Sub: Publishing of Technical Bulletin in electronic form on the KPCL website

Ref: IOL of CE(KERP) No.A1L/Systems/Website/20 dt.22.04.2020

Date of submission	:	29.05.2020.
Type of document submitted	:	1) Cold startup of the unit when MDBFP not in service. File in pdf form (5 pages) 2) Revised/ Optimised/ recommended operating procedure for cold startup of BTPS Unit-1&2 File in pdf form (6 pages)
Details of activity	:	Cold startup of the unit when MDBFP was not available in BTPS-Unit-1.
Period /date of activity	:	October 2010
Activity conceived/initiated/ performed by	:	Krishna Bhat, AEE(M) EC No.06-1773
Division of working at the time of implementation of referred activity	:	EE (Efficiency & Planning), responsible for monitoring & improvement of efficiency of the units.
Performance improvement achieved	:	• Avoided probable shut down of the unit for about 5 days & loss of generation of about 60MU. • Modified/improved/ efficient procedure for boiler feeding during cold startup of the unit was successfully implemented resulting in reduction of auxiliary consumption during each startup of the unit in future.
Present post of working	:	Executive Engineer (Mechanical)
Present place of working	:	EE(MSP)Y, YCCPP, Yelahanka.
Contact details	:	Krishna Bhat, EE(M), EC No.05-1773, O/o EE(MSP)Y, YCCPP, Yelahanka e-mail: eemspyccppkpcl@karnataka.gov.in Mobile:8277396830

BTPS-500MW-UNIT-1

COLD STARTUP OF THE UNIT WHEN MDBFP WAS NOT AVAILABLE

1. INTRODUCTION:

At Bellary Thermal Power Station, 1X500MW plant was commissioned during 2007.

The plant was not equipped with back up steam from package boiler, as it was provided in other thermal units. Being the first unit of the station, there was no provision for backup steam from adjacent units also, since originally only one unit was planned in BTPS.

Steam is essential during any clod startup of the unit, for HFO heating & firing. However standard practice followed was to light up the boiler with LDO (provision only in one elevation) and then charge the PRDS (Pressure Regulating & de-superheating Station) from self-steam from the boiler. HFO heating & subsequent firing was possible only after charging the PRDS.

There is a provision to run steam driven BFP by drawing steam from PRDS.

2. TECHNICAL DETAILS IN BRIEF:

Boiler feed pump arrangement:

The KWU- series machine (500MW) supplied by BHEL is provided with two TDBFP (Turbine Driven Boiler Feed Pump) and one MDBFP (Motor Driven Boiler Feed Pump).

Turbine driven boiler feed pumps are run during normal plant operation with steam source from A4 extraction/ CRH/ aux PRDS and motor driven boiler feed pump is run from 11kV supply source from startup supply, during non-availability of any one TDBFP.

As per standard operating practice inculcated by OEM- M/s. BHEL, only MDBFP was used to run during all cold startups & low load operation, since there was no backup steam available during such period as explained above.

Boiler filling and feeding arrangement:

As per design,

- Boiler is to be initially filled using boiler fill pump.
- Boiler drum can be fed through economiser up to drum pressure of 7.5 KSC by running boiler fill pump since discharge pressure is 14 KSC.
- Above 7.5 KSC drum pressure boiler drum is to be fed by running boiler feed pump.

3. BACKGROUND:

During one of the cold startup of Unit-1, (in year 2010) winding of MDBFP motor got failed and hence it was not available for service. It was estimated that, about 4-5 days time was required for resuming MDBFP by replacing the motor by new one.

It was a major hurdle for unit startup, as available two TDBFPs could not be taken into service due to non availability of steam. This has created a situation of loosing generation of about 4-5 days.

4. RESOLUTION:

To overcome this situation; other possible alternatives for feeding the boiler were explored. One alternative method of boiler feeding was thought of in the form of feeding the drum through CEP (Condensate Extraction Pump).

