Brief Introduction on Company/Unit

1690MW TPP JSW Energy Ltd Tornagallu (Vijayanagar Capacity) Ballari Dist. Karnataka

860MW - SBU2– 2 X 300MW
SBU1- 2 X 130MW

SBU – Strategic Business Unit
CPP – Captive power plant

JSW ENERGY LTD., VIJAYANAGAR

2 X 130 MW & 2 X 300 MW

Mr. Sam Devadhas , DGM (OS&TS)
Mr. Hanumanth Rao, Sr. Mgr (OS)
Mr. P Venkateswara rao, Mgr (OS)

Unit	Fuel
SBU1 2 X 130MW	Imported Coal, Corex Gas
SBU2 2 X 300MW	Imported Coal & BFG Gas
CPP1 100MW	BFG & Corex Gas
CPP2 125MW	BFG & Corex Gas
CPP3&4 2 X 300MW	Imported Coal & BFG gas

Brief introduction on Company/Unit

Better Everyday

Introduction

JSW Energy is one of the most efficient power generation companies in India. With a capacity of 5.39 GW spread across several locations, it is a major player in the Indian power industry. It also owns strategic stakes in natural resource companies in South Africa. The company operates as India's leading power trading company. JSW Energy has a joint venture with Toshiba Corporation for manufacturing of supercritical Steam Turbines and Generators.

JSW Energy began its commercial operations in the year 2000 with a capacity of 0.26 GW and has gradually increased to 5.39 GW by 2018 with 4 generation facilities viz. Vijayanagar, Ratnagiri, Barmer and Sholtu

Vijayanagar Plant:

Located in Vijayanagar, Karnataka, this plant consists of two separate business units, along with steel captive power with a combined capacity of 1690 MW. The plant stands out as extremely efficient and has received several accolades from the Govt. of India. The Vijayanagar plant comprises of two separate business units: SBU I: This unit was commissioned in the year 2000. It is the first of its kind in India, which is operating on multi-fuel technology of any combinations. 2x130 MW project is one of the first kind registered under Clean Development Mechanism (CDM) mechanism for reduction of GHG emissions and received CERs of 4.95 Million.

SBU II: This unit became operational in the year 2009.

Running on imported coal and a blend of coal from other different sources that help boost cost effectiveness. This unit is retrofitted with in-house burners to operate with steel plant by-product gases.

Energy Consumption Overview FY 20-21

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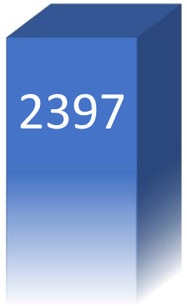
GENERATION MU



PLANT LOAD FACTOR (%)

AVAILABILITY FACTOR (%)

AUXILIARY POWER CONSUMPTION (%)

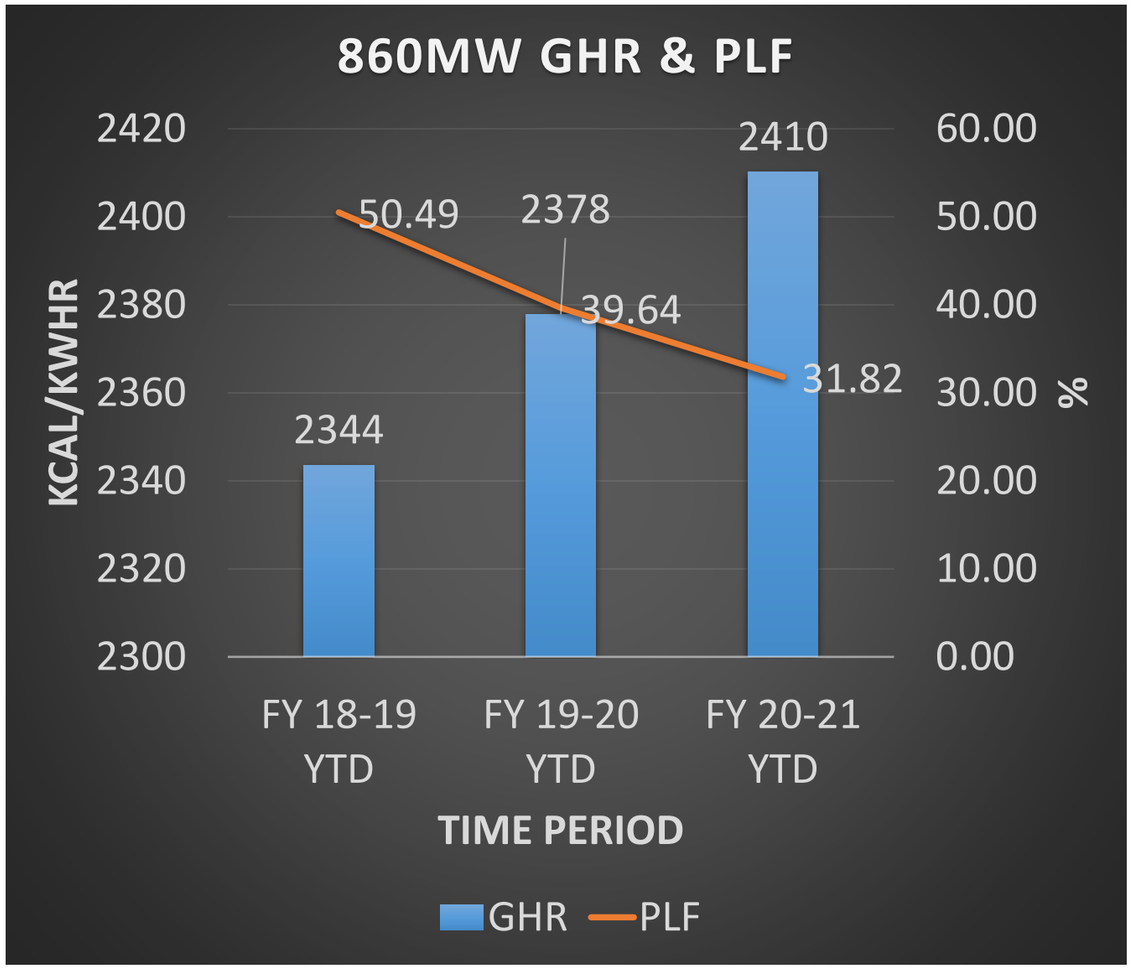
GROSS HEATRATE (KCAL/KWH)

