JSW Steel Limited

JSW Steel

JSWSL/ENVT/MoEF&CC/HYR/2023-24/117
27th Nov 2023

The Director
Regional office
Ministry of Environment Forest and Climate Change
1st Floor, Additional office block for GPOA,
Shastri Bhawan, Haddows Road,
Nungambakkam, Chennai -600006

Dear Sir,

Sub: JSW Steel Ltd., Salem Works - EC- Six Monthly Compliance Status Report submission for the period April 2023 - September 2023 - Reg.

Ref: Environmental Clearances F. No. J-11011/281/2006-IA. II(I) dated 07.07.2017, EC amendment dated 07.08.2019 and EC dated 10.02.2020

With reference to the above subject, herewith we are enclosing a six monthly condition compliance status report of the Environmental Clearances issued by your good office on 07.07.2017, 07.08.2019 &10.02.2020 for the period **April 2023 – September 2023.**

We kindly request you to acknowledge the receipt of this letter for our record purpose.

Thanking you,

Yours faithfully,

For JSW Steel Limited., Salem Works

B. N. S. Prakash Rao
Executive Vice President - Plant Head

Encl: Conditions compliance status report for the period April 2023 to September 2023

Cc:

Regional Directorate, Central Pollution Control Board,
77-A, Padi, Ambattur Industrial Estate Road, Mogappair, Chennai, Tamil Nadu -58

The Member Secretary, Tamil Nadu Pollution Control Board,
100, Anna Salai, Guindy, Chennai – 600 032.

The Joint Chief Environmental Engineer (M), Tamil Nadu Pollution Control Board,
Salem Region, No # 9, 4th Cross Street, Brindhavan road, Fairlands, Salem -16.

Salem Works
P.O. Pottaneri, Mecheri,
Mettur - Tk, Salem - Dt. Pin : 636 453
Tamilnadu, India.
CIN No L27102MH1994PLC152925
T +91 4298 272000
www.jsw.in

Registered Office
JSW Centre
Bandra Kurla Complex
Bandra East, Mumbai 400 051
T +91 22 4286 1000
F +91 22 4286 3000

JINDAL
O P Jindal Group

SIX MONTHLY CONDITION COMPLIANCE REPORT OF ENVIRONMENT CLEARANCE (EC) FOR1.15 MTPA INTEGRATED STEEL PLANT

Reporting Period: April 2023 to September 2023

JSW Steel Limited., Salem Works,

Pottaneri (P.O), Mecheri, Mettur(Tk), Salem(Dt)

Tamil Nadu, India, 636453

Submitted to

REGIONAL OFFICE, MoEF&CC

Shastri Bhawan, Haddows road, Nungambakkam,
Chennai -600006

REGIONAL DIRECTORATE, CPCB,
Ambattur Industrial Estate Road, Mogappair,
Chennai, Tamil Nadu -58

JCEE (M), TNPCB, SALEM REGION,
Fairlands, Salem -16

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JSW STEEL LTD., SALEM WORKS
COMPLIANCE STATUS REPORT TO ENVIRONMENTAL CLEARANCE (EC)
Compliance status report to the EC dated.10.02.2020 as on 30.09.2023

Status of the approved projects and present status of the EC dated 10.02.2020 Expansion details are given below:

S. No	Facilities	Project status	CTO-EXP-II	CTO-EXP-III
1	COP #1 stack replacement by 2 number of stacks	Completed		√
	COP #2 stack replacement by 2 number of stacks	Yet to start		
2	Sinter plant sinter cooler waste heat diversion to GGBFS	Completed		√
3	Emission reduction project in SP#2-WGF	Completed		
4	GGBFS	Completed		√
5	LRF#1 stack modification	Completed		√
6	Additional one LRF with VD system (BF gas fired boilers 2 Nos)	Yet to start		
7	Fume exhaust system in CCM#1 & 3	Yet to start		
8	ABGM in CCM#1 & 2	Completed		√
9	Pickling & Annealing Steel	Completed	√	
10	Emission reduction project in CPP#2 coal-based boiler	Partially completed	√	
11	DG set - 8 No's (6 Nos for Steel and 2 Nos for CPII)	Completed		√ (6 Nos)
12	Paver block making facility	Completed		√
13	Acid fumes extraction system in Etching lab	Completed		√
14	Slag crushing unit	Completed		√
15	Batching plant	Completed		√
16	Coke cutter dedusting system in COP	Completed		√
17	COP chimney #3 stack modification	Completed		√
18	WHRB#3 stack modification	Completed		√
19	Steam exhaust system#2 in CCM#3	Completed		√
20	Thermic fluid heater for ATFD in pickling plant ETP	Yet to start		

*** BF1 RMHS stack withdrawn from consent & same has been communicated to SPCB vide letter no. JSWSL/Steel/ENVT/CTE& CTO-Stack/JCEE/2022-23/88, 20th September 2022.
*** Steel Ball making facility of 0.20 MTPA added within the existing production capacity of 1.15 MTPA, No Increase In Pollution Load (NIPL) certificate obtained for the same from SPCB dated 28.11.2022.

Compliance to EC Conditions of 0.8 MTPA Slag grinding unit, new facilities related to value addition and technological upgradation within the existing 1.3 MTPA integrated steel plant premises. The manufacturing facilities details as per EC dated 10.02.2020 is given in the below table

