



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

PROCEDURE FOR MECHANICAL MAINTENANCE – GAS
TURBINE



INTEGRATED MANAGEMENT SYSTEM

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1.0 Purpose

- To establish effective mechanical maintenance system for the plant and machinery for ensuring continuing process capability
- To plan and implement mechanical maintenance of gas turbine

2.0 Scope

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

3.0 Terms & Definition

Definition

None

Abbreviations

BPDB –Bangladesh Power Development Board
MR – Management Representative
CI - Combustion Inspection

4.0 Roles and Responsibility

Tasks in Reference Clause nos.	Responsibility
5.0, 5.1, 5.2, 5.3, 5.4	Head of mechanical maintenance, Concerned technician/engineer, SDE/AE/SAE,
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

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- 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 is done as per procedure following the operation and maintenance manual. Gas turbine instruction & maintenance instructions
- Combustion Inspection (CI)
 - Disassembly of GT unit
 - Preparing of turbine compartment roof for removal
 - Removal inlet & Exhaust duct access panel
 - Removal turbine compartment roof and side panels
 - Taking initial compressor and rotor positioning checks
 - Removal fuel gas lines
 - Removal Fuel nozzles
 - Unbolt and Removal combustion can cover
 - Removal cross fire tube, Retainer, seal ring combustion liners, flow sleeves
 - Removal combustion chambers
 - Removal upper half cooling and sealing air piping
 - Placing mechanical support jacks under unit casings
 - Inspection and Checking of GT unit
 - Inspection fuel nozzles
 - Inspection combustion liners
 - Inspection cross fire tubes and retainers
 - Inspection transition places
 - Inspection combustion chamber flow sleeve and seal ring
 - Inspection combustion chambers
 - Reassembly of GT unit
 - Reassembling 1st sage bucket
 - Reassembling 2nd sage bucket

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- Reassembling 3rd stage bucket
- Re-checking tubing clearances
- Installation upper half turbine shell
- Installation upper half cooling & sealing air piping
- Installation transition piece
- Installation Liner & crossfire Tubes
- Installation flow sleeves & combustion chamber
- Installation fuel nozzles
- Installation fuel gas piping
- Hot Gas Path Inspection
 - Disassembly of GT unit
 - Preparing of turbine "compartment roof for removal
 - Removal inlet & Exhaust duct access panel
 - Removal turbine compartment roof and side panels
 - Taking initial compressor and rotor positioning checks
 - Removal Fuel gas lines
 - Removal Fuel nozzles
 - Unbolt and Removal combustion can cover
 - Removal cross fire tubes. Retainer, seal ring combustion liners, flow ' sleeves
 - Removal combustion chambers
 - Removal upper half cooling
 - Placing mechanical support jacks under unit casings
 - Removal Turbine shelf bolts and
 - Upper half 1st stage nozzle eccentric pin
 - Removal upper half turbine shell with necessary jacking as per
 - Taking turbine clearance checks
 - unbolt and Removal transition pieces
 - Disassembling 1st stage buckets
 - Disassembling 2nd stage nozzle
 - Disassembling 1st & 2nd stage nozzle
 - Disassembling bearing
 - Disassembling inlet guide vanes
 - Inspection and Checking of GT unit
 - Inspection fuel nozzles
 - Inspection combustion liners
 - Inspection cross fire tubes and retainers

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- Inspection transition places
- Inspection combustion chamber flow sleeve and seal ring
- Inspection combustion chambers
- Inspection 1st & 2nd stage nozzle
- Inspection 1st & 2nd & 3rd stage buckets
- Inspection shroud blocks
- Inspection 2nd & 3rd stage diaphragm
- Checking clearance of bearing
- Inspection of bearing
- Inspection inlet guide van (IGV)
- Inspection compressor bleed valve
- Inspection 6 point checking of compressor
- Reassembly of GT unit
 - Reassembling 1st stage bucket
 - Reassembling 2nd stage nozzle
 - Reassembling 1st & 2nd stage shroud
 - Re-checking turbine clearances
 - Inspection upper half turbine shell
 - Inspection upper half cooling & sealing air piping
 - Inspection transition pieces
 - Inspection liner & crossfire Tubes
 - Inspection flow sleeves & combustion chamber
 - Inspection fuel nozzles
 - Installation fuel gas piping
 - Re-assembling bearing
 - Removal jacks and support from under turbine shell
 - Taking final compressor and Turbine rotor positioning checks
 - Assembling turbine compartment roof and side panels
 - Installation of IGV vanes & Re-assembling inlet duct access panel
 - Re-assembling turbine compartment roof components
- All clearance checking for Turbine and compressor
 - All actual clearances are recorded & noted and submitted along with report for future references
- Repairing Works or Exhaust Plenum side walls & Bottom
- Rectification of Oil leakage
 - Rectification of Oil leakage through Bearing and inlet Guide Van (IGV)
Necessary all works are carried out by the contractor
- Load rejection and over speed test