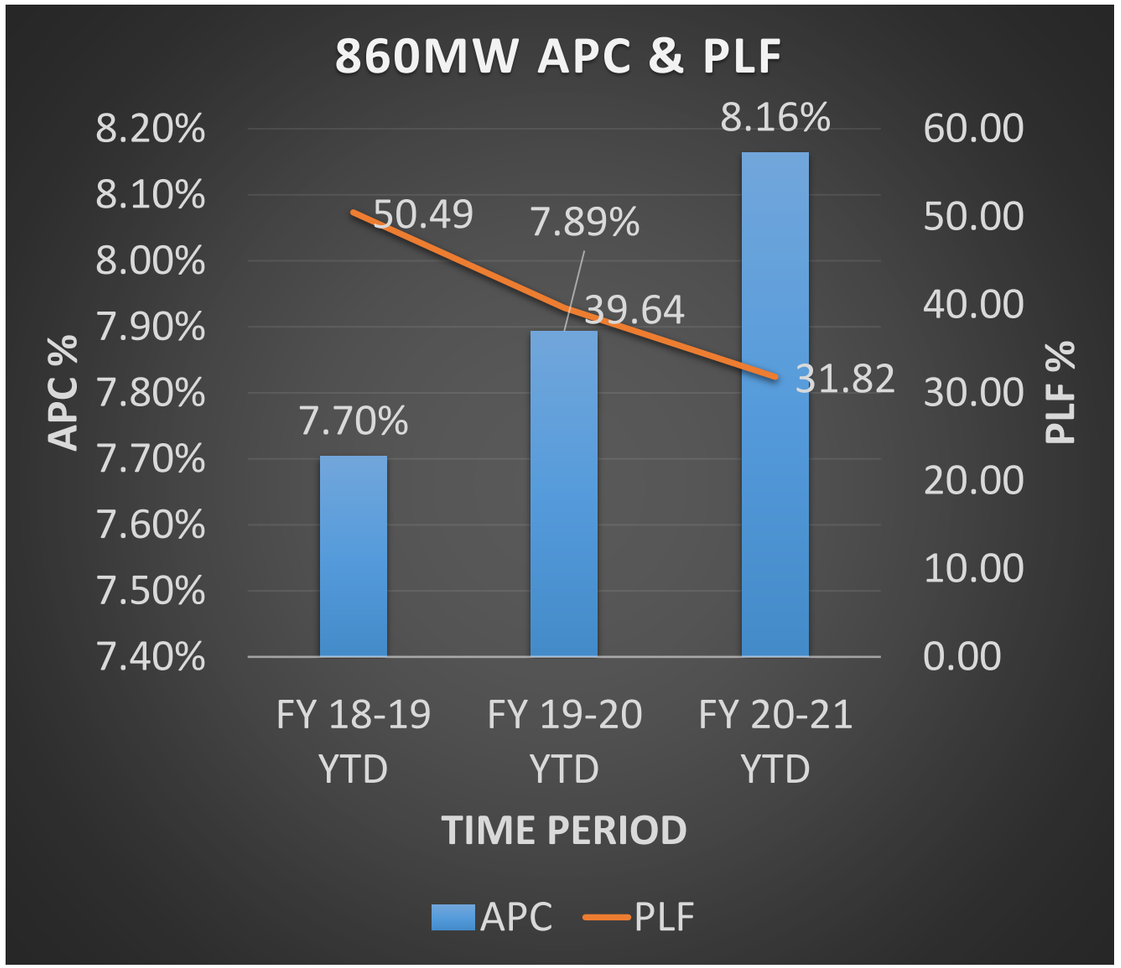
SP. DM WATER CONSUMPTION (%)

SP. RAW WATER CONSUMPTION (M3/MU)

SP. OIL CONSUMPTION (%)

Sp. Energy Consumption in last 3 years (FY 2018-21)

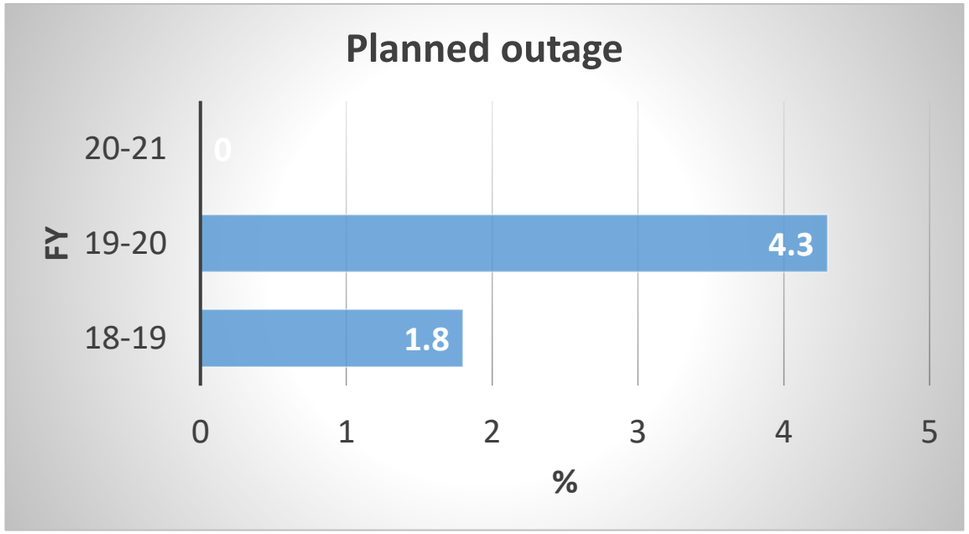


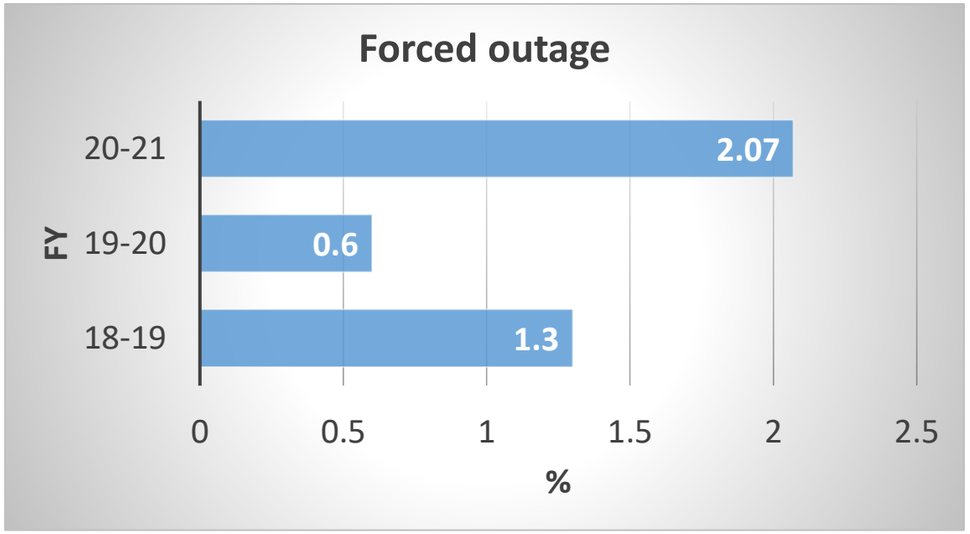


GHR has increase due to reduction in PLF.
Less demand due to increase of Renewable Energy capacity

APC has increase due to reduction in PLF.
Less demand due to increase of Renewable Energy capacity

Availability Trend for last 3 years (FY 2018-21)