Sl. No.	Manufacturing Units	Existing Capacity (MTPA)	Proposed Expansion (MTPA)	Total Capacity after Expansion (MTPA)	Project execution phase and current status
1	Coke Oven Plant -1(Non–Recovery Type)	0.50	-	0.5	In operation
2	Sinter Plant–1 (20 Square Meter)	0.175	-	0	In operation
3	Sinter Plant–2 (90 Square Meter)	1.06	-	1.06	In operation
4	Sinter Plant–3(90 Square Meter)	-	1.06	1.06	Yet to start (phase#2)
5	Blast Furnace – 1 (402 to 650 Cubic Meter)	0.367	0.316	0.683	Yet to start
6	Blast Furnace–2 (550 to 650 Cubic Meter)	0.578	0.105	0.683	Completed in phase#1 and under operation
7	Energy Optimizing Furnace–1(65T)	0.41	0.23	0.64	Completed in phase#1 and under operation
8	Energy Optimizing Furnace – 2 (65T)	0.62	-	0.62	In operation
9	Ladle Furnace-1with Common VD (45T to 65T)	45T/heat	20T/heat	65T/heat	Completed in phase#1 and under operation
10	Ladle Furnace–2(65T)	65T/heat	-	65T/heat	Nil
11	LadleFurnace-3 common VD (65T)	65T/heat	-	65T/heat	Nil
12	LadleFurnace-4(65T)	65T/heat	-	65T/heat	Nil
13	ContinuousCastingMachine-1	0.35	-	0.35	Nil
14	ContinuousCastingMachine-2	0.50	-	0.50	Nil
15	ContinuousCastingMachine-3	-	0.45	0.45	Completed in phase#1 and under operation
16	Bar & Rod Mill Augmentation	0.4	0.08	0.48	Completed in phase#1 and under operation
17	Blooming Mill Augmentation	0.36	0.12	0.48	Completed in phase#1 and under operation
18	Pickling and Annealing Steel unit	-	0.06	0.06	Completed in phase#1 and under operation
19	Peeled and ground	-	0.04	0.04	Phase #2 (0.01 MTPA completed in phase #1)
20	Air Separation Plant 1	150 T/day	-	150 T/day	Nil

21	Air Separation Plant 2	390 T/day	-	390 T/day	Nil
22	Air Separation Plant 3	-	250 T/day	250 T/day	Yet to start Phase #2
23	Captive Power Plant-1	7 MW	-	7 MW	Power generation has been stopped from 01.10.2021 and the product has withdrawn from the consent
24	Captive Power Plant-2	2 x 30 MW		2 x30 MW	In operations
25	CaptivePowerPlant-3 (Unit 3 of CPP#2)	-	1 x 30 MW	1 x 30 MW	Completed in phase#1 and under operation

The production details for the period **April 2023 to September 2023** is given in ***Annexure 1***

Sl.No	Condition	Self-Declaration
A.	**Specific Conditions**	
i	Particulate emission from the rod mill of slag grinding unit shall be less than 10 mg/Nm^3.	To meet the specified condition of particulate emissions from the rod mill of our slag grinding unit below 10 mg/Nm^3 a dedicated air pollution control device, bag filter is installed. The latest TNPCB survey conducted from 14.06.2023 to 20.06.2023 and the results was 8.5 mg/Nm^3 which is well within the standard of 10 mg/Nm^3
ii.	Green belt shall be developed in an area of 85 ha (210 acres) in and around the plant in a time frame of two years.	The existing greenbelt encompasses approximately 2,68,524 trees, covering an area of about 91.30 hectares, constituting approximately 34.07% of the total area. The survival rate is about 85-90%
B.	**General Conditions**	
I.	**Statutory Compliance**	
i	The project proponent shall obtain Consent to Establish / Operate under the provisions of Air (Prevention & Control of Pollution) Act, 1981 and the Water (Prevention & Control of Pollution) Act, 1974 from the concerned State Pollution Control Board / Committee.	Being Complied.
ii.	The project proponent shall obtain the necessary permission from the Central Ground Water Authority, in case of drawl of ground water / from the competent authority concerned in case of drawl of surface water required for the project.	Being complied
iii.	The project proponent shall obtain authorization under the Hazardous and other Waste Management Rules, 2016 as amended from time to time.	Being complied, the existing authorization is valid till 31.03.2026 and if any amendments shall be complied.
II	**Air Quality monitoring & Preservation**	
i	The project proponent shall install 24x7 continuous emission monitoring system at process stacks to monitor stack emission with respect to standards prescribed in Environment (Protection) Rules 1986 vide G.S.R. 277(E) dated 31st March 2012 (Integrated iron & Steel); G.S.R. 414 (E) dated 30th May 2008 (Sponge Iron) as amended from time to time; S.O. 3305 (E) dated 7th December 2015 (Thermal Power Plant) as amended from time to time and connected to SPCB and CPCB online servers and calibrate these system from system from time to time according to equipment supplier specification through labs recognized under Environment (Protection) Act, 1986 or NABL accredited laboratories.	Being Complied, there are 39 no. of dust analyzers & 23 no. gas analyzers are installed as per CTO condition and the real time data of SPM, SO_2, NOx and CO are transmitted to the Care Air Centre of TNPCB and CPCB servers. Apart from the this, TNPCB is conducting bi-annual survey and manual monitoring is being conducted by NABL accredited external laboratory on monthly basis. The latest TNPCB survey conducted from 14.06.2023 to 20.06.2023 and the results are well within the standards issued by the authority. The monitoring results are attached as **Annexure 2 & 3**