One exclusive line (200NB) from condensate header to boiler fill line is provided as per original design to use during following situations:

- To fill the boiler by transferring water directly from condenser hot well.
- To raise the boiler pressure for boiler preservation during prolonged plant shut down.

This scheme was never used before either during commissioning or during initial operation of the unit. Even the OEM-M/s. BHEL was unaware of this scheme.

It was decided to use this facility for feeding the boiler drum through economiser till any one TDBFP is put into service.

Note: For schematic representation of boiler feeding scheme, refer FIGURE-1.

5. ACTION PLAN:

- Boiler was initially filled using boiler fill pump.
- Boiler was lighted up with only one oil elevation (LDO). Boiler drum pressure was raised slowly and PRDS was charged at 7 to 8 KSC of MS pressure.
- Steam supply to HFO heating station was kept isolated to minimise the steam consumption of PRDS and thereby catering the steam demand of TDBFPs.
- Boiler drum feeding was carried out through boiler fill pump up to drum pressure of 7.5 KSC. Further boiler feed was carried out through CEP till TDBFP was taken into service. Boiler feed was regulated by operating economiser filling line valve at LPD station (manual valve)
- Chemical dosing (LP dosing) was diverted to boiler fill line by using existing connection.
- After attaining the required PRDS steam temperature (215^0C) for gland steam requirement, vacuum was pulled in the condenser and gland steam to both TDBFP was charged.
- Both TDBFPs were rolled to 1500RPM and waited till required casing temperature (230^0C) was attained.

- Boiler feeding was switched over to TDBFP by slowly raising the speed of one of the TDBFP.

  Note: This activity took about 3 Hours.
- Till switching over to TDBFP, boiler drum pressure was restricted to 18 KSC, as feeding the drum using CEP could be possible only up to drum pressure of 20KSC.(CEP header pressure:27 KSC & boiler head:70 M)
- Feed water pressure build up by TDBFP & steam consumption was recorded as below:

Speed	F.W pressure	Steam consumption
Barring gear (350 RPM)	7 KSC	Nil
1500 RPM	24 KSC	5 T
2000RPM	36 KSC	8 T
3000RPM	78 KSC	14 T

- After successful switching over to TDBFP, boiler drum pressure was slowly raised and HFO heating station was charged.
- After attaining required HFO temperature (120^0C) boiler firing was changed over to HFO.
- Required steam parameters for turbine rolling were attained at around 2 hours.
- Turbine rolling, unit synchronization & loading were carried out as per the established operating procedure.

Note: Total time taken for synchronization was 7 Hours as against the usual time of 6 hours (with MDBFP)

6. CONCLUSION:

- This methodology of boiler feeding during a cold startup was never tried by the OEM-M/s. BHEL or in any other power station of similar capacity.
- By conceiving, initiating & successful implementation of the above methodology for boiler feeding, loss of generation of about 5 days (around 60MU) was avoided (in particularly during peak demand from grid).

- Minor modification in the scheme of boiler filling line from CEP was suggested, to enable regulating the boiler feed from control room instead of operating manual valve at local.
- By successful implementation of this scheme, it was also confirmed that, necessity of running MDBFP during cold startups of the unit can be avoided in future, resulting in considerable reduction in auxiliary consumption.(Capacity of MDBFP:10 MW & average running time during each cold startup will be 6-8 hours)

- This feedback was also forwarded to Technical Services wing of M/s. BHEL, Delhi, with a request to publish this feedback in their technical Journal, through which it can be communicated to other customers with as part of knowledge sharing purpose. This effort of KPCL engineers was highly appreciated by the commissioning group of BHEL-PSSR-Chennai with their comment as "***new technical initiative in the field of startup of a 500MW unit by successful utilization of the hidden facility by an esteemed customer, which is commendable.***"

7. **MODIFICATION SUGGESTED & IMPLEMENTED SUBSEQUENTLY**:

To have ease in operation following modification were carried out:

- The excess condensate line (unused pipeline) provided in the condensate system which was running parallel with the boiler fill line was interconnected with minor modification.
- Consequent to this modification, regulation of boiler feeding was made possible through the control valve or its motorized bypass valve (earlier envisaged for excess condensate flow control)
- The control valve and its motorized bypass line operations were hooked to DCS control system & thereby enabling a provision for remote operation of these valves from control room for better boiler feeding/ regulation.

