Bangladesh Power Development Board

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

PROCEDURE FOR GENERATION-HIGH SPEED FURNACE OIL

1.0 Purpose

a. To determine and plan its processes and define the functions that are necessary for providing generation of electric power that can continue to meet the needs and expectations of customers
b. To plan and control in accordance with the organization's strategy
c. To run the process under controlled conditions which shall include
- the availability of up to date information from customer regarding the load, outage etc.
- the availability of information that describes the characteristics of the product,
- the availability of plant supplier's document, work instructions, as necessary,
- the use of suitable equipment,
- the availability and use of monitoring and measuring equipment,

d. To monitor, measure and review activities.
e. To ensure a method for safe and quality generation.

2.0 Scope

Applies to all HFO based Power Station of Integrated Management System of Bangladesh Power
Development Board (BPDB).

3.0 Terms & Definition

None

Abbreviations

BPDB- Bangladesh Power Development Board
MR- Management Representative
HFO- High Speed Furnace Oil

4.0 Responsibility

Tasks in Reference Clause Nos.	Responsibility
5.1	Shift Engineer
7, 8	MR

5.0 Procedure

5.1 Before starting generation, following things must be considered and ensured,

i. Condenser,
ii. Feed tank and
iii. Boiler.

5.1.1 Condenser

- Chemical water treatment plant must be in operation (demi pump running) for the filling of condenser, feed tank and boiler with demi-water to provide for a sufficient quantity of the demi-water.
- Cold demi-water will be used for the filling. The filling of condenser (Hot well) should be done by opening Quick Filling valve. Filling of Feed Tank will be carried out by running 1 condensate pump.
- Filling of boiler may be carried out in two ways:
  a) Via boiler filling line,
  b) Via economizer.
- Filling via boiler filling line will be carried out by 1 condensate pump through LPH-3/4 and drain header of boiler. Filling through economizer will be carried out by the feed pump from the feed tank through feed head. Filling of boiler will be cut-off when water level exceeds the normal edge of straight water-level gauge.

5.2 Boiler Startup (Not applicable for engine based power plant.)

- Open all deaerating valves on the super-heater of the boiler and on the drum as well' as the re-heater deaeration.
- Open all drain valves of the super-heater and the drain valves of the re-heater.
- Open the main stream slide valve
- Put both the Lungstroms into operation (in compliance with the combustion product and air flap valves before and after the Lj-stroms are open, cooling water is open.)
- Put one forced-draught fan into operation, flue gas fan and the recirculation fan (in compliance with the respective flap valves in the suction and the delivery sides are open, cooling water is open.)
- Put one fan into operation for the cooling of the flame scanners of the burners.

- Check the readiness of the light heating oil for operation and make free the light heating oil line to the burners.

- In compliance with the purging of burners put the couple of burners into operation of the lower row.
- After the ignition of burners (after about 15 min.) the level in the drum starts increasing. Open the fittings for the discharge of water in the drum, therefore.
- In compliance with the start-up diagram increase the output of burners, and/or put the further burners into operation. Observe the admissible trends of the increase of pressure and temperature.
- The deaeration is terminated at the reaching of the continuous stream of steam in the deaeration of the super-heater, the re-heater and drum. Close the dearation fittings, therefore.
- At the reaching of the pressure of 10 kp/sq.cm. in the super-heater and at the streaming through the drainage lines without impacts the super-heater drainage is completed. Close the drainage fittings.
- At the reaching of 5 kp/sq.cm. Pressure in the re-heater the re-heater drainage is completed. Close the drainage fittings.
- At the reaching of outlet pressure of steam from the boiler about 12 kp/sq.cm, output 30 t/h put the RS-3 into operation through by-pass.
- Heat and drain the line to the steam air heater and heavy heating oil (HFO) system at the same time.
- Maintain pressure on the value of 11 kp/sq.cm by the hand -operated governor valve in the RS-2-pass.
- After the reaching of vacuum in the condenser it is possible to realize circulation of steam through the high-pressure and the low-pressure by-pass and to heat air and the heavy heating oil system through the RS at the same time.
- After the reaching of the steam output of about 140 - 180 t/h put the second forced- draught fan and the second flue gas fan into operation.
- Till the boiler synchronizing to the turbine control, the start-up in compliance with the requirement of boiler - the adhering to the admissible trends of the increase of the temperature and pressure of steam.

