Turbine Start Up, Loading and Shutdown.

Plant Status – 30Mw Condensing Turbo Generator, steam conditions at ESV 4Mpa at 454^0C.

Turbine Supervisory – Critical speeds are at 950 & 2400 RPM,
Differential Expansion, rotor long or short alarms and trips.
Eccentricity indicated at < 300RPM.
Casing expansion.
Bearings Vibration, alarm and trip.
Thrust bearing position, alarm and trip.
Low Vacuum Alarm, unloading and trip on falling vacuum.
Low Bearing oil pressure alarm and trip with facility to test off load.
Overspeed bolts, with facility to test on load.

Turbine Limits - Speed acceleration rate.
Steam/Metal differential temperature. (-20°C +80°C)
Turbine metal rate of change.
Turbine Exhaust temperature. (Max 85°C

Pre Start Checks.

Check Log and Instructions, all permits and personnel clear.

Alarms, communications systems and emergency equipment available and tested.

Carry out prestart inspections.

System checks include the following where applicable: Pumps checked for power on, charged and vented, freedom of movement, cooling water supplies, guards in place, valves set. Check all Valves and flanged joints for leaks. Coolers check for charged and vented. Filters and strainers cleaned, check for charged and vented. Heaters check for charged and vented, when on load check water level controls are operating.

When plant is in service the following checks should be made, pressure, differential pressures, where applicable, temperature, noise, vibration, flow, check for leaks, check level control systems are operating correctly.

Condensate checked for quality, dissolved O_2 (15 to 30ppb), minimise corrosion, conductivity, (<0.3), identifies tube leaks and pH, (9), minimise corrosion.

Systems and Operations Run Up.

Check Turbine metal temperatures and determine steam conditions required, time for run up, temperature ramp rates, acceleration rates, loading rates as per manufacturers recommendations or specific site procedures. Selecting correct rates and steam temperature as per Manufacturers recommendations minimises Thermal Stress and conserves Cyclic Life. Note this Turbine is run up on Full Arc Admission, Governor Valves full open and steam supply is via operation of the ESV

- Set Main steam leg and Turbine drains. (1)
- Crack Open MSSV bypass and warm main steam leg. (2)
- Open MSSV when the leg is Pressurised. (2)
- Warm through auxiliary steam range if applicable. (2)
- Warm through Gland steam pipework. (2)
- If Flange Warming facility is available put steam on.
- Check and start Oil system, test auto starts, warm oil, purifier in service, check flow and quality from bearings. Charge and Vent Oil Coolers and Filters (3)
- Start Jacking Oil Pump, check pressure at each bearing. (3)
- Start Barring Gear. Check amps, check for any rubbing noise and eccentricity. Bar for required time. (4)
- Check and start CW system. Charge and vent pipework and Waterboxes. (5)
- Check and start condensate system, condensate recirculating valve open. (6)
- Start Gland steam exhauster if applicable, Seal Glands. (7)
- Put Start up ejector in service, shut vacuum breaker. (8)
- Start main ejectors, when vacuum OK shutdown start up ejector. (8)
- Start Auxiliary Oil pump, (AOP), reset machine; check for smooth movement of Governor valves. (9)
- Carry out low vacuum alarm, trip and Auto Oil Pumps start checks. (10)
- After trip checks, Reset Turbine and carry out systems checks, steam conditions, eccentricity, expansions, oil temps etc. (10)
- Crack ESV and roll Turbine off barring, check barring Gear disengaged. (10)
- Accelerate smoothly at required rate to 1st heat soak, check exhaust temp, vacuum, expansions, vibrations, oil temps, etc. (10)
- Accelerate smoothly through critical speeds to governor speed (if no further heat soaks are required), Governor Valves should close in smoothly and take control of the Turbine Speed, open ESV fully, (check speed) Carry out checks of exhaust temp, vacuum, expansions, vibrations, oil temps, main oil pump, water levels, etc. (10)
- Check systems, AOP out of service and Main Oil Pump in service.
- Raise to synchronous speed, synchronise, load at required rate to initial load heat soak, check on load overspeed bolts if required. (10)
- Change gland steam to bled steam, (BS) as required. (7)

- Check systems, check exhaust temp, vacuum, expansions, vibrations, oil temps, water levels, etc.
- Load at the required rate to system requirements, close in Condensate Recirculating Valve as required, place Cooling Tower fans in service as required, adjust gland steam Lube Oil Temperature as required.
- Monitor systems, check exhaust temp, vacuum, expansions, vibrations, oil temps, pressures, flows, water levels, etc.

Unloading and Shutdown.

- Unload Turbine, open condensate recirculating valve as required or Condenser will go low.
- Shutdown Cooling Tower fans as required.
- Change gland steam to auxiliary steam.
- (Turbine may be tripped at this stage check Breaker opens, Steam is off and turbine is decelerating)
- Or Desynchronise, Close ESV and trip Turbine.
- Check AOP starts.
- Open Turbine steam drains.
- Take ejectors out of service, break vacuum as required.
- When vacuum decayed take off gland steam and shutdown gland steam exhauster.
- Shut MSSV and open Main Steam Leg drain.
- Shutdown Condensate system.
- **As soon as shaft comes to rest start Jacking Oil Pump and place on barring gear, check amps check for rubbing.**
- Start Barring oil pump and stop AOP, check oil flow sight glasses.
- When Condenser CW inlet and outlet temperatures are equal shutdown CW system.