Internal benchmarking/external benchmarking

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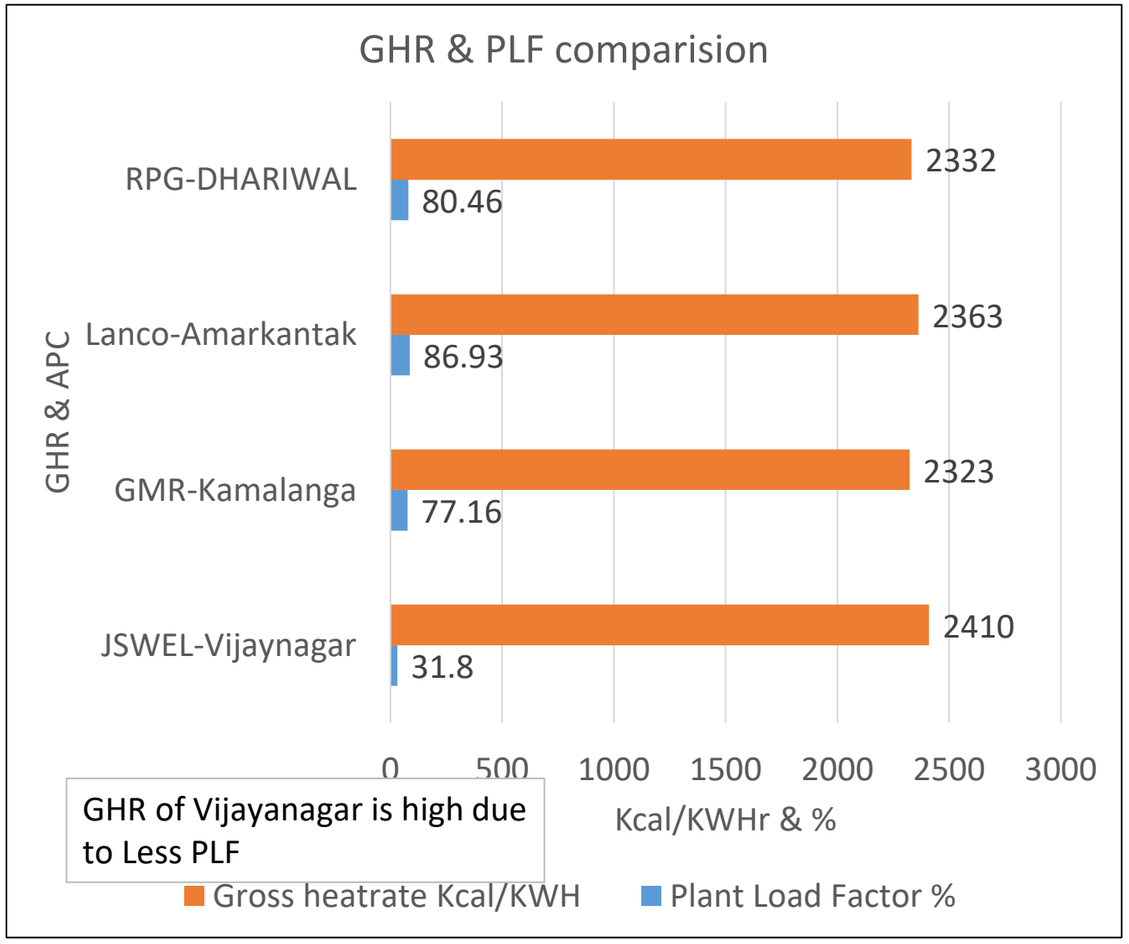
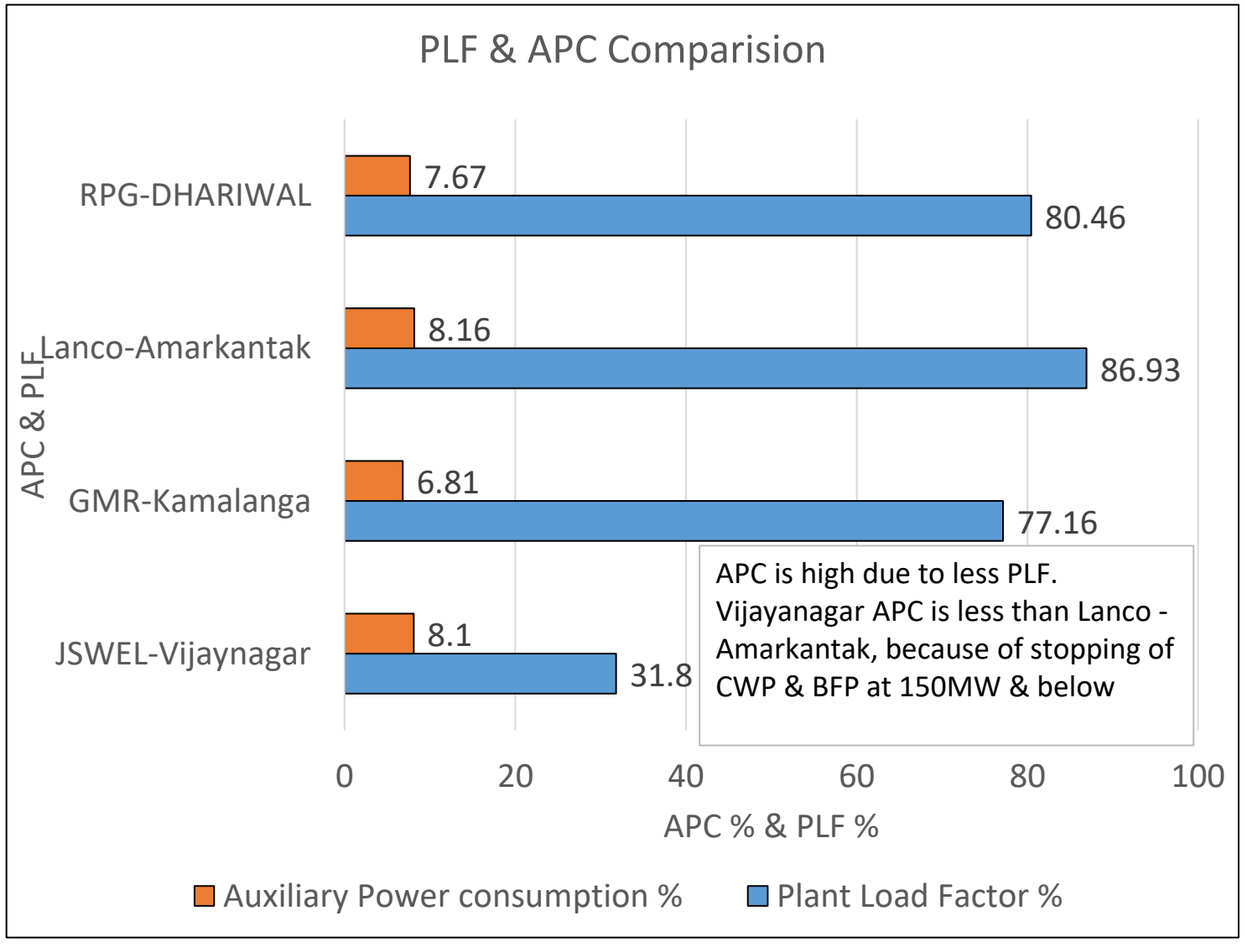
CERC Norms

- Availability Factor 85%
- APC 8.25%
- SOC 0.25ml/kwh





Encon PROJECTS PLANNED IN FY 21-22

Project Planned	Savings in Lakhs Rs.	Expected savings per annum in Lakh Rs	ROI in months
SBU1 U1 Fills Replacement	50	53.43	11.23
SBU2 U1 Fills Replacement	70	98.81	8.50
SBU1 U1 COH	250	149.62	20.05
SBU2 U1 COH	250	254.08	11.81

ENERGY SAVING PROJECTS IMPLEMENTED

JSW Energy
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Financial Year	No. of Energy savings project	Investment Rs. Million	Electrical savings (Million KWHr)	Thermal savings (Million Kcal/MTOE)	Savings (INR Million)
2020-2021	5	14.265	3.0495	0.000536	15.88
2019-2020	9	47.29	4.93294	0.001445	40.92
2018-2019	4	0	25.0705	---	102.03
Total	18	61.55	33.05	0.001991	158.83

