CII National Award for Excellence in Energy Management 2022

Bhushan Power and Steel Ltd, Sambalpur

Mr. Manoj Kumar Patwari (AVP : Power Plant)
Mr. Ranjan Kumar Singh (AGM : OSTS)

Company Overview

JSW Steel

- India's leading integrated steel producer
- Installed crude steel capacity of 27 mtpa, growing to **37 mtpa**
- Market capitalization of **$16.8bn**

JSW Energy

- Power producer with installed capacity of 4.6 GW (Hydro, Renewable and Thermal)
- Growing to 20 GW by 2030 **with 85% renewable portfolio**
- Market capitalization of **$6.0bn**

JSW PAINTS

- Commenced operations in March 2019
- Annual operating capacity of **130,000KL**
- Fully automated coil coating capacity
- Only fully-automated, water-based plant in India

JSW Better Everyday

Presence across the core sectors of India.

JSW Infrastructure

- Engaged in development and operations of ports
- Operational capacity 110 mtpa
- Operations across East, West & Southern coasts of India.

JSW Cement

- Manufacturer of Portland Slag Cement(PSC), Ordinary Portland Cement9OPC0 and Ground Granulated Blast furnace Slag(GGBS)
- Operational capacity of 14 mtpa, growing to **25 mtpa**

Bhushan Power and Steel Ltd

Village: Thelkoloi, P.O.: Lapanga,

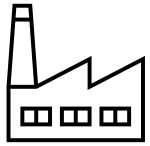
Tehshil: Rengali, Dist: Sambalpur, Odisha

- Integrated Steel Plant : 3.5 MTPA
- Power Plant : 390 MW
- DRI : 6000 TPD
- Pellet Plant : 3.5 MTPA
- Sinter Plant : 1 x 105m2
- Coke Oven Plant 1 & 2 : 0.45 & 1.09 MTPA
- CSP HRM : 1.8 MTPA
- WRM : 0.45 MTPA
- Pipe & Tube Mill : 0.2 MTPA
- Coal Washeries 1 & 2 : 1x1.0,1x3.5MTPA

About Bhushan Power and steel

Bhushan Power & Steel Ltd. (A subsidiary of JSW Steel) is located in District: Sambalpur in the state of Odisha.

This is an integrated Steel Plant with a 3.5 MTPA manufacturing capacity and 390 MW Power generating capacity.



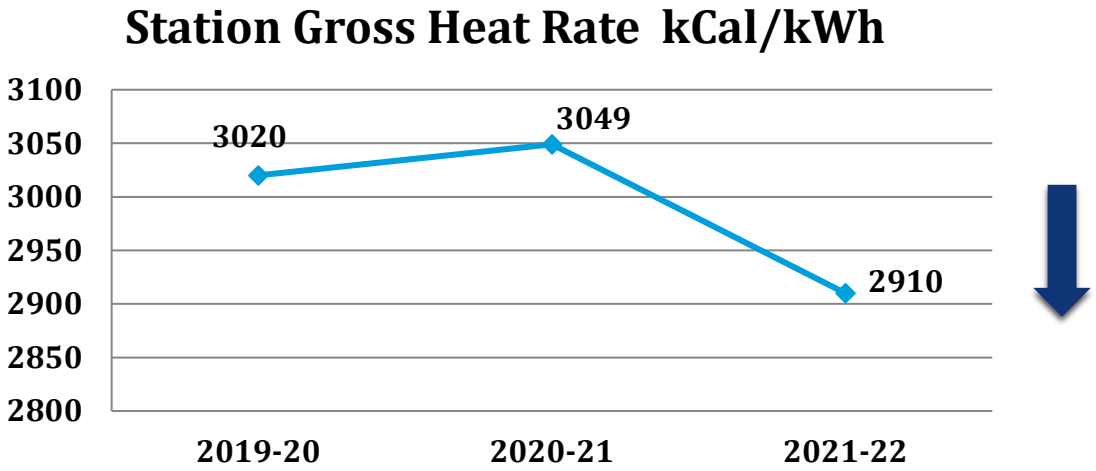
BPSL is a leading manufacturer of flat and long products and has state-of-the-art plants in Odisha, Chandigarh, Derabassi, and Kolkata in India.