ii.	The project proponent shall monitor fugitive emissions in the plant premises at least once in every quarter through labs recognized under Environment (Protection) Act, 1986.	Being Complied, Fugitive emissions in the plant premises are being monitored on monthly basis and as and when required basis by a NABL accredited external laboratory and the monitoring reports are being submitted to TNPCB on monthly basis. Also, Biannual survey is being conducted by AEL, TNPCB for fugitive emissions and the results are also well within the standards.
iii.	The project proponent shall install system to carryout Continuous Ambient Air Quality monitoring for common/criterion parameters relevant to the main pollutants released (e.g. PM_{10} and $PM_{2.5}$ in reference to PM emission, and SO_2 and NO_x in reference to SO_2 and NO_x emissions) within and outside the plant area at least at four locations (one within and three outside the plant area at an angle of 120° each), covering upwind and downwind directions.	Being complied, Continuous Ambient Air Quality monitoring stations of four numbers are installed in the plant periphery covering upwind & downwind directions. One station is installed to monitor PM_{10}, $PM_{2.5}$, SO_2, NO_x and CO and other 3 stations are installed to monitor PM_{10}, $PM_{2.5}$, SO_2 as per the CTO condition. The real time parameters are connected to Care Air Centre of TNPCB.
iv.	The cameras shall be installed at suitable locations for 24x7 recording of battery emissions on the both sides of coke oven batteries and videos shall be preserved for at least one-month recordings.	Complied, there are three coke oven batteries which are installed adjacent to each other. An IP camera has been installed in the top of the COP area to monitor battery emissions on the both sides with recording option and the minimum preservation time is one month.
v.	Sampling facility at process stacks and at quenching towers shall be provided as per CPCB guidelines for manual monitoring of emissions.	Being complied, Sampling facilities at process stacks and quenching towers are provided for manual monitoring of emissions. However, there is no dust is being vented through the quenching stacks.
vi.	The project proponent shall submit monthly summary report of continuous stack emission and air quality monitoring and results of manual stack monitoring and manual monitoring of air quality/fugitive emissions to Regional Office of MoEF&CC, Zonal Office of CPCB and Regional Office of SPCB along with six-monthly monitoring report.	Being Complied, Monthly summary report of continuous stack emission and ambient air quality monitoring and results of manual stack monitoring and manual monitoring of air quality/fugitive emissions are being submitted along with six monthly compliance reports to Regional Office of MoEF&CC, Zonal Office of CPCB and Regional Office of SPCB. Please refer **Annexure 2 & 3**
vii.	Appropriate Air Pollution Control (APC) system shall be provided for all the dust generating points including fugitive dust from all vulnerable sources, so as to comply prescribed stack emission and fugitive emission standards.	Complied, adequate Air Pollution Control measures are installed in the respective process and raw material handling areas. Water sprinklers, dry & wet fog systems, GI sheets (as dust barrier) are provided in raw material handling areas to control fugitive emission.
viii.	The project proponent shall provide leakage detection and mechanized bag cleaning facilities for better maintenance of bags.	Complied, appropriate leakage detection systems and mechanized bag cleaning facilities are provided in respective bag filter systems.

ix.	Secondary emission control system shall be provided at SMS converters.	Complied, dedicated secondary de-dusting systems are provided at EOF & LRF processes to control the secondary fugitive emission.
x.	Pollution control system in the steel plant shall be provided as per the CREP guidelines of CPCB.	Complied, as per the CREP guidelines of CPCB, Pollution control systems are provided. Please refer **Annexure 4**
xi.	Sufficient number of mobile or stationery vacuum cleaners shall be provided to clean plant roads, shop floors, and roofs regularly.	Complied, three numbers of road sweeping machines are dedicatedly deployed for road cleaning applications and Mobile vacuum cleaners are also provided to clean shop floors, roofs regularly.
xii	Recycle and reuse iron ore fines, coal and coke fines, lime fines and such other fines collected the pollution control devices and vacuum cleaning devices in the process after briquetting/agglomeration.	Being complied, Iron ore fines, coal and coke fines, lime fines, and such other fines collected in the pollution control devices are being reused in the sinter plant for agglomeration processes which is basically a wealth from the waste to minimize the resource depletion.
xiii.	The project proponent use leak proof trucks/dumpers carrying coal and other raw materials and cover them with tarpaulin.	Being complied, Standard Operating Procedure developed to avoid spillage and leakage. Trucks/dumpers carrying coal and other raw materials are covered with tarpaulin. Leak proof trucks are used for fly ash transportation and other materials.
xiv.	Facilities for spillage collection shall be provided for coal and coke on wharf of coke oven batteries (Chain conveyors, land based industrial vacuum cleaning facility).	Being complied, Coking coal is transferred through closed conveyor system to stamping station. The stamped coal (wet condition) is charged into coke oven batteries through a dedicated coal charging system. Hence spillage of coal is not anticipated.
xv.	Land-based APC system shall be installed to control coke pushing emissions.	Our coke oven plant is non-recovery type and installed in the year 2007. These are heat recovery coke ovens which are operating in high negative pressure and no visible emission is anticipated/noticed. Hence, it is not anticipated to install Land-based APC system into the existing non-recovery type coke ovens. The same has been communicated to MoEF&CC dated 26.09.2020 and 24.05.2022 to exempt the condition. However, a dedicated dedusting system is installed in one of the coke pushing car and it is in operation from FY22. The horizontal deployment will be done in one more pusher car.

xvi.	Monitor CO, HC and O_2 in flue gases of the coke oven battery to detect combustion efficiency and cross leakages in the combustion chamber.	Our coke oven plant is non-recovery type. The heat for carbonisation is provided by the radiation heat by burning of evolved gases from the bottom and top of the coal mass. The requirement of monitoring of HC, CO and O_2 were intended for recovery type of coke ovens. However, the monitoring of parameters CO and O2 are installed at Waste Heat recover boilers which are directly connected with flue gas of coke ovens. The same has been communicated to MoEF&CC dated 26.09.2020 and 24.05.2022 to exempt the condition.
xvii.	Vapor absorption system shall be provided in place of vapor compression system for cooling of coke oven gas in case of recovery type coke ovens.	Not Applicable as our Coke oven is non-recovery type.
xviii.	In case concentrated ammonia liquor is incinerated, adopt high temperature incineration to destroy Dioxins and Furans, Suitable NOx control facility shall be provided to meet the prescribed standards.	Not Applicable as Our Coke oven is non-recovery type.
xix.	The coke oven gas shall be subjected to desulphurization if the Sulphur content in the coal exceeds 1%.	The coal usage in coke oven contains Sulphur content less than 1%.
xx.	Wind shelter fence and chemical spraying shall be provided on the raw material stock piles.	Complied, GI sheets cover (as dust barrier), wind nets, water sprinkler systems and dry/wet fog systems are provided on the raw material stock piles and there is no fugitive emission observed during the process.
xxi.	Design the ventilation system for adequate air changes as per ACGIH document for all tunnels, motor houses, Oil cellars.	Being complied, the ventilation system for adequate air changes for all tunnels, motor houses, Oil cellars are being complied as per the CEIG rules.
xxii.	The project proponent shall install Dry Gas Cleaning Plant with bag filter for Blast Furnace and SMS converter.	With reference to the EC dated 10.02.2020 there is no plan to install new Blast Furnace and Steel Making process and also the existing steel plant consist of small capacity Blast Furnaces (BF#1 402 m^3 with 0.367 MTPA & BF#2 650 m^3 with 0.683 MTPA capacity) in Iron Zone and EOFs (EOF#1 with the capacity of 0.64 & EOF#2 with the capacity of 0.62 MTPA) in SMS zone.

