Bangladesh Power Development Board

INTEGRATED MANAGEMENT SYSTEM
(BASED ON ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018 STANDARDS)

PROCEDURE FOR ELECTRICAL MAINTENANCE – HIGH SPEED DIESEL

1.0 Purpose

a. To establish effective electrical maintenance system for the plant and machinery to ensure continuing process capability
b. To plan and implement electrical maintenance

2.0 Scope

Applies to whole of Integrated Management System of Bangladesh Power Development Board (BPDB).

Terms & Definition

Definition

None

Abbreviations

BPDB – Bangladesh Power Development Board
MR – Management Representative

4.0 Roles and Responsibility

Tasks in Reference Clause nos.	Responsibility
5.3, 5.4	Head of electrical maintenance
5.5	MR/ Head of the plant

5.0 Procedure

Plan of the maintenance procedures

Following 3 types of maintenance is carried out

- Breakdown maintenance
- Schedule maintenance
- Preventive maintenance

5.1 Breakdown Maintenance

On-Load
Off-Load

- Concerned operation unit report breakdown or abnormality
- Job allocated to concerned official
- Concerned technician/ official/ engineer check the facility and assess the maintenance task

- Maintenance task is approved
- If the maintenance can be done on load, then it is carried out
- If the maintenance of repair requires to be carried out off load, permission of the concerned authority is taken
- Maintenance work is carried out accordingly
- On completion of Maintenance work, required checking is carried out.
- Maintenance work is recorded

5.2 Schedule Maintenance

- Seek permit from operation department on schedule issue
- Operation gives permit after isolation
- Respective maintenance work is carried out accordingly
- DC Motors
    - Inspect to see if the brush orientation markings on the side of the brush yoke and bearing bracket are aligned. If the brushes are not properly orientated, it could affect the speed of the motor and cause excessive sparking.
    - Check the indicator marker on the brush pigtails for evidence of brush wear. If the marker reaches the top of the brush holder box, the brush is worn to the point where it should be discarded
    - Check the commutator for cleanliness and wear by placing a fiber stick against the brushes and feeling to see if it jumps during rotation
    - Check the commutator for roughness while running by placing a fiber stick against the brushes and feeling to see if it jumps during rotation
    - Check the insulation and windings for contamination, mechanical defects and temperature defects
    - Check the insulation integrity for electrical resistance
    - Check the vibration of the motor while coupled to the pump. The vibration should not exceed 3 mils.
- AC Motors
    - Examine the collector rings, brushes, brush holders and studs or cleanliness and wear
    - Collector rings should maintain their polished surface
    - Brushes should move freely within their holders but set firmly in contact with the collector rings
    - 3e sure the pigtail conductors are securely fastened to the brush holders
    - Check the insulation for cleanliness and wear
    - Check the vibration of the motor 'while it is coupled to the pump. The vibration should not exceed 3 mils.
    - Check the cooling passages and louvers of the motor to make sure they are clean, undamaged and unobstructed
- Over speed Protection System (Electronic)
    - Magnetic Pickups

        - The clearances between the OD of the toothed wheel and the tip of the magnetic pickup should be checked annually and at each removal and installation
        - The clearances should be within the limits specified in the Control Arrangement Drawing, Model List Item 0501 or the Device Summary
    - Calibration Checks
        - These calibration checks of the over speed protection system should be performed annually and after each major inspection or at any time wiring has been disconnected or when a replacement over speed card has been installed
- Speedtronic™ Controls and Equipment
    - Power Supply Components
        - Any indication of corrosion or discoloration due to heat should be investigated and the equipment repaired or replaced as necessary
        - In atmospheres that contain contaminants such as hydrogen sulfide, sulfuric acid, sulfur dioxide, chlorine and chlorine dioxide, the relative humidity of the SPEEDTRONIC™ location should be maintained at 50% or less to minimize any possible corrosion problems
        - Conformal coatings are used to protect electronic equipment; however, high relative humidity can cause accelerated corrosion in any area not properly protected
    - Circuit Boards, Card Guides and Sockets
        - Circuit Board Cleaning
            - Immerse the board in a lukewarm (approximately 100"F (38'C)) solution of mild household detergent. With the aid of a soft bristled brush (an ordinary paint brush will be sufficient), scrub thoroughly
            - After cleaning, rinse thoroughly in several baths of lukewarm, running fresh water
            - Shake off the excess water and immerse in isopropyl alcohol. Move the board rapidly back and forth in the bath
            - Visually inspect the board for cleanliness and repeat Step c, if necessary
            - Thoroughly air dry for several hours, then test the board in an operating panel. Do not use compressed air
        - Cleaning Card Guides And Sockets
            - Using a hand pump-type spray container, apply TF or TE Freon only to the area to be cleaned. The use of any other solvent/ cleaner except TF or TE Freon can result in destruction of the Lexan. Below is a partial list of chemical materials which cannot be used.
            - 1 . Aldehydes (butyraldehyde)
            - 2. Alkalies (sodium hydroxide)