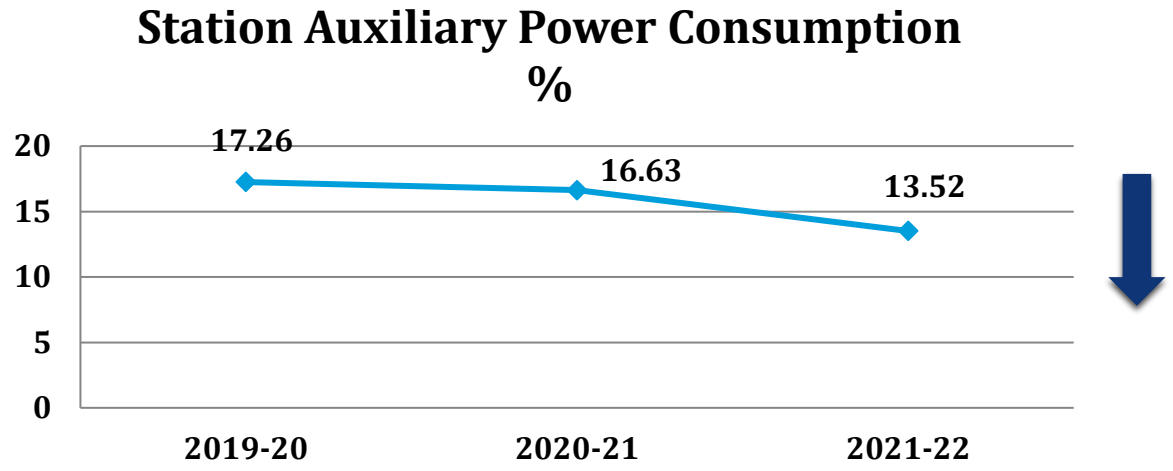
These plants manufacture value-added products covering the entire steel value chain right from Coal Mining to manufacturing Pig Iron, DRI, Billets, HR Coils, CR Coils, GP/GC Sheets, Precision Tubes, Black Pipe/GI Pipe, Cable Tapes, Tor Steel, Carbon, and Special Alloy Steel Wire Rods.

Energy consumption overview

Parameters	UOM	2021-2022
Installed Capacity	MWh	390
Annual Generation	MWh	319.07
Plant Load Factor	%	81.79
Plant Availability Factor	%	97.87
Gross Heat Rate	kCal /kWh	2910
Auxiliary Power Consumption	%	13.52
Station Gross Boiler efficiency	%	81.11
Station Gross Turbine heat rate	kCal/kWh	2360
DM Water consumption	%	3.96
Raw Water consumption	M^3/MW	3.23
Specific Oil consumption	ml/KWh	0.18

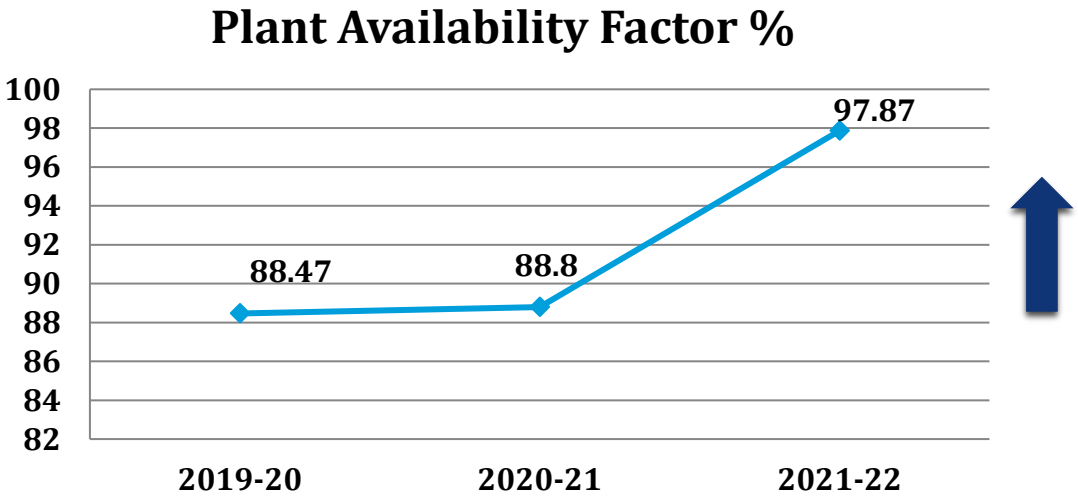
Specific Energy consumption

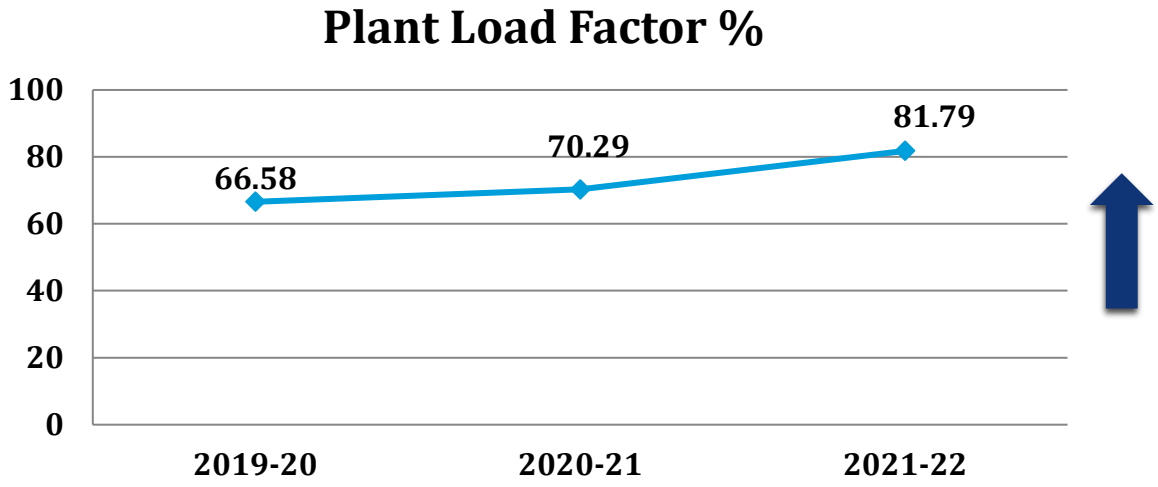




	% Improvement	Reason
Gross Heat Rate	4.6	Bullet cleaning of condenser and then Installation of on load condenser cleaning system. Optimization of O2% in Boiler, steam drain line passing arrested.
Auxiliary Power Consumption	18.7	Reduction in BFP discharge pressure, Reduction in steam losses, Optimization in conveying air consumption.