SUMMARY OF ENERGY SAVING PROJECTS IMPLEMENTED FOR LAST 3 FINANCIAL YEARS

JSW Energy
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Financial Year	PROJECT	Investment Rs. Million	Electrical savings (Million KWHr)	Thermal savings (Million Kcal/MTOE)	Savings (INR Million)
2020-2021	SBU2 U1 Clear water pump sump Level Auto control by varying VFD speed	0	0.1253	0	0.40974
2020-2021	CEP VFD Deaerator level logic implementation to reduce throttling losses of Deaerator control valve	0	0.5326	0	1.7416
2020-2021	SBU2 U1 4 CT cell fills replaced with trickle grid	14	0.69826	0.0001721	4.182
2020-2021	SBU2 U1 Reduction in Net Unit Heatrate by improving the vacuum at 140MW by Keeping 2 CWP in service	0	1.35001	0.000286	7.565
2020-2021	SBU2 U1 Condenser cleaning 8-March-2021	0.265	0.34336	0.00007823	1.986
2019-2020	Energy conservation by seal air header pressure optimization w.r.to coal flow	0	0.12813	0	0.45
2019-2020	Energy conservation by stopping of Standby Mill Lube Oil Pumps in SBU2 units	0	0.021447	0	0.07
2019-2020	SBU-2 Unit-1 improvement in cooling tower effectiveness by 7% by replacing the existing cross flute PVC CT fills with anti-clogging trickle grid fills in 06 Nos of CT cells	19.79	0	0.0013388	18.08

SUMMARY OF ENERGY SAVING PROJECTS IMPLEMENTED FOR LAST 3 FINANCIAL YEARS

Financial Year	PROJECT	Investment Rs. Million	Electrical savings (Million KWHr)	Thermal savings (Million Kcal/MTOE)	Savings (INR Million)
2019-2020	Replacement of APH baskets and reducing the DP across APH there by reducing power consumption of ID and PA fans	27.5	0.876	0	3.06 *
2019-2020	SBU-1- Reduction of power consumption of 135kWh by switching OFF ESP hopper heater, shaft insulator heaters and rapping motors during reserve shutdown of unit	0	1.137645	0	3.98
2019-2020	SBU-1- Reduction of power consumption of 30Kwh in Instrument air compressor by running in suction throttle mode over Base mode.	0	0.26352	0	0.92
2019-2020	Reduction of Auxiliary power nearly 172 KWh by optimisation of equipment running during the minimum export schedule, optimisation of total air flow with respect to % of Oxygen at APH inlet thereby reduction of power consumption in ID,FD and PA fans	0	1.066195	0	3.73
2019-2020	Reduction of Start-up Auxiliary power from 85MWh to 45MWh for every cold start-up by optimising the equipment's in service	0	1.44	0	5.04
2019-2020	SBU-2 reserve unit Cold startup oil consumption optimization	0	0	0.0001058	5.59

SUMMARY OF ENERGY SAVING PROJECTS IMPLEMENTED FOR LAST 3 FINANCIAL YEARS

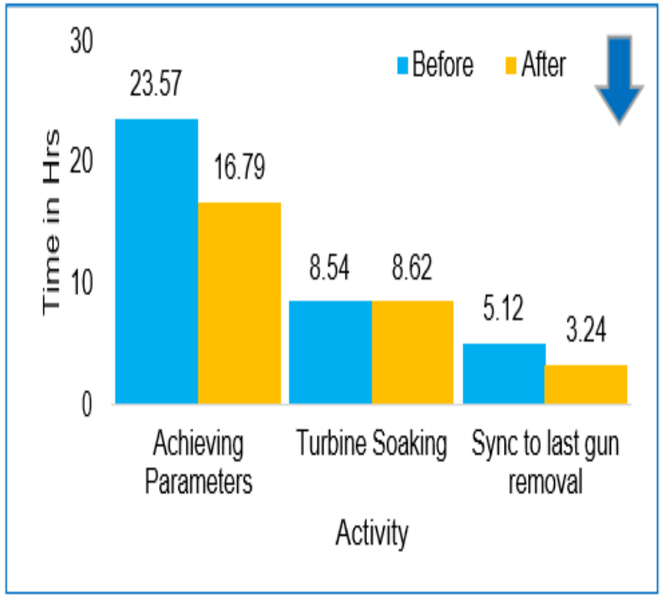
Financial Year	PROJECT	Investment Rs. Million	Electrical savings (Million KWHr)	Thermal savings (Million Kcal/MTOE)	Savings (INR Million)
2018-2019	Optimisation of Auxiliary power consumption in Balance of plant equipments(CHP & APH)	0	7.458935	0	30.35
2018-2019	Energy Saving through overhauling of 300MW Circulating Water Pump-A	0	0.153225	0	0.62
2018-2019	CEP header Pressure Optimization @ Part load(150 MW)	0	1.320967	0	5.38
2018-2019	Part load power consumption optimisation by best operation practices. After detailed study of the operating regime in part load at 150MW, One Boiler Feed water Pump, 1 Circulating Water Pump and 1 Closed cycle Circulating water pump were stopped and kept standby.	0	16.137414	0	65.68

* Payback time is high due to unit not running because of non availability of schedule

INNOVATIVE PROJECT

4X300MW – SBU2, CPP3&4

1. Optimization of Startup oil consumption



Objective:

To reduce startup oil consumption while starting the unit

Execution Department:

Operations

Investment:

Nil

Project Description:

In reducing startup time which ultimately reflected in Startup oil consumption.

On Prior to Boiler light-up other running unit LPH 4 outlet of 120 °C water filled in deaerator, with the deaerator pegging hot water filled in the boiler through Boiler Feed pump, by admitting blowdown and continuous filling of hot water, slowly brought drum metal temperature down to 100°C.

During Turbine, soaking Boiler was stabilized only with one oil burners and one BF gas burners with minimum oil pressure, earlier Two oil burners & Two BF gas burners were kept in service.

Earlier turbine Soaking time is approximately 3.5 to 4.0 hrs. Now soaking time reduced as per the OEM Chest metal temperature conditions resulted in decreased soaking time of 1.0 Hrs.

Micro level planning in the initial stages was challenging, as the objective was to eliminate all the hurdles encountered during startup & Ensuring the drum differential metal temperature < 40°C during the raising of boiler temperature.

Description	UOM	Values	Monetary loss/Gain
Monetary Loss due to hot water filling			
Increase in DM water Consumption	M3	523	0.18
Increase in BFP power Consumption	Kwh	5335.43	0.19
Increase in U1 heat rate for Hot water consumption	Kcal/Kwh	53	0.61
Total Monetary Loss	Lakhs		**0.98**
Monetary gain due to reduction on startup oil consumption			
Reduction in U2 Startup oil Consumption	KL	**8.3**	**3.984**
Net monetary gain	Lakhs		**3.00**

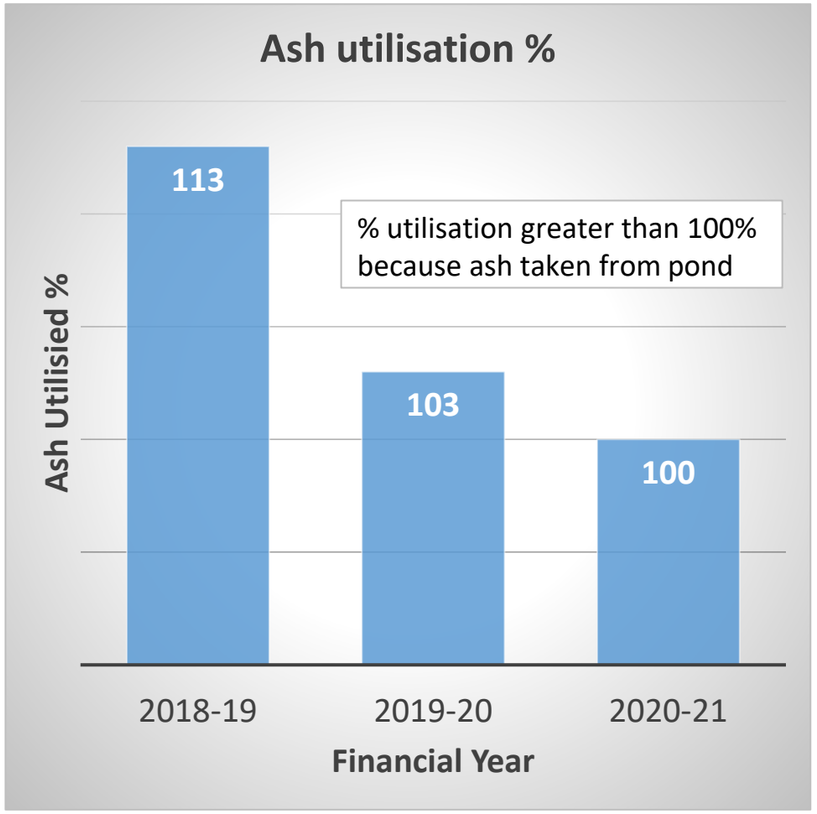
Results:

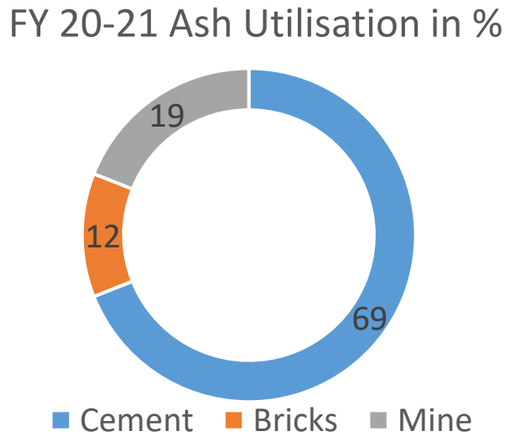
Cold startup oil consumption is reduced from **37 KL to 28.7 KL** net 8.3 KL, Monitory Benefit of 3 Lack per light-up

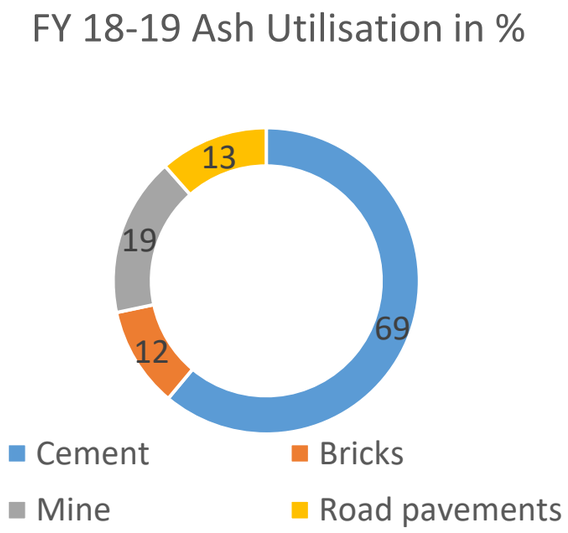
Utilisation of Renewable Energy sources (*Investment made, capacity addition)*

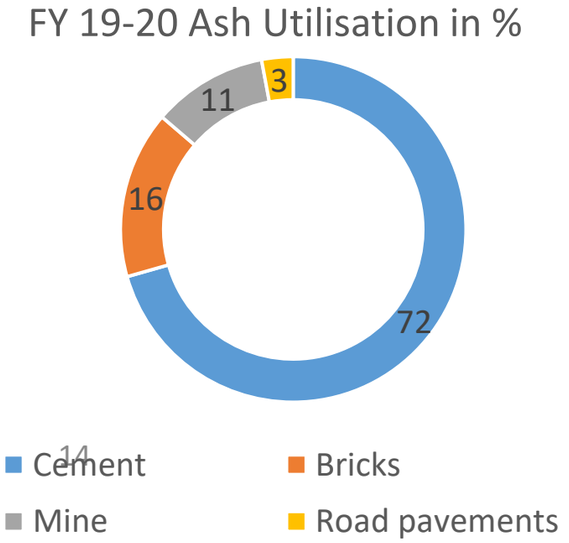
- 930 Acres of land procured on lease in the near by villages of Sandur, Ballari district. For 225MW Solar park. Panel Installation work started.
- Land acquisition under progress for 600MW - IPP & 800MW – SECI Wind mill projects in Karnataka.
- JSW Energy has installed 50KW Solar project for support of Mid Day Meal Scheme program at Akshya patra foundation , this is being used for cooking meals under mid day meals program to surrounding villages.
- **Bio gas unit** –Bio gas unit was commissioned using the canteen waste and the gas generated being used as a supplement to LPG at plant canteen. Reduced LPG consumption by 4hrs daily.

Environment Management- Ash Utilization









Environment Management- Ash Utilization

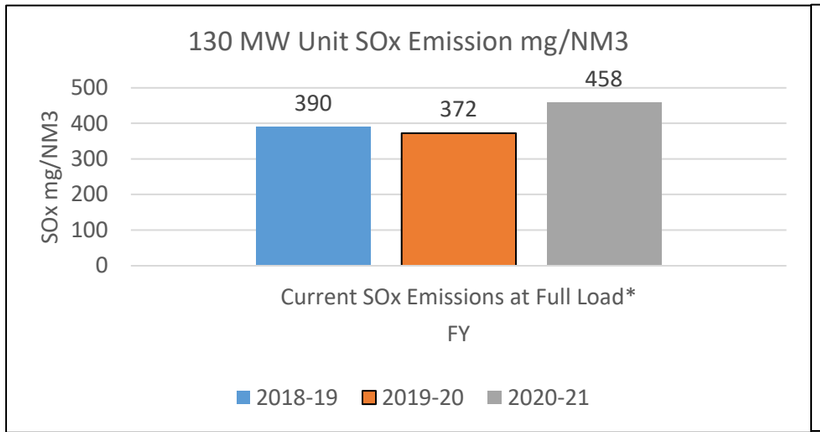
Particulars	UOM	2018-19	2019-20	2020-21
Ash Stock in Plant (yard + pond)	Tons	123914	119660	119660
Ash Generated	Tons	237822	145776	113599
Ash Utilization	%	113	103	100
Ash Utilized in manufacturing of cement/concrete – other similar products	%	78	72	69
Ash Utilized in Fly Ash Bricks	%	11	16	12
Ash Utilized in Mine filling	%	11	11	19
Ash Utilized for Roads pavements	%	13	3	
Ash Utilization in Other Areas – Please mention below	%			
1.	%			
2.	%			
3.	%			
4.	%			
5.	%			
Expenditure on Ash Utilization (annual)	INR (Lakhs)	**10.97**	**18.50**	**86**

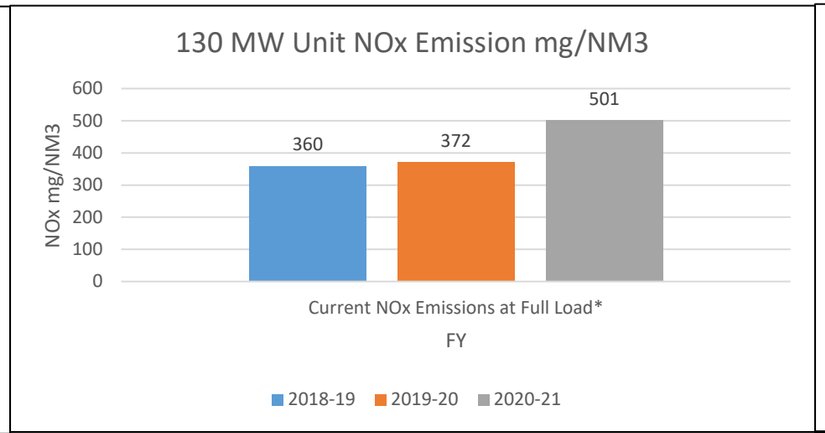
Ash Handling done through various methods

