



GMR WARORA ENERGY LTD.
(Formerly GMR EMCO Energy Ltd)
2 x 300 MW Thermal Power Plant
REDUCTION IN COOLING TIME
OF
TURBINE (SEC MAKE)

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ABSTRACT:

For carrying out any maintenance or routine overhauling of turbine and its associate auxiliaries, the time required for making turbine available for maintenance was very high. As per the data available from different utilities of SEC make, it requires approximately 12-14 days for turbine on Barring Gear to cool down the FSMT.

The GWEL team took this as a challenge and different strategies were explored to bring down the downtime for cooling of turbine. The team deployed these strategies in 1st Overhauling in unit-01 and cooling time reduced to 7 days , further these strategies were modified and in Overhauling of unit-02 the downtime for cooling of machine has been brought down to 6 days.

The paper describes strategies adopted at GWEL for reduction in down time of turbine cooling and benefits achieved has resulted into increase in machine availability above 95%, which is highest amongst other units supplied by SEC.

1.0 INTRODUCTION

GMR Energy has an asset of 4630 MW of aggregate capacity with a diversified mix of coal & gas based and renewable energy (Hydro & Solar). GMR Warora Energy Ltd (GWEL) operates 2×300MW Coal based Power Plant at Warora in Maharashtra. Plant is certified for ISO 9001, ISO 14001, OHSAS 18000 & Energy Management system, ISO 50001 and also 5S certified for good housekeeping & work environment.

GWEL 2×300 MW BTG were supplied by Shanghai Electric Company (SEC) China. The boiler is sub critical tangential fire balance draft natural circulation single reheat having steam generation capacity 1014 T/Hr. The turbine is subcritical single-shaft condensing turbine with primary intermediate reheat, combination of HP-IP cylinders and double cylinder double exhaust. 353MVA hydrogen cooled generator with brushless excitation.

SEC also supplied same specification machines in India to different power utilities like JSW Energy, RPG group, Reliance Power; HPGCL etc. These machines were installed in India from the year 2008 onwards in different organizations. There was apprehension about availability of these units in long term. It was observed that the availability of machines was around 90% which was well below other units operating in the country. We analyzed down time for these machines and it was observed that the non-availability was on account of planned maintenance of turbine and generator.

For carrying out any maintenance or routine overhauling of turbine and its associate auxiliaries, the time required for making turbine available for maintenance was very high. As per the data available from different utilities, it requires approximately 12-14 days for turbine on Barring Gear to cool down the FSMT (First stage metal temperature). Some utilities are using forced cooling device to reduce the time for barring gear stoppage, which has its effect in long term running. This cooling time was one of major reason for lesser availability of units supplied by Chinese.

The GWEL team took this as a challenge and different strategies were explored to bring down the down time for cooling of turbine. The GWEL team deployed these strategies in first Over Hauling in one of the unit and cooling time was reduced to 8 days , further these strategies were modified slightly and in Over hauling of unit-02 the down time for cooling of machine has been brought down to 6 days.

The paper describes the strategies adopted at GWEL for reduction in down time of turbine cooling for units supplied by SEC. the benefits achieved through this project has resulted into increase in machine availability above 95%, which is the highest amongst the other units supplied by SEC.

2.0 PROCEDURES ADOPTED AT GWEL

- Unit#1 overhauling was done in the Jan, 2015. Total overhauling period was from 23.01.2015 to 21.02.2015 (Days:29.13)
- Unit#2 overhauling was planned in the year Jan, 2016 for 20 days. Accordingly operation side made overhauling plan for 20 days.
- Plan was made such that Unit#2 to be desynchronized from grid at 00:00 Hrs. on 10.01.2016. the strategy adopted was to cool the turbine by reducing M.S pressure and temperature with controlled operation.
- Checklist was prepared for checks required for unit#2 shutdown activities so that time and activities planned can be followed as per plan to avoid any delay which may cause any delay in overhauling time.
- As during last overhauling, period taken for Unit#1 was 29.13 days we made operation plan so that Unit#2 overhauling could be completed within targeted date of 20 days. TG cooling was main part of the plan which can allow us to put TG out from barring gear earlier.
- Plan for TG cooling was made primarily by reducing M.S temperature so that we can achieve FSMT to 350 °C, which is 20°C lesser than the FSMT temperature achieved during last Unit#1 overhauling (FSMT-1/2: 366°C / 370°C).
- Plan made for reducing M.S temperature for Unit#2 is as below Table-1:

Date	Time		Load (MW)	M.S. Pressure	M.S Temp	Saturation Temp	Temp Drop
09.01.2016	16:30	17:30	Min load as per schedule	140	510	337	30
	17:30	18:15	210	130	490	331	20
	18:15	19:00		120	480	325	10
	19:00	19:45		115	460	322	20
	19:45	20:30	200	110	450	319	10
	20:30	21:00	190	105	430	315	20
	21:00	22:00	180	100	410	312	20
	22:00	22:30	150	90	400	304	10
	22:30	23:00	125	80	380	296	20
	23:00	23:15	95	70	370	287	10
	23:15	23:30	70	65	360	282	10
	23:30	23:45	60	60	355	277	5
	23:45	23:55	45	60	355	277	0
	0:00		40	60	350	277	5

Table 1: Plan for reducing M.S temperature for Unit#2

3.0 RESULTS ACHIEVED

- As per plan Unit-2 got de-synchronized from grid by hand tripping Turbine at 00:00:02 hrs on 10.01.2016.
- Turbine was hand tripped within 10 Hrs. from the time when M.S temperature started reducing for turbine cooling, whereas earlier it was taken 14 Hrs. during Unit#1 overhauling.

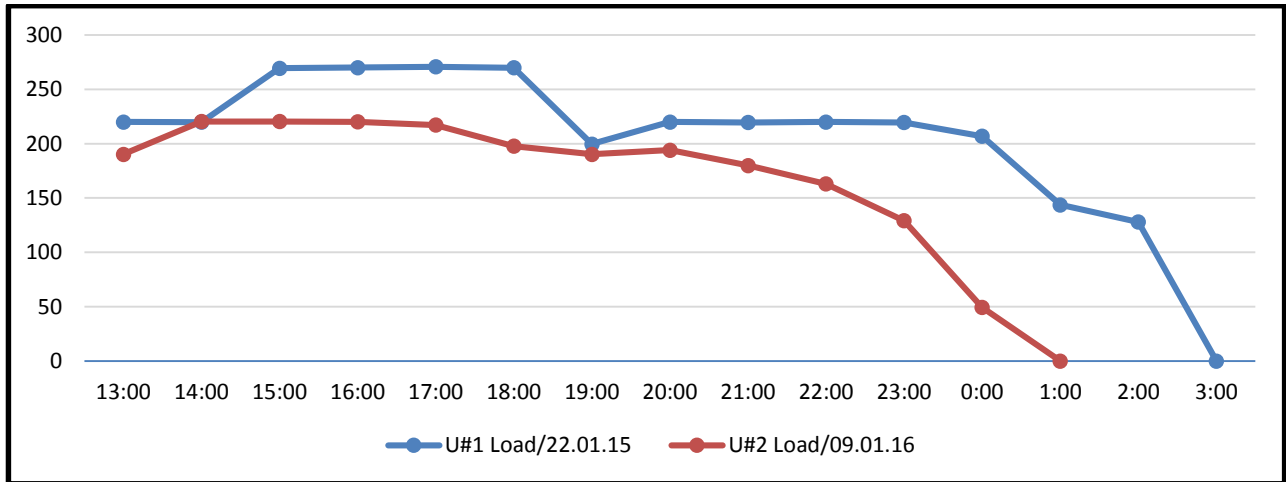


Fig-1: U-1 VS. U-2 LOAD

- Further with respect to plan made, we had operated unit#2 in such a way so that all 4 governing valves shall remain full open which allows entry of maximum steam for better cooling of turbine casing and rotor.
- This helps us to maintain Differential expansion within range to operate the unit at lower M.S temperature to achieve FSMT <350°C.

