

BOILER COMMISSIONING.

OBJECTIVE:

It is a systematic procedure used after completion of erection in making the Boiler and its auxiliaries available for safe, smooth and reliable Operation.

Major events in Boiler Commissioning

01. Air leakage test.
02. Hydro testing of boiler.
03. Readiness of Boiler auxiliaries.
04. Gas distribution test.
05. Boiler light up
06. Alkali boil-out and first stage passivation.
07. Acid cleaning and second stage passivation.
08. Steam blowing of critical piping.
09. Safety valve floating.
10. Coal firing.

AIR LEAK TEST.

Air leak test is an erection activity and is conducted before conducting the Hydro test of boiler. The aim of air leak test is to ensure that erection of pressure parts is completed.

Air leak test is conducted by introducing air into the boiler pressure parts at a pressure of approximately 8 ksc and the entire boiler pressure parts are checked manually for any leakage.

BOILER HYDRO TEST.

Boiler hydro test is an erection activity and conducted after ensuring zero leakage from air leak test. Boiler hydro test is done at 1.5 times the design pressure of drum for the first time. It is statutory requirement and conducted every year. It is a major milestone activity in power plant installation schedule.

Boiler hydro test is done by filling water from the bottom most portion of the boiler. After ensuring full flow of water through the vents the vents are closed and pressurization is done by an external pump installed near the drain header.

REFRACTORY DRYOUT.

After completion of refractory erection which is around 1400 tons per units it has to be dried out to remove the moisture and to attain the physical and chemical properties. Refractory dry out is carried out as per the curve given by Refractory manufacturer.

READNESS OF BOILER AUXILIARIES.

After erection completion of individual equipments and their related systems, commissioning of each system and sub system are done individually to confirm the availability of each equipment.

1. ID Fans & Auxiliaries
2. PA Fans & Auxiliaries
3. SA Fans & Auxiliaries
4. Start-up burners and Bed Lances i.e Oil System
5. Blowers safety settings

GAS DISTRIBUTION TEST.

Gas distribution test is conducted in ESP to ensure that the velocity of flue gas is ESP in uniform through the entire cross sectional area of ESP.

GD test is done by operating all fans and blower at the rated parameters and the velocity of flue gas is measured between the collecting electrodes for the entire width of ESP at various elevation and the values are recorded based on the values correction are made in GD screen hence ensuring uniform flow across ESP cross section.

BOILER LIGHT UP.

The following activities are to be done in sequence for light up of boiler.

1. All HT / LT supplies of boiler auxiliaries are to kept on .
2. Compressor to be started and air pressure to be maintained at boiler end.
3. HFO to be kept in recirculation.
4. Electric heater to be taken into service.
5. Air heater to be charged.
6. Electric heat tracing of HFO lines to be kept on.
7. Lube Oil system of fans to be kept in operation.
8. Cooling water to be charged for all boiler auxiliaries.
9. Propane / LPG to be kept charged till boiler area.
10. Cold trial of igniter to be completed.

BOILER LIGHT UP.

10. CST to be filled with DM water and quality to be confirmed.
11. Drum level to be maintained to the required level.
12. Position of all drains and vents to be confirmed.
13. Bed material filling inside combustor to be ensured.
14. Free flow of bed material from BM bunker to be confirmed.
15. Complete box up of boiler to be confirmed.
16. Fans and blowers to be started as per sequence.
17. Boiler purge to be completed.
18. Air flow to be adjusted as required.
19. Combustor DP to be adjusted as required.
20. Boiler light up to be done.

CHEMICAL CLEANING OF BOILERS.

The primary reasons for chemical cleaning of boilers are to prevent tube failures and improve unit availability. A relatively smaller quantity of deposits creates difficulties in high pressure boilers. Deposits originating both from fabrication should be considered potential problem.

All pressure parts of a steam generator may be subjected to heat treatment of some sort during fabrication or erection – during forming operations, stress relief, welding or bending. Whenever carbon low alloy steels are subjected to high temperatures in the presence of air, oxidation occurs, the oxides produced is known as mill scale.

Chemical cleaning are done for removal of these foreign materials and keeping the pressure part internals clean.

CHEMICAL CLEANING OF BOILERS STAGE - I.

Chemical cleaning of boilers adopt the following procedure.