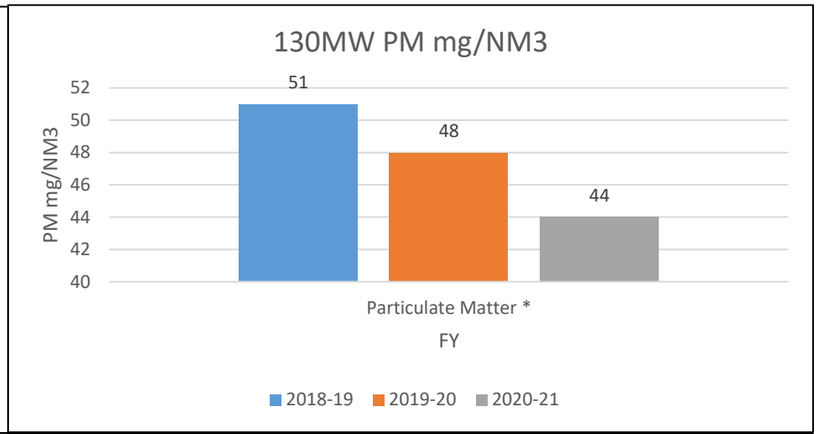
Ash Handled (WetMethod)	%	81
Ash Handled (Dry Method)	%	19
Ash Handled (semi wet)	%	

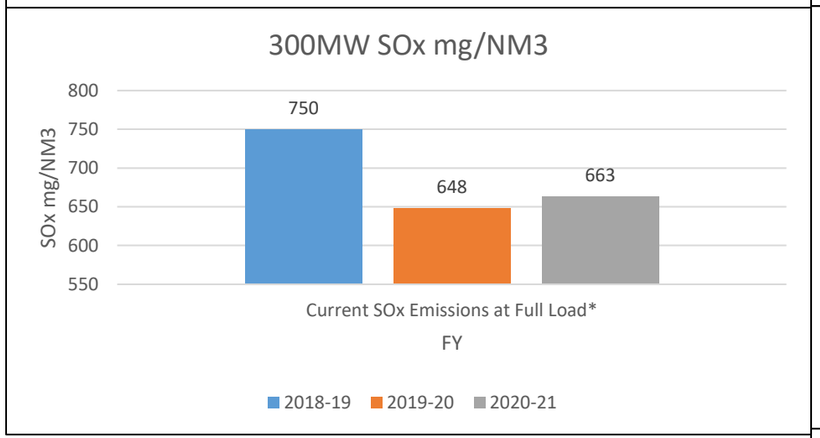
Till FY 19-20, ACC was handling the entire ash handling system, and only SBU 1 bottom ash was handled by the Company, whereas FY 20-21 onwards entire ash system is being handled by the Company, hence expenditure not comparable.

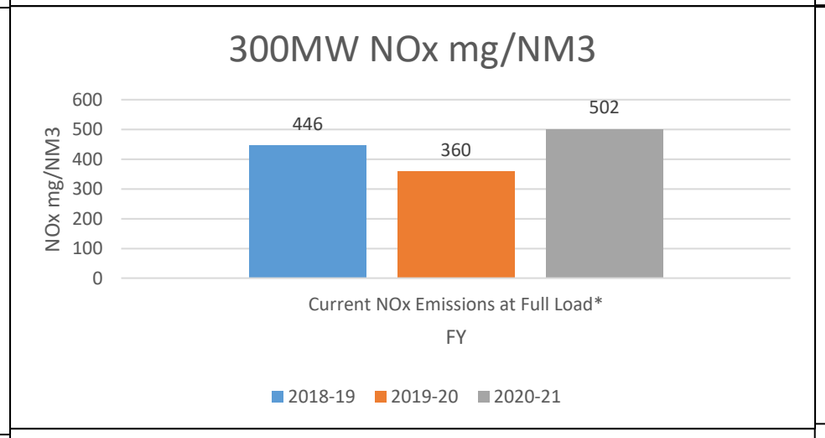
ENVIRONMENT MANAGEMENT - EMISSIONS

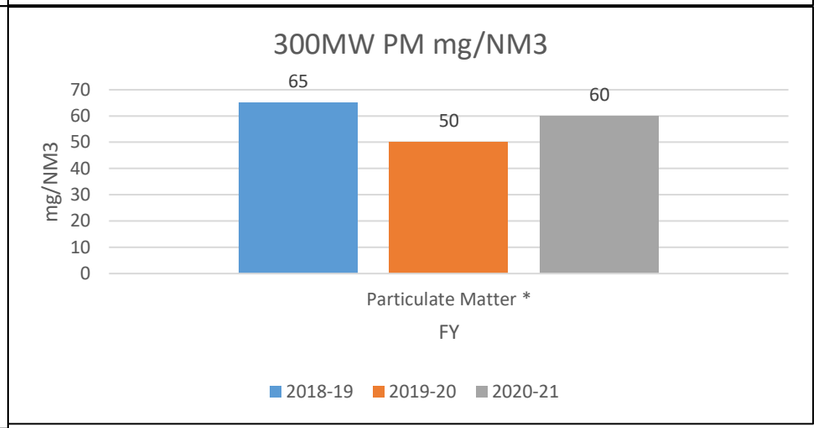


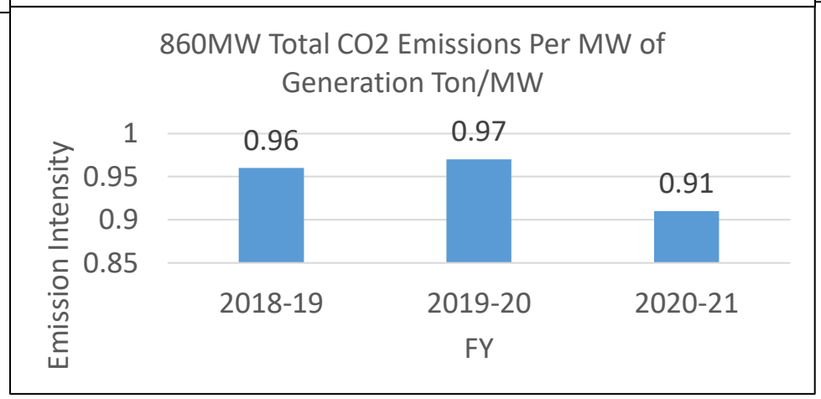












ENVIRONMENT MANAGEMENT - WATER

Better Everyday

Weather Plant is Zero Liquid Discharge - YES

Best Practices in Water Management

3. RO plant water treatment chemical cost reduction

Objective:

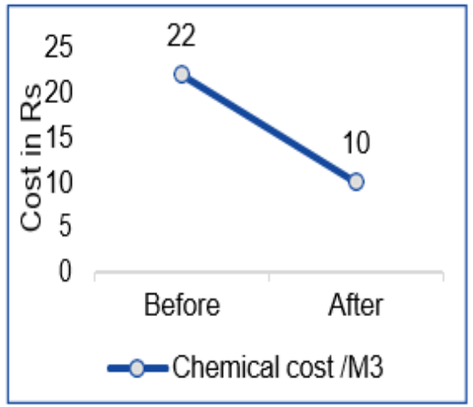
Reduction RO water treatment chemicals.