  Note: For schematic representation of the scheme of modification refer FIGURE-2
- Subsequently a document indicating detailed guideline for using this methodology of boiler feeding during cold startup of BTPS Unit-1 & 2 was prepared & submitted to Planning & Efficiency division, for circulation. In that document different combinations of running of TDBFPs & MDBFPs were explained in detail, so that reduction in auxiliary consumption can be achieved during each startup of the units.

FIGURE-1

BOILER FEEDING SCHEME THROUGH CEP

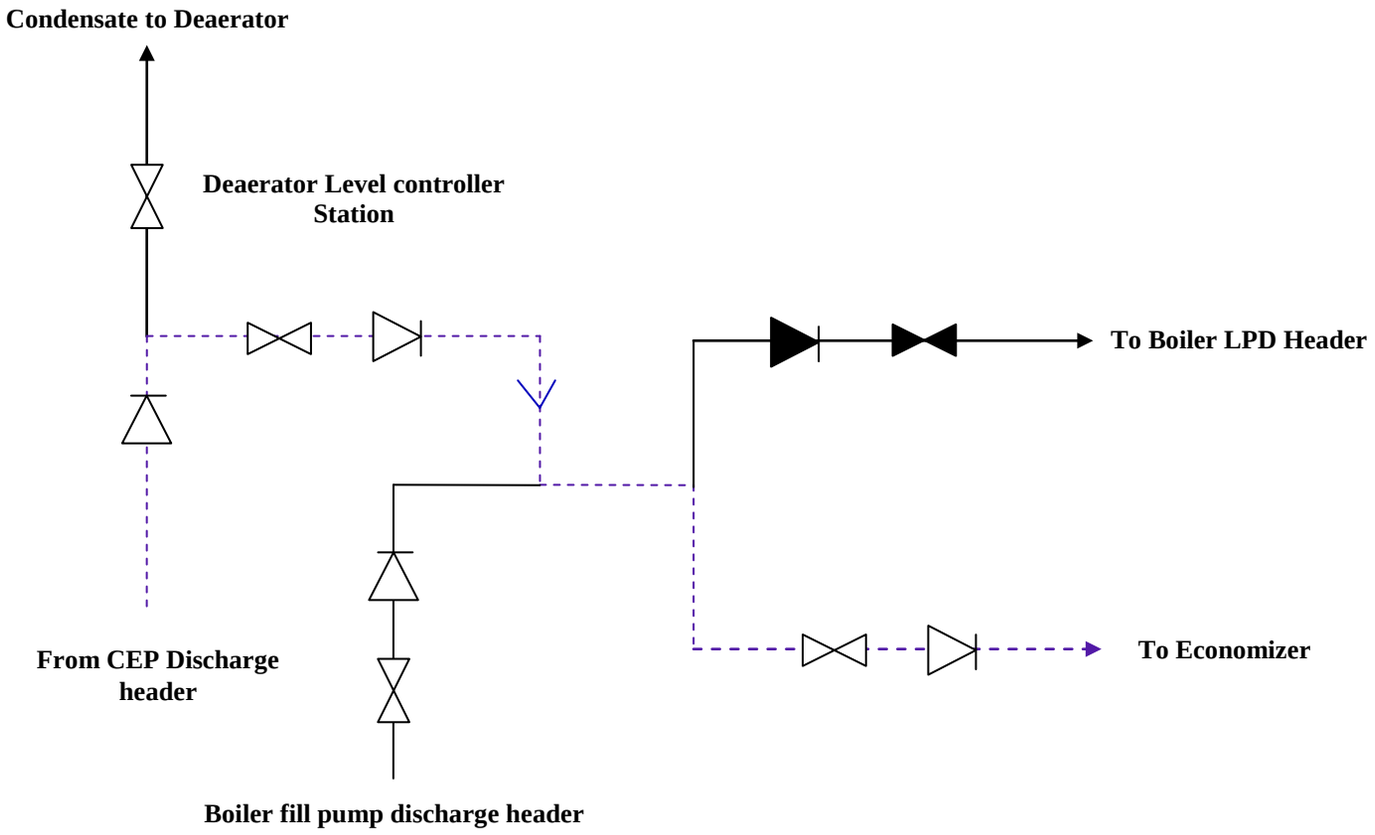
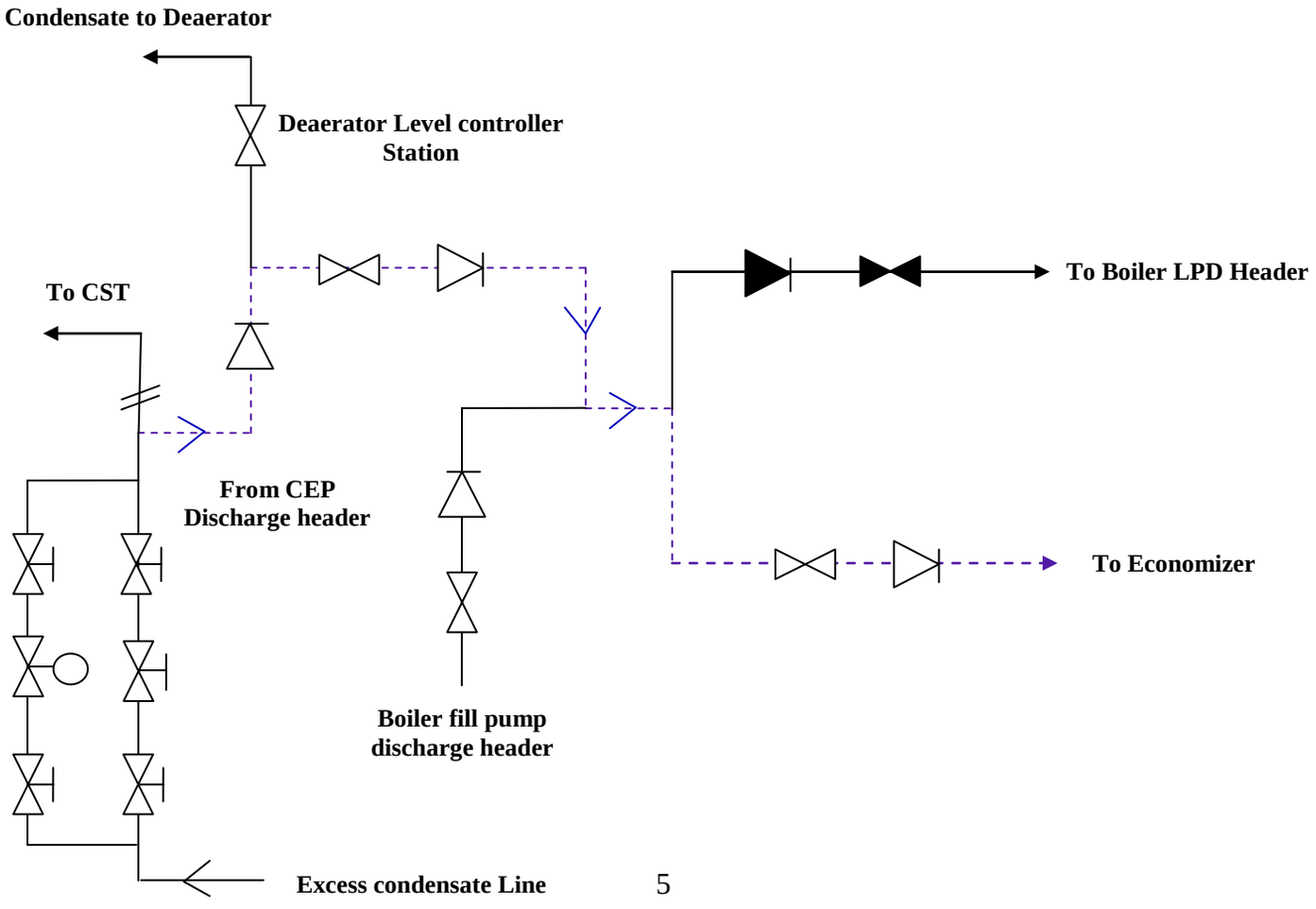