Water washing :

Before starting of alkali boil out, boiler is completely flushed with DM water. Boiler is filled through economizer till the drum is filled completely, care to be taken to ensure that DM water does not enters the super heater section. After filling boiler is drained in the shortest possible time by opening all drain valves. This process is repeated two or three times till the water collected from the drains are clear.

CHEMICAL CLEANING OF BOILERS STAGE - I.

Alkali Boil Out :

The alkali boil out is performed by lighting up of boiler and boiling out alkaline solution of 1000 ppm of TSP and 500 ppm of DSP at 40 ksc drum pressure.

Required chemicals are prepared outside and directly charged into the boiler drum through the drum manhole doors. Before charging chemicals boiler shall be filled to the bottom of drum and after addition of chemical drum manhole doors to be boxed up and drum level to be raised to normal working level.

CHEMICAL CLEANING OF BOILERS STAGE - I.

Boiler is lighted up and pressure is raised gradually to 40 ksc. After attaining this pressure, blow down is given through individual blow down valves for one minute each to remove substantial quantities of impurities collected in water wall header.

Blow down are given at an interval of 4 hours and samples are taken for analysis every 2 hours for PH, Alkalinity, Phosphate and Oil. Boil out to be continued for about 24 hours till oil ppm comes to less than 5 ppm. Care should be taken to maintain feeding rate to keep the drum level normal. Care should be taken to keep furnace flue gas outlet temperature at super heater and re heater below 540 deg. C.

CHEMICAL CLEANING OF BOILERS STAGE - I.

After completion of boil out, boiler is boxed up and pressure in the drum allowed to fall gradually. Drum vents are opened at 3 ksc. Boiler to be drained when drum metal temperature has dropped to 90 deg. C.

Rinsing :

Rinsing operation is carried out by filling and draining method. Rinsing should be done till drain water is free from alkali and PO₄ content has reduced to less than 50 ppm. Drum is inspected and cleaned manually.

CHEMICAL CLEANING OF BOILERS STAGE - II.

After completion of rinsing subsequent system are made ready for acid pickling after super heater is filled and plugged. Drum internals are removed, orifice are fixed in down comers and nitrogen blanketing connection is made.

SH filling :

Hydrazine (200 ppm) and ammonia (to raise PH to 10) are added to DM water in dissolving tank and slowly pumped in super heaters. When PH of water raises to 10 at connecting tubes from super heaters in drum, connecting pipes are plugged and super heater is kept under pressure atleast 5.0 ksc above the drum pressure through out the acid cleaning process.

CHEMICAL CLEANING OF BOILERS STAGE - II.

Acid Pickling :

System is filled with DM water and circulation is established. Temperature of DM water is raised and maintained at 65 deg. C by admitting heating system to dissolving tank.

First inhibitor (Rodine 213) is charged fully (0.2%) and after confirming inhibitor in return line, Hydrochloric acid and ammonia bifluoride are charged simultaneously, addition of HCL is regulated to get an ultimate concentration of 4% in return line preferably within 90 minutes. Care to taken to confirm that the concentration does not exceed beyond 6% during charging.

CHEMICAL CLEANING OF BOILERS STAGE - II.

During acid cleaning concentration of Hcl and Fe content in the system is checked every half an hour. Concentration of Hcl decreases rapidly at first and slowly afterwards and then steadies at a constant value. Similarly, Iron value increases and attains a steady value. Constant value of Hcl and iron content marks the completion of acid pickling. System is drained under nitrogen blanketing and the drained acid is neutralized before disposal.

DM Rinse:

After draining of acid boiler is filled with DM water circulated for one hour and the system is drained under nitrogen blanketing.

CHEMICAL CLEANING OF BOILERS STAGE - II.

Citric acid rinse:

The system is again filled with water containing 0.2% by weight of citric acid and PH maintained to 3.5 to 4 by adding ammonia. While filling the system with DM water add proportionate quantity of citric acid so as to get a uniform concentration of 0.2%. Ammonia is added to increase the PH to 3.5 to 4.0. During this process steam is admitted to raise the temperature to 55-60 Deg. C. After achieving uniform concentration circulation is maintained for one hour. Samples are collected for discharge and return lines and are analysed for PH and iron. When value are stabilized system is drained under nitrogen blanketing.

CHEMICAL CLEANING OF BOILERS STAGE - II.