Execution Department:

Environment & Chemistry

Investment:

Nil

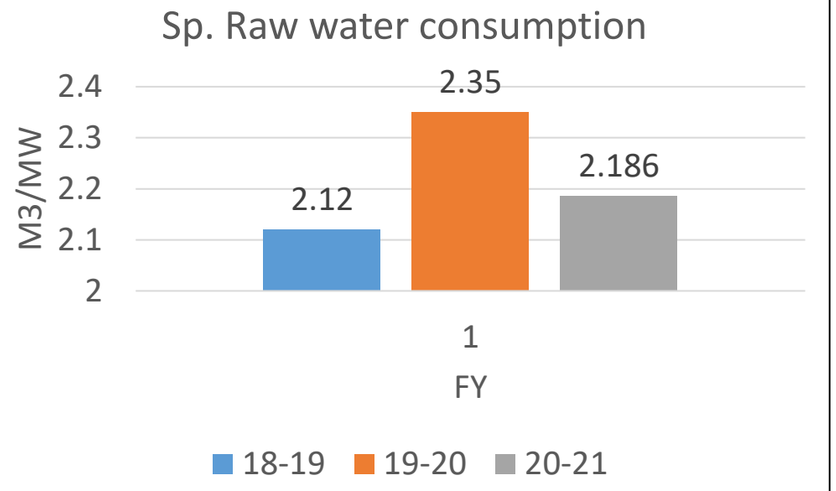


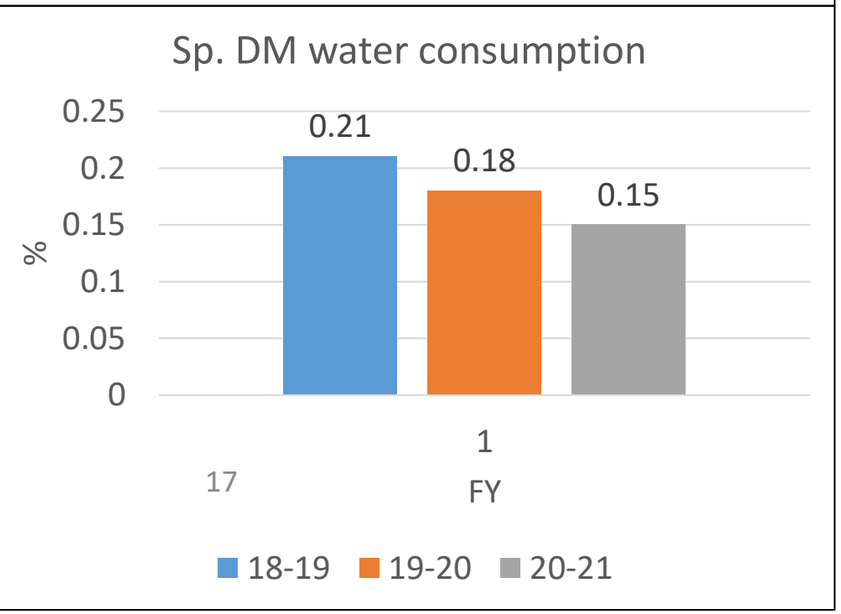
Project Description:

RO treatment chemical cost is high due to complexity in chemical pre-treatment philosophy. This lead to the increase in consumable cost which impacts the O&M expenses.

The present RO treatment chemical cost is Rs 22/m3. It is proposed to reduce/optimize/eliminate the chemicals consumption of lime, soda ash, HCL and other chemicals by using suitable proprietary chemicals (Antiscalent, coagulant & polymer) which can allow to feed RO membranes with water having high hardness and silica without effecting the overall performance of the RO plant.

Results:	The RO water treatment chemical cost is reduced to 10 Rs/m3 which is equivalent to 88.1 Lacs.





BEST PRACTICES

Flexibilization

Flexible operation of unit below technical minimum loadObjective:

Power optimization & Automation.

Execution Department:
Operations

SBU2 U2 was operated at 70MW

Investment:
Nil

Project Description:
300MW of SBU-2 Unit-2 was planned for reserve shutdown after CPP-4 was synchronized back. Before the reserve shutdown of unit trials were carried out at 90, 70 and 60MW with different fuel combinations.

90MW with 2 Mills and BFG – 45 Mins
Load stabilized at 90MW with 2 Mills of each at 16TPH load and BFG was fired in all the 8 burners at 84kNM³ /h. PA flow in each mill maintained 48 TPH, Further reduction in air flow resulted in slight flickering in flame scanners. Mill loading further reduced to 15 TPH as BFG flow increased from 79 to 87 kNM³/h. even at 15TPH loading flame found to be stable.

Observations:

1. No disturbance in the flame intensity
2. MS & RH temperatures are maintained @ 19 TPH & 0 TPH respectively
3. Average flue gas exit temperature was found 137°C.
4. No changes in Turbine TSI parameters.

70MW with 2 Mills and zero BFG – Duration – 2 Hrs
After completing the trial at 90MW the load was reduced to 70MW @ 2MW/min by cutting of BFG completely. Mill loading was raised from 15 TPH to 17TPH to have a stable flame. Total air flow adjusted to 510 TPH.

Observations:

1. Flame was stable as long as the mill loading was kept at 17TPH, but reduction of coal flow from 17TPH to 15TPH resulted in flickering of flame scanners.
2. MS & RH temperatures are maintained @ 24 TPH & 3.5 TPH respectively
3. Average flue gas exit temperature was found 117°C. less than acid dew point temperature
4. No changes in Turbine TSI parameters.

Results:	At 90MW no abnormalities were observed, but at 60 MW SH temperature is maintained very high due to inconsistency in SH spray flow and also flue gas exit temperature was maintained very low at an avg. of 115°C.

BEST PRACTICES

Maintenance and reliability

Reduction of MTTR for CT Fan shaft replacement

Objective:

Reduction in MTTR (Mean time to repair).

Execution Department:

Mechanical

Investment:

Nil

Project Description:

Standard maintenance procedure (SMP) has been revised. Earlier we used to remove the motor from the location and shaft pulled out through the opening. It takes around 8 hours to complete the job till CT fan trial.

But now we are not removing the motor from its location. We are making down the shaft at its location by arranging a temporary support below the shaft and bringing out through manhole of CT fan. It takes around 4 hours till completion of CT fan trial.

Results:	MTTR reduced from 8 Hours to 4 Hours

Oil Centrifuge level switch modified from float type to tuning fork type

Objective:

Increase in MTBF & decrease the MTTR of turbine oil centrifuge system

Execution Department:

Instrumentation

Investment:

Rs 30,000.00

Project Description:

The level switch at drain pot in centrifuge oil is replaced from float type to **tuning fork type switch**. This is to eliminate the inherent time delay of float type switch during spillage of oil, after centrifuge seal break. It also increases the reliability of the system due to the fast response time (≈ 1 Sec) of tuning fork type level switch. It initiates trip command to the oil centrifuge immediately and avoids drain pot over flow & oil wastage.

Results:	1 barrel of ISO VG 32G oil would cost approx. Rs. 16,468, ROI will be achieved if approximately 2-barrel oil spillage is avoided

BEST PRACTICES

Better Everyday

Maintenance and reliability

18. Replacement of FD fan-4A motor grease

Objective:

Improve equipment availability

Execution Department:

Mechanical

Investment:

Rs 1450.00

Project Description:

Earlier Servo Gem-3 grease was used to lubricate FD fan motor bearing. Bearing temperature was maintaining high (70 °C with air hose & 80 °C) after replacing Servo Gem-3 grease with Mobil XHP-222 temperature came down to 39 °C & maintaining the same.

Results:	FD fan motor bearing temperature dropped to 39 °C & maintaining the same.