FIGURE-2

MODIFIED SCHEME FOR BOILER FEEDING THROUGH CEP



Revised/Optimized/recommended operating procure for cold startup of BTPS Unit-1&2

Unit Startup with TDBFP
(Energy saving technique)

1.0 INTRODUCTION:

Cold startup of Unit-1 of BTPS was successfully carried out earlier, by running of TDBFP when MDBFP was not available. By this activity it was proven that startup of the unit can be taken up by running of TDBFP using self-steam from the boiler and feeding the boiler through CEP. Now it has become necessary to reconsider the necessity of running MDBFP during unit start-up as it is in practice as part of standard operating procedure.

Now with the commissioning of Unit-2 of 500MW, with interconnecting facility between PRDS of both the units, following operating procedure can be considered as efficient during any startup of Unit-1&2. By implementation of this revised/ modified/ improved procedure will definitely result in reduction in auxiliary consumption, reduction in unit startup time & prolonged life of MDBFP and thereby reduction in maintenance cost of MDBFP due to the reduction in equipment running hour.

2.0 TECHNICAL DETAILS IN BRIEF:

2.1 Boiler feed pump arrangement:

The KWU- series machine (500MW) supplied by BHEL (BTPS-1&2) is provided with two turbine driven boiler feed pumps (2X 100%) and one motor driven boiler feed pump.

Turbine driven boiler feed pumps are run during normal plant operation with steam source from A4 extraction/ CRH/ aux PRDS and motor driven boiler feed pump is run during cold startups, low load operation and during non availability of any one turbine driven boiler feed pumps.

2.2 Boiler filling and feeding arrangement:

As per design,

- Initial filling of the boiler is to be carried out through boiler fill pump.
- Boiler drum can be fed through economiser up to drum pressure of 7.5 KSC by running boiler fill pump, since discharge pressure is 14 KSC.
- Above 7.5 KSC and up to 22 KSC drum pressure, boiler drum to be fed through CEP, since discharge pressure is 27 KSC.

- Above 22 KSC drum pressure, boiler drum to be fed through boiler feed pumps (MDBFP or TDBFP)

2.3 Cold startup procedures:

Following 4 different startup conditions are considered below & detailed procedure for boiler filling & feeding are explained in subsequent paragraphs for better understanding.

CONDITION-1: MDBFP is not available & auxiliary steam is also not available.

CONDITION-2: MDBFP is not available & auxiliary steam is available.

CONDITION-3: MDBFP is available & auxiliary steam is available.

CONDITION-4: MDBFP is available & TDBFPs are not available.

<u>CONDITION-1: MDBFP is not available & auxiliary steam is also not available</u>:

- Initial filling of the boiler is to be carried out using boiler fill pump.
- Unit startup activity to be carried out by feeding the drum through CEP, using exclusive line (200NB) from condensate header to boiler fill line.
- Light up the boiler with only one oil elevation (LDO).
- Raise the boiler drum pressure slowly and charge Auxiliary PRDS at 7 to 8 KSC of MS pressure.
- Keep steam supply to HFO heating station isolated to minimise the steam consumption of PRDS and thereby catering the steam demand of TDBFPs.
- Boiler drum feeding to be carried out through boiler fill pump up to drum pressure of 7.5 KSC. Further boiler feed shall be carried out through CEP till TDBFP is taken into service. Boiler feed is to be regulated by operating economiser filling line valve at LPD station (manual valve) or regulating the control valve provided in the modified scheme of boiler filling through CEP.
- Chemical dosing (LP dosing) shall be diverted to boiler fill line by using existing connection, during feeding through economizer/LPD station.
- After attaining the required PRDS steam temperature (215^0C) for gland steam requirement, vacuum shall be pulled in the condenser and gland steam to both/ anyone available TDBFP shall be charged.
- Roll any one TDBFP to 1500RPM and wait till required TDBFP casing temperature (230^0C) is attained.
- Change over boiler feeding to TDBFP by slowly raising the speed of the running TDBFP. (Approximate time: 3 Hours).