5.3 Startup

- Start the CW pump and raw water booster pump. Start all equipment parts using this water as cooling medium, i.e. Condenser,
  - b) Turbo- generator oil coolers,
  - c) Feed pump oil coolers,
  - d) Filtered water - raw water coolers,
  - e) Coolers of condensate for hydrogen cooling.
- Start the vacuum zing system of the condenser water header.

- Start one condensate pump. Prepare the main line of condensate up to the feed tank for operation.
- Start one feed pump. Prepare the line of feed water through the high-pressure heater for operation
- Start the turbine oil system and operate the turbine with the turning device. Open the gate valves.
- Start the high-pressure by-pass station to 40% opening connect, the automatic control of temperature after the high-pressure by-pass station.
- Ignite the burners in the boiler.
- Start the gland steam system at the reaching of RS pressure at 5 kp/sq.cm.
- At the reaching of vacuum in the condenser of .80 kp/sq.cm. The running ejector will put into operation, it is possible to start the low-pressure by-pass station.
- Running ejector put into operation.
- At the reaching of the quantity of feed water of about 200 t/h to 220 t/h the second feed pump will be put into operation.

5.4 Turbo-Set Start-Up (Not applicable for engine based power plant.)

- At the reaching of steam parameters of T, P kp/sq.cm It will be possible to increase the speed of the turbo- generator to RPM
- During operation, some important values are recorded continuously. The maximum permissible temperature differences which must take into consideration are as follows:
- The temperature difference between the top and bottom parts of the high-pressure as well as medium-pressure cylinders must not exceed. The turbo-set must be shut down upon an excess of this value.
- There should be checking of maximum temperature differences between the filaments of horizontal flanges in the high-pressure and medium-pressure cylinders. The difference should not exceed the values of.
- The condenser rate of flow increases together with increasing the quantity of steam supplied to the condenser. It is necessary to check the heating in the 5^{1h} low-pressure heater and the heating of the deaerator.
- The secondary oil pressure will be increased by means of the limiter. Upon a pressure of approx. at, the check valves get opened, steam flows into the medium-pressure cylinder, the speed starts increasing. After the rotation of the turbine rotors with steam, there should be carried out the checking of the turning equipment whether the pinion is disengaged and motor put out of operation. Then it will be possible to increase the speed continuously for

desired rpm at desired rpm, there should be done a dwelling of about minimum min.

- At the turbo-generator speed increasing to the limit mentioned, it is necessary to follow carefully the lubricating oil pressure, the temperature of oil after the coolers, the displacement of the turbine rotors, the temperatures of the high-pressure and the medium- pressure casings, the vibration of Hearings, the condensing system operation, of the high-pressure and the low -pressure by-pass stations. If no defects are ascertained, it will be possible to go on starting according to the diagram to desired rpm. Here,-a desired minutes dwell should be secured.
- The' further increasing of the speed should be carried out according to the start-up diagram The limiter should be adjusted in the so-called idling position. In this position, the limiter allows to reach desired rpm. As the critical speed zones of single rotors are traversed, it will be necessary to pay the set running increased attention, specially then the vibrations o single bearings. Dwells in the sphere of speeds of 1200 -2500 rpm are improper, as the motor critical speeds vary within this range.

5.5 Synchronization

- First excitation will be ON. Field breaker will be ON
- Adjust generator and grid voltage.
- Bus will be select (A or B). Synchroscope will be ON. Choice of syn. put into auto mode.
- When synchroscope needle is in the slow direction green signal will be push.
- Plant synchronizes with national grid automatically.
- Immediately after paralleling load the turbo-set by jump to desired MW and start increasing the load by the speed of desired MW/min. in compliance with the diagram.
- At the reaching of the rated parameters the starting is completed.