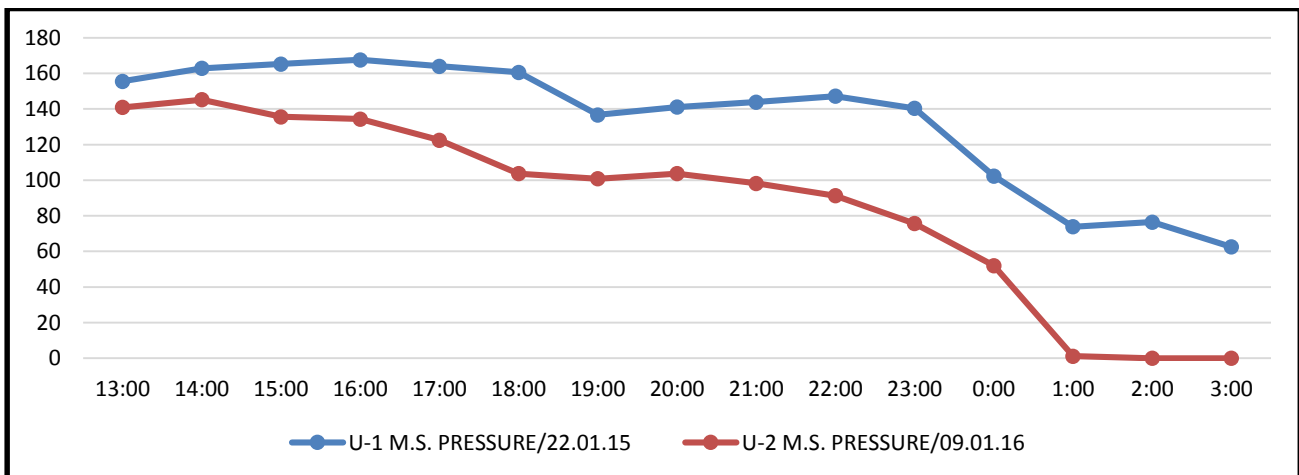


Fig -2 U-1 Vs U-2 M.S PRESSURE

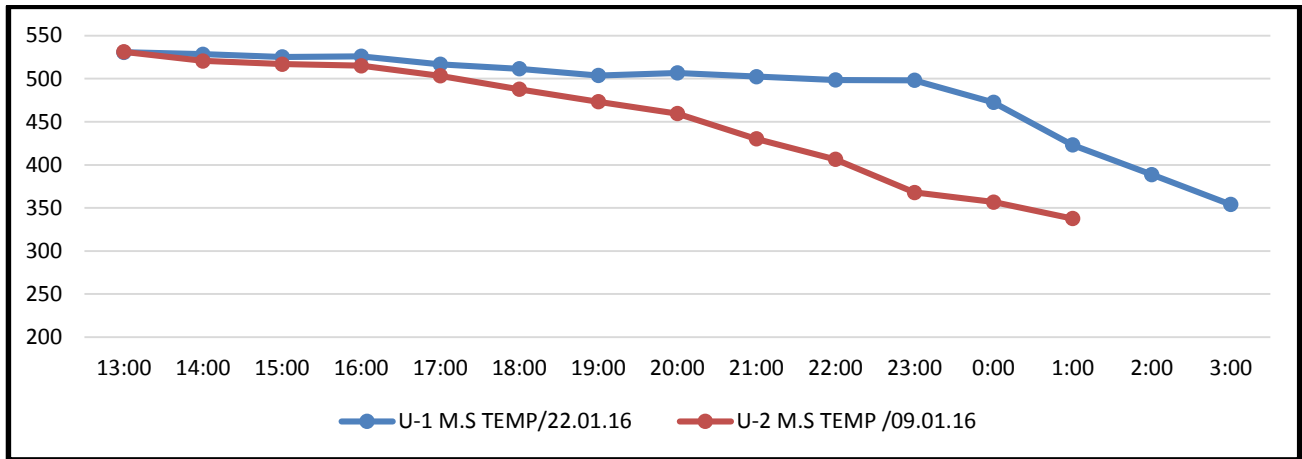


Fig-3: U-1 VS. U-2 M.S TEMPERATURE

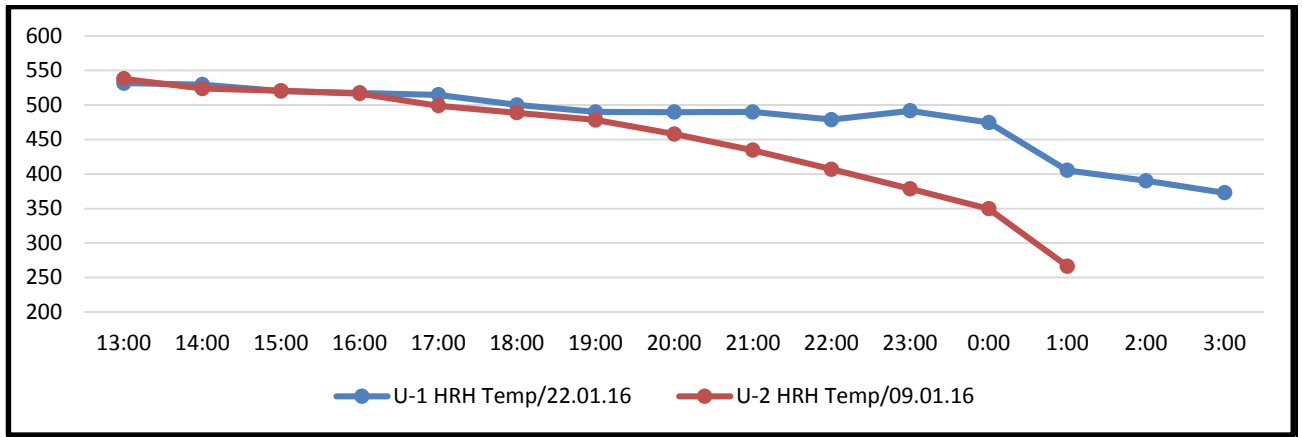


Fig-4 U-1 vs U-2 HRH TEMPERATURE

- When Unit was desynchronized with grid, Unit-1 & Unit-2 FSMT was 370°C & 343°C respectively, which was comparatively 27°C less in case of Unit-2.

