PURPOSE: Define a procedure of TDBFP Charging and Rolling

SCOPE: This SOP is applicable at NTPL

RESPONSIBILITY: Shift Engineer/ Operation Engineer

Sequence of TDBFP charging is as follows:

Cooling water charging ➢ Oil charging ➢ water charging➢ STG➢ Seal stem charging➢ vacuum Pulling➢Turbine rolling ➢Soaking ➢Turbine loading ➢BFP Parallel

Activity

1.COOLING WATER AND MECHANICAL SEAL CHARGING

- Keep at least one DMCWTG in service.
- Ensure opening of inlet and outlet valve to the lube oil coolers at zero-meter level. And keep any one cooler in service.
- Ensure Temperature control valve of corresponding cooler in service and its Bypass is ready at zero-meter level.
- Ensure opening of isolation valves of jacket cooling of booster and main pump at 17 meter.
- Ensure opening of isolation valves of mechanical seal coolers of Booster pump and main pump.

2.OIL SYSTEM CHARGING

- Tank level is adequate(@Local).
- Keep centrifuge in service
- Keep one vapour exhauster in service.
- Line up one oil cooler and filter. Keep vents open and Close the drains of filter and cooler.
- Ensure suction and discharge valve is open for LOPs, EOP, JOP.
- Start DCEOP and establish oil flow through the lines. Ensure there is no leakage.
- Start one LOP
- Close the cooler and filter vents.
- Check LOP discharge pressure (>12 ksc), lube oil header pressure (>3.5 ksc)
- Observe return oil flow from the bearings.
- Start JOP. Ensure jacking oil pressure (>50 ksc) is adequate.

- Open the governing rack isolation valve.
- Monitor the pressure after duplex filter at zero meter and governing oil filter at 17 meter.

3.FEED WATER CHARGING

- Ensure Dea. Level is adequate(>0mm) and Open manual valve in recirculation line.
- Close Discharge valve and its IBV and Open recirculation(RC) valve.
- Close drains in Suction (BP suction strainer drain, BFP suction strainer drain), Discharge (near Discharge MOV) and RC line and keep the casing vents (1 for BP and 2 for BFP) open.
- Crack open the suction valve. Close the vents after water starts coming out.
- Open the suction valve fully. Check suction pressure is adequate.
- Superheater and reheater spray line to be normalized.
- Engage hand barring at local and open STG MOV.
- Ensure speed reaches in the range of 350-400 rpm (STG should not be put before feed water charging).

4.TURBINE ROLLING

Checklist before Rolling

1. Main condenser under vacuum (<0.6 ksc)
2. TDBFP at STG
3. BFP and Booster pump is charged with water
4. Trip present
5. BFP discharge valve closed condition
6. BFP suction Valve opened
7. Governing isolation opened
8. Lube oil hdr pressure and Control oil pressure adequate
9. PRDS HT header charged
10. BFP RC valve opened
11. PRDS to TDBFP isolation closed
12. Atleast one TGDMCW is running
13. CW and ACW in service
14. Mechanical seal and jacket cooling line is charged
15. PRDS pressure and temperature: 15 KSC and 300 ^{0}C

Rolling Procedure (via ACV-PRDS)

