



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

PROCEDURE FOR GENERATION- GAS STEAM POWER
PLANT



INTEGRATED MANAGEMENT SYSTEM

Document No.:
BPDB-IMS-PR-013

Revision No.: 00

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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 Generation-Gas Steam turbine 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

4.0 Roles and Responsibility

None

5.0 Procedure

Plan of the operational procedures

5.1 Start-up Procedure of Boiler of Ghorashal Power Station (GPS)

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5.1.1 Filling up of the Boiler with water

- Before filling-in of the boiler with water at the start-up of the boiler after maintenance or erection, it is necessary to make sure that all the man-holes of the drum are completely closed, t mark and 'write down zero positions of the bench marks, snowing movement of its elements.
- Filing-up of the boiler before its lighting-up should be carried out by deaerated water only through the economizer. During filing-in of the empty drum the temperature of the water coming into the drum should not differ on more than 40°C from the temperature of the drum metal as per its perimeter.
- To check up the condition of valves on the feed sub-unit.
- To fill in and keep under pressure the area up to the lowered feed sub-unit. It is necessary to be careful enough during filling-in of the line, avoiding kicks and impacts. If the water jets appear from the air vents of the feed line, it is necessary to close the air vents.
- To open valve Ø 65 (RL32S02) on the bypass line of the feed sub-unit and start up filling-in of the boiler by the water. Gate valve Ø 100 (NA32S01) on the water recirculation line from the boiler drum should be kept close. After filling-in of the boiler before lighting-up of the burners it is necessary to open gate valve Ø 100 on the recirculation line. Filling-in of the non-cooled drum should be carried out with the opened recirculation line. With the appearance of the level in the drum it is necessary to close the recirculation and additionally to feed-up the boiler in order to be sure that the economizer has been filling in
- During filling in of the boiler with water if is necessary
 - a) To conduct continuous control for the water level in the drum as per water measuring columns. Filling-in should be stopped with the approaching of the lighting-up level i.e. 100mm below the average.
 - (b) To check up the tightness of feed valves economizer's drains, blowing valves (regarding leak, it may be seen from the temperature of the pipes after stop valves). If a leakage appears in the flanges or glands, they should be tightened. In case if the leak is not removed, it is necessary to stop further filing-in of the boiler till this defect won't be removed. Filing-in of the boiler should be also stopped with the appearance of kicks and shocks within the pipe lines.
- If the boiler was filled in, it is necessary to feed it up or to remove some water up to the lighting-in level (-100 mm below medium)
- After filling-in of the boiler with water, close valve Dy-65 and gate valve RL32S02, to make sure that the level-of the drum is not deceasing.
- Decreasing of the -level is an investigation of the drain valves leakage. This leak should be removed before lighting up of the boiler and the level should be set up to the lighting in one.
- To open gate valve NA32S01 on the recirculation line
- To check up and write down the position of the bench marks after filling-in of the boiler.

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- At 10 minutes before the lighting-in of the boiler it is necessary to put into operation steam heating of the drum.

5.1.2 Preparation of Gas Facilities for Lighting-

- Prepare the pipeline inside the boiler (directly before the boiler lighting-up simultaneously with the furnace ventilation).
- Open gas and air slide valves of the boiler
- (see table 1 of the present instruction);
- Close the guide vanes of I.D.F.D. and flue gases recirculation I.D. fans;
- Close manually and electrically operated gate valves before the furnaces; manually operated valves before ignition torches:
- Open all the gas vents;
- Open the stop valves in succession downstream' stroke before the take-off point; slide valves No. NPIOS011, NPIOS012, NPIOS013, NPIOS014, NPIOS07, NPIOS08, NPIOS09, NPIOS10, cut-off valve No. NP10S02; slide valve No. NP20S01 on the gas-line of the filled fuel; regulating valves No. NPIOS03, NPIOS04, NPIOS05.
- Take out the plug on the main gas line after me valve No NPIOS1, the latter must be firmly closed;
- Switch the regenerative air pre-heater, I.D. fan F.D. and flue gases recirculation I.D. fan of both flows on load them by 50 or 60%, make sure that all the mechanisms are in good repair;
- adjust vacuum of 2 to 3 mm of water column in the upper part of the furnace;
- Open the valve No. NPIOS01, fill the gas line in with gas, check the tightness of flange joints and valve' glands by means of soaring;
- Prepare gas analyzer or gas sampling cup to determine oxygen content in the gas;
- Switch the flow meter and the gauges on the gas line on (and check the "ON" position
- Gas line is considered to be filled with gas if oxygen content in it is not above 1%. Completion of blow-down is checked either by means of an analysis or by means of on burning the samples which are taken from the connection on the common line of gas vents. Gas burning should proceed smoothly without puffs.
 - Pressurized inlet slide valve No. NPIOS01 and quick-acting cut of valve No. NPIOS02, to effect this; -close the quick-acting cut-off valve No. NPIOS02, and the by-pass of the quick-acting cut off valve; -close slide valve No. NPIOS01 ; -decrease gas pressure to 0.4-0.5 kgf/cm² on the section from the inlet slide valve to the quick-acting cut-off valve, through the by pass of quick acting cut off valve, than close the bypass. Determine the tightness of both inlet slide valve No. NPIOS01 and quick-acting cutoff valve by manometer readings during 5 min, if pressure is increasing, the inlet valve is not tight, if quick-acting cut-off valve No. NPIOS02 is uptight, pressure is decreasing.

