in stator, reversing the procedure for disassembly. Protect shaft bearing journals.

8.2.4 Replace air baffles on stator assembly if necessary.

8.2.5 Replace inner seals, inner seal gaskets and oil rings on shaft if motor is so equipped.

8.2.6 Replace lower end bells.

8.2.7 Raise motor shaft a few mils and roll lower halves of bearing bushings into their seats. Replace any bearing temperature devices.

8.2.8 Measure and record the air gap as specified on the Equipment History Form.

8.2.9 Place top bearing bushing halves on shaft with the oil ring in the bearing slots. Align upper bearing halves carefully with lower halves.

8.2.10 Install bearing caps, oil seals and end cap.

8.2.11 After reassembly, flush then fill the bearing oil reservoir with the proper grade oil. (See Lubrication instructions.)

8.2.12 After reassembly of the motor, verify that the bearings are properly lubricated (oil level at the oil level mark or in the middle of the sight glass, ball bearings packed with the proper grease). Turn motor by hand a few turns to ensure that oil or grease is distributed over the entire bearing surface.

8.2.13 Reconnect leads for stator RTD's, and/or bearing thermocouples if any.

8.2.14 Replace air inlet louvers and dust covers if any.

8.2.15 Megger motor per Reference 11.13, then makeup the motor leads.

8.2.16 Verify correct motor rotation using Motor Rotation Tester.

8.2.17 If required, run the motor without load and check for any oil leaks or excessive vibrations.

8.2.18 Measure and record the coupling alignment as specified on the Equipment History Form.

8.3 Cleaning and Drying Insulation

NOTE: A variety of satisfactory and acceptable methods are available for keeping equipment in a state of cleanliness that will result in longer life and greater reliability. The choice of method will

depend greatly on time, availability of equipment, and, to some extent, on the insulation system.

8.3.1 Outside

8.3.1.1 Stop the motor to be cleaned.

8.3.1.2 Wipe off dust, dirt, oil, water, etc., from external surfaces of the machine.

8.3.1.3 Remove dirt, dust or other debris from ventilating air inlets.

8.3.2 Vacuum Cleaning

For removal of loose dust, dirt and particles, the use of suction is preferable to blowing out with compressed air since there is less possibility of damage to the insulation and less chance of getting conducting or other harmful particles into areas that may later result in damage during operation.

CAUTION: Do not use a metal suction piece. This will prevent damage to the windings.

8.3.3 Compressed-air Cleaning

Compressed air is effective and convenient for removing loose dust and particles in otherwise inaccessible areas such as airducts and between coils at the end turns.

CAUTION: Care must be taken to make sure that the air supply is dry and that excessive air pressure is not used.

See the vendor instruction manual for recommended air pressure; if not stated, limit to 30 psig.

8.3.4 Cleaning with Water and Detergent

8.3.4.1 Disassemble the motor per procedure 8.1 or 8.2 as applicable.

CAUTION: To minimize possible damage to varnish and insulation, a fairly neutral nonconducting type of detergent should be used. See vendor instruction manual for recommended detergents and concentrations.

8.3.4.2 Use the portable Ebcor Electro-Jet Steam Cleaner to clean the stator windings. (See Reference 11.11 for operating instruction for the Ebcor Electro-Jet Steam Cleaner.)

8.3.4.3 After cleaning, rinse the windings with low pressure steam.

8.3.4.4 Dry the windings per procedure 8.3.5.

8.3.5 Drying Stator Windings

NOTE: Insulation resistance will decrease as the motor warms up; but will begin to increase shortly as the dryout continues.

8.3.5.1 Electric Heater Drying

.1 Remove the rotor per procedure 8.1.1 or 8.4 as applicable.

.2 Install the heaters if possible under the motor and allow for even distribution of the heat along the length of the motor.

.3 Attach temperature indicators to windings.

.4 Direct a fan on stator to carry away the moisture.

.5 Erect an enclosure making it as air-tight as practicable and leaving a hole in the top to allow moisture to escape.

.6 Apply heat as specified in the vendor's instruction manual.

.7 Discontinue the heating when the megger readings remain constant.

8.3.5.2 Circulating Current Drying

.1 Remove bearing housings.

.2 Center the rotor in the stator core.

.3 Wedge fiber strips into the lower part of the air gap, so rotor does not touch stator core.

.4 Direct fan on unit to blow away excessive moisture.

NOTE: If an enclosure is used, ensure that a hole is made in the top to allow moisture to escape.

.5 Attach temperature indicators to windings.

.6 Apply a controlled current of the same number of phases, and the same, or less than rated frequency to the windings. The voltage used should not be more than 10% of normal, nor should it cause more than 60% of normal full load current to pass through the windings.

.7 Maintain heat as specified in the vendors instruction manual.

.8 Discontinue the heating when the megger readings remain constant.

8.4 Vertical Motor Disassembly

8.4.1 Ensure the prerequisites of Section 5.0 have been met.

8.4.2 Disassemble the coupling and check the alignment. Record the coupling alignment as specified on the Equipment History Form.

8.4.3 If necessary, disconnect the motor from the pump, and matchmark both coupling halves before disconnecting, if not already done.

8.4.4 Remove the electrical leads and tag for identification. Megger the motor in accordance with Reference 11.13.

8.4.5 Drain upper and lower bearing reservoirs.

8.4.6 Remove lower drain pipe and gauge if provided.

8.4.7 Remove end shield cover.

8.4.8 Measure and record the shaft height, if necessary, as specified on the Equipment History Form.

8.4.9 Remove coupling (if hollow shaft) and ratchet, if provided.

NOTE: Do not remove water coils in water cooled bearings unless coils need repairs.