Specific Energy consumption



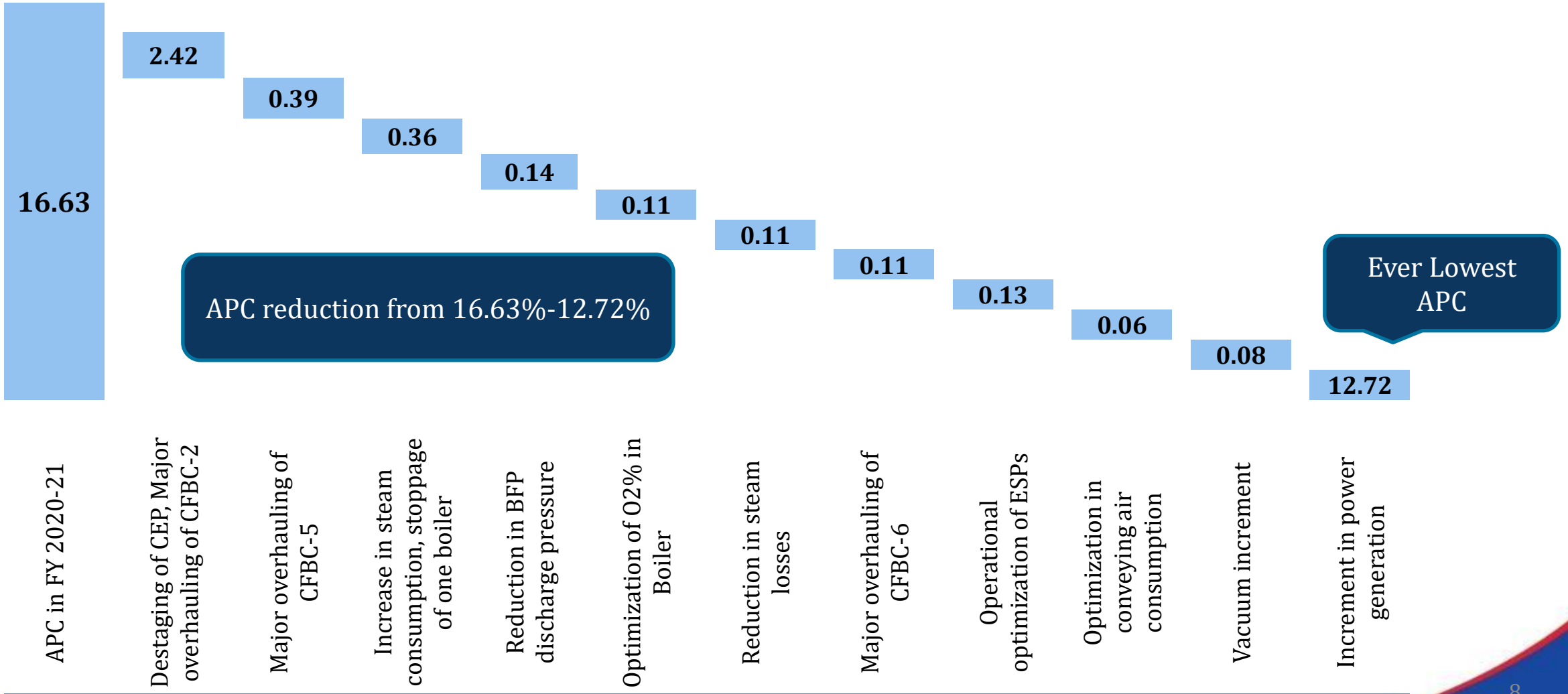


	% Improvement	Reason
Plant Availability Factor	10.2	Regular Overhauling of Boiler, Tube replacement, condition monitoring of equipment.
Plant Load Factor	16.4	Generation increased, Availability of boiler and turbine improved.

Month wise APC Reduction in FY 2021-22

Our Encon Journey in APC Projects:

Auxiliary Power Consumption in %



Competitors, National and Global Benchmarking

	Gross Heat Rate (Kcal/ Kwh)	Auxiliary Power Consumption (%)
BPSL Achieved	2910	13.52
BPSL Internal benchmark	2850	12.0
CPP Hirakud (Aditya Birla)	2462	8.97
National	2653	7.5
Global	2450	6.92