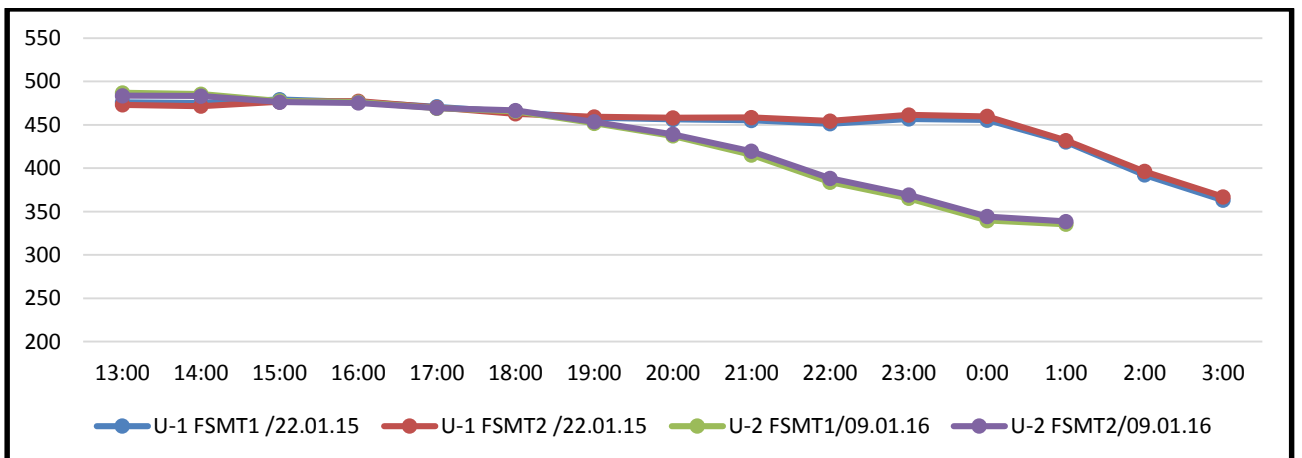


Fig-5 U-1 VS. U-2 FSMT-1 & FSMT-2

- This helps to take TG-2 out of barring gear earlier, within 6.66 days where as Unit-1 was taken 8 days that too with forced cooling by starting vacuum pump.
- In unit-2, instead of starting vacuum pump only Extraction-5 NRV flap open when FSMT reached to 230°C which helps out for faster but natural cooling of Turbine.