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- If pressure test of the inlet slide valve and quick-acting cut-off valve position results, check the tightness of the valves to the upper and lower tiers of burners, open the quick-acting cut-off valve, previously depressurize the section from valve No. NPIOS01 the quick-acting cut-off valve; -close slide valves No. NPIOS09 and NPIOS010; -open valve No. NPIOS01 partially, fill in the section from the inlet slide valve to valves No. NPIOS09, NPIOS010, after that close valve No. NPIOS01. Check the tightness of valve No. NPIOS09 and NPIOS010 5 min. at operation pressure in the pipeline. When one of the two valves, No Pressure decreases. To determine uptightness of valve No. NP10S09, close gas vents on the end of the Dy-300 gas line in the lower Tier of burners, follow pressure increase by manometer readings during 15 mines. To determine the uptightness of valve No NPIOS010 close gas vents on the ends of the dy-300 Gas line in the lower tier of burners follow pressure increase by manometer readings during 15 min
- Check if the first, upstream valves near the burners are tight for this;
 - Open slide valves no. NP10S09 and NPIOS10;
 - Close valve no. NP20S01 at the ignition of the gas line.
 - Fill the gas line in with gas, to do so open inlet valve No. NPIOS01 than again close it;
 - Close gas vents No. NP30S01 and NP30S02, adjust gas line pressure 0.1 Kgf/cm check pressure drop 10 min. (not over 10 mm water column or 60 mm water column per hour).
- Check if the second upstream valves near the burners are tight. For this; - close safety gas vents 1 to 12 of the burners; -fill the sections of gas lines of burners 1 to 12 between manually and electrically operated valves of the burners, to do so open manually operated valves partially; -adjust gas line pressure 0.1 kgf/cm², check gas pressure drop 10 min., pressure drop should not exceed 10 mm water column (60 mm water column per hour).
- In case tightness test showed that either manually or electrically operated valve are uptight, the operation personnel should stop lighting-up, close valve No. NPIOS01 and quick-acting cut-off No. NPIOS02 and both valves near each burner, open gas vents and safety gas vents of the burners, inform the management to take necessary measures. As soon as the defect is rectified, tightness is to be tested.
- Blow the ignition gas line down with gas, for this;
 - Check that the valves near igniters of the burners are closed;
 - Open manually operate valve of igniters gas
 - lines by tiers (2 PC)
 - Open-valve No. NP40S01, NP40S02 on the blow down line of ignition-
 - Open valves No. NP10S01 blow the ignition line down/gas.
 - To determine that blow down is over either an analysis should by made or a sample burnt which is taken from a connecting pipe on the common gas vents line of ignition gas;

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- Oxygen content should not exceed 1% and burning should proceed smoothly without puffs.
- In case pressure test of the gas lines and valves are successful, perform further, procedures; blow the gas line down again as per Para and 6.1.2.; Switch on protections for boiler shut down with the tripping of I.D., F.D fans, regenerative air heaters, pressure decrease in the gas line. Test a protection for cut-off valve no NP10S02 Operation as well as the closing of electrically operated valves in the gas line. Manually operated valves before burners should be closed. If protection isolated draft plants, put them into operation again, and continue ventilating the furnace

5.1.3 Boiler Lighting Up

- Ventilate the furnace and the air-gas duct thoroughly 15 min. I.D. and F.D. fans should operate on the 1st speed. After the gas line is filled in with gas and blow down, close slide valves No. NP10S011 and NP10S013; close valves No. NP10S03 and NPIOS04 of the pressure regulator. Lighting-up should be carried up on the lighting-up by pass line (Dia 150 mm) using valve No. NP10S05.
- Close valves (Dia 20 mm and dia 50 mm) on the drainage lines of guarding surface and radiation on wall super heater leave Dia 10 valve open
- After ventilation stop flue gas recirculation I.D. fans, close their guide vanes. In addition close the following.
 - Valves No. NS10S01, NS20S01 on the suction line and first upstream valves (No. NS10S04, No. NS20S04) on the recirculation gas delivery line.
 - Valves No. NS10S06, NS20S06, on the recirculation gas supply line to the burners peripheral channels;
 - First upstream valve No. NS11S01 and NS21S01 on the recirculation gases supply to the nozzles on the front water-wall; - close by 85% second upstream valves (NS11S02, No. NS20S02) on the recirculation gases supply line to the nozzles; -valves no. NG16S01, NG16S02, NG26S01, NG26S02 on the peripheral airline to the group of 3 (three) burners in the upper tier, open valves No. NG41S02, NG42S02 on the line of the hot box blow down to the atm.osphere approximately by 2%, adjust pressure difference between the hotbox and the furnace 10 to 15 kgf/cm by means of valve no NC31001 on the supply the to the hotbox
- To take a gas sample for analysis both in the furnace and the hotbox, to do so set pressure 2 to 3 mm of water column in the furnace, take samples through sampling devices from both sides of the furnace and the hotbox. Lighting-up is forbidden if samples contain methane.
 - Adjust air pressure before the burners 50 kgf/cm² by loading I.D and F.D. Fans.
 - For some reason the lighting-up of the first burner was delayed for more than 5 min. after taking the sample in the upper part of the

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furnace, take another sample in the upper part of the furnace, if no methane is present, light up the first burner.