		The BF#1 & EOF#1 were installed in the year 1998 with wet type gas cleaning system and BF#2 & EOF#2 were installed in 2007. BF#2 installed with Dry type gas cleaning system during establishment stage itself and EOF#2 installed with wet type gas cleaning system. The same has been communicated to MoEF&CC dated 26.09.2020 and 24.05.2022 to exempt the condition.
xxiii	Dry quenching (CDQ) system shall be installed along with power generation facility from waste heat recovery from hot coke.	NA, the existing coke oven (non-recovery type) has installed with wet quenching in line with the EC approved in 2007. There is no modification proposed in the existing coke ovens in the recently approved EC dated 10.02.2020. However, the installation of CDQ matter has been taken up with the OEM and it is reported that installation of CDQ within the existing capacity of 0.5 MTPA Coke Oven is not technically feasible and viable. The same has been communicated to MoEF&CC dated 26.09.2020 and 24.05.2022 to exempt the condition. We will be approaching to MoEF&CC for EC Amendment.
III	**Water Quality Monitoring & Preservation**	
i	The project proponent shall install 24x7 continuous effluent monitoring system with respect to standards prescribed in Environment (Protection) Rules 1986 vide G.S.R. 277(E) dated 31st March 2012 (Integrated iron & Steel); G.S.R. 414 (E) dated 30th May 2008 (Sponge Iron) as amended from time to time; S.O. 3305 (E) dated 7th December 2015 (Thermal Power Plant) as amended from time to time and connected to SPCB and CPCB online servers and calibrate these system from time to time according to equipment supplier specification through labs recognized under Environment (Protection) Act, 1986 or NABL accredited laboratories. The project proponent shall monitor regularly ground water quality at least twice a year (pre and post monsoon) at sufficient numbers of piezometers/sampling wells in the plant and adjacent areas through labs recognized under Environment (Protection) Act, 1986 and NABL accredited laboratories.	Complied, flow meters for continuous monitoring system of effluent flow are provided at the Guard pond inlet & outlet and the real time values are connected to TNPCB & CPCB server. A dedicated EMFM is installed in the ETP discharge point along with IP camera (with PTZ option). Analysers are installed with respect to the standards related to Iron & Steel and Thermal Power Plant and the real time parameters are connected to TNPCB/CPCB servers from Aug'2020. EMFM and sensors are being calibrated from time to time according to equipment supplier specification. Apart from this, treated wastewater quality is also monitored by NABL accredited laboratory & TNPCB on monthly basis and reports are periodically submitted to TNPCB.

		Ground water quality around the periphery of the plant is being monitored by TNPCB and NABL accredited laboratory on monthly/quarterly basis. Piezo metric sampling bore well is provided inside the plant premises and the water quality is being monitored on monthly basis by NABL laboratory.
ii.	The project proponent shall submit monthly summary report of continuous effluent monitoring and results of manual effluent testing and manual monitoring of ground water quality to Regional Office of MoEF&CC, Zonal Office of CPCB and Regional Office of SPCB along with six-monthly monitoring report.	Complied, monthly summary reports of continuous effluent monitoring, results of manual effluent testing and manual monitoring of ground water quality by TNPCB & NABL accredited laboratory are being submitted to the Regional Office of MoEF&CC, Zonal Office of CPCB and Regional Office of SPCB along with the six-monthly monitoring report. Please refer **Annexure 5**
iii.	The project proponent shall provide the ETP for coke oven and by-product to meet the standards prescribed in G.S.R. 277(E) dated 31st March 2012 (Integrated iron & Steel); G.S.R. 414 (E) dated 30th May 2008 (Sponge Iron) as amended from time to time; S.O. 3305 (E) dated 7th December 2015 (Thermal Power Plant) as amended from time to time.	Our Coke Oven plant is non-recovery type. Sponge iron plant not installed in our plant. In the additional 1 x 30 MW CPP (TPP) Air Cooled Condenser has been installed in place of water cooled condenser and the entire quantity (705 KLD) of trade effluent is transferred to steel plant guard pond for treatment and reuse in steel plant.
iv	Adhere to 'Zero Liquid Discharge'	Being Complied, wastewater generated from the various process of steel plant and CPP II (3 x 30 MW) is collected in a guard pond at steel plant and after the pretreatment treated water is 100 % reused in steel plant process to the application of Slag Granulation plant of BF, gas cleaning plant of BF & EOF, slag quenching, coke quenching, dust suppression systems and green belt as consented. To treat the effluent arising out of the pickling plant & etching lab a dedicated ETP is installed with the facility of Pretreatment, Ultra filter, Multistage RO plant, MEE and ATFD. The treated water is reused in pickling process and etching lab.
v.	Sewage Treatment Plant shall be provided for treatment of domestic wastewater to meet the prescribed standards.	Being complied, Sewage Treatment Plants are provided for treatment of domestic wastewater and treated water is meeting the prescribed standards. Treated water sample is being collected by TNPCB & NABL accredited laboratory on monthly basis and the results are well within the prescribed standards. Please refer **Annexure 6**
vi.	Garland drains and collection pits shall be provided for each stock pile to arrest the run-off in the event of heavy rains and to check the water pollution due to surface run off.	Complied, Various collection pits are provided to arrest the run-off and ensure there is no water pollution due to surface run off.

