DETECTION & RECTIFICATION OF TURBINE BALANCE DRUM LABYRINTH SEAL FAILURE OF TDBFP: A CASE STUDY

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INTRODUCTION
BALANCE DRUM FUNCTION
METHODOLOGY FOR FIND OUT ROOT CAUSE

• Thrust bearing temperature increases with increase in load & decreases with decrease in load
• Seal steam consumption less i.e. seal steam controller open less
• Chances of gland seal steam leakage
• Moisture content of lube oil found higher value
CASE STUDY OF UNIT # 5 TDBFP

➢ TDBFP # 5B was maintaining higher (92°C - 95°C) than the normal operating value (55° to 60°C) from January, 2012

➢ TDBFP # 5A was maintaining higher thrust bearing temperature (90°C - 94°C) from Febabury, 2012

➢ Thrust bearing temperature used to increase with the increase of load

➢ The unit load was kept below 450 MW, due to high thrust bearing temperature
OBSERVATIONS

✓ The thrust bearing temperature increased gradually for both the turbine
✓ For a particular operating point of pump, Steam consumption & turbine speed was required to maintain high
✓ Gland steam leakage observed form both end of the turbine
✓ Moisture content of lube oil found higher value
OBSERVATIONS

✓ By throttling gland seal inlet valve manually, there is no significant change in gland steam leakage
✓ Re-circulation valve of both the TDBFP were found passing
✓ Internal Noise level of Booster Pump found higher than the normal
CORRELATION OF DATA

- High thrust bearing temperature might be a reason for failure of thrust bearing and/or high thrust load acting on the thrust bearing
CORRELATION OF DATA

• high moisture content in lube oil and leakages from the glands of the turbine indicates the failure of gland seals and/or balance drum labyrinth seal failure
CORRELATION OF DATA

• High steam consumption in both the TDBFP turbines was mainly to compensate the passing of the re-circulation valves of both the pumps

• scoring marks on the Thrust pad of Bearing on Booster Pump Side due to high axial thrust on the bearing on failure of balance drum
CORRELATION OF DATA

• High internal noise due to short circuiting of feed water in Booster Pump
• Thrust bearing temperature directly depends on thrust load on the bearing. In this case it was observed that the thrust bearing temperature of the turbine increases with increase in turbine load, which clearly indicates that the balance drum was not functioning properly.
FINDINGS & ANALYSIS DURING OVERHAULING OF TURBINE

i. Rotor axial position found to be shifted towards main pump by 0.7 mm from the center position.

ii. Labyrinth fins of the turbine balance drum were found totally damaged.

iii. Deformation of Balance Drum Labyrinth Seal Segment (Elliptical Shape with difference in diameter, on left-right to top-bottom, by 2.53 mm) of TDBFP #5B.
FINDINGS & ANALYSIS DURING OVERHAULING OF TURBINE

• Labyrinth fins of both the glands of turbine were found partially damaged
• Inter-stage labyrinth clearance was within the limit
• Heavy scoring marks on Thrust Bearing Pad (on Booster Pump Side) found and thrust float increased from design clearance (0.175 – 0.275 mm) to 0.520 mm.
FINDINGS & ANALYSIS DURING OVERHAULING OF TURBINE

- Booster Pump was dismantled and found that Clearance between Casing Wear ring & Impeller Wear ring increased beyond acceptable limit
- Recirculation Valve Seat & Plug were found severely damaged
REMEDIAL ACTION

- All the fins of both side Gland Labyrinth Seal were replaced with new fins.
- Thrust Bearing Pads were replaced with new pads and thrust float was set to the designed value.
- All the damaged Fins were removed from the Segments for balance drum.
- Re-finishing with new fins was carried out with special tools by engaging specialized manpower.
REMEDIAL ACTION

- Both half of the Seal Segment was fixed together and the deformation was removed with Special Mechanical Fixture
- Machining of the fins was carried out at Departmental Workshop with special Tools by engaging Specialized Machinist
- After placement of the Seal Segment in the Casing, uniform clearance with Balance Drum was ensured
- Turbine was boxed up by ensuring all the required dimensions to the design value
OBSERVATION AFTER OVERHAULING

✓ No abnormality were observed for both pumps
✓ All the bearing temperatures were within limit
✓ Turbine speed found nearer to the design value
CONCLUSIONS

i. Online continuous monitoring & analysis of turbo-visory parameters as well as all operating parameters such as bearing temperatures, vibration, axial shift, gland steam pressure, gland steam control valve position, steam consumption etc are the vital parameters for detecting balance drum failure

ii. Periodic overhauling of Drive Turbine should be followed as per manufacturer’s recommendation

iii. It is suggested to replace the entire fins of these components during each periodic overhauling
THANK YOU