5.6 Planned Shutdown Procedure

- First start decreases the Load. In course of the decreasing of power by 04 MW/ min. The Steam pressure will be reduced at the same time but the temperature will be maintained at the rated value (530 °C).
- After decreasing the power to about desired MW the extraction point VI will be put out of operation by the closing of Non-Return extraction valve. The feed tank heating system will be changed over for heating from the reducing station III.

- At the decreasing of power to MW high-pressure heaters will be put out of operation by the closing of Non-Return extraction valves VI & VIII and closing the electrical fittings.
- When the load is about MW put the by-pass stations in operation and open the starting steam valve & close the Steam supply. In this time we have to maintain the pressure desired kg/ cm^2 by the operation of by-pass stations. In this situation the pressure of live steam is maintained on a *low* value at the highest possible temperature.
- Put out the low-pressure heaters step by step from. At the same time Boiler burner should be cut-off step by step according the pressure of live steam is maintained on a low value at the highest possible temperature (Not less than 480° C).
- When the load is decreased in 20 ~ 25 MW cut-off the Turbo-set manually as well as Turn-off the fire of the rest burners of boiler at the same time. In this way we will prevent the sudden steam pressure increasing and a possible opening of by-pass stations will be minimum and for the shortest time. After cutting-off the Turbo set put out the operation of H cooling condensate pump.
- At a drop of speed about to 300 RPM the gland steam condenser put-out of operation by closing the electrical fittings at the inlet and opening the fittings to condenser.
- It is necessary to start immediately start-up lube oil pump after cut-off the turbine to maintain the operation of by-pass stations & sufficient lube oil pressure for Turbine-Generator bearings. The Start-up oil pump will remain under operation up to the drop of the bearings temperatures below 45°C permanently.
- After cut-off the all burners of the boiler the all induced draught fan (IDF) & Forced draught fan (FDF) will be Turn-off. Maintain the Boiler Drum level in maximum level & Turn-off the feed water pump & close the by-pass stations at a low value steam pressure.
- But the both Lj-stroms (Air pre -heater) will remain in operation before the flue gas temperature drop to 50 ° C. High pressure fuel oil pump, low pressure fuel oil pump also .will remain in operation before the fuel temperature drop to 80 ° C. After reaching the fuel temperature in 80 ° C start the Diesel pump & change over the fuel header HO to LO for about 30 min. Then stop the Diesel pump. Burner cooling fan will remain in operation before stopped all the fuel pumps.
- After closing the by-pass stations cut-off the vacuum system. Start the starting ejector &-turn-off the running ejector
- After reaching the bearings temperature to 45 ° C and closing the by-pass stations change over the start-up lube oil pump to run out lube oil pump for only bearings lubricating.

- When the turbine rotor will be in 0 RPM start the turning gear. The turning gear will remain under operation till the high pressure flange temperature as well as the low pressure parts drop to 100 °C: One condensate pump will remain in operation with re-circulating from condenser to condensate pump up to 6 ~8 hours after cut-off the turbine.
- Circulating pump will also remain in operation to condenser raw water side up to 08 ~ 10 hours after cut-off the turbine.
- After the cooling down the heaters the drainage system of piping between the Non-Return extraction flap valves and heaters towards the channel will be opened. The drainage system of Turbine casing as well as the drainage system of piping of Non-Return extraction flap valves will be opened no sooner than 12 hours after the turbine cut-off for prevention of quick cooling down of casing.
- Boiler will be drained when the superheated steam temperature will drop to 180 ° C. After completing the boiler draining must seal the draining valves.
- All the turbine drainage system remains closed in course of the cut-off period in order that the cooling of the casing did not occur.
- Perform the drainage of piping as well as of turbine casing just before start-up again.