vii.	Tyre washing facilities shall be provided at the entrance of the plant gates.	Being complied, tyre washing unit is provided at the entrance of the plant gate to control the fugitive emission from vehicular movement.
viii.	CO_2 injection shall be provided in GCP of SMS to reduce pH in circulating water to ensure optimal recycling of treated water for converter gas cleaning.	pH of existing circulating water of GCP is the range of 9.0 to 10. Due to the minimum alkalinity, addition of CO_2 injection is not anticipated to the recycling water. However, actions will be initiated to the trial application.
ix.	The project proponent shall practice rainwater harvesting to maximum possible extent.	Being Complied, Rain water harvesting ponds are provided near to township (East side) with the capacity of 17500 KL, West side of Township STP with the capacity of 33000 KL, Near RO plant area 15000 KL and plant guest house backside 4000 KL. Recently RWH capacity augmentation done by adding two ponds one at COP with capacity 2000 KL & other one near Paver Block unit of 350 KL capacity. The overall collection capacity is 71,850 KL. The collected rain water is recharged to mother earth, reused in steel plant wherever applicable for secondary applications. Capacity of the rain water harvesting ponds will be enhanced based on the needs and requirement.
x.	Treated water from ETP of COBP shall not be used for coke quenching.	Not Applicable, Our Coke oven plant is non-recovery type.
xi.	Water meters shall be provided at the inlet to all unit processes in the steel plants.	Being complied, Water meters are provided at the inlet to all unit processes in our steel plant.
xii.	The project proponent shall make efforts to minimize water consumption in the steel plant complex by segregation of used water, practicing cascade use and by recycling treated water.	Being complied, segregation of used water according to the quality characteristics treated and utilized accordingly. Efforts are taken to minimize water consumption by installation of RO plant, maximize cooling water COCs and adopting the Best Available Technologies (BAT) like installation of Air Cooled Condenser Instead Water Cooled Condenser, etc.,
IV	**Noise monitoring and prevention**	
i	Noise level survey shall be carried as per the prescribed guidelines and report in this regard shall be submitted to Regional Officer of the Ministry as a part of six-monthly compliance report.	Being complied, noise level is being monitored on regular basis by a NABL accredited laboratory &TNPCB and the results are well within the standards and reports are being submitted to the Regional Officer of the Ministry as a part of six-monthly compliance report. Kindly refer **Annexure 7**

ii.	The ambient noise levels should conform to the standards prescribed under E(P)A Rules, 1986 viz.75 dB(A) during day time and 70 dB(A) during night time.	Complied, the ambient noise levels are being monitored monthly basis and the results are well within the prescribed limit of limits 75 dB(A) during day time and 70 dB(A) during night time and reports are being submitted to the Regional Officer of the Ministry as a part of six-monthly compliance report. Kindly refer **Annexure 7**
V	**Energy Conservation measures**	
i.	The project proponent shall provide TRTs to recover energy from top gases of Blast Furnaces.	Not Applicable. The capacity of the existing furnaces is very small and operating at low top pressure (< 1.3 bar). Hence, it is not technically feasible to install TRT in the existing blast furnaces. There is no modification in the existing BFs in the EC approved now. The same has been communicated to MoEF&CC dated 26.09.2020 and 24.05.2022 to exempt the condition. For this we will be approaching MoEF&CC for EC amendment
ii.	Coke Dry quenching (CDQ) shall be provided for coke quenching for both recovery and non-recovery type coke ovens.	The existing coke oven (Non-recovery type) has installed with wet quenching in line with the EC approved in 2007. There is no modification proposed in the existing coke ovens in the recently approved EC dated 10.02.2020. However, the installation of CDQ matter has been taken up with the OEM and it is reported that installation of CDQ within the existing capacity of 0.5 MTPA Coke Oven is not technically feasible and viable and the same has been communicated to MoEF&CC dated 26.09.2020 and 24.05.2022 to exempt the condition. For this we will be approaching MoEF&CC for EC amendment.
iii.	Waste heat shall be recovered from Sinter Plants coolers and Sinter Machines.	Being complied, Waste heat from Sinter plant cooler is diverted to the BF Slag grinding unit to recover sensible heat.
iv.	Use torpedo ladle for hot metal transfer as far as possible. If ladles not used, provide covers for open top ladles.	Not applicable, as usage of torpedo ladle is mostly applicable to larger capacity of BF. Our BF capacity is smaller, ladle covering is done by means of heat insulating compounds such as dry rice husk.
v.	Use hot charging of slabs and billets/blooms as far as possible.	Being Complied, based on the product specification, hot charging is done for billets/blooms. Slabs are not produced in our facility.
vi.	Waste heat recovery systems shall be provided in all units where the flue gas or process gas exceeds 300°C.	Being complied, waste heat recovery boilers are in operation to recover maximum heat from flue gas and produce energy. Waste heat from Sinter plant cooler is diverted to the BF Slag grinding unit to recover sensible heat.