- Light up the burners in the lower tiers in the following sequence; Nos. 4&5, 2&6. The order of the burners lighting-up is as follows;
 - i. Switch on ignition device;
 - ii. if there is a tongue in the igniter close safety gas vents of the burners, open electrically craven gas regulating slide valve ignite the gas in !he burner by means of opening manually operated gas regulating slide valve. Make sure that combustion is smokeless and without pulsation, adjust, gas pressure above 0.05 kgf/cm² and air presser above 50-60 kgf/cm. Properly adjusted flame neither pulsates nor beats against the front water-wall.
- If after gas supply to the furnace the burner both does not igniter or goes out, ventilate the furnace and gas ducts of the boiler 10 min. find out the cause of extinction, remove it, repeat the analysis and light up the burners again.
- If any burner of the upper tier goes out (or does not ignite) while all the burners of the lower tiers are burning, switch the faulty burner off, fine out the cause of fault and remove it, ignite the burner again. As soon as the jet is stable (approximately 15 min. after lighting all the burners of the lower tier) switch off the ignition devices.
- In any operating conditions of the boiler switch off the non-operating gas burners by means of both manually and electrically operated slide valves of the burner, when doing so, safety gas vent between the slide valves should be open.
- When steam pressure in the boiler drum reaches;
 - i. 3kgf/cm² blow down water gauge columns and make sure that their readings are correct;
 - ii. 5kgf/cm² close the slide valve on the blow down line after wall radiation deam super
 - iii. 10kgf/cm² close the valves (Dia.10 mm) on the drainage lines of guarding surfaces. As soon as the boiler pressure reaches 30 kgf/cm² blow down the water level gauge again.
- When the boiler is warning up and water level in the drum increases, drain the water off via emergency drain.
- The order of water level gauge blow down is as follows;
- Open the blow-down valve, when doing so steam pipe, water pipe and the glass are blow down; close the water valve, when doing so steam pipe and the glass are blown down; open the water valve, close steam valves, when doing so the water pipe is blow down;
- Close the blow down valve, open the steam valve, check water level and compare it to that of other columns and the lowered level meters. While blowing down water level gauges, control the water level; when the blow-down valve closed and the water valve open, water level quickly increases and then various slightly. When the

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water line is blocked, water level rises slowly. If this is the case, repeat blow down.

- Water level in the drum to be controlled by means of lowered level meters only after their readings coincide which chose of water level gauges.
- To maintain the average level, feed up the boiler via bypass line (Dia. 65mm). Before feeding .up close the valve on the recirculation water line from the boiler drum, and after feeding up, close this valve again.
- To remove sludge and ensure uniform warming up of all the circulation circuits, blow-down all the lower points of the water walls at pressure 5 to 10 kgf/cm². When blowing down, make sure (both by touch and from sound) that blow-down points operate normally and are not blocked with sludge. If the blow-down points are blocked clean them. When blowing down, slowly open the first valve near the header, then open the second valve. The valves are closed in the reverse order each point should not be blow down linger that 30 sec. During blow down control water level in the drum and maintain it constant, without drop.
- When the boiler is started after erection or an overhaul, control expansion of boiler units until operation parameter are reached. Measure Movement of bench marks both before filling the boiler in with water and after feeling it, and also during the lighting up, at aturn pressure 15 30 to 40.60 to 80 and about 50 kgf/cm When expansion of certain units is no enough, locate the cause of jamming and remove it.
- At boiler drum pressure about 20 kgf/cm" blows down the filters on condensate and water supply lines to steam atm.ospheres. The duration of each filter blow down is 2 to 3 min.
- The rate of pressure increase should not exceed values specified blow;
 - a) 1 to 1 0 kgf/cm² 75 to 80 min.
 - b) 1 0 to 40 kgf/cm² 30 to 35 min.
 - c) 40 to 1 00 kgf/cm² 25 min.
 - d) 100 to 155 kgf/cm² 20 min.
- Prior to the generator loading, gas temperature before the re-heater should not .exceed 600°C
- As soon as the load reaches 25% of the nominal one, change over from ignition bypass line (Dia. 150 mm) to the main gas line, for this to the following; -open slide valve No. NP10S011 (13) and control valve No. NP10S04 (No. NP10S03); -close both slide valves No. NP10S07 and control valve No. NP10S05, supply to the operating burners of the lower tier at first and then to those of the upper tier. Prior to switching on the burners of the upper tier, open four gate valves (Nos. NG16S01, NG16S02, NG26S01, NG26S02) to the group of three burners of the upper tier.
 - Switch on burner Nos. 8 & 11, 9& 10, 7 & 12, avoid temperature difference across the boiler width. Both gas supply and the inter valves, at which the burners are put into operation, are regulated according to the schedule of the boiler lighting and the unit start-up.
 - When supply is changed over to a continuous mode, feed up the boiler via bypass line (Dia 100) and switch on the starting feed

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water regulator. Since the change-over to continuous supply close the slide valve on the recirculation water line from the drum.

- At water flow rate above 200 ton per hour, when water supply via the bypass line) (Dia. 100mm) is exhausted, changeover to remote control of supply by the main feed line by means of regulating valve RL30S02 (Dia 250 mm), for this, -test that the feed control valve RL30S02 on the main feed line is closed; -open gate valve RL30S01 before the regulating valve and check flow by means of water meter, simultaneously observing water level in the drum; - changed over to supply through control valve RL33S02, for this partially close feed control valve RL30S02 -close valve RL31S02 and slide RL31S01 on the bypass line (Dial 00) when boiler supply is changed over to via the main feed control valve, put the main feed water regulator into operation.
- Since the moment of the burners switch on, watch the following; - the burners operation;
 - operating condition of the furnace, while doing this, regulate draught and air distribution on the burners, gradually increasing heat release in the furnace;
 - water level in the drum;
 - gas and water temperature along the boiler route, do not allow their increase above specified values;
 - the temperature of super heater rental;
 - temperature difference between the lower and the upper part of the drum, this difference should not exceed 40°C; - rate of saturation temperature increase, which should not 2.5°C per min
- When pressure in the boiler drum increases to about 25 Atm. (the boiler water wall temperature is 150 to 200°C, close the valves on the steam warming up line (Temperature difference of the boiler should not exceed 40°C.
- Warm up the live steam line up to 500°C at a rate 4 to 5°C per min; in the temperature range 500 to 545°C at a rate 1 to 2°C per min. Warm up reheat line in the temperature range 500 to 545°C at a rate 7 to 8°C per min; in the range 500 to 545°C at a rate 3 to 4°C per min.
- Quick acting pressure reducing and de superheating plant is put into operation when pressure in the boiler drum raises to 10 kgf/cm² switch on continuous blow down when pressure in the boiler drum is 10 to 15 Kgf/cm². Switch on phosphate pump (plant) at the order of the chemical plant personnel.
- When, during lighting or load increase, primary steam temperature increase, switch on feed water injection to the first steam temperatures (upstream) and then to the second steam temperatures (if necessary).
- When injection is necessary perform the following operations:

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-with actuator valve RL46S01 on the feed water injection point before the valves, and manually operated ones after the valves;
-open, slide valve RL41S01 (Dia 65 mm) on water supply line to injection via orifice plate; open slide valve RL47S01 (Dia 65 mm) on feed water discharge to the deaerator line and put actuator valve RL47S02 & RL47S03 of this line into operation;
-Supply the necessary amount of feed water to the steam temperature by means of actuator valve RL425G2 (RL425G2) on the injection point. When steam temperature reaches the value close to the nominal one, close water discharge to the deaerator and open valve RL40S02 (Dia. 100mm) on the main water supply line to injection by passing orifice plate.

a) Regulation of reheat of secondary steam in the period of lighting up and increasing the load is performed by injection of feed water (RL54S02, RL55S02) and connection between cold not hot reheat (RP20S01, RP20S02).

b) Recirculation I.D. Fan is put into operation under approx. 20-30% load (heat) with the guide vanes closed. Then close air-supply line in gas recirculation duct by closing slide valve No. NG32S02 open slide-valves in the pressure line at full (line of chimney gases recirculation) NS10S04, NS10S05, NS20S04, NS20S05, slide-valves on recirculation gas supply line into peripheral burner channels (NS10S06, NS20S06), NS21S01, NS11S02, NS21S02, on recirculation gas line to nozzles. Slightly open the guide vanes of recirculation I.D. Fan. Close hot air recirculation line to suction of F.D. Fan by closing slide valves NG 13301, NG23301.

Further increase of recirculation gases coming to the furnace is done by increasing the load of Recirculation ID. Fan

- Under load 200-250 t/h prepare for operation boiler condensate injection unit; open stop gate valves at reduced feed unit (Manually operated), and just before supplying condensate to injection open NA20S01 and by regulating valves NA21S02 (NA22S02, NA23S05, NA24S02, NA26S02) adjust required condensate flow-rate. Before of injection by steam back-flow.
- Control steam temperature in the period of lighting up the boiler in every element of a super-heater, and also pipe metal. All operations regarding regulation of fuel supply, air supply and regulation of reheat in the period of firing must be done manually (by remote control).
- Protections and interlocking that cannot influence negatively the unit startup must be started in operation before firing the boiler after their checking at idle boiler as per instruction on testing and putting protections into operation. Automatic regulators and protections which required definite steam parameters for their operation are switched into operation after achieving

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these parameters. The first group of Boiler protection is switched before switch SAB1 (gas, air pressure switching off of two I.D. Fans, FD. Fans and R.A.H). The second protection unit (drums level and flow rate through a reheat super heater). The following major requirements of reliability and safeties must be observed for the boiler start up.

- Water level in the drum must be in a medium position deviations must not exceed ± 50 mm. Expansion of walls and other boiler elements must be even;- in initial period of lighting up under low steam flow rate pay a special attention to the temperature of platens and radiant super heater; do not allow temperature of gases stratifications as the width of the furnace regards and in the gas ducts and also stratifications of steam temperature in super heater boxes; maximum difference of temperatures between upper and lower generalizes of the drum must not exceed 40°C ; do not allow overheating of metal of heat transfer surfaces; the temperature valves must be;

5.1.4 Shut-down procedure of the Boiler

5.1.4.1 Planned Shutdown

- With the planned shut-down (for reserve) in case if the maintenance of the boiler is not bring foreseen, the shutdown of the boiler is carried out without its cooling at almost invariable live steam temperature and reheat steam temperature.
- Unloading is carried out at first by decreasing of gas pressure up to desired kgf/cm^2 and then by uniform switching-off of the burners of lower and upper tiers.
- During stipulated hours it is necessary to decrease the Unit load up to desired MW with reducing the load the temperature of the fresh steam should be left invariable, equal to $530+540^{\circ}\text{C}$
- To put out all the burners, to stop the turbo/generator with closing the main steam gate valve in accordance with the instruction.
- The order of switching off of the burners; (a) To close manual and electrified valves in front of the burner and open safety gas vents; (b) To make sure that there is no a torch of the burners; (c) To switch off the protective-ignition device (if it was switched on).
- When the last burner is switched off, make sure that the torch in the furnace is put out, close gate valve NP 10S0, NP10S02 and that open the blowing vents NP30S01 NP30S02, gas vents of the line and parts of the gas pipe-lines for the lower and upper tiers of burners (4 PCS.)
- After putting out the torch it is necessary;
 - (1) To close phosphates supply to the boiler;
 - (2) To feed up the boiler up to the upper level (+200mm);
 - (3) To stop flue gas recirculation pumps;
 - (4) To close stop and regulation valves of the injection sub-unit;
 - (5) To close stop valves and regulation valves of feed sub-unit;

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(6) To the gate valve on the water recirculation line from the drum.

- In ten minutes after putting out of all the burners to stop all the J.D, fans and F.D. fans, to close their guide vanes.
- Just after the shut-down of the boiler to listen to the furnace and gas ducts, to carry out the internal (though eye-sights) and external inspection of the RAH. The shut-down of the RAH is permitted after the reducing the gas temperature in front of them up to desired temperature.
- Watch the water level in the boiler.