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- Over speed and load rejection test of GT unit is performed during commissioning after completion of Hot Gas Path Inspection works
- Testing and commissioning
 - The contractor test as required and commissioned the unit with 1/4 , 2/4, 3/4 and 4/4 toad after completion of All works related to Gas Turbine Hot Gas Path inspection "But not limited to aforementioned works must be carried out during Hot Gas Path
 - Manufacturer's recommendation as per Operation and Maintenance manual, Volume #8. section # 03,03 will be followed as a reference, to avoid any conflict between) Bangladesh Power Development Board & Contractor
- Major Overhauling (MOH)
 - Disassembly of GT unit
 - Decouple Turbine and generator
 - Perform alignment check between i turbine-generator rotor
 - Remove all piping and all combustion parts
 - Perform six-point checks
 - Decouple accessory coupling & note alignment reading
 - Place mechanical jacks and load the casings
 - Remove turbine casing
 - Remove combustion wrapper
 - Remove Transition Pieces
 - Remove First Stage Nozzle & Support ring
 - Remove compressor discharge casing
 - Remove forward and aft compressor casings
 - Measure and record compressor and turbine clearance
 - Remove Bearing housing & bearing top halves
 - Support the compressor rotor
 - Decouple the marriage joint between Turbine & compressor rotors
 - Rig & lift turbine rotor and place it on supports
 - Remove nozzles
 - Inspection of all gas turbine parts & replace as required
 - Remove Turbine buckets stage I,II & III
 - Complete and keep the unit ready for reassembly after receipt of rotor
 - Reassemble of GT unit
 - Install bearings lower halves
 - Install turbine rotor

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- Install compressor rotor
- Support compressor rotor
- Assemble marriage joint of compressor & turbine rotors
- Reassemble bearings and perform leak check
- Install 1st , 2nd & 3rd stage nozzles
- Record closing clearances
- Install compressor and turbine casings
- Install the wheel-space thermocouple in the 2nd and 3rd stages
- Install exhaust diffuser, exhaust, frame, exhaust plenum and flex seals
- Install piping and all combustion parts with new design combustion liners
- Remove mechanical jacks
- Install inlet plenum, exhaust and inlet ducts etc.
- Install turbine compartment roof etc.
 - Reassemble and perform alignment check and correction (if required) between accessory gear shaft - GT Rotor, GT Rotor – Load coupling shaft & Load coupling shaft - generator shaft.
 - Clean the compartments and check for startup.
 - Start turning gear.
 - Crank and check and attend for fuel/water injection leakages (if any).
 - Put the unit to FSNL and Load
- Daily maintenance is done according to the Operation and maintenance manual, Gas turbine instruction & maintenance instructions
- Monthly maintenance is done according to the Operation and maintenance manual, Gas turbine instruction & maintenance instructions
- Quarterly maintenance is done according to the Operation and maintenance manual. Gas turbine instruction & maintenance instructions
- Semi-annual maintenance is done according to the Operation and I maintenance manual, Gas turbine instruction & maintenance \ instruction
-
- Annual maintenance is done according to the Operation and maintenance manual, as turbine instruction & maintenance instructions

5.3 Preventive maintenance

- Prepare long-term preventive maintenance plan, at least for 3 years for major facilities

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- Concerned authority approves preventive maintenance plan
- Resources and spares are mobilized to earn/out 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 of Records

- All maintenance jobs HIT 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 & Review

- Procedure for Maintenance and its effectiveness after implementation will be checked and reviewed during
- 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 Mechanical Maintenance – Gas Turbine are as below:

SI Nos.	Aspect	Impact	Controls
1.	Disposal of Metal / Plastics parts, which are not recycled	Soil pollution	1. Follow the waste management plan
2.	Oil / Lubricants	Soil pollution	1. Work and dispose as per

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	disposal		the chemical disposal plan
3.	Usage of Chemical during overhaul	Soil / Water Pollution	1. Work and dispose as per the chemical disposal plan 2. Provide Necessary Training
4.	Oil filled clothes(Jute)	Soil pollution	1. Follow the waste management plan
5.	Oil Spill	Soil pollution	1. Work and dispose as per the chemical disposal plan
6.	Electrode disposal	Soil pollution	1. Follow the waste management plan
7.	Carbon Powder - Soil Pollution	Soil pollution	1. Follow the waste management plan
8.	Water bearing chemical discharged from radiator	Soil / Water Pollution	1. Discharge as per 'Effluent water Quality' guidelines

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.

5.7 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 Mechanical Maintenance – Gas Turbine are as below:

SI Nos.	OHS Hazard	Controls
1.	Failure of PTW Process	1. Provide Necessary Training 2. Active Supervision of activity
2.	Wrong Use of tools	1. Provide Necessary Training 2. Active Supervision of activity

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3.	Wrong use of Lifting equipment	<ol style="list-style-type: none"> 1. Provide Necessary Training 2. Active Supervision of activity. 3. Maintain adequate PPE whilst at worksite
4.	Dropped object	<ol style="list-style-type: none"> 1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite
5.	Fall	<ol style="list-style-type: none"> 1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite
6.	Expose to Chemicals	<ol style="list-style-type: none"> 1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite
7.	Entrapment	<ol style="list-style-type: none"> 1. Provide Necessary Training 2. Active Supervision of activity. 3. Maintain adequate PPE whilst at worksite
8.	Cold Burn	<ol style="list-style-type: none"> 1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite
9.	Chemical Burn	<ol style="list-style-type: none"> 1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite 3. Maintain adequate housekeeping
10.	Manual Handling	<ol style="list-style-type: none"> 1. Provide Necessary Training
11.	Electric Shock	<ol style="list-style-type: none"> 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
12.	Wrong Startup	<ol style="list-style-type: none"> 1. Alarm 2. Ensure a Permit to Work is issued as per guidance before personnel is sent for work
13.	Improper re-assembly of equipment	<ol style="list-style-type: none"> 1. Provide Necessary Training 2. Active Supervision of activity
14.	Noise	<ol style="list-style-type: none"> 1. Staff must wear Earmuff whilst at worksite
15.	Heat Stress	<ol style="list-style-type: none"> 1. Provide Necessary training 2. Schedule proper work plan

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

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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 and maintenance manual, Gas turbine instruction & maintenance Instructions
- b) Audit Report

7.0 Appendix

None

8.0 Revision History

SI No.	Revision Number	Section	Change Made	Date of Revision

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