1. Open atmospheric drain valve and flash tank drain valve before ASV1/3(Aux. Steam to TDBFP block valve (@8.5ML)
2. Open ASV 1/3 HOV
3. Open seal steam drain to flash tank
4. Seal steam supply control valve and its bypass MOV is closed
5. Ensure gland seal to GSC isolation (at 8,5 ML near condenser) open.
6. Open ACV atmospheric drain (just below ACV O/L line) and flash tank drain MOV
7. Then slowly open the PRDS to TDBFP isolation valve @ APRDS level
8. Ensure steam flow in all drains.
9. Ensure temp rise at ASV 1/3
10. Then slowly open seal steam isolation root valve and make one of the parallel lines through and wait till seal steam temperature before control valve comes > 250 ^{0}C
11. Steam temperature is ready for vacuum pulling.
12. Slowly open exhaust valve (EXV 27/28) charging line and Observe the condenser vacuum and TDBFP exhaust pressure. Once exhaust pressure start reducing then admit seal steam by opening control valve and monitoring seal steam header pressure (300-350 mmwc).
13. Once exhaust pressure come close to condenser pressure, open exhaust valve EXV 27/28 full and close charging line. Maintain seal steam header pressure with control valve (put in Auto) and its bypass valve.
14. Open drain valve and start-up vent (EXV 31/32) before ESV
15. Open turbine casing drain, cross over drain and seal steam header drain
16. Open Extraction steam block valve EXV 15 and drain after EXV15
17. Open drain valve CRHV-122/129 before CRH to TDBFP block valve
18. Once Aux. Steam temperature before ASV 1/3 comes > 280 ^{0}C, open ACV warmup line/Bypass and observe rise in live steam temperature
19. **#**Once live steam temperature becomes almost same as Aux. Steam temperature (Live steam temp > Casing temp by 50 deg.C), reset the turbine and open the ESV.
20. Turbine is ready for rolling. Give local speed command to 1000 RPM. MCV will start opening, then accordingly open ACV to maintain live steam pressure 4-5 Ksc (after opening ACV, close its warmup line). Give time for soaking and let the casing temperature rise, then gradually rise speed reference to 2000, 2500, 3000 RPM with 5-7 mins time gap. Try to maintain casing 100% and 50% temperature difference < 50 ^{0}C.

21. When BFP discharge pressure becomes >20 Ksc, open its Discharge valve IBV and after that discharge valve. After opening Discharge valve, close its IBV.
22. Put ACV in Auto keeping pressure set point manual with set point of 4-5 ksc.
23. Put speed reference in Remote.
24. TDBFP MCV response will be good if 50% casing (mid wall) temperature is >250 ^{0}C
25. *For feeding to the Drum, use 30% feed control line with FDV-14
26. For feeding to drum raise speed set point in remote and control feed water by FDV 14. Keep BFP discharge pressure 9-10 ksc higher than drum pressure.
27. After 3000 RPM and keeping live steam pressure 4-5 ksc, close startup vent, close drain before ESV, close drain after ACV and drain before ASV1/3, if all corresponding temperatures are maintaining within the range.
28. Feed the drum by raising speed reference and live steam pressure by ACV pressure set point.
29. **When FDV-14 (in Auto) is sufficiently open for feeding, put TDBFP in auto when error is 0, under DP Control mode and monitor the response of TDBFP.
30. **Before changing feed water line from 30%-FDV14 to 100%-FDV16(at drum pressure >80 KSC), take TDBFP into manual because DP mode will change to FEED Water mode.
31. Close RC valve, monitoring BFP Suction flow and Drum level.
32. Observe TDBFP response in auto and in case of emergency (speed difference in manual and reference) take into manual.
33. Once unit get synch., at >100 MW put other TDBFP in warmup (using extraction source if ACV is not ready). Raise the speed step by step giving sufficient soaking time for casing metal temperature keeping 100% casing and 50% casing temperature difference <50 ^{0}C
34. When other TDBFP is ready for loading raise its speed and match the feed water discharge pressure with running TDBFP. After that, this pump will start taking load, then slowly raise suction flow and match with running one. Once both pump suction flow matches smoothly, put that TDBFP in auto keeping RC valve in open condition due to low load (between 200 to 240 MW)

*During light up and initial filling time.

** DP mode if DP Txr and loop is healthy.

Steam flow shall be ensured through all Atm drain valves available to avoid any water entry before admitting into the system

Note: 1. ACV has an interlock related to PRDS/CRH pressure and temperature. If pressure goes down below 10 ksc OR temperature below 250 ^{0}C, ACV will close in auto. Therefore, PRDS pressure and temperate to be maintained (15 ksc and 300 ^{0}C).