Energy Data

Parameters	UOM	2018-2019	2019-2020	2020-2021	2021-2022
Installed Capacity	MW	390	390	390	390
Plant Load Factor	%	69.4	66.6	70.3	81.8
Plant Availability Factor	%	96.5	88.5	88.8	97.9
Station Gross Turbine heat rate (Actual)	kCal /kWh	2428	2398	2462	2360
Station Gross Boiler efficiency (Actual)	%	78.6	79.4	80.8	81.1
Station Auxiliary Power Consumption	%	17.8	17.3	16.6	13.5
Station Gross Heat Rate	kCal/kWh	3090	3020	3049	2910
Station Net Heat Rate (Actual)	kCal/kWh	3759	3653	3662	3366
Design Net Heat Rate	kCal/kWh	2494	2494	2494	2494
Design Gross Turbine Heat Rate	kCal/kWh	2205	2205	2205	2205
Design Gross Boiler Efficiency	%	81.7	81.7	81.7	81.7
Average GCV (Actual)	kCal/kg	2993	2857	2973	2964
Cost of Thermal Energy Consumed	Rs/kCal/Ton		879	692	946
Per Unit cost of power	Rs/kWh	--	4.8	4.5	4.7

Encon projects planned in FY 2022-23

Sl No	List of Energy Conservation projects planned in FY:22-23	Annual Electrical Saving (million Kwh)	Annual Thermal Saving (million Kcal)	Investment (Rs million)
1	Steam header interconnection between 3x130 MW and 100 MW power plant	88	75336	300
2	Installation of VFD in CT Fan	0.3	226	2.0
3	APH Tube replacement CFBC-1	1.8	1582	9.5
4	Overhauling of CFBC-4	1.8	1582	230
5	Replacement/repairing of ARC valves of Boiler feed pumps	2.1	1808	2
6	Replacement of HPSV lamps with LED lights	0.1	100	10
7	Installation of onload tube cleaning system	47.9	41219	23
8	Arresting of passing steam drain valves and steam traps	0.9	753	5

Encon projects implemented in last three years

Year	Number of Energy Saving Projects	Investment (INR Million)	Electrical Savings (Million KWh)	Savings (INR Million)
FY 2019-20	4	4.4	789.8	5201.4
FY 2020-21	5	46.3	20.2	133.2
FY 2021-22	10	391.2	93.8	223.9
Total	**19**	**441.9**	**903.8**	**5558.5**

Encon projects implemented in FY 2019-20

Sl. No	List of Energy Conservation projects executed in FY:2019-20	Annual Electrical Saving (Kwh)	Annual Electrical cost saving in Rs million	Annual Thermal Saving		Annual Thermal Cost Saving (Rs million)	Total Annual saving (Rs million)	Investment Made in Million
				Quantity	Unit of Measurement			
1	Repairing of BFP ARC valves	240329.6	1.0	225	Kwh/ton	0.6	1.6	0.9
2	Replacement of NRV in WHRB in main steam line	182500	0.8	172	Kwh/ton	0.4	1.2	0.5
3	Increase in power generation by overhauling of 3x130 MW Turbines	788400000	3311	741096	Kwh/ton	1881	5192	3
4	Trimming of DMCCW pump impeller	981120	4	922	Kwh/ton	2	6.5	0

Encon projects implemented in FY 2020-21

Sl.No	List of Energy Conservation projects executed in FY: 2020-21	Annual Electrical Saving (Kwh)	Annual Electrical cost saving in Rs million	Annual Thermal Saving		Annual Thermal Cost Saving (Rs million)	Total Annual saving (Rs million)	Investment Made in Million
				Quantity	Unit of Measurement			
1	Installation of energy efficient FRP blades in Cooling Tower Fans	2312640	9.7	2173.9	Kwh/ton	5.5	15.2	14.1
2	Improvement in vacuum by Condenser tube cleaning	15976190.5	67.1	15017.6	Kwh/ton	38.1	105.2	0.2
3	Overhauling of AFBC-1	657000	2.8	617.6	Kwh/ton	1.6	4.3	30
4	Replacement of HPSV lights into Led lights	490805	2.0	461.4	Kwh/ton	1.2	3.2	0.2
5	Repairing of BFP ARC valves	788400	3.3	741.1	Kwh/ton	1.9	5.2	1.8

Encon projects implemented in FY 2021-22

Sl.No	List of Energy Conservation projects executed in FY:21-22	Annual Electrical Saving (Kwh)	Annual Electrical cost saving in Rs million	Annual Thermal Saving		Annual Thermal Cost Saving (Rs million)	Total Annual saving (Rs million)	Investment Made in (Rs million)
				Quantity	Unit of Measurement			
1	Overhauling of AFBC-2	1314000	5.5	1235.2	Kwh/ton	3.1	8.6	43
2	Overhauling of CFBC-5	9155952	38.5	8606.6	Kwh/ton	21.8	60.3	91
3	Overhauling of CFBC-6	8041680	33.8	7559.2	Kwh/ton	19.2	52.9	102
4	De staging of Condensate extraction pump	2404620	10.1	2260.3	Kwh/ton	5.7	15.8	0.06
5	Reduction in Conveying air consumption	21900000	91.9	20586.0	Kwh/ton	52.2	144.2	0