5.1.5 Shut-down of the boiler (for maintenance)

- With the shut-down of the boiler for the maintenance, when some preparing works are planned to be carried out on the steam water duct, furnace, gas ducts etc. It is necessary before the shut-down of the boiler to cool it by reducing is not more than 2.5°C/ min. and the difference "up-down" of the drum should not be more than 40°C.
- During 1-1.5 hours to reduce the load up to 70MW. With smooth loading of the quick acting reducing cooling unit it is necessary to unload the turbo generator up to Zero and disconnect from the grid in accordance with the instruction. At the same time protection separation is to be put on Turbine, position by use of switch SAB-2. II. Groups protection is to be removed.
- With the loading of the boiler below 200 t/h it is necessary to pass to lighting-up by-pass Dy-100 on the feed sub-unit and for that purpose; To close the valve on the main feed line diameter 250 (RL30S02) and line Dy-100, to adjust the required water flow rate; with the reducing the steam temperature it is necessary to full close the temperature regulators and gate valves and make sure due to temperatures behind the steam coolers mat there is no wafer leakage to the injection-
- Unloading of the boiler is being performed by reducing the pressure in the drum with the provision for the uniform speed of change of the saturated steam temperature.
- Before putting out the boiler, it is necessary to leave 2 burners under operation.
- To put into operation the device for steam cooling of the boiler's drum and for this purpose;

(a) To open the drains of the steam supply line from the boiler of the existing power station (1st stage);

(b) To open the valves on the line of the steam cooling of the upper part of the drum and steam bleed off from the working boiler (or the 1st stage) and to heat the lines of the steam supply;

(c) To open the valves on steam cooling lines and steam bleed-off of the cooling boiler; Top and Bottom of the drum,

(d) To close the drainage of the steam supply line;

- To put out all the burners. Actions with the gas valves; are to be carried out in accordance with items M;K39rii& To close the quick
- Action reducing cooling unit.

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- To make sure of non-availability of burning in the furnace, having listened to the boiler, inspected the RAH.
- To feed up the boiler up to the upper generation of the drum as per the water measuring column.
- After putting the torch in the furnace stop the phosphates supply to the boiler, stop the gas recirculation I.D. fan. P.S. Attention before switching off of the turbine, gases temperature before L.P. convection super heater should not exceed 60°C cooling of the boiler through the quick action reducing cooling unit is determined by relative expansion of turbine rotors, later, cooling should be carried but into the atmosphere. Later on close the stop and regulation valves of the injection sub-unit, stop and regulating valves of the feed sub-unit, open the gate valve on the line of water recirculation from the boiler.
- In ten minutes after putting out of all the burners stop all the F/D fans and I.D. fans and close their guide vanes.
- To stop the RAH after reducing the gases temperature in front of when up to 120+140°C.
- To watch the water level in the boiler's drum until the excess pressure is available. In order to speed up the cooling process of the drum it is allowed to carry out the drain of water from the boiler with posterior feeding-up.
- In two hours after putting out the boiler open the guide vanes F.D. Fans and I.D. Fans and create the vacuum in the furnace. To wait within one hour and at normal difference of "up-down" of the drum to switch on one line of I.D. fan and F.D. fan with 20-30% load. Then, depending upon the degree of cooling the load of I.D. fan & F.D. fan should be increased.

ATTENTION:

In case of increasing 'up/down' difference of the drum up to 40°C and further continuation of its growth it is necessary to stop the ventilation. To carry out the time delay for the reducing the difference up to the norm

- After closing the quick-acting reducing-cooling unit passes to the steam discharge through the steam super heater blower into the atmosphere through gate valves RA10S01, RA1QS02.
- With the reducing of the pressure in the drum up to atmospheric switch off the device of steam cooling of the drum, for the purpose first close the drum valves where the steam is bleed-off and then near the drum of the boiler being stopped. The temperature of walls at this is approximately 150°C.
- KD. fan should be stopped when the temperature of flue gases in the furnace and gas ducts and the metal of the "hot box" headers is approximately 50°C.
- Fuel gas pipeline is taken for maintenance at first by switching off as per item 10.1.8 and then is blown through by air, for that purpose it is necessary to connect the compressed air, line after gate valve NP10S01 (NP20S01), to open the gate valve on the compressed air supply to the gas pipeline, to create the pressure in it 1.0 Kgf/cm², to

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blow through the gas pipeline by air and take the analysis on gas (methane) content in the sample. Completion of the blowing is determined by the gas content in the air not more 1/5 from the lower limit of explosively (1%). The sample is taken up from the gas pipeline of the gas vents NP30S01, NP30S02 (NP40S01, NP40SQ2), NP50S01, NP50S02.

- The gas pipeline is considered to be taken for maintenance after the installation of the plug behind NP10S01 only; the above plug is closed with a lock and chain. It is necessary to remove power from the electrified valves of the gas pipeline.

5.1.6 Shut-down of the Boiler (for emergency)

- The boiler set should be immediately stopped and tripped out by the operation of protections or by the personal in case of
 - a) Inadmissible increase (+200mm) or decrease (-100mm) of the level from the average;
 - (b) All the water-indicating instruments are out of order;
 - (c) Breakage of the pipes of the steam-water duct or finding-out creaks and holes in steam pipelines or feed line;
 - (d) Decreasing of air pressure in front of the burners up to 40Kgf/m .
 - (e) In admissibly high increase of the steam pressure (1.08 P'.non), failure in operation of the safety valves.
 - (f) Putting out of the torch in the furnace or inadmissible decrease of gas pressure up to 0.35,kgf/cm²
 - (g) switching-off of two I.D. fans or two F.D.fans;
 - (h) switching-off of two RAHs;
 - (i) explosion in the furnace, ignition of combustible materials, heating-up of the carrying beams of the frame till they are red and as well as other damage threatening the personnel or equipment;
 - (j) Discontinuation of the steam consumption through the intermediate steam super heater;
 - (k) Losses of power on the devices of remote and automatic control and at all the control measuring instruments;
 - (l) Fault of more than 50% of safety valves;
 - (m) fire-hazard, threatening to the personnel or equipment and also to the circuits of remote control of the tripping valves included into the protection system of the boiler.
- If the protection is not switched on or it did not operate, it is necessary manually to close quick-acting shut-off valve. So, as a result of interlocking effect the boiler would be put out, the stop^ valves of the turbine would be closed.