19. Replacement of Corroded Metallic Drive shaft with Carbon Fibre Shaft

Objective:

Improve equipment availability

Execution Department:

Mechanical

Investment:

Rs 1,50,000.00

Project Description:

Existing CT Drive shaft get corroded and Vibration is maintained (7.5mm/s) above recommended Valve. This may lead to Gearbox Gear Failure. So, replaced with carbon fibre shaft

Results:	After replacing carbon Fibre shaft Vibration Reduced Below 4.5mm/s

BEST PRACTICES

Better Everyday

Maintenance and reliability

21. Day light sensors for auto control & Energy savings

Objective:

To install self-powered daylight sensors in outdoor lighting control circuits in place of battery operated timers

Execution Department:

Electrical

Investment:

Rs 1,00,000.00

Project Description:

All the outdoor lighting circuits modified for automatic control using Space Grade **Nature Switch**-02 Sensors with Digital Clock. It is useful to control all varieties of outdoor lamps. These sensors switch ON & Off by sensing day light. No battery is required for operation. Wide range of operation selection is available for manual time setting & auto dawn sensing & override options. **Nature Switch**-02 based on **INFRARED SENSING** which is tuned by nature itself offering complete and ultimate automation.

Results:

1. No battery required hence no environmental impact.
2. Switch OFF provision at dawn is selectable for control of street lamps, security lamps etc.

22. MFT Single point protection logic modification

Objective:

To ensure increased availability of critical signals for MFT protection & also to avoid fault tripping of Unit.

Execution Department:

Instrumentation

Investment:

Nil

Project Description:

Identified the critical MFT related signals (Drum Level LoLo, Drum Level HiHi, Air Flow LoLo, Furnace Pressure HiHi & Furnace Pressure LoLo) which were connected to DCS I/O Cards mounted in a single I/O Rack. Since failure of any one such I/O rack's communication may lead to fault tripping of the Unit or non-availability of protection, modified the critical signals configuration in DCS to distribute them across the different I/O Racks.

Results:

Ensured increased availability of critical signals for MFT protection & also to avoid fault tripping of Unit.

BEST PRACTICES

Better Everyday

Projects implemented through Kaizens (Workers and Supervisor level)

Kaizen, POKA YOKE & OPL

Objective	Result	Before	After
To demonstrate correct position of Operator during 6.6 KV breaker operation	Safe operation		
To demonstrate correct operation procedure of steam trap	Safe operation		
To demonstrate Usage of Saddle for Trench cleaning	Reduction of manpower for trench cleaning		
To provide easy identification of SOT make up MIV during emergency	Avoids Seal oil pump tripping		
To demonstrate safe 6.6kv Circuit breaker operation wearing electric fire resistant suit	Safe operation		
To demonstrate Air Washer Blower 1A starting and stopping instructions at control panel to avoid VFD failure	Avoid VFD failure due to mal-operation		

BEST PRACTICES

Better Everyday

Projects implemented through Kaizens (Workers and Supervisor level)

Objective	Result	Before	After
To avoid bypassing Islanding switch without resetting the relay at MSDS	Correct reset of islanding relays		
To reduce water spillage in Air compressor area	Hazard potential at compressor area reduced from RPN 12 to 3		
To provide Emergency Procedure at local panel, In case Diesel generator fails to start in Auto	Emergency operation reference		
To provide Canopy over CT Fan Motors to prevent from damage and short-circuit	Prevent damage and short-circuit		
To provide Procedure for Fire console report generation	Obtain sequence of fire console events		
To reduce water spillage in Air compressor drier area	Air compressor drier area housekeeping improved		

BEST PRACTICES

DIGITISATION

Better Everyday

This dash board gives the information JSW Energy Ltd Generation along with MTD & YTD

Critical Parameters trend

Teamwork, Employee Involvement & Monitoring

Better Everyday

1. Daily monitoring system

Is done through DM (Daily Management) board in all department with SIC & dept. Employees. Daily O&M Meeting. HOD Meeting, Quality Assurance Review Meeting (QAR)

2. Review meeting chaired by

Head of the Plant

3. Separate budget for Energy Conservation

In CAPEX Energy conservation budget is included

4. Energy efficiency / awareness training program

Energy Efficiency Training programs conducted by CII, BEE, QSHEEN (ISO)

5. Projects implemented through Kaizens (Workers and Supervisor level)

Projects list attached in previous slide. (IQM Portal is developed around 250 ideas recorded)

6. % Major Areas of concern in terms of energy efficiency and reliability

** Cooling tower Performance Sustenance*

ISO CERTIFICATION

BUREAU VERITAS
Certification

JSW ENERGY LIMITED

JSW Energy

POST BOX NO. 09, TORANAGALLU, BALLARI DISTRICT – 583 123, KARNATAKA, INDIA.

Bureau Veritas (India) Pvt. Ltd. (Certification Business) certify that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the management system standards detailed below

Standards

ISO 9001:2015, ISO 14001:2015, BS OHSAS 18001:2007 & ISO 50001:2011

Scope of certification

GENERATION OF ELECTRICITY FROM OPERATION OF 2X130MW & 2X300MW THERMAL POWER PLANT

Original cycle start date For	ISO 9001, ISO 14001 & BS OHSAS 18001:	08 December 2007
Original cycle start date For	ISO 50001:	09 May 2014
Expiry date of previous cycle For	ISO 9001, ISO 14001 & BS OHSAS 18001:	07 December 2018
Expiry date of previous cycle For	ISO 50001:	08 May 2020
Recertification Audit date:		26 October 2019
Recertification cycle start date:		21 November 2019
Subject to the continued satisfactory operation of the organization's Management System, this certificate expires on:	For ISO 9001 & ISO 14001:	07 December 2022
	For BS OHSAS 18001:	11 March 2021
	For ISO 50001:	21 August 2021

Certificate No. IND19.8998 Version : 1 Revision date: 21 November 2019

Certification Authority
Jagdheesh N. MANIAN
Head – CERTIFICATION, South Asia
Commodities, Industry & Facilities Division

NABCB NABCB NABCB NABCB
QM 003 EM 004 OHSMS 001 EnM003

Local office: *Bureau Veritas (India) Private Limited (Certification Business) 72 Business Park, Marol Industrial Area, MIDC Cross Road "C", Andheri (East), Mumbai – 400 093, India.*

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organization. To check this certificate validity please call +91 22 6274 2000.

FY 20-21
0.133% investment of energy saving projects on total turnover of the company

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LONG TERM VISION ON ENERGY EFFICIENCY

- 300KNM3/Hr additional Gas Firing additional boiler Errection. To consume the gas from 18MTPA JSW Steel Plant. & to reduce Pollution & other Environment hazards if the gas would have been let to atmosphere. To reduce the coal consumption & Pollution issues due to Flue gas.
- 70MW Operation of 300MW plants, when the Solar & Wind Power starts Generating Power. Wrt bundling Thermal, Solar & Wind Power.
- Solar Plant 225MW – Commissioning by March 2022.
- 1400MW Wind Mill Project – By FY 2023
- Exploring the possibility of PSP – Pumped storage plant

learning from CII Energy Award 2020 or any other award program

Better Everyday

1. There scope for Energy savings in Electrical Systems Case studies such as :-
   Isolation of one TFR 's, Paralleling of TFR's to reduce the transformer losses, Using Solar Energy for APC reduction,
2. Awareness related to Energy conservation, Water conservation, digitization measures taken by other Similar Power plants.

learning from CII Energy Award 2020 or any other award program

Certificate of appreciation from Ministry of Finance

Green Maple Diamond Award under Energy Conservation FY 20-21.

THANK YOU

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