2. NRTD gives commands to SPEED Controller Output which is the input to the I/H converter for operating MCV. NRTD response is related to the 50% casing temperature. Monitoring the casing temperature, if difference between NRTD and actual speed is >65 RPM, NRTD will freeze and will stop further opening OR closing of MCV till speed difference reduces to <65 RPM, no matter what the speed reference is.

TDBFP PROTECTION

1.	TDBFP working & suction flow	Very Low (< 200 tph)
2.	Deaerator level	Very Low (< -1610 mmwc)
3.	TDBFP Lube OIL header pressure	Very Low (< 1.0 ksc)
4.	TDBFP Suction valve	Not OPEN
5.	TDBFP Exhaust steam temperature	Very High (> 120 ^{o}C)
6.	TDBFP Live steam pressure	Very High (> 12.5 ksc)
7.	TDBFP Exhaust steam pressure	Very High (> -0.4 ksc)
8.	Governing OIL pressure	Very Low (< 4.5 ksc)
9.	Trip OIL pressure	Very Low (< 2 ksc)
10.	Turbine Axial shift	High (> 0.7 mm)
11.	Turbine eccentricity	Very High (> 92 mic)
12.	Trip PB	Operated
13.	Trip command	from OWS
14.	Turbine Over speed	(> 6300 rpm)
15.	Turbine GB i/p vibration	Very High (> 70 mic)
16.	Turbine GB o/p vibration	Very High (> 70 mic)
17.	Turbine FJB vibration	Very High (> 70 mic)
18.	Turbine RJB vibration	Very High (> 70 mic)
19.	Turbine GB bearing temp	Very High (> 105 ^{o}C)
20.	Turbine bearing temp	Very High (> 120 ^{o}C)
21.	Booster pump bearing temp	Very High (> 95 ^{o}C)
22.	Booster pump thrust bearing temp	Very High (> 105 ^{o}C)
23.	BFP thrust bearing temp	Very High (> 105 ^{o}C)
24.	BFP bearing temp	Very High (> 95 ^{o}C)
25.	FW Suction / discharge ?T	High (> 15 ^{o}C)
26.	TDBFP working AND Variable set point	Fault

TDBFP INTERLOCKS

1.	STEAM SYSTEM	AUTO OPEN/OPEN PERMISSSIVE	AUTO CLOSE/CLOSE PERMISSIVE
1	CRH Drain before Block valve (CRHV129)	1. CRH steam BLOCK valve CLOSE 2. . CRH temp < 250 deg C 3. TDBFP tripped	CRH steam BLOCK valve OPEN AND CRH temp > 290 deg C
2	Block valve CRHV 3	open permissive: CRH steam temp.>280degC and CRH pressure> 12 Ksc	
3	Aux. Steam Drain before Block valve (ASV 109)	1.Aux. steam temp at TDBFP inlet < 250 deg C AND TDBFP working 2. TDBFP tripped	Aux. steam temp. at TDBFP inlet > 280 deg C And Aux steam to TDBFP BLOCK valve OPEN AND TDBFP suction flow > 500 tph
4	Extraction Steam Block valve EXV-15	Open permissive: EXTRACTION steam press > 3.5 ksc AND EXTRACTION steam temp > 250 °C	
5	Drain valve EXV 109	-	EXTRACTION steam press > 3.5 ksc AND Any TDBFP suction flow > 500 tph AND EXTRACTION steam BLOCK valve OPEN
6	Steam Exhaust valve-EXV-28	Release open: Gland steam press > 0.1 ksc and ESV CLOSE	-
7	ACV	-	1.PRDS/CRH pressure <10ksc 2.PRDS/CRH temperature bef.Block valve <250deg.C
8	Aux. Control Valve(ACV) Warmup valve CRHV 13	-	close permissive: ACV > 2% open
9	Drain after ACV CRHV 147	1.TDBFP Tripped 2.TDBFP warm up valve to aux. CV not OPEN AND ACV < 2 % OPEN	1. TDBFP warm up valve to aux.CV OPEN OR 2. ACV > 2 % OPEN , TDBFP suction flow > 500 tph
10	Drain before ESV-CRHV 153	TDBFP Tripped	TDBFP suction FW flow >500 tph
11	Vent before ESV-EXV 32	TDBFP Tripped	TDBFP suction FW flow >500 tph
12	Turbine Casing Drain valve	1. Casing temp < 120 deg C AND TDBFP working 2. TDBFP tripped	Casing temp > 120 deg C AND FW suction flow > 500 tph
13	Casing cross drain valve	1. TDBFP turbine casing temp < 120 deg C AND TDBFP working 2. TDBFP Tripped	Casing temp > 120 deg C AND suction flow > 500 tph