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- If in the emergency shut-down the interlocking did not operate it is necessary perform the following operations manually;
 - (a) To close the quick-acting shut-off valve on gas line of the boiler.
 - (b) To close all the stop and regulating valves of the feed sub-unit (in emergency cases linked with losing the level of over-feeding) in other cases to carry out feeding-up of the boiler through by-pass dy-65;
 - (c) To close gate valve RL40S01 on the feed water supply line to the injection sub-unit.
- After that it is necessary:-
 - (a) To close main gate valve NP10S01 on the gas line.
 - (b) To close electrified and manually operated gate valves in front of burners,
 - (c) To open blowing "safety" gas vents;
 - (d) To close all the stop gate valves and regulating valves of the injection sub-unit.
- When the steam discharge from the boiler is stopped, feed up the boiler's drum up to most high admissible level (+200mm) on the upper water measuring column, then stop feeding-up (if the emergency shut-down is not connected with the breakage of the water wall system pipes or economizer)
- After ventilation of the furnace within 10 minutes switch off I.D. fans and F.D. fans.
All the posterior operations on the on the emergency shut-down of the boiler depend upon the reasons and the character of the break-down.
- (he boiler should be stopped in cases of;
 - (a) finding-out of holes in the pipes of heating surfaces, steam cross-over pipes and water down coming pipes of the boiler, steam pipe lines, headers, feed pipe-lines and leaks and steaming in the valves flange connections;
 - (b) Inadmissible increase of the metal temperature of the heating surfaces if it is not possible to reduce the temperature by changing the operation mode of the boiler;
 - (c) With" the fault o- all the remote water level indicators in the boilers drum;
 - (d) Sharp deterioration of the feed water against fixed norm;
 - (e) Faults of separate protections or devices of remote and automatic central and also control-measuring instruments,
 - (f) The time of the shut-down in such cases is determined by the Chief Engineer of the Power Station.
- During the lamination of the emergency situation it is necessary to proceed from the provision of maximum safe keeping of the equipment from its damage.
- With the appearance of the emergency situation in the shop, the operation personnel should inform the management of the shop and the station. Shop shift charge engineer is responsible to solve the liquidation of the emergency situation.

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5.1.6 Start-up Procedure of Generator of GPS

5.1.6.1 Preparation of Generator for a Start

- It is allowed to proceed with starting operations on generator after completion of all works on the Unit and presence of record in the register of start-up of equipment after erection or overhaul. Shift leader of electrical shop should be the following;
 - a) To check completion of works on orders;
 - b) to , examine thoroughly and get convinced cleanness and service When examining special attention should be paid on fulfillment of safety regulations, anti-fire measures as well as on lighting of the equipment and premises;
 - c) To check open position of blow-off valve;
 - d) To remove all special and protective ear things;
 - e) All permanent fencing and placards should be on their places.
- Resistance of insulation of generator winding, generator excitation circuit, transformer windings should be checked and the entry should be made in the register of measurement of generator insulation. Checking of insulation of stator winding, low-voltage windings of unit transformer and high voltage windings of auxiliary transformer is carried out by meager. The value of resistance of insulation of generator winding with disconnected bus bar duct depends on windings temperature and varies with in the range of 4.7-5C 5MΩ (t=75-1.50C). The value of absorption factor of insulation $60\Omega/15\Omega$ measured at the temperature of windings+ 10+300C should not be less than 1.3: The value of resistance of the bused generator together with winding 15.75kv of unit transformer and tapped transformer and during circulation of distillate in stator winding is not standardized and putting of generator into a net work is allowed if total resistance of insulation is more than 100kΩ.
- The resistance of insulation of generator excitation circuit, measured by meager 1000v should not be less than 0.5mΩ. If the resistance of rotor insulation is less than .5mΩ it is necessary to take measures for its restoration. Operation of generator with resistance of rotor winding insulation less than 0.5mΩ is possible with the permission of Chief engineer.
- Resistance of winding 6kv of tapped transformer measured by meager 2500V depends on conditions of measurement and as usual should not be less than 1mΩ for 1kv.
- If the resistance of insulation on the equipment is less than the above values shift leader of electrical shop should inform shift leader of the station and Chief of Electrical shop and should act according to their instructions.
- The circuit of the unit is assembled by switching on;
 - a) Short-circulating switch of neutral terminal of unit transformer.
 - b) Bus isolator for a corresponding bus bar system and isolation on the
 - c) Circuit-breakers and knife-blade switches of voltage instrument transformer and emergency reserve transformer;

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d) knife-blade switches and circuit-breakers of generator excitation of working or stand-by exciter;

e) Knife-blade power switches to the assembly of forced air cooling of transformers.

- Preparation of gas-oil circuit of the generator should be down in accordance with section III of the present instruction.
- Emergency start of reserve of oil pumps in the system of oil supply and seals and emergency start of reserve of gas coolers pumps are checked
- Gas cooler pumps are started and cooling water into generator gas cooler is supplied.
- Stator cooling pump is started and distillate is supplied into stator winding.
- Thyristor converters cooling pump is started and distillate is supplied for cooling, if generator is operating on stand-by exciter cooling water is supplied into its air coolers before start of the exciter.
- When fulfilling the requirements of the present section of the instruction shift loader of electrical shop informs station shift leader about the readiness of generator for start.

5.1.7 Start of Generator

- Start of generator on air cooling is allowed only for adjustment without excitation.
- After reaching 3000 RPM blow-off valve is closed and the generator is examined again in accordance with requirements of item 3. Pressure difference of hydrogen should be measured on the compressor and it should not exceed 63mm. w.c.
- Hydrogen dryer is put into operation.