vii.	Explore feasibility to install WHRS at Waste Gases from BF stoves; Sinter Machine; Sinter Cooler, and all reheating furnaces and if feasible shall be installed.	Being complied, Waste gas utilization from BF stoves not feasible and Sinter machine waste heat being utilized. Waste heat from Sinter plant cooler is diverted to the BF Slag grinding unit to recover sensible heat and BF gas is utilized in Mills operations, BF stoves as fuel and CPPs for power generation. Also, in view of waste heat and energy conservation measures power generation through the existing CPP#1 (7 MW) is stopped from 01.10.2021 and the 2 Nos of boilers are used for process steam supply with the capacity of 1 number with 25 TPH and 1 Number with 8 TPH.
viii.	Restrict Gas flaring to < 1%	Being complied, BF waste gas is maximum used in all the shop floors as gaseous fuel where by usage of fossil fuel is optimized. To the effective utilization online monitoring system(SCADA) is installed to maximize the BF gas utilization.
ix.	Provide solar power generation on roof tops of buildings, for solar light system for all common areas, street lights, parking around project area and maintain the same regularly.	Being Complied, Solar panel is installed with the capacity of 60 KW (50 KW at Canteen and 10 KW at R&D building) and the average power generation is in the range of 12 kWh and further installations will be done in phased manner.
x.	Provide LED lights in their officers and residential areas.	Being Complied, LED based lightings are provided in the offices and township area and the replacement of sodium vapor lamp to LED is increased from 800 KW to 950 KW. Further planning will be done to install LED lights every year in a phased to manner.
xi.	Ensure installation of regenerative type burners on all reheating furnaces.	Being complied, BF gas is used as fuel and regenerative type burners are installed in reheating furnaces (Mills).
VI	**Waste Management**	
i.	An attrition grinding unit to improve the bulk density of BF granulated slag from 1.0 to 1.5 kg/l shall be installed to use slag as river sand in construction industry.	Complied, BF slag grinding unit is under operations to produce ground granulated BF slag which is directly sold to cement industries and open market as a value addition byproduct.
ii.	In case of Non-Recovery coke ovens, the gas main carrying hot flue gases to the boiler shall be insulated to conserve heat and to maximize heat recovery.	Being complied, the gas main carrying hot flue gases to the boilers is completely insulated to conserve heat and to maximize heat recovery.
iii.	Tar Sludge and waste oil shall be blended with coal charged in coke ovens (applicable only to recovery coke ovens).	Not applicable, we have installed non-recovery type coke oven and hence the general condition not applicable
iv.	Carbon recovery plant to recover the elemental carbon present in GCP slurries for use in Sinter plant shall be installed.	Complied, after clarification and thickener treatment GCP slurry is treated in sludge handling unit and the carbon recovered is reused in the sinter plant.

v	Waste recycling plant shall be installed to recover scrap, metallic and flux for recycling to sinter plant and SMS.	Being complied, scrap and metallic contents are recovered and recycled in the SMS where by certain level of GHG emission is offset.
vi.	Used refractories shall be recycled as far as possible.	Being complied, Refractories are selected to withstand high temperature whose self-life is longer and generations of used refractories is lesser. The same is recycled in downstream applications.
vii.	SMS slag after metal recovery in waste recycling facility shall be conditioned and used for road making, railway track ballast and other applications. The project proponent shall install a waste recycling facility to recover metallic and flux for recycle to sinter plant. The project proponent shall establish linkage for 100% reuse of rejects from Waste Recycling Plant.	Being Complied, SMS slag is sent for metal recovery system and the crushed slag with various sizes is reused in internal applications like sinter plant, EOF as hearth layer and cooling media respectively and to cement industries. Portion of crushed slag will be used in paver block facility as replacement to the natural aggregate. With these efforts are being taken to maximise 100% reuse of rejects.
viii.	100% utilization of fly ash shall be ensured. All the fly ash shall be provided to cement and brick manufacturers for further utilization and Memorandum of Understanding in this regard shall be submitted to the Ministry's Regional Office.	Being Complied, a coal-based boiler is installed in 2006 and imported coal with low ash is used as fuel and the boiler is being operated with flexible load to cater the captive power requirement. Fly ash generated from the coal based boilers is 100% sent to local fly ash brick manufacturers. Sale order (MoU) has been issued all the fly ash brick manufactures through Sale audit team.
ix.	Oil collection pits shall be provided in oil cellars to collect and reuse/recycle spilled oil. Oil collection trays shall be provided under coils on saddles in cold rolled coil storage area.	Being complied, oil collection pits are provided in oil cellars to collect and reuse the spilled oil. Cold rolled products are not applicable to our plant.
x.	The waste oil, grease and other hazardous waste like acidic sludge from pickling, galvanizing, chrome plating mills etc. shall be disposed of as per the Hazardous & Other waste (Management & Transboundary Movement) Rules, 2016. Coal tar sludge / decanter shall be recycled to coke ovens.	Being Complied, the waste oil, grease and other hazardous waste like acidic sludge from pickling will be disposed as per the Hazardous & Other waste (Management & Transboundary Movement) Rules, 2016.
xi.	Kitchen waste shall be composted or converted to biogas for further use.	Being Complied, biogas plant is installed and kitchen waste is being converted in to biogas and about 40 - 50 kg food waste per day is digested in bio gas plant and 5-6 kg LPG equivalent bio gas is produced per day.
VII	**Green Belt**	
i	Green belt shall be developed in an area equal to 33% of the plant area with native tree species in accordance with CPCB guidelines. The greenbelt shall inter alia cover the entire periphery of the plant.	Being complied, the existing greenbelt developed is around 2,68,524 Nos with area cover of about 91.30 Ha of the total area which is about 34.07%. The survival rate is about 85-90 %. The month wise tree plantation details are given in the **Annexure 8**

ii.	The project proponent shall prepare GHG emissions inventory for the plant and shall submit the programme for reduction of the same including carbon sequestration including plantation.	Being complied, GHG emissions inventory for the plant and carbon sequestration including plantation are prepared and being submitted every year. Carbon sequestration study report is attached as **Annexure 9**
VIII	**Public hearing and Human health issues**	
i.	Emergency prepared plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan shall be implemented.	Being complied, emergency prepared plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan is being implemented and periodic review is also being conducted.
ii.	The project proponent shall carry out heat stress analysis for the workmen who work in high temperature work zone and provide Personal Protection Equipment (PPE) as per the norms of Factory Act.	Being Complied, OHC team periodically conduct Heat stress analyses for the workmen working in high temperature work zone and suitable Personal Protection Equipment (PPE)s and other adequate requirements are provided as per the norms of Factory Act. Heat Stress Analysis report attached as **Annexure 14**
iii.	Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, Safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.	Being complied, provisions will be made for the expansion project activities and as per the condition temporary structure will be removed after the completion of expansion activities.
iv.	Occupational health surveillance of the workers shall be done on a regular basis and records maintained as per the Factories Act.	Annual Health Check-ups conducted as per the Factories Act for all employees on yearly basis and records are being maintained in the OHC.
IX	**Corporate Environmental Responsibility**	
i.	The project proponent shall comply with the provisions contained in this Ministry's OM vide F. No. 22-65/2017-IA.III dated 1st May 2018, as applicable, regarding Corporate Environmental Responsibility.	Being complied, with respect to the Corporate Environmental Responsibility all the actions are being implemented and progress report is being submitted **Annexure 10** regularly along with the six monthly compliance reports. The changes with respect to the needs of surrounding villages are reviewed and accordingly the ESC revised action plan status was communicated through to the MoEF&CC vide their letter dated 26.09.2020