- 3. Amines (DTA)
- 4.Aromatic hydrocarbons (benzene)
- 5. Esters (ethyl acetate)
- 6.Halogenated hydrocarbons (methylene chloride)
- 7. Ketones (MEK)
- Wait two or three minutes to allow the solvent to 'work, then wipe off the dirt with a soft cloth.

- Relay Contacts
  - Contact Cleaning
    - The relay contact(s) must be clean and free from dust to energize the load device
    - The main source of problems with relays is dirty load contacts. Man industrial relays (such as the type HGA relay) are furnished with a dust tight cover. Open-type relays particularly in a dust-laden atmosphere, should be cleaned a regular intervals
    - The removable contact carriage should also be checked for mechanical freedom and alignment with the stationary contacts
    - If a contact is deformed by unusual arcing and has developed a large projection, it should be repaired as described below
    - If it is necessary to clean the silver contact, use a burnishing tool. This tool consists of a flexible strip of metal, with an etched (roughened) surface, similar to a superfine file. Do not clean the contact with knives, files, or abrasive paper or cloth.
  - Contact Replacement and Pressure
    - Since short circuit currents that flow through a relay's contacts can completely melt or weld them closed, relays, or relay contacts, should be replaced if evidence requires it
    - As the contact wears, the pressure of the movable contact (when closed) is maintained against the stationary one by the wiping springs
    - inspection of the spring is carried out, since heating may cause tempering and eventually reduce he pressure
    - The correct spring pressure is usually shown in the instruction sheet accompanying the relay. (See Volume II of the Service Manual.)
    - The spring pressure on all poles should be approximately the same, f one is considerably lower, the contact should be replaced.
  - Contact Arcing

- Where arcing is a problem, two or more contacts are connected in series
- The voltage induced across each contact is reduced accordingly
- This in turn, reduces or entirely eliminates arcing. Other solutions are:
- a. Connect a capacitor and resistor across the contacts.
- b. Connect a diode across the contact load

- Battery System
  - Safety and security
    - Batteries-give off hazardous fumes during normal operation. Do not smoke, use open lights or allow open flame near batteries
    - Always wear protective clothing such as a rubber apron, safety goggles and rubber gloves when performing any maintenance or inspections on batteries.
  - Battery
    - Clean the outside of the battery with a water-dampened cloth
    - Neutralize any acid on the covers or connectors with a cloth moistened with a solution of baking soda and water
    - Wipe off all traces of the baking soda
    - Distilled (or approved) water is added with a battery cell filler when the electrolyte level is low
    - When checking the specific gravity of the electrolyte, correct the reading to 77_F (25_C) in order to read 1.230/1.250 for a 56-cell battery, or 1.200/1.220 for a 60-cell battery. Deviations from these indicate a partially charged Battery.
    - Record the specific gravity, temperature and electrolyte level of the battery periodically
    - Check the battery and battery compartment for signs of loss of electrolyte, which may be due to overfilling, damaged containers or cell covers, faulty sealing, or missing vent plugs.
    - In addition to the above, every month record the amount of water added, if any
    - Semi-annually, check and record the specific gravity and electrolyte level of each cell
    - Check and record the temperature of each pilot cell. If the specific gravity readings are more than 20 to 30 points; or if repairs to the covers or containers are indicated, make repairs immediately.
  - Battery Charger
    - Clean the charger panel of all dirt and dust with a vacuum cleaner or with low-pressure, dry, compressed air
    - Every six months, check the floating voltage on the charger panel voltmeter, using a portable standard voltmeter. If necessary, adjust the panel voltmeter to agree with the standard by using the zero adjustment