Note: Boiler drum pressure should be restricted to 18 KSC (till switching over to TDBFP) as feeding the drum using CEP is possible only up to drum pressure of 20KSC. (CEP header pressure: 27 KSC & boiler head: 70 M).

- After successful switching over of boiler feeding to TDBFP, boiler drum pressure shall be slowly raised and HFO heating station shall be charged as per procedure.
- Change over boiler firing to HFO after attaining required HFO temperature (120^0C).
- Required steam parameters for turbine rolling can be attained in approximately 2 hours.
- Turbine rolling, unit synchronization & loading shall be carried out as per the established operating procedure.
- When MDBFP is made ready/available, it shall be selected as auto standby mode as per standard operating procedure.

CONDITION-2: MDBFP is not available & auxiliary steam is available.

- Initial filling of the boiler is to be carried out using boiler fill pump.
- Unit startup activity to be carried out by feeding the drum through CEP, using exclusive line (200NB) from condensate header to boiler fill line.
- Light up the boiler with LDO firing in AB elevation.
- Raise the boiler drum pressure as per the standard operating practice.
- Simultaneously charge High Temp PRDS (HTAPRDS) and Low Temp PRDS (LTAPRDS) from adjacent Unit (where aux steam is available) through interconnection. Ensure spray water is made available from CEP discharge header.
- Charge steam supply to HFO heating station.
- Charge gland steam system and pull the vacuum in the condenser as per the standard operating procedure.
- Charge gland steam system both/ anyone available TDBFP.
- Roll any one TDBFP to 1500RPM and wait till required TDBFP casing temperature (230^0C) is attained.
- Change over boiler firing to HFO after attaining required HFO temperature (120^0C).
- Boiler drum feeding to be carried out through boiler fill pump up to drum pressure of 7.5 KSC. Further boiler feed shall be carried out through CEP till TDBFP is taken into service. Boiler feed is to be regulated by operating economiser filling line valve at LPD station (manual valve) or regulating the control valve provided in the modified scheme of boiler filling through CEP.

- Chemical dosing (LP dosing) shall be diverted to boiler fill line by using existing connection, during feeding through economizer/LPD station.
- Change over boiler feeding to TDBFP by slowly raising the speed of the running TDBFP.

  Note: Boiler drum pressure should be restricted to 18 KSC (till switching over to TDBFP) as feeding the drum using CEP is possible only up to drum pressure of 20KSC. (CEP header pressure: 27 KSC & boiler head: 70 M).
- After successful switching over of boiler feeding to TDBFP, boiler drum pressure shall be raised as per standard operating procedure.
- Roll the turbine after attaining required steam parameters.
- Turbine rolling, unit synchronization & loading shall be carried out as per the established operating procedure.
- When MDBFP is made ready/available, it shall be selected as auto standby mode as per standard operating procedure.

CONDITION-3: MDBFP is available & auxiliary steam is available:

In this case unit startup activates can be taken up either through MDBFP or TDBFP. However under such condition, startup with TDBFP is more economical. But following steps can be considered as useful:

If TDBFP is used for startup activity, procedure as explained in CONDITION-2 above shall be followed.