5.7 Implementation & Review

- Procedure for Generation-HFO and its effectiveness after implementation of its decisions will be checked and reviewed during internal audits.
- Review consideration will be raised in MRC Meeting for decision
- Corrective actions will be taken to improve the system on the basis of review

5.8 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 Generation – high Speed Furnace Oil are as below:

Sl Nos.	Aspect	Impact	Controls
1.	Release of Carbon dioxide	GHG emission	1. Carbon Capture, Utilization, and Storage (CCUS) Plan 2. CO2 Scrubbing
2.	Water consumption from River & Ground Water Source	Depletes Natural Reserve	1. Follow 'Water Consumption Procedure' 2.Wastewater reuse from other source such as municipal wastewater reuse
3.	Warm water rejection to river	Contaminates natural reserve & impacts wildlife / aquatic life	1. Implement cooling canals, open-water algae bioreactors, spray ponds, and modified solar updraft towers
4.	Natural Resource (Fossil fuel) consumption and depletion	Natural Source Depletion	1. Run engine at set operating parameters. 2. Perform routine maintenance to ensure efficient function. 3. Match the quality of fuel and check it it matches with the original parameters while construction of the plant. 4. Conduct audit by energy efficiency experts to help identify equipment and processes with improvement potential
5.	Noise Emission	Surrounding Wildlife Disturbed	1. Implement an acoustic enclosure and pedestal barrier

			2. Implement silencing for the air inlet, namely larger (deeper) acoustic baffles.
6.	Electricity Consumption from Ancillaries	Global Warming	1. Ensure Efficient Operation
7.	Use of lubricant	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.

5.9 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 Generation – high Speed Furnace Oil are as below:

SI Nos.	OHS Hazard	Controls
1.	Engine Hall Explosion	1. Follow the 'Prevention of Fire and Explosion' Procedure
2.	Crank Shaft may break and explode out of assembly	1. Maintenance of alarm system
3.	Possibility of flamable gases/fumes in engine room chamber	1. Follow the 'Prevention of Fire and Explosion' Procedure

4.	Tearing of belts and pulleys and hitting personnel	1. Use of Guards to ensure torn belt doesn't hit anyone
5.	High Noise Level	1. Staff must wear Earmuff whilst in the Engine room
6.	Slipping due to water spillage on floors	1. Maintain adequate housekeeping. 2. Maintain signage if there is any spill.
7.	Dropping / falling object	1. Maintain adequate PPE (e.g. Helmet) whilst at worksite
8.	Electric shock / Electric Arc	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
9.	Fire / Explosion at worksite	1. Follow the 'Prevention of Fire and Explosion' Procedure
10.	Heat Stress	1. Ensure Heat Stress Training for all the employees 2. Ensure a good work plan
11.	Getting Stuck in moving / Rotating Parts	1. Ensure protocols are maintained, such as not leave loose long hair, or loose long dress 2. Proper signage 3. Maintain barrier / mark area so that when personnel enter that zone, he/she is obliged to take adequate precautions
12.	Chemical Spillage / Burn	1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite 3. Ensure good House Keeping
13.	Burn from contact with hot surface	1. Use of Guards to ensure contact can't be made directly 2. Provide Caution Sign 3. Maintain adequate PPE whilst at worksite
14.	Fumes and gases	1. Maintain adequate PPE whilst at worksite 2. Ensure a Permit to Work is issued as per guidance before personnel is sent for work

15.	Light from welding	1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite 3. Proper Supervision
16.	Unhygienic work environment e.g. canteen, toilet etc.	1. Maintain adequate housekeeping.
17.	Cuts from Material Handling / movement	1. Maintain Material handling Procedure 2. Ensure a Permit to Work is issued as per guidance before personnel is sent for work
18.	Poor Visibility due to improper lighting	1. Maintain adequate housekeeping. 2. Installing adequate Lighting
19.	Lifting heavy objects	1. Maintain Material handling Procedure 2. Ensure a Permit to Work is issued as per guidance before personnel is sent for work
20.	Dusty environment	1. Ensure adequate housekeeping

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) Auxiliary manual of LFO boiler
b) ISO 9001

7.0 Appendix

None

8.0 Revision History

Sl No.	Revision Number	Section	Change Made	Date of Revision