Encon projects implemented in FY 2021-22

Sl.No	List of Energy Conservation projects executed in FY:21-22	Annual Electrical Saving (Kwh)	Annual Electrical cost saving in Rs million	Annual Thermal Saving		Annual Thermal Cost Saving (Rs million)	Total Annual saving (Rs million)	Investment Made in (Rs million)
				Quantity	Unit of Measurement			
6	Optimizing discharge pressure of Boiler feed Pumps	8760000	36.8	8234.4	Kwh/ton	20.9	57.7	0
7	Replacement of HPSV lamps with LED lights	490805	2.06	461.4	Kwh/ton	1.2	3.2	0.2
8	Installation of on load tube cleaning system	4915751	20.7	4620.8	Kwh/ton	11.7	32.4	3.5
9	Overhauling of cooling tower	31952380	134.2	30035.2	Kwh/ton	76.2	210.4	11.4
10	Overhauling of CFBC-2	4930128	20.7	4634.3	Kwh/ton	11.8	32.5	140

Innovative Projects Implemented

Reduction of flue gas temperature by modifying of bed nozzle of CFBC boiler:

Pig tail type boiler bed nozzles were replaced with arrow head type bed nozzles in CFBC boilers.

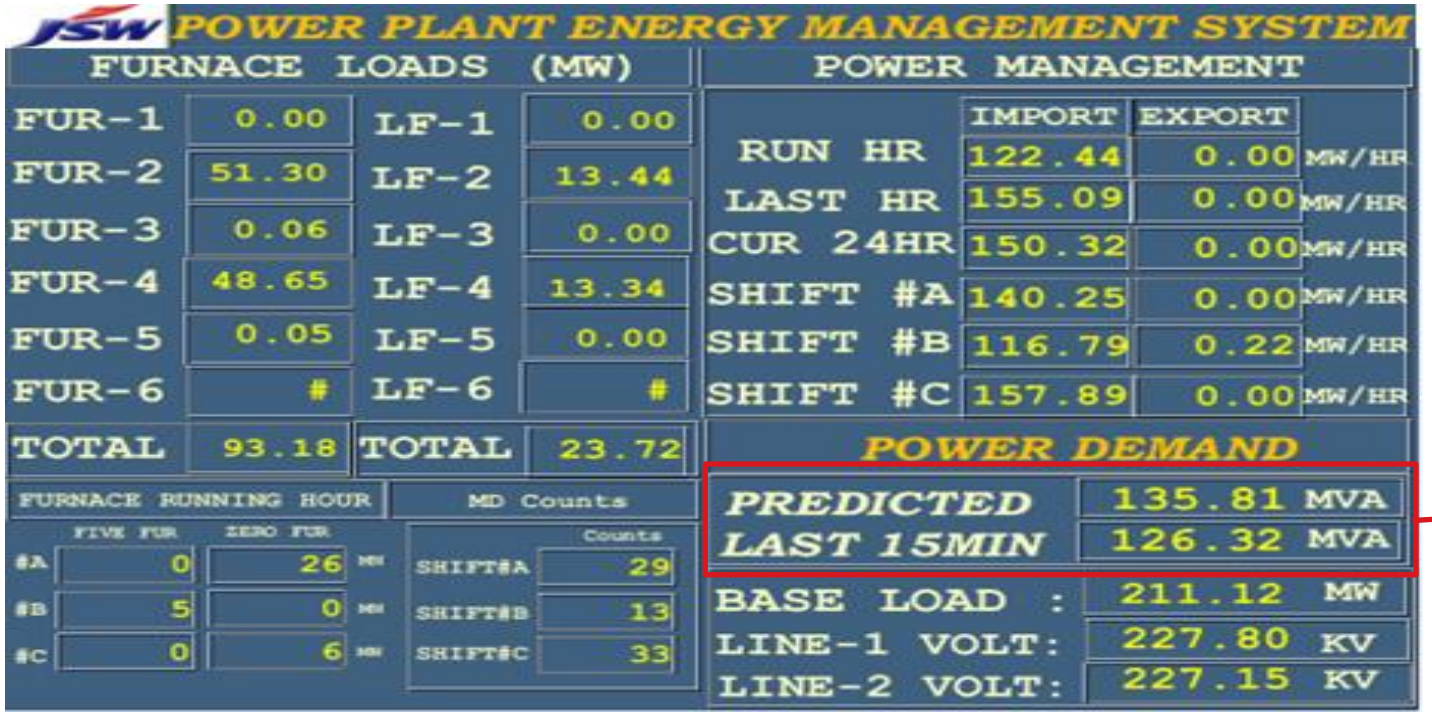
The modification resulted in uniformity in air distribution and reduction in flue gas temperature from 190 degree to 160 degree.

Outlet flue gas temperature was maintained high and bed temperature was being maintained high causing lower boiler efficiency.