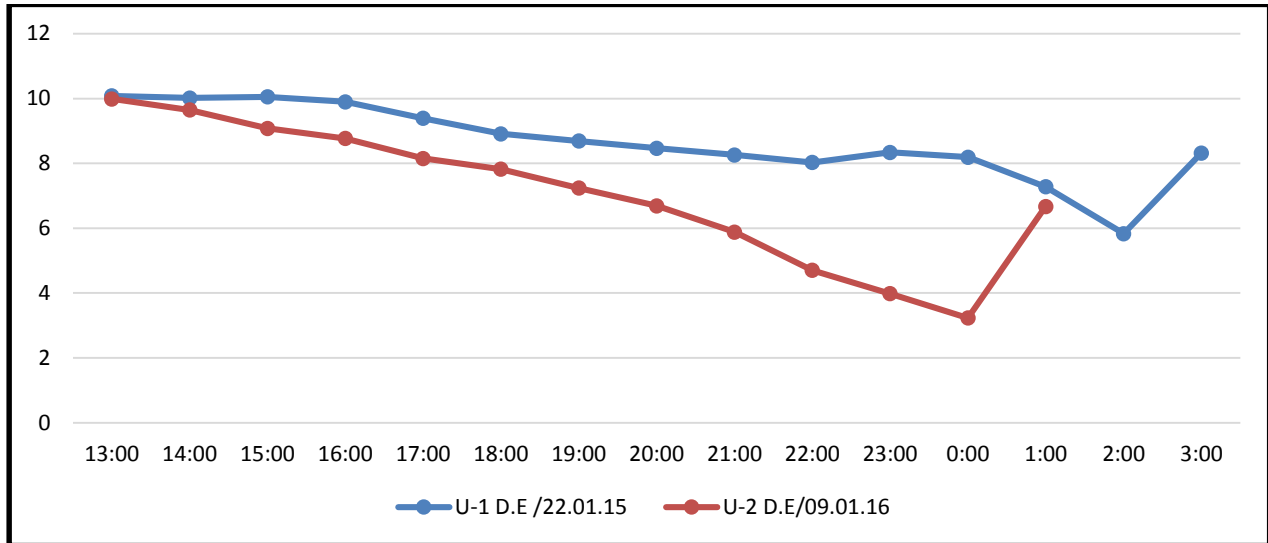



Fig-6 U-1 VS. U-2 DIFFERENTIAL EXPANSION

- We have analyzed that further we can go for cooling of turbine up to FSMT in the range of 325-330°C by following the same procedure by keeping TG in synchronize condition for one more hour at @50MW.
- Unit-2 total overhauling time was 18.24 days which is the minimum time taken by any SEC make unit in India.

4.0 REPLICATION:

After successfully completion of two major Over hauling's and achieving turbine cooling in controlled and safely manner in 6 days, standard operating procedures were prepared. After achieving full speed of TG-2 after overhauling, OEM (SEC) agreed and signed the protocol for following M.S dropping rate for Turbine cooling as standard operating procedure. GWEL shared these standard operating procedures with other power utilities like GKEL (GMR Kamalanga Energy LTD) a 4*350 MW Dong Fang make machine which planned over hauling of Unit-03 in September-16. GKEL completed the Over hauling and achieved its turbine cooling within 7 days by adopting standard procedures implemented in GWEL. Similarly Reliance Butubori a 2*300 MW SEC make also adopted standard procedures implemented in GWEL and cooled it's turbine within 8 days.

 2X300 MW GMR WARORA ENERGY LIMITED	Unit Shutdown Protocol	Unit :2
		Date: 27-01-16

M.S Temperature Dropping Rate Protocol

Job Description: During Unit#2 annual overhauling MS Temperature and pressure drop rate

DATE	TIME		LOAD (MW)	M.S. PRESSURE	M.S TEMP	SATURATION TEMP	TEMP DROP	MHI I/S	CUT IN OIL GUN	OIL CONS.	CHECK BY		
09.01.2016	16:30	17:30	Min load as per schedule	140	510	337	30	B/C/D/E	NIL	NIL			
	17:30	18:15	210	130	490	331	20	B/C/D/E	NIL	NIL			
	18:15	19:00		120	480	325	10	B/C/D/E	NIL	NIL			
	19:00	19:45	200	115	460	322	20	B/C/D/E	NIL	NIL			
	19:45	20:30		110	450	319	10	B/C/D/E	NIL	NIL			
	20:30	21:00	190	105	430	315	20	B/C/D/E	NIL	NIL			
	21:00	22:00	180	100	410	312	20	B/C/D/E	NIL	NIL			
	22:00	22:30	150	90	400	304	10	B/C/D	AB-2/4	2.5			
	22:30	23:00	125	80	380	296	20						
	23:00	23:15	95	70	370	287	10	B/C	AB-1/3	5			
	23:15	23:30	70	65	360	282	10						
	23:30	23:45	60	60	355	277	5	B	BC-1/3	7.2			
	23:45	23:55	45	60	355	277	0						
	0:00		40	60	350	277	5						

Further oil support can be taken depends upon flame intensity to avoid MFT on flame loss

As per OEM discussion, approved for MS temperature and pressure drop for shutdown.

Reviewed by	Name	Signature	Date & Time
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