Stepping up of Voltage, Synchronization and Putting of Generator In to a Network.

- After receiving an order from station shift leader, shift leader of electrical shop starts synchronization and putting of generator into a network. If the state of thyristor excitation is normal generator should be excited and put into a network on a working exciter and if it is out of order on a stand-by exciter. The speed of stepping up of voltage is not restricted. It is necessary to control that smooth increase of current in rotor winding corresponds to smooth increase of voltage on generator bush the current in stator phases should equal zero at his. At $U_{nom}=15$. kv rotor current should be equal to 720A. So Before Synchronization ensures the
 - ii) Thyristor cooling system
 - iii) Sealing oil system of generator
 - (iv) Generator is filled with hydrogen with pressure 3 kg/cm² & purity & hydrogen is more than 98%
- After that
 - (a) Open the generator circuit breaker (Unit Breaker) & close the isolator in 230 kv Switchyard.

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- (b) Switch on the cooling fans of Unit X-former
- (c) Initial excitation auto circuit breaker must be "ON" & knife switch should be kept in close position.
- (d) Switch ON the supply of control circuit (Generator ckt breaker in relay room, field killer, input of working excitation)
- (e) At Speed 3000 rpm place the selector switch in synchronous position. Close SAE-4 (Input of working excitation)
- (f) Close SAE-1 (Auto field killer).
- (g) Close SAE-2 (Switch on Thyristor excitation) & wait for 5-18 seconds.
- (h) Within 5-18 seconds generator terminal voltage is 15.75 KV when excitation amps 720. For getting required voltage can be operate SAC-1 (if necessary).
- (i) Switch ON (with key) SS-1 & synchronous Scope pointer rotates.
- (j) SV-1 is put into coarse position (Left) operate SAC-1 to obtain real voltage & speed of turbine.
- (k) Put SV-1 in accurate position (Right).
- (l) Switch ON the Unit Breaker when the synchronous Scope pointer is 7-10° ahead before zero position & it rotates at a speed of 2-3 RPM in clockwise direction. Now Synchronization is complete.
- (m) Put SV-1 in neutral position.
- (n) SS-1 is switched off & it should be kept in safe position

Loading and Control Over Operating Generator

- After putting the generator into a network it is necessary to take 5-7 MW of active load, 5-10 MW of reactive load and to start forcing.
- To assemble the circuit of supply of sections of 5kv assembled switchgear. To shift power supply of bays of 6kv assembled switch-gear for working auxiliary transformer for what it is necessary to; Depending on voltage of generator bushings to set voltage regulator of working transformer into position which corresponds approximately to voltage on sections of 6kv assembled switch-gear;
 - a) To turn on oil circuit-breaker of working supply of bay 3BA and get convinced in
 - b) To turn off oil circuit-breaker of reserve supply of bay 3BA and to check the value of voltage on the Section,
 - c) To turn on emergency start or interlocking switch of reserve of section 3BA;
 - d) To turn on oil circuit-breaker of working supply of section 3BB and get convinced in presence of load on it;
 - e) To turn off oil circuit-breaker of reserve supply of section 3BB.
 - f) To switch on emergency start of reserve of section 3BB;
 - g) To apply nominal voltage on section 3BA and 3BB by changing the position of voltage regulator of working transformer
- Further increase of active load should be made according to the schedule of warming-up of turbine with average rate of 0.8 MW/min. Total time from the

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moment of start of generator till complete load of 210 MW is 5.0-6.0h. Increase of active load on generator after its start and decrease till its shut-down is done by personnel of boiler-turbine shop. The rate of picking up reactive load should not exceed the rate of increase of active load (0.8MV/min).

- The rate of loading of generator at a hot state of turbine depends on temperature of separate components of turbine and loading is carried out in accordance with "The instruction on operation of steam turbine" K-200-130-3"
- Loading of generator on active and reactive power is done not more than to nominal values. In order to prevent sweating of gas coolers the lower limit of temperature of cooling gas is set at 22°C. Operation of generator at hydrogen temperature exceeding 55°C is not allowed.

5.2 Turbo-Generator Shut-down

- After getting the instruction on coming shutdown of the turbo-generator it is necessary; -to test the stand-by/emergency oil pumps and their automatic reserve closing; -to make sure that stop valves and regulating valves of HPC and IPC move smoothly without sticking; -to test the operation of registering and indicating instruments of the turbo-generator; -to check up wither the main steam valve of by-pass lines are closed; - to make sure that the quick reducing-cooling system is ready to be set in operation; -to switch off the protective pressure regulator of fresh steam, if it was in operation (upstream controller makes it manual);
- Decrease the load of the turbine step by step with the help of the control mechanism at the rate of 3 MW per minute up to 70 MW The rate of decreasing the load should allow the operational personnel to keep the nominal temperature of fresh steam and pressure of fresh steam close to nominal.
- While decreasing the turbine load it is necessary to thoroughly control the relative position of the turbine rotor, difference in temperature between the top and bottom of cylinders in sections under control, vibration of the bearings, temperature of flanges and studs and other indication under control. In order to decrease contraction of rotors of HPC and IPC and it is required to apply fresh steam to the secondary chambers of the front seals of HPC and I PC. The temperature of the applied steam should be higher than the temperature of metal in the area of the regulating stage.
- When reducing the load it is necessary;
 - to shut off H.P. heaters at a load of 150 to 160.MW;
 - to supply the deaerator with steam from the 10 atm. unit 3 auxiliary collector;
 - to switch off one feed pump out of use and keep another one running continuously at a load of 120 to 130 MW.

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-that the drain drip pump switches off automatically and LPH No. 2 heating steam be condensate drained to the condenser at a load of 70 MW.