ii	The company shall have a well laid down environmental policy duly approved by the Board of Directors. The environmental policy should prescribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental/forest/wildlife norms/conditions. The company shall have defined system of reporting infringements/deviation/violation of the environmental / forest / wildlife norms / conditions and / or shareholders' / stake holders. The copy of the board resolution in this regard shall be submitted to the MoEF&CC as a part of six-monthly report.	Complied, Environmental policy duly approved by the Board of Directors is in place. Systems for reporting deviation/violation of environmental norms/conditions exists and are being followed.
iii.	A separate Environmental Cell both at the project and company head quarter level, with qualified personnel shall be set up under the control of senior Executive, who will directly to the head of the organization.	Complied, Environmental cell is in place with qualified personnel under the control of Senior Executive, who is reporting directly to the head of the organization.
iv	Action plan for implementing EMP and environmental conditions along with responsibility matrix of the company shall be prepared and shall be approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose. Year wise progress of implementation of action plan shall be reported to the Ministry/Regional office along with the Six-Monthly Compliance Report.	Being complied, EMP implementation with action plan and environmental conditions along with responsibility matrix is implemented and year wise funds (CAPEX) earmarked for environmental protection measures are kept as separate account and not be diverted for any other purpose.
v.	Self-environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.	Being complied, Self-environmental audit is being conducted monthly/annually. Environment Audit is being carried out by external agencies once in year and confirming with the standard of ISO 14001:2015.
vi.	All the recommendations made in the Charter on Corporate Responsibility for Environment Protection (CREP) for the Iron and Steel plants shall be implemented.	Being complied, all the recommendations of the Charter on the Corporate Responsibility for the Environmental Protection (CREP) issued for the steel plants are implemented and the compliance status report **Annexure 4** is being submitted along with six monthly compliance reports.

X	Miscellaneous	
i	The project proponent shall make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising in at least in two local newspapers of the District or State of which one shall be in the vernacular language within seven days and in addition, this shall also be displayed in the project proponent's website permanently.	Complied, Environmental Clearance accorded from MoEF&CC dated on 10.02.2020 and the same was advertised in two local newspapers on 14.02.2020 (Dinamani and The New Indian Express) which are widely circulated in the region of which Tamil is the vernacular language of the locality concerned. EC accorded is displayed in our website. Copy of the same is attached as **Annexure 11**
ii.	The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.	Complied, copy of the Environmental Clearance dated 10.02.2020 is submitted to the Heads of local bodies on 30.05.2020 and Panchayats on 20.02.2020. Copy of the same is attached as **Annexure 12**
iii.	The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same on half-yearly basis.	Complied, the compliance of the stipulated Environment Clearance conditions including results of monitored data is uploaded on our website at half-yearly basis and the latest one updated on to website on 30.06.2023
iv	The project proponent shall monitor the criteria pollutants level namely; PM_{10}, SO_2, NO_X (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the projects and display the same at a convenient location for disclosure to the public and put on the website of the company.	Complied, the criteria pollutant levels namely; PM_{10}, $PM_{2.5}$, SO_2, NO_X, CO are displayed near the entrance of main gates of our company in the public domain & also uploaded in our website as in the six-monthly compliance report.
v.	The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the ministry of Environment, Forest & Climate Change at environmental clearance portal.	Being complied, Six-monthly reports on the status of the compliance of the stipulated EC are being uploaded to the website of the ministry of Environment, Forest & Climate Change, Parivesh portal.
vi.	The project proponent shall submit the environmental statement for each financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company.	Being complied, the Environmental Statement as prescribed under the Environment (Protection) Rules, 1986, for each financial year ending 31st March in Form-V is being submitted every year and displayed on the website of the company. To the FY 2022-23 the report has been submitted on 27.09.2023.
vii	The Project authorities shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities, commencing the land development work and start of production operation by the project.	Complied, date of financial closure and land development work has been informed to the JCEE of TNPCB, Salem dated 25.11.2020 and the same has been communicated through six months compliance report.

viii.	The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.	Abide by the order
ix.	The project proponent shall abide by all the commitments and recommendations made in the EIA/EMP report, commitment made during Public Hearing and also that during their presentation to the Expert Appraisal Committee.	Abide by the order
x.	No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).	Abide by the order
xi.	Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.	Abide by the order
xii.	The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.	Abide by the order
xiii.	The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.	Abide by the order
xiv.	The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data / information / monitoring reports	Abide by the order
xv.	The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon'ble Supreme Court of India / High Courts and any other Court of Law relating to the subject matter.	Abide by the order
xvi.	Any appeal against this EC shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010	Abide by the order

Compliance status to the EC (Amendment) dated 07.08.2019

Subject: Expansion of integrated Steel Plant (1.0 MTPA to 1.3 MTPA) of M/s. JSW Steel Ltd., located at Mecheri, Taluk Mettur, District Salem, Tamil Nadu – Amendment in Environmental Clearance issued dated 07.07.2017 – Reg.

1.This refers to the application of M/s. JSW Steel Limited made vide proposal no. IA/TN/IND/26508/2015 dated 15th March, 2019 along with Form I and sought for amendment in the **specific condition no. vii pertaining to zero liquid discharge of the Environmental Clearance accorded by the Ministry vide letter no. F.No. J-11011/281/2006-IA-II(I) dated 7th July, 2017.**

2. As per specific condition no. vii. "no effluent shall be discharged outside the plant premises and Zero discharge shall be adopted". Project proponent sought amendment in the condition as "Zero discharge for the complete steel plant complex including CPPs".

