

ANNEXURE 10 – PARTICULARS OF ENERGY CONSERVATION, TECHNOLOGY ABSORPTION AND FOREIGN EXCHANGE EARNINGS AND OUTGO REQUIRED UNDER THE COMPANIES (ACCOUNTS) RULES, 2014

A. Conservation of Energy

I. STEPS TAKEN OR IMPACT ON CONSERVATION OF ENERGY

- Lowest ever Plant specific energy consumption - 5.767 Gcal / tcs.
- Lowest ever fuel rate at Blast Furnaces - 548 kg / thm - Use of Pellets and higher coal injection (164 kg / thm) at Blast Furnaces.
- Plant Specific Overall Power Rate – 381 Kwh / tss
- Lowest ever steam coal (middling) consumption at Power House # 4 - 42460 t
- Lowest ever LDO consumption in the Works for power generation - 783 kl
- Efficient use of by-product gases for Power Generation – Highest ever total power generation (including Power House # 6) through by product gases - 216.24 MW

II. STEPS TAKEN BY THE COMPANY FOR UTILISING ALTERNATE SOURCES OF ENERGY

- Installation of 3MW Solar Power Generation panel at Noamundi

- Feasibility study of 15 MW Solar Power generations at Jamshedpur

III. CAPITAL INVESTMENT ON ENERGY CONSERVATION EQUIPMENTS

Particulars	(₹ crore)
Commissioning and operation of new Linz Donavitz (LD) Gas Holder and its export system.	25.2
Commissioning and operation of BF Gas Holder.	23.48
Commissioning and operation of new CO Gas Holder.	19.85
Recovery of sensible heat of Coke by installation of Coke Dry Quenching System in Battery # 10 & 11 at Coke Plant.	13.96
Commissioning of Top Recovery Turbine at F Blast Furnace.	0.18
Pulverized coal injection at H Blast Furnaces.	9.32

B. Technology Absorption

1. EFFORTS MADE TOWARDS TECHNOLOGY ABSORPTION

(i) Projects under Research and Development

Project Title	Benefits
Development of methodology to produce coke with CSR>70, CRI>28, AMS>52mm for stamp charging technology	Improved coke quality by using organic polymers, unconventional crushing, column flotation
Design and Fabrication of coal tar sludge removal system for the coal tar decanters	Two numbers of strainers with 1,500 microns mesh size are installed in the coal tar line of Battery #7 at pump house. Strainer removes 1.2% of secondary QI and can filter up to approximately 2,000 tons without maintenance
To determine maximum level of Jamadoba coal ash suitable for SC coke making and possible coal blend with that coal to produce good quality of coke.	Effects of Jamadoba coal ash was observed on CSN, fluidity, dilation and blend is suggested for ash-19.20% which leads to reduction in imported coal in blend up to 5%
Development of High Basicity & high MgO pellets	Higher MgO addition (1.8%) to Dual flux pellets resulted in improving the reducibility of pellets from 68 to 73% and thereby reducing the coke rate by 7 kg/THM.
Population Balance model for iron ore grinding process in pellet plant	Rationalized grinding media size in ball mill resulted in lower specific power consumption from 13.5 to 10 kWh/ton
Optimization of grate bar chemistry in pellet indurating machine	Optimized grate bars with new chemistry (revised Cr & Ni contents) are performing better than the existing grate bars. Even after 12 months they are intact whereas regular grate bars are replaced after 8 months, i.e. 50% life increase and still counting.
Briquetting of Chrome concentrate micro fines for their utilization in Ferroalloy production	Study and establish the process parameters for briquetting of fine chrome concentrate (micro fines) to produce briquettes with at least 980N strength.