14	Exhaust hood spary valve	TDBFP exhaust hood steam temp > 85°C AND TDBFP working	1.TDBFP Tripped 2. TDBFP exhaust hood steam temp < 85 deg C
15	Gland Steam Drain Valve	1.Temp at u/s of gland steam inlet valve < 250 degC AND TDBFP working 2.. TDBFP tripped	Temp. at u/s of gland steam inlet valve >280 deg C

2.	**OIL SYSTEM**	**AUTO START/**	**AUTO STOP/ STOP PERMISSIVE**
1	LOP A& B	Standby SLC ON and 1.Running LOP tripped 2. other LOP start command given AND pump not ON TD2s 3. [TDBFP working OR other LOP ON] AND [Lube OIL discharge. header. press. < 1.5 ksc OR LOP discharge. press. < 7 ksc] TD1m	Release Stop: 1. TDBFP not working 2.TDBFP speed zero 3. Other LOP ON AND L.O. discharge. header. press. > 1.5 ksc AND LOP discharge. press. > 7 ksc
2	Vapour extraction fan	1.other OVEF start command given AND Fan not ON TD15s 2. other OVEF tripped	-
3	DC Emergency oil pump	EOP AUTO on selected AND TDBFP Lube OIL header. press. very low < 0.7 ksc	Release Stop: EOP AUTO ON not selected OR TDBFP Lube OIL header. press. not very low AND Any LOP ON OR TDBFP speed zero
4	JOP	TDBFP Turbine speed < 510 rpm	Stop Permissive: 1. Speed zero 2.Turbine speed > 540 RPM Auto Stop: TDBFP Turbine speed > 540 rpm
5	Turning Gear Valve	TDBFP turbine Speed < 510 rpm	Release close: 1. TDBFP turbine Speed > 540RPM 2.TDBFP turbine Casing temp < 85 degC Auto Close: TDBFP turbine Speed > 540 rpm

3.	FEED WATER	AUTO OPEN	AUTO CLOSE
1	Feed water discharge valve	Open permissive: Discharge valve IBV open Auto open: TDBFP working AND Discharge press. > 20 ksc	1.TDBFP tripped 2.TDBFP not working AND Discharge header press > 60 ksc
2	Discharge valve IBV	1.TDBFP Working AND Discharge press. > 20 ksc 2. Discharge valve OPEN command	TDBFP Discharge valve OPEN
3	Recirculation Valve	1.TDBFP Working. AND [Suction flow < 400 tph OR .FW suction/discharge. DT > 10 deg C OR Suction flow measurement fault 2.TDBFP Tripped 3. **Protection Open**: 1. TDBFP suction flow < 250tph 2.TDBFP not working	Close permissive: 1. 1) TDBFP suction flow >550tph AND FW suction / discharge. DT < 10 deg C AND No AUTO OPEN command 2.TDBFP not working AND No AUTO OPEN command Auto Close: TDBFP suction flow > 850 tph AND FW suction/discharge DT < 10 deg C

RECORDS:

Record Title	Record No.	Location	Responsibility	Type	Retention Time

VERIFICATION, CORRECTIVE AND PREVENTIVE ACTION:

HOD shall ensure adequacy and implementation of the above procedure through periodic interaction with department personnel, and regular review and monitoring of the processes and compliances. In case of any observed deviation, corrective and preventive action shall be immediately undertaken.

HOD