Project category	Replicability	Impact on SEC	Year of Implementation	Annual Savings (Rs. In lakhs)	Investment (Rs. In lakhs)
C	Yes	No	2018	5	0.01

Innovative Projects Implemented

Creating the predictive demand for the furnace system to reduce MD trip:



MD Predicted data

Import and export data are communicated through smart meters installed in furnaces and grid feeders

Predicted demand values recorded in smart meters in grid feeders communicated and displayed in SCADA

Unwanted tripping on reaching MD has been reduced.180tons of heat increased amounts to Rs. 1cr increase in production per day

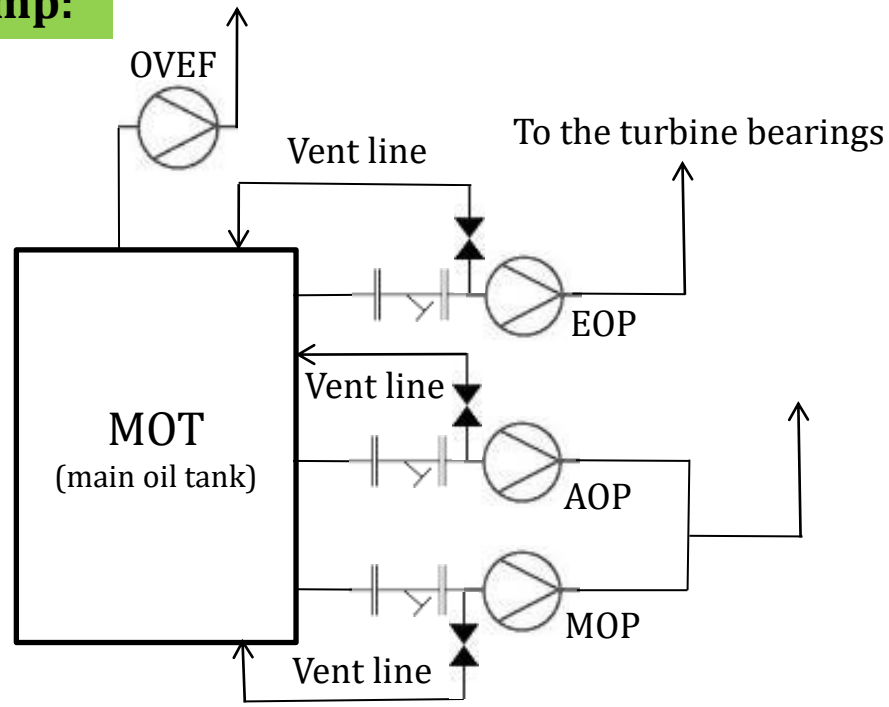
Innovative Projects Implemented

Prevention of Turbine trip by the reliable hot start of turbine main oil pump:

During change over of main oil pump stand by pump was not able to develop pressure due to negative suction in the main oil tank.

Multiple tripping of Turbine while changing over of main oil pump.

An equalizing line (Vent line) was provided to break the negative suction pressure.



Project Category	Replicability	Impact on SEC	Year of Implementation	Annual Savings (Rs. In lakhs)	Investment (Rs. In lakhs)
C	Yes	Yes	2021	15923	3

Environment Management-Ash Utilization

Particular	UOM	2019-20	2020-21	2021-22
Ash stock in plant (yard + pond)	Tons	1336.5	3732	9277
Ash generation	Tons	138236	1199388	1279401
Ash utilization	%	99.9	99.7	99
Ash utilized in manufacturing of cement	%	0	0	0
Ash utilized in fly ash bricks	%	15.9	18.9	14.5
Ash utilized in mine filling	%	25.6	27.0	65.5
Ash utilized in roads pavements	%	3.4	0	0
Embankment and dyke rising solid	%	28.0	25.9	17.6
Small land filling	%	27.0	28.1	2.2
Expenditure on ash utilization (Annual)	Rs in Lakhs			

Mode of ash handling

Ash handled (Wet method)	%	0
Ash handled (Dry method)	%	0
Ash handled (semi method)	%	100

Environment Management-Ash Utilization

Ash mountain

Bricks Making

Road Pavement

Afforestation

Environment Management- Emission

Particular	UOM	2019-20	2020-21	2021-22
Total CO2 Emissions Per kW of Generation	Ton/kW	0.7	0.7	0.6
Current SOx Emissions at Full Load	mg/Nm3	327	331	366.5
Current NOx Emissions at Full Load	mg/Nm3	151	159	191.2
Particulate Matter	mg/Nm3	49	48	41.8
Mercury	mg/Nm3			0.000073

Best Practices Adopted for emission Control

- ✓ Up gradation of Existing ESP with additional field addition.
- ✓ Replacement of existing single-phase transformers with new 3-phase and HFTR sets.
- ✓ Replacement of Existing GD screens with redesigned GD screens as per CFD analysis.
- ✓ Replacement of existing controllers with advanced controllers.
- ✓ Increase in dust collection area by redesigning rapping system and electrodes

Environment Management- Water

Particular	UOM	2019-20	2020-21	2021-22
DM Water Consumption	%	6.41	5.16	3.96
Raw Water Consumption	M^3/MW	3.31	3.63	3.23

- Weather Plant is Zero Liquid Discharge- Yes

Best Practices in Water Management

- ✓ All Volatile treatment is carried out to reduce boiler blow-down water quantity. Optimization of the cooling tower blow down by increasing COC. .(potential:2000m3/day:0.25 m3/TCS) by June-22
- ✓ Waste and sewage water is treated and used for horticulture and ash conditioner application.
- ✓ Automation of makeup pumps for the reduction in wastage due to overflow.
- ✓ Use of road sweeping machine for cleaning of plant roads and boiler areas instead of water cleaning
- ✓ Installation of flow meter in individual units to monitor water consumption.