Project Title	Benefits
Plant trials for Smelting of high grade refractory chromite ores	Carried out smelting trials of chrome ore (Cr ₂ O ₃ = 55% and Cr:Fe > 3.0) in a 16.5 MVA Submerged Arc Furnace and chromium grade increase of 1% (Chromium increase from 61.5% to 62.5%) was observed in liquid ferrochrome metal (C<8.0%). During the 50% input Cr replacement trials for one week, ferrochrome grade 63.0 plus chromium, 8.2% Carbon and Sinter (Si)=2.5 was produced.
Dewatering performance improvement of dry disposal system of tailing circuit at COB Plant, Sukinda	Based on the laboratory results and plant trial, it is concluded that total slurry generated from the thickener can be dewatered by using the existing filter. Several recommendations are made and few implemented within the project execution period. The plant data is analyzed and concluded that the cake production has increased significantly. Similarly, the cycle time of the filter has decreased to 27.6 minutes compared to initial 35.3 minutes. The pup density of the thickener underflow has enhanced to 29.1% solids by weight compared to previous 26.4% solids by weight.
Reduction of skull loss by 50 % in LD3 tundish	New tundish lining profile has been implemented in few tundishes at LD3 & Thin Slab Casting and Rolling (TSCR) resulting in reduction of skull loss.
Development Al-rich IF/IFHS steel composition to obtain improved drawability	This project shows that r-bar for IFHS 350 grade can be improved considerably through batch annealing route (up to 1.95). This opens up possibilities for using the same grade in more critical auto components.
Development of lean chemistry Fe500 S rebar for earthquake resistance using the TMT process	As many parts of India are earth quake prone, making safer buildings is important. With large scale plant trial it has been proved that earthquake resistant rebars can be made following TMT route. This is a "First in the World" type of product and expected to have a good market.
Development of DP600GA through Continuous Galvanising Line (CGL)#2	We have designed a suitable new chemistry and processing parameters and developing this grade in existing CGL2 line. Successful plant trials have been taken. This grade can be an attractive one for auto makers as localization would be possible.
Reduction of edge burst in hot rolled coils produced through TSCR	Edge burst is a common and repetitive problem for a few grades in TSCR. In-depth analysis has revealed the reasons behind this. Suitable recommendation has also been proposed which helped in reducing the defect.
Value Analysis and Value engineering (VAVE) and Advanced technical support to external customers	As part of the advanced technical support to external automotive customers several VAVE workshops were conducted with significant economic benefit to the customers. A new advanced support, reverse engineering, was rolled out for automotive and other customers to solve press shop problems while using steel. Such support is being offered for the first time by any Indian steel company. Such supports help Tata Steel have better Customer Satisfaction Index (CSI) and develop close relationship with its customers
To improve blast furnace Tap Hole Clay performance and to reduce consumption	Successful trial with modified Tap-hole clay in Mini Blast Furnace (MBF)-1 as well as MBF-2 indicating financial savings
To improve the HM runner availability and reduce specific consumption and cost	New design of trough has been suggested to change over from drainable to non-drainable trough
Optimization of raw flux addition in BF's- TML	Successful trial in MBF-1 with 20.2 % slag alumina in 1st stage of the trial and 21 % in 2nd stage: Slag rate dropped by 38 kg/THM
Development of Forged Hammer for Mining Industries	Hardness at both the faces of 58 +/-1 HRC
Indigenous development of NDT technique to monitor the condition of cast steel staves in C-Blast furnace	Development of ultrasonic sensor for intricate cast steel stave and universal design of flexible fixture was done. Thickness measurement of stave at stage 5,6,7 and 8 was carried out two times in BF-C in FY16.
Manufacturing solution of welding of P460 steel for teeming & tapping ladle at TGS	Recommendation implemented
Welding solution of GA for fuel tank & other applications	Address the 5 % rejection of the supply of GA
Anti-stick coating in LD1	Successful completion of project with financial benefit

(ii) Process Improvement:

Mining:

Identified initiatives to improve the blasting efficiency in open cast mines.

Ore Beneficiation:

- Established the dry magnetic separation technique for beneficiation of low grade Manganese ore fines.
- Modification in existing slime circuit of Noamundi resulted in higher yield of Iron ore fines.
- Improved variability of Iron ore fines chemistry through pile visibility and pile modeling.

Coal Beneficiation:

- Significant increase in production from reflux classifier (scavenging circuit) by changing the feeding regime at West Bokaro.
- To improve the metallurgical efficiency of the flotation cell, conventional rotor-stator mixing mechanism has been replaced with "Float Force" in one bank.
- Enhanced process visibility to improve process efficiency.

Coke making: Successful design of coal blend using only imported coals (first time at the Company) leading to achievement of smooth operation and high Coke Strength Reactivity (CSR) (high temperature properties) of coke at Kalinganagar coke ovens.

Agglomeration:

- Maximize solid waste utilization in sinter making by developing dynamic model for Phosphorus management in iron making.

- Managing quality and productivity of pellet plant using Joda ore which is relatively softer than Noamundi ore with which the plant was designed.

Blast Furnace:

Change in blowing and burden distribution philosophy enabled to maintain stable run of Blast furnaces at lower coke rates. It also enabled in increasing coal injection rate by almost 30% over FY15 which helped in lowering hot metal cost and saving scarce coking coal. Tata Steel BFs have set a benchmark for large blast furnaces in India in terms of injection rate and efficiency and are in the league of few selected blast furnaces worldwide that are consistently operating at higher efficiency and injection rate.