The compliance status for the EC conditions to the Amendment dated 07.08.2019 is given in below table.

Sl. No	Condition	Self-Declaration
i	The specific condition no. vii given at paragraph no.26 of the EC accorded vide letter dated 7 /07/2017 shall read as below: "No effluent shall be discharged outside the plant premises and 'zero' discharge for the complete steel plant complex including Captive Power Plants (CPPs) shall be adopted.	Complied. There is no discharge of effluent outside the plant premises and Zero Wastewater Discharge (except rainwater along with surface runoff during monsoon) for the complete steel plant completed including Captive Power Plant. As per the latest CTO of CPP II the entire wastewater from the CPP II (3 x 30 MW -705 KLD) is being transferred to Steel plant guard pond for collection, treatment and reuse in Steel plant for cooling, dust suppression and gardening purpose as consented.

Sl. No	Condition	Self-Declaration
A.	**Specific Condition**	
i.	The occupational health survey of the active workmen involved shall be carried as per the ILO guidelines and all the employees shall cover in every 5 years @ 20% every year.	Being complied. Occupational health survey of the active workmen involved is being carried out as per the ILO guidelines and all the employees are being covered in health survey by 100% every year. All the medical records are available in OHC for ready reference.
ii.	The amount allocated for ESC i.e. Rs.13 Crores shall be provided as CAPEX and the ESC shall be treated as project and monitored annually and the report of same shall be submitted to Regional office of MoEF&CC.	The amount allocated for ESC i.e. Rs.13 Crores is provided as CAPEX and as the action plans are being implemented. The expansion activity has planned in a phased manner (Viz Phase-I: 1.0 MTPA to 1.15 MTPA and Phase-II: 1.15 MTPA to 1.3 MTPA) at an estimated cost of Rs. 1025 Cr. Phase-I expansion activities have been completed and the cost involvement is about Rs.650 Crs till 30.09.2023 the amount spent is 5.44 Crs.
iii.	The project proponent shall provide for solar light system for all common areas, street lights, villages, parking around project area and maintain the same regularly.	Solar panel is installed with the capacity of 60 KW (50 KW at Canteen and 10 KW at R& D building) and the average power generation is in the range of 12 Kwhr and further installations are scheduled year on year.
iv.	The project proponent shall provide for LED lights in their offices and residential areas.	LED based lightings are provided in the offices and township area and the replacement of sodium vapour lamp to LED is increased from 800 KW to 950 KW. Further, plan to install LED lights all over plant.
v.	The project proponent should install 24X7 air monitoring devices to monitor air emission and submit report to Ministry and its Regional Office.	Being Complied: There are 39 nos. of Dust analyzers & 23 Nos Gaseous emission monitoring systems are installed as per CTO condition and the real time data of SPM, SO_2, NOx and CO are transmitted to the Care Air Centre of TNPCB and CPCB servers. Apart from the above, TNPCB is conducting bi-annual survey and Manual monitoring is being conducted by a NABL accredited external laboratory on a monthly basis. The monitoring results are attached as **(Annexure 2)** and values are well within the permissible limits. The latest TNPCB survey conducted (14.06.2023 to 20.06.2023) results are well within the standards issued by the Board.

vi.	The ETP for Blast furnace effluent should be designed to meet Cyanide standards as notified by the MoEF&CC.	There are two blast furnaces in our plant. BF#1 is having wet type gas cleaning plant and BF#2 is having dry type GCP. Presence of Cyanide level is not detected in Blast Furnace #1 effluent and the same is periodically ensured with external NABL accredited lab analysis SPCB also collecting effluent sample on monthly basis from the guard pond and the results evident that cyanides are not detected.
vii.	No effluent shall be discharged outside the plant premises and 'zero' discharge shall be adopted.	Wastewater generated from the various processes of steel plant and CPP II (3 x 30 MW) is collected in a guard pond which is installed in steel plant and after pretreatment, treated water is 100% reused in steel plant processes as per the CTO.
viii.	The ETP for coke oven by-product should be designed to meet EPA notified standards especially the cyanide and phenol.	Our Coke oven plant is non-recovery type. Hence, ETP is not envisaged.
ix.	Coke oven plant should meet visible emission standards notified by the MoEF&CC.	Our plant is non recovery type and also the coke oven process works on i) negative pressure ii) stamped wet coal is being charged to the ovens which is side loading and thereby no visible emissions are noticed.
x.	The standards issued by the Ministry vide G.S.R. 277(E) dated 31st March 2012 shall be strictly adhered to and the standards prescribed for the Coke oven plant shall be monitored and the report should be submitted along with the six-monthly compliance report.	Being complied. The standards issued by the Ministry vide G.S.R. 277(E) dated 31st March 2012 are related to emission standards of Iron and Steel plant. As per the standard the emission related to coke oven plant is applicable to by product type and our Coke Oven plant is of non-recovery type. Emission standards with respect to stack (COP waste gas is used for steam generation and COP stacks are functioning as emergency stack) and fugitive emissions to the COP are being monitored and the results are submitted along with the six-monthly compliance report. Since, our plant is non-recovery type ETP is not anticipated for COP. All other emissions & effluent parameters related to sinter plant, blast furnace, steel making shop, mills are being monitored monthly and the values are well within the standard prescribed. The six months monitoring results (maximum, minimum and average) by TNPCB and NABL accredited laboratory for stack emissions are given in

		Annexure 2 and Effluent quality monitoring results are given in **Annexure 5**
xi.	The emission standards specified in the Environmental (Protection) Amendment Rules, 2015 issued by vide S.O. 3305 (E) dated 7th December 2015 for the Thermal Power Plant shall be strictly adhered to.	Being Complied: At present CPP-II power generation capacity is 90 MW (3x30 MW). A coal-based boiler which is installed in CPP II in 2006 and the parameters of SPM, SO_2, Mercury are