8.4.10 Jack up the shaft or support by chain fall.

8.4.11 Remove lock nut and washer, thrust rings or pump shaft adjusting nut.

8.4.12 Remove thrust bearing and upper guide bearing (Journal sleeve) if provided.

8.4.13 If rotor has to be removed, remove end shield.

8.4.14 Remove motor half coupling.

8.4.15 Remove the rotor out of the stator.

8.4.16 Remove lower guide bearing.

8.5 Vertical Motor Reassembly

8.5.1 Clean all motor parts, especially stator and rotor ventilating passages and machine mating surfaces such as bearing brackets, stator support seats and stator bars before reassembling.

8.5.2 Check for wear on bearing parts including journals, bearings, and seals.

8.5.3 Install lower guide bearing.

8.5.4 Replace rotor in stator. Protect shaft bearing journals.

8.5.5 Install end shield.

8.5.6 Install thermocouples if provided.

8.5.7 Install upper guide bearing, if provided, and thrust bearing according to vendors instructions.

8.5.8 Replace the lock nut and washer, thrust rings or pump shaft adjusting nut according to vendors instructions.

8.5.9 Measure and record the shaft height as specified on the Equipment History Form if necessary.

8.5.10 Install the rachet, if provided, and the coupling (if hollow shaft).

8.5.11 Install lower drain pipe and gauge if provided.

8.5.12 Fill the upper and lower bearing reservoirs with the proper grade oil (See lubrication instructions).

8.5.13 Turn motor by hand a few turns to ensure that oil is distributed over the entire bearing surface.

8.5.14 Reconnect the motor to the load and verify correct motor rotation using Motor Rotation Tester.

8.5.15 Megger the motor per Reference 11.13.

8.5.16 If required, run the motor without load and check for any oil leaks or excessive vibrations.

8.5.17 Measure and record the coupling alignment as specified on the Equipment History Form.

9.0 ACCEPTANCE CRITERIA

9.1 Insulation Resistance tests are above minimum readings per instruction manual.

10.0 FINAL CONDITIONS

10.1 Master Hold Off returned to the NSO.

10.2 Radiation Work Permit terminated (if applicable).

10.3 Equipment History Form forwarded to the Maintenance Engineer for review and filing per Reference 11.12.

11.0 REFERENCES

11.1 GEH-3160, G.E., Induction Motors, File No. 1C11.12Ø.

11.2 GEH-3292B, G.E., Vertical Induction Motors, File No. E11.12Ø.

11.3 GEH-1897B, G.E., Vertical, High-Thrust Polyphase Induction Motors, File No. 1E21.12Ø.

11.4 51X2349-03, Allis Chalmers, Large Frame Horizontal Induction Motors, File No. 1Z51.12Ø.

11.5 (Later) Electric Machinery Mfg. Company, Large Vertical Induction Motors 250 HP and Larger, File Code 1N21.12Ø.

11.6 05X2574-02, Allis Chalmers, Versa Pac Squirrel - Cage Induction Motors, File No. 1N21.12Ø.

11.7 1400-1NS-227A, Electric Machinery Mfg. Company Large Vertical Induction Motors 250 HP and Larger, File No. 1N71.12Ø.

11.8 (Later)

11.9 I.L. 3030-D1, Westinghouse, Instruction for Large AC Motors, File No. 1P41.110.

11.10 (Later)

11.11 SP 32.ØØ7.Ø1, Decontamination Equipment Operation.

11.12 ANSI N45.2.9 Requirements for the Collection Storage and Maintenance of Quality Assurance Records for Nuclear Power Plants.

11.13 SP 32.ØØ9.Ø1, Insulation Resistance Test of Auxiliary Electrical Equipment.

11.14 SP 12.Ø23.Ø1, Station Housekeeping

12.0 APPENDICES

12.1 List of Large Electrical Motors.

LIST OF LARGE ELECTRICAL MOTORS

Name/Number	Number	Manufacturer*	Type	Operating Manual
CRD Water Pump/1C11-P-Ø17A & B	2	GE	Custom 8000 Horizontal	Reference 11.1
RHR Pump/1E11*P-Ø14A-D	4	GE	TRI-CLAD Veritcal	Reference 11.2
Core Spray Pump/1E21* P-Ø13A & B	2	GE	TRI-CLAD Vertical	Reference 11.3
Fire Pump/1M43-P-Ø59	1	A-C	(LATER) Horizontal	Reference 11.4
Condensate Pump/1N21-P-ØØ7A & B	2	E-M	(LATER) Vertical	Reference 11.5
Condensate Booster Pump/ 1N21-P-Ø27A & B	2	A-C	ANW Horizontal	Reference 11.6
Circulating Water/1N71-P-Ø63A-D	4	E-M	(LATER) Vertical	Reference 11.7
Screen Wash Pump/1N71-P-217A & B	2	E-M	(LATER) Vertical	Reference 11.7
Condensate Transfer/1P11-P-Ø11	1	A-C	(LATER) Horizontal	Reference 11.8
Service Water Pump/1P41* P-ØØ3A-D	4	West.	Life-Line D Vertical	Reference 11.9
TBCLCW Pump/1P43-P-ØØ4A & B	2	A-C	(LATER) Horizontal	Reference 11.4
Instrument & Service Air Compressor/1P5Ø-C-ØØ1A-C	3	West.	(LATER) Horizontal	Reference 11.10

*Manufacturer:
- G.E. General Electric
- A-C Allis Chalmers
- E-M Electric Machinery Mfg. Co.
- West. Westinghouse