However, if MDBFP is used for startup activity, following steps shall be followed:

- Initial filling of the boiler is to be carried out using boiler fill pump.
- Boiler drum feeding is to be carried out by feeding the drum through CEP, using exclusive line (200NB) from condensate header to boiler fill line.
- Light up the boiler with LDO firing in AB elevation.
- Raise the boiler drum pressure as per the standard operating practice.
- Simultaneously charge High Temp PRDS (HTAPRDS) and Low Temp PRDS (LTAPRDS) from adjacent Unit (where aux steam is available) through interconnection. Ensure spray water is made available from CEP discharge header.
- Charge steam supply to HFO heating station.
- Change over boiler firing to HFO after attaining required HFO temperature (120^0C).
- Boiler drum feeding to be carried out through boiler fill pump up to drum pressure of 7.5 KSC. Further boiler feed shall be carried out through CEP upto drum pressure of 20 KSC. Boiler feed is to be regulated by operating economiser filling line valve

at LPD station (manual valve) or regulating the control valve provided in the modified scheme of boiler filling through CEP.

- Chemical dosing (LP dosing) shall be diverted to boiler fill line by using existing connection, during feeding through economizer/LPD station.
- In the meantime, take MDBFP into service & change over boiler feeding to MDBFP.
- After successful switching over boiler feeding to MDBFP, boiler drum pressure shall be raised as per standard operating procedure.
- Charge gland steam system and pull the vacuum in the condenser as per the standard operating procedure.
- Charge gland steam system both/ anyone available TDBFP.
- Roll any one TDBFP to 1500RPM and wait till required TDBFP casing temperature (230^0C) is attained.
- Change over boiler feeding to any one TDBFP by raising the speed and stop MDBFP.
- Simultaneously, roll the turbine after attaining required steam parameters.
- Turbine rolling, unit synchronization & loading shall be carried out as per the established operating procedure.
- Take another TDBFP into service & put MDBFP on auto standby mode.
- Charge PRDS from self-steam & normalize the PRDS.

Note: Boiler feeding shall be prudently changed over to TDBFP, immediately when one of the TDBFPs is ready, since auxiliary consumption can be reduced considerably.

CONDITION-4: MDBFP is available & TDBFPs are not available:

In this case, there is no other option for unit startup activates other than MDBFP. However under such condition, MDBFP is to be run prudently, keeping in mind that it leads to more auxiliary consumption. But following steps can be considered as useful:

- Initial filling of the boiler is to be carried out using boiler fill pump.
- Unit startup activity to be carried out by feeding the drum through CEP, using exclusive line (200NB) from condensate header to boiler fill line.
- Light up the boiler with LDO firing in AB elevation.
- Raise the boiler drum pressure slowly and charge Auxiliary PRDS at 7 to 8 KSC of MS pressure.

- Keep other unit HTAPRDS &LTAPRDS stations isolated, by closing respective interconnecting valves.
- Charge steam supply to HFO heating station.
- Change over boiler firing to HFO after attaining required HFO temperature (120^0C).
- Boiler drum feeding to be carried out through boiler fill pump up to drum pressure of 7.5 KSC. Further boiler feed shall be carried out through CEP up to drum pressure of 20 KSC. Boiler feed is to be regulated by operating economiser filling line valve at LPD station (manual valve) or regulating the control valve provided in the modified scheme of boiler filling through CEP.
- Chemical dosing (LP dosing) shall be diverted to boiler fill line by using existing connection, during feeding through economizer/LPD station.
- In the meantime, take MDBFP into service & change over boiler drum feeding to MDBFP.
- After successful switching over boiler feeding to MDBFP, boiler drum pressure shall be raised as per standard operating procedure.
- Charge gland steam system and pull the vacuum in the condenser as per the standard operating procedure.
- Roll the turbine after attaining required steam parameters.
- Turbine rolling, unit synchronization & loading shall be carried out as per the established operating procedure. Unit load shall be restricted till TDBFP is taken into service.
- Charge gland steam system of TDBFP, when it is made available.
- Roll any one TDBFP to 1500RPM and wait till required TDBFP casing temperature (230^0C) is attained.
- Take TDBFP into service along with MDBFP and raise the unit load.
- Take 2nd TDBFP into service when made available, stop MDBFP & put it on auto standby mode.