(iii) Product Development

- Development of high ductility seismic resistant rebars (8 mm - 16 mm) – First time in India
- Development of 5.5 mm high carbon wire rods for high tensile fine tyre bead wires – Superior drawability and torsion properties
- Development of 5.5 mm high carbon wire rods for high speed direct drawn 1.60 mm thick motor tyre bead wire – An import substitution
- Development of high ductility low carbon wire rods for manufacturing fine wires for steel fibers - New application and new customer
- Development of high Strength Low Relaxation Pre-stressed Concrete (LRPC) wire rods for half inch Pre-stressed Concrete (PC) strands – Improvement in wire drawing performance and wire properties
- Development of low carbon high Manganese wire rods for SAW (submerged arc welding) electrodes – Entry into a new segment of continuous welding electrodes

2. BENEFITS DERIVED FROM KEY PROJECTS

Project Title	Benefits Derived
Reduce the variability of dephosphorization at LD Converter	A modified regime of blowing in LD converter has been developed and implemented to achieve low phosphorous levels in steel (<0.015%) by changing the profile of lime and iron ore addition. The steel melting shop has been able to reduce the turndown phosphorous in steel as well as improve consistency.
Improving capability of closed casting with respect to submerged entry nozzle [SEN] erosion at slag zone	Incidence of pinholes and slag patch in closed cast billets is undesirable. The erosion mechanism of SEN was understood. Improved erosion profile could be achieved by standardizing the tundish ramping practices. Defects occurring at higher sequence length fully eliminated.
Reduction in Rhomboidity in Billets (cross section 130 x 130 mm ²) at Continuous Caster (CC)3 of LD1	Shifting/rotation of the headers during the operation lead to non-uniform cooling of shell below the mould leading to rhomboidity. New header frame and nozzle design has reduced this leading to improved performance with respect to rhomboidity
High Carbon (HC) Internal quality improvement	Electro Magnetic Stirring (EMS) shifting to lower position at CC1 has led to increased heat extraction leading to superior internal structure (higher equiaxed zone). Thus lower EMS position enabled to achieve 'good' central structure of billets.
Reduce rejection due to cracks in billets at CC1	Proper mould design was determined for casting all grades. Multi-taper moulds were adopted in place of existing convex design. This resulted in significant reduction in rejection from 0.94% to 0.10% of the CC1 production

Project Title	Benefits Derived
Reduce heat diversion in HC grades by 50%	Modified Standard Operating Procedure (SOP) for additions of carburizers. Improved stirring practices to achieve homogeneity of the additions in liquid steel. Reduced diversion on account of carbon by 60%
Reduction in fuel consumption of reheating furnace at Wire Rod Mill - West	Overall fuel consumption in reheating furnace reduced by 1.5 kg/ ton by appropriate burner design modifications.
Cost optimization of ferro alloy addition in LD1	Additions based on cost optimized model for Thermo Mechanical Treated (TMT) grade, which led to reduction in cost by ₹35/ ton.

3. INFORMATION REGARDING IMPORTED TECHNOLOGY (LAST THREE YEARS)

Sl No.	Technology imported	Year	Status
a	Installation and commissioning of secondary emission control system at LD # 1	2014	Commissioned
b	Installation of Nozzlex addition facility in tilters at LD # 1	2014	Commissioned
c	Installation of Multifunctional gauge for Finishing Mill at Hot Strip Mill	2014	Commissioned
d	Installation of Variable Frequency Drive with Inverter Duty Motor for FD fans at Power House No. 4	2014	Commissioned
e	Installation of 0.75 mtpa Coke Oven Battery 11	2015	Commissioned
f	Pulverised Coal Injection at existing F Blast Furnace	2015	Commissioned
g	Installation of Sub-lance for LD Converter at LD Shop No 2 (Set 1)	2015	Commissioned
h	Coal Handling Yard & Stacker Reclaimer #3	2015	Commissioned
i	Up gradation of Vessels at LD Shop No.1	2015	Commissioned
j	Capacity Up-gradation of Track Hopper No 1 from 1100 tph to 1500 tph	2015	Commissioned
k	Pulverised coal injection at existing H Blast Furnace	2016	Commissioned
l	CO gas holder	2016	Commissioned
m	BF gas holder	2016	Commissioned
n	Installation of 3rd blower & interconnecting piping for 'G' & 'H' BFs	2016	Commissioned

4. EXPENDITURE ON RESEARCH AND DEVELOPMENT (R&D)

		(₹ crore)
(a)	Capital	13.06
(b)	Recurring	116.25
(c)	Total	129.32
(d)	Total R&D expenditure as a % of Total Turnover	0.34

C. Foreign exchange earnings and outgo

		(₹ crore)	
		FY 2015-16	FY 2014-15
a.	Foreign exchange earnings	1,089.60	939.97
b.	Value of direct imports (C.I.F. Value)	6,370.35	9,284.32
c.	Expenditure in foreign currency	544.25	634.94

On behalf of the Board of Directors

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CYRUS P. MISTRY

Chairman

(DIN: 00010178)

Mumbai
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