Best Practices in the Plant

Maintenance & Reliability:

✓Predictive maintenance through Condition monitoring of equipment and condition-based maintenance.

Asset Management through ERP

✓Notification generation through ERP-SAP. Scheduling, triggering of preventive maintenance of equipment

Performance monitoring of Turbine, Boiler & Auxiliary equipment.

✓Regular O_2 Mapping of Boilers to improve the combustion efficiency.

Digitization

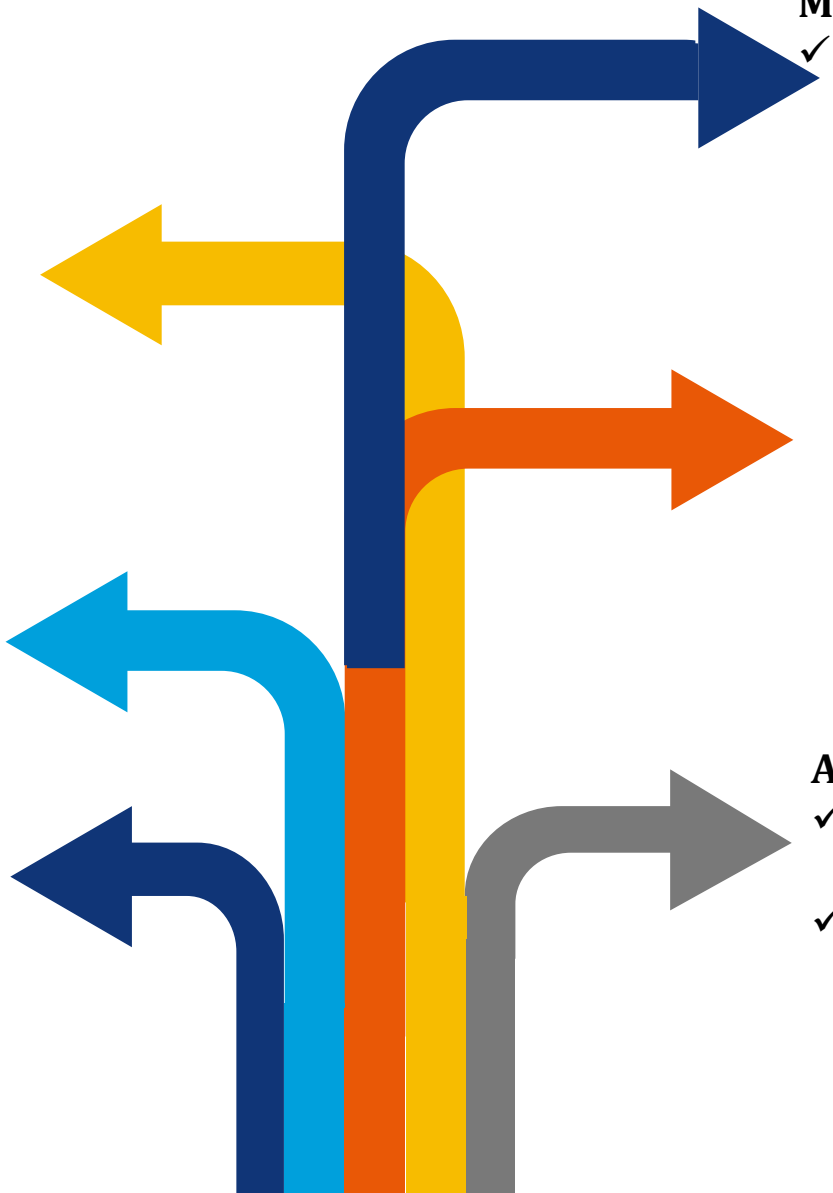
✓Power management dashboard to minimize the import and export of power from the plant.

Application of NDTS:

- ✓ Thickness mapping of boiler tubes by ultrasonic phased array,
- ✓ Videoscopic inspection of turbine internals

Afforestation

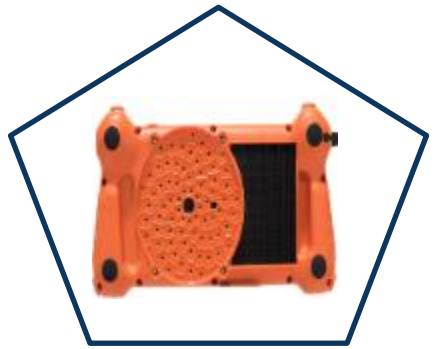
✓Plantation in remaining areas of plant and township.