- Set the quick acting pressure reducing cooling system in operation when the load is 70 MW. Decrease the turbine load till idling mode within 10-15 minutes with the regulating valves. After the unloading is completed, close the stop and regulating valve of the turbine acting on emergency turbine shutdown key (or acting with one of the protections). Close the valve on the steam suction line from the turbine valve steams into the deaerator.
 - If it is required to shut-down the turbine for a short period of time and to keep vacuum in the condenser without boiler shut-down, it is necessary prior to turbine shut-down to eliminate the effect of stop valve fits on the boiler shut down and disconnects the Unit protection. Steam from the boiler is to be discharge through the quick reducing cooling system, maintaining the temperature of discharge up to 200°C and vacuum in the condenser not lower than 540 mm of mercury column.
 - If, during Unit shut-down it is required to cool down the boiler and not to cool down the turbine, it is necessary, after turbine shutdown and as per instructions on boiler, to thoroughly vacuum in the condenser and temperature of exhaust. The turbine should be cooled down through the quick reducing cooling system until the temperature of live steam is decreased, at which steam supply to the rotor seals provides relative expansion within the limits.
 - It is required to cool down the turbine, decrease the temperature of steam when the load is 70 MW till 500°C and start operation HPC & !PC regulating valves fully opened. Opening the quick reducing system, decrease further the load till 10 MW at sliding parameters of steam until its pressure becomes 30 atm. and temperature 350°C with 2.5 hours (i.e. merely in the reverse order of taking the load from the "cold state"). When the load is 30-40 MW, stop supplying steam to LPH. In this mode it is necessary to particularly control thermal and temperature condition of the turbine, relative expansion of rotors, bend of turbine and vibration of bearings, temperature of thrust-bearing pad, axial shift. If the parameters under control are "violated, the turbine must be immediately stopped by fitting the stop valves. The relative rotor expansion is to be maintained by supplying live steam to the rotor seals, flanges and studs of cylinders. Shut-down of the turbine with its cool-down should be carried out under the guidance of Head of the turbine shop or his assistant.
- After stopping steam supply into Turbine the following operations are to be carried out; -make sure the stop valve and regulating valves closed; if there is

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jamming in setting of valves immediately close steam gate valves; -make sure that Turbine steam stop valve is close after setting of stop valves and in case they are not closed, do this by control switch; open discharge gate-valves of hot reheat, -make sure by active power meter (Mega Watt meter) and kilowatt, meter in consumption of active power and that there is no steam flow through Turbine.

- trip the Generator from the grid after performing the above operations. Turbine can operate in steam less mode for not more than 4 minutes.
- After making sure that frequency of rotation of Turbine rotors is decreasing make the following operations;
 - on reaching 2850 r.p.m start a reserve el. pump of lubrication of Turbine with A.C. Motor and control that oil pressure in lubrication system is normal;
 - write down in 'operating log-book time of Generator tripping form the grid

5.3 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-Gas Steam Power Plant are as below:

SI Nos.	Aspect	Impact	Controls
1.	Release of NOx -	Causes chronic lung disease, impacts tree growth	1. Injection of water or steam into the combustion zone, a control technology that lowers flame temperature. 2. Implement dry low NOx combustion (DLN), a technology that uses staged combustion and lean-premixed fuel-air mixtures, and 3. Catalytic combustion
2.	Release of Carbon	GHG emission	1. Carbon Capture,

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	dioxide		Utilization, and Storage (CCUS) Plan 2. CO2 Scrubbing
3.	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
4.	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
5.	Natural Resource (gas) 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 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
6.	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.
7.	Electricity Consumption from Ancillaries	Global Warming	1. Ensure Efficient Operation
8.	Use of lubricant	Soil Pollution	1. Follow the waste

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			management plan
9.	Leakage of gas from pipeline	Natural Source Depletion	1 . Regular Inspection and monitoring
10.	Warm water rejection to river	Thermal Pollution	1. Monitoring Engine System to ensure it not generating excess heat

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.

5.4 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-Gas Steam Power Plant are as below:

SI Nos.	OHS Hazard	Controls
1.	Leaking Gas Supply Pipeline	1. Check LEL detector Status
2.	Possibility of flammable gases/fumes in engine room chamber	1. Ensure Good Ventilation 2. Follow the 'Prevention of Fire and Explosion' Procedure
3.	Explosion in turbine due to cooling system failure	1. Ensure Regular Maintenance
4.	High Noise Level	1. Staff must wear Earmuff whilst in the Engine room
5.	Slipping due to water spillage on floors	1. Maintain adequate housekeeping. 2. Maintain signage if there is any spill.
6.	dropping / falling object	1. Maintain adequate PPE (e.g. Helmet) whilst at worksite
7.	Electric shock / Electric Arc	1. Ensure a Permit to Work is issued as per guidance before personnel is

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		sent for work 2. Maintain LoTo Procedure 3. Maintain adequate PPE whilst at worksite
8.	Fire / Explosion at worksite	1. Follow the 'Prevention of Fire and Explosion' Procedure
9.	Heat Stress	1. Ensure Heat Stress Training for all the employees 2. Ensure a good work plan
10.	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
11.	Chemical Spillage / Burn	1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite 3. Ensure good House Keeping
12.	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
13.	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
14.	Light from welding	1. Provide Necessary Training 2. Maintain adequate PPE whilst at worksite 3. Proper Supervision
15.	Unhygienic work environment e.g. canteen, toilet etc	1. Maintain adequate housekeeping.
16.	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
17.	Poor Visibility due to improper lighting	1. Maintain adequate housekeeping. 2. Installing adequate Lighting
18.	Lifting heavy objects	1. Maintain Material handling Procedure

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		2. Ensure a Permit to Work is issued as per guidance before personnel is sent for work
19.	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

None

7.0 Appendix

None

8.0 Revision History

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