DM rinse:

System is filled with DM water and circulated for one hour, after one hour system is drained under nitrogen blanketing. During rinsing operation drain samples are checked for PH and iron contents. The same procedure is repeated will iron content is less than 50 ppm.

After completion of rinsing boiler is boxed up and allowed for natural cooling. At 3 ksc super heater and drum vents are opened and at 90 deg. C boiler drum metal temperature the system is drained and left aerated by natural draft. After this second stage passivation is completed which marks the completion of chemical cleaning.

STEAM BLOWING.

Introduction :

The purpose of steam blowing is to remove scales, loose material, iron cutting etc., which have been entrapped in super heater, re heater and related piping during manufacture, storage and erection. Failure to remove these debris may result in damage to the turbine blades, valves etc.

Technique adopted:

The steam blowing is carried out by puffing method. This technique will give thermal shock to the contour being purged to dislodge the scales etc., which will be subsequently cleared by the expanding steam.

STEAM BLOWING.

Steam blowing is done in four stage a follows.

Stage I : Super heaters and Main steam lines upto HP stop cum control valve.

Stage II : SH, MS lines and cold re heat lines, during last few blows the HP by pass lines are included in parallel. If necessary, HP by pass line are blown separately.

Stage III : SH, MS lines, CRH lines, re heater, Hot re heater lines an upstream of LP by pass valve.

Stage IV: Extraction lines & Misc. auxiliary steam lines.

STEAM BLOWING.

Procedure :

The boiler drum pressure is raised to 40ksc and the line to be blown is warmed up. Then firing is stopped and simultaneously both the temporary stop valves are opened. It is preferred to have a single switch to operate both the stop valves.

To prevent thermal stresses in the drum the saturation temperature change in the drum is limited to 40 deg C maximum i.e when the pressure in the drum comes down to around 19 ksc, the temporary stop valves are closed. The standard practice is to limit the number of blows per day to 8/10 at an interval of 90 minutes with overnight cooling usually from 2200 hrs. to 0600 hrs.

STEAM BLOWING.

Disturbance factor (DF) :

The ratio of force exerted by blowing steam on particular matter to the force exerted by steam at MCR condition during normal operation, is referred to as Disturbance factor which is also known as Clean Force Ratio or Cleanliness factor.

$$\begin{aligned} \text{DF} &= (\text{Drag under steam blowing}) / (\text{Drag under MCR flow}). \\ &= (Q^2_{\text{SB}} \times V_{\text{SB}}) / (Q^2_{\text{MCR}} \times V_{\text{MCR}}). \end{aligned}$$

Where

QSB = Steam flow during steam blowing.

QMCR = Steam flow at MCR.

VSB = Specific volume of steam during steam blowing.

VMCR = Specific volume of steam at MCR.

British Electricity International, England recommend DF of 1.3 to 1.6 while a per GE, it should be > 1.0 .

STEAM BLOWING.

Acceptance :

The colour of the steam charged to atmosphere can be used as an indication of the debris being removed from the contour. In addition, the aberration on the polished target plates fixed in the exhaust piping will be used to indicate the effectiveness of blowing. Softer material like aluminum, brass, copper etc. can also be used for target plates. For evaluating the cleanliness and termination point of steam blowing, target plates made of alloy steel are to be used.

SAFETY VALVE FLOATING.

Safety valve floating is done to confirm the freeness and automatic operation of the valve. Safety valve are used to prevent the boiler pressure parts from being pressurized more than the design value. It is also a statutory requirement and is done yearly.

The sequence of floating at SLPP is

Drum (Right)

Drum (Left)

Main steam.

SAFETY VALVE FLOATING.

Location.	Set Pr.	Re set Pr.	% BD.
Drum (Right)	157.0	149.2	5.0
Drum (Left)	161.7	153.7	5.0
Main steam	140.0	133.0	5.0
CRH	35.0	33.3	5.0
HRH (Right)	32.4	30.8	5.0
HRH (Left)	33.1	31.5	5.0

COAL FIRING.

After completion of safety valve floating coal firing is done. After achieving required parameters coal feeding is started by opening MFT, and starting LRALF and lignite conveyor in sequence . Parallel opening of manual isolation gates of lignite bunker are done. After reaching rated parameters the expansion readings of entire boiler is noted.

Thank You