Maintenance & Reliability

Vibration Analyzer

Vibration Monitoring
Advanced analysis
Dynamic Balancing



Acoustic Ultrasound

Compressed Air/Gas/steam Leak localization
Partial discharge localization
Air Ingress/ Valves & Drains passing inspection

Lube Oil Analysis & WDA

Mechanical Impurities identification
Viscosity Testing
NAS, TAN
Moisture

Flow measurement

Measurement of Velocity, volume, mass & energy flow of water, oil

Thermal Imaging Camera

Hot Spot Detection
Boiler Insulation survey

Ultrasonic Thickness Gauge

Thickness mapping of boiler tube, Ash handling pipeline etc

Maintenance & Reliability

Electrical Discharge detector

Detection of electric discharge in motor bearings

Pocket Vibration Meter

Measurement vibration of rotary equipment

Tachometer

RPM measurement of rotary equipments

Air Velocity Analyzer

Measurement of air velocity & compute differential pressure

Stroboscope

Inspection of material & components during fast movements

Sound pressure meter

Measures the noise level

Maintenance & Reliability

XRF Analyzer

Positive material identification(PMI) for determination of the elemental composition of material

Pyrometer

Noncontact measurement of the temperature of a distant object

Flue gas Analyzer

Measurement of Flue gas CO,NO,SO2,NO2,O2

Dissolved Gas Analyzer

Analyze transformer oil sample for all dissolved fault gases and moisture

Industrial Stethoscope

Checking of bearing noise of rotary equipment

Tan Delta Analyzer

Single Phase Excitation
Power Factor
Capacitance testing

Encon Projects Implemented

Turbine Overhauling

Boiler Overhauling

APH Tube Replacement

DMCC Impeller Trimming

Condenser onload cleaning system

BFP ARC Valve

Condenser Cleaning

Cooling Tower Overhauling

CEP De-staging

Team Work, Employee Involvement & Monitoring

1	Daily Information system	Total steam flow, steam pressure, steam temperature, vacuum, DM water, and Clarifier water flow are monitored and documented daily.
2	Review meeting chaired by	Head-Power Plant (Associate Vice President)
3	Separate budget for energy conservation	A separate budget is allocated for energy conservation projects
4	Energy efficiency / awareness training program	No
5	Project implemented through Kaizen	Increase in availability of AVGF by installing an online turbidity measurement system.
		Minimization of flashover in transformer by the installation of silica breather.
		Minimization of scaffolding preparation time for application of refractory in boiler area.
		Prediction of bearing failure in MCW pumps by the installation of RTD.

Employee Involvement

5S Championship Moment

Road Safety March

Tree Plantation

Awarding the Employees

Walk-a-thon For health awareness

Daily review meeting

Empowering our communities

India's First Skill Impact Bond

Impact bonds are innovative and results-based finance mechanisms that leverage private sector capital and expertise. Private investors (risk investors) initially finance the initiative and are repaid by 'outcome funders', only if the agreed outcome are achieved.

•The skill impact bond partnered by JSW foundation (outcome funder) will provide skills to 50,000 individuals, with a special focus on women.

•4,400 candidates enrolled so far with 70% women candidates.

JSW Foundation becomes member of United Nations Global Compact

Largest platform for business and non-profit's to ensure greater transparency and accountability in CSR initiatives within the larger ecosystem

Aligns with UNGC

Human Rights | Labour | Environment | Anti-corruption

New Initiatives & Updates

Inculcating Critical Life Skills

•Projects reach expanded to 17,000+ children under project ASPIRE.

•We are reaching out to 800,000 students through smart projects for English and mathematics learning outcomes.

Additional Water Storage capacity

•Water resource mapping study with CII Triveni Water institute.

•Lake rejuvenation in Karnataka and Gujarat

Enhancing Anti-value Chain

•Targeting 100,000 farmers over the next 4 years.

•Outreach to 6 Farm producer Organization (FPOs) and 8,000 farmers.

Facilitating Better Health

•Outreach camps via JSW Sanjeevani hospital Dolvi benefitting 100,00+ individuals in FY22

Partners

JSW Foundation | Dubai Cares | Michael & Susan Dell Foundation | CIFF Children's Investment Fund Foundation | N·S·D·C National Skill Development Corporation | HSBC

Health & Nutrition | Water & Environment | Waste Management | Agri-business | Education | Women's BPO & Livelihoods | Skill Enhancement | Art, Culture & Heritage | Sports

Awards and Recognition

INSTITUTE of QUALITY

CII Confederation of Indian Industry

Certificate

This is to certify that team from

JSW Bhushan Power & Steel Ltd

is recognized as

Gold Winner

in Muri Category

for presenting a Case Study at the

13th Edition of CII National 3M Competition

Programme Date: 24 - 25 May 2022
Certificate Unique Code: CIHQ/2022/MAY/3051
Certificate Issued on: 31st May 2022

Vipin Sahni
Executive Director
CII Institute of Quality

INSTITUTE of QUALITY

CII Confederation of Indian Industry

Certificate

This is to certify that team from

JSW Bhushan Power & Steel Ltd.

is recognized as

Silver Winner

in Muda Category

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13th Edition of CII National 3M Competition

Programme Date: 24 - 25 May 2022
Certificate Unique Code: CIHQ/2022/MAY/2995
Certificate Issued on: 30th May 2022

Vipin Sahni
Executive Director
CII Institute of Quality

INSTITUTE of QUALITY

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Certificate

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JSW BPSL, Sambalpur Works

is recognized as

Silver Award Winner

under Renovative Category

for presenting a Case Study at the

43rd CII National Kai-Zen Competition

Programme Date: 21 – 23 July 2022
Certificate Unique Code: CIHQ/2022/JULY/2926
Certificate Issued on: 28th July 2022

Vipin Sahni
Executive Director
CII Institute of Quality

Thank You

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