- Capacitor trouble can be spotted by a ruptured or broken can; an open capacitor will look normal
- To check capacitors, first open the AC circuit breaker and disconnect the battery from the charger
- All capacitors in the charger will then bleed to zero voltage. Second, isolate the capacitor to be tested, and with an ohmmeter on its highest scale (apply the test prods to the capacitor terminals)
- If the capacitor is good, it will show a definite meter deflection, followed by a decay to zero. If it is bad, it will show meter deflection but no decay, or it will show no deflection at all
- Replace faulty capacitors with the same rating as stamped on the original. See the parts list on the charger layout drawing received with the charger. Filter capacitors are connected in parallel and polarities must be observed. The red dot indicates positive
- To detect faulty diodes, disconnect the ac and the battery from the charger Then, with an insulated screwdriver, short-circuit each individual capacitor
- For each transformer in the charger disconnect one of the secondary windings
- With the ohmmeter, measure the resistance across each diode in both directions
- Place one prod on the positive and one on the negative rectified terminals; note the resistance, then reverse the prods and again note the resistance
- If the two resistances are about the same, either high or low, the diode is faulty and should be replaced
- A good diode will show high resistance in one direction and low resistance in the opposite direction

- Motor Control Center
  - Circuit Breakers
    - Check the circuit breakers for physical damage to the switching unit
    - Check the switching unit for accumulation of dust, dirt and the security of all connections
  - Magnetic Contactors and Starters
    - Check to see if the relay contacts are welded together by depressing the brown operator (actuator), located at the top of the overload relay contact housing
    - When the relay is in a reset condition, an audible click will be heard when the operator is depressed. This indicates that the contacts are operating normally
    - A continuity check can also be made by disconnecting the control wiring from the terminals of the relay and placing a bell set, or a resistance measuring instrument, in the circuit

        - Connecting either of these across the relay terminals will indicate the relay contact is closed until the contact-check operator is depressed, interrupting the circuit
        - Check the magnet mating surfaces and assure they are free from dust, dirt, oil and grease
        - Check the silver contacts for wear
        - If the silver tip is worn, and the contact tip support is expose replace the contacts
        - Do not file the silver contacts to clean off projections, nicks scratches, etc.
    - Magnetic Relays
        - Check the contact surfaces for cleanliness, dirt, dust, oil and grease, etc.
        - Check the silver contacts for wear and replace them before the silver is completely gone
        - Do not file the silver contacts to clean off projections, nicks scratches, etc.
    - General Purpose Contactors
        - Inspect the arc chute for physical damage
        - Check the arcing horn clearances
        - Check the armature spring adjustments, contact force, tie gaps and wires
    - Load Gear and Collector Compartments
        - Make sure that:
            (1) there are no loose rubber expansion joints in this compartment,
            (2) all interfaces between the compartment and the generator ends are watertight and
            (3) the seals are not damaged.
        - if there is an accumulation of dust or dirt, it should be cleaned out
        - Check the cooling air discharge vents to be sure they are not clogged
- Inlet Air Systems Maintenance and System Equipment
    - Refer to the Maintenance Section of the Manufacturer's Operation and Maintenance material included in the Operation & Maintenance Manual

5.3 Preventive maintenance

- Prepare long-term preventive maintenance plan , at least for 3 ear for major facilities
- Concerned authority approves preventive maintenance plan
- Resources and spares are mobilized to carryout preventive maintenance
- Where applicable, plant shutdown is solicited
- Plan/ Scheduled maintenance is modified to adjust with the approval of shut down

- Maintenance work is carried out following approved plan
- Necessary checks are performed after maintenance work

5.4 Maintenance Records

- All maintenance jobs are recorded in maintenance log book
- Machine history cards are maintained and maintenance records, specially breakdown reports, are recorded.
- Equipment check list are prepared and carrying out routine checks

5.5 Implementation & Internal Audit

- Procedure for Maintenance and its effectiveness after implementation will be checked and reviewed during internal audits.
- Actions are taken on the basis of review.

5.6 Environmental Aspect, Impact & Controls

Any activity at the plant, whether it is carried out for ensuring quality of service or meeting requirement of the interested parties, there will be some environmental aspects associated with it. It is a requirement of the IMS of BPDB to identify those environmental aspects, evaluate their impact and determine necessary controls.
While carrying out the activities and operation, the employees of BPDB need to exercise appropriate and predetermined controls so as to prevent or mitigate any adverse impact that may be associated with the activity or the process.
Some examples of environmental aspects associated with the Procedure for Electrical Maintenance-High Speed Diesel are as below:

Sl Nos.	Aspect	Impact	Controls
1.	Solid Waste (wires, plastics)	Pollution	1. Follow the waste management plan
2.	Discarding of Rare Earth Metals	Depletion of Resource	1. Follow the waste management plan
3.	Transformer Oil Disposal	Soil pollution	1. Work and dispose as per the chemical disposal plan
4.	Use of Chemical	Soil / Water Pollution	1. Work and dispose as per the chemical disposal plan 2. Provide Necessary Training
5.	Packaging Disposal	Waste Generation	1. Follow the waste management plan

6.	Paper Use	Natural resource depletion	1. Reuse of Paper with the blank side
7.	Chemical Filled Cloth (Jute)	Water / Soil Pollution	1. Follow the waste management plan

The table above provides examples only. The IMS team of each site needs to identify the aspect impact and controls related to specific activities and ensures that the environmental performance of the organization is effectively maintained. For this purpose, the procedure “Environmental Aspect Impact Assessment Procedure” is to be followed and forms “Environmental Aspect Impact Register” is to be filled up by the IMS team.

5.8 OHS Hazard, Risk & Controls

Any activity at the plant, whether it is carried out for ensuring quality of service or meeting requirement of the interested parties, there will be some occupational hazards with it related to the occupational health and safety (OHS) to the workers and employees. It is a requirement of the IMS of BPDB to identify those OHS hazards and determine necessary controls.
While carrying out the activities and operation, the employees of BPDB need to exercise appropriate and predetermined controls so as to prevent or mitigate any adverse consequence that may be associated with the activity or the process.
Some examples of OHS hazards and with the Procedure for Electrical Maintenance-High Speed Diesel are as below:

Sl Nos.	OHS Hazard	Controls
1.	Soldering	1. Provide Necessary training 2. Maintain adequate PPE whilst at worksite 3. Ensure a Permit to Work is issued as per guidance before personnel is sent for work
2.	Energized Components	1. Completely de-energizing equipment, conductors or circuits before an employee begins work 2. Maintain adequate PPE whilst at worksite 3. Ensure a Permit to Work is issued as per guidance before personnel is sent for work
3.	Handling Battery	1. Maintain adequate PPE whilst at worksite
4.	Failure of PTW Process	1. Provide Necessary Training 2. Active Supervision of activity
5.	Wrong Use of tools	1. Provide Necessary Training 2. Active Supervision of activity

6.	Wrong use of Lifting equipment	1. Provide Necessary Training 2. Active Supervision of activity. 3.Maintain adequate PPE whilst at worksite
7.	Dropped object	1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite
8.	Fall	1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite
9.	Expose to Chemicals	1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite
10.	Entrapment	1. Provide Necessary Training 2. Active Supervision of activity. 3. Maintain adequate PPE whilst at worksite
11.	Cold Burn	1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite
12.0	Chemical Burn	1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite 3. Maintain adequate housekeeping
13.	Manual Handling	1. Provide Necessary Training
14.	Electric Shock	1. Ensure a Permit to Work is issued as per guidance before personnel is sent for work 2. Maintain LOTO Procedure 3. Maintain adequate PPE whilst at worksite
15.	Wrong Startup	1. Alarm 2. Ensure a Permit to Work is issued as per guidance before personnel is sent for work
16.	Improper re-assembly of equipment	1. Provide Necessary Training 2. Active Supervision of activity

The table above provides examples only. The IMS team of each site needs to identify the OHS hazards and necessary controls related to specific activities and ensures that the environmental performance of the organization is effectively maintained. For this, the procedure Hazard Identification and Risk Assessment Procedure is to be followed and Hazard Identification and Risk Assessment Register is to be filled up by the IMS team.

6.0 References

a) Operation & Maintenance Manual
b) Volume II of the Service Manual
c) Parts list on the charger layout drawing
d) Audit Report

7.0 Appendix

None

8.0 Revision History

Sl No.	Revision Number	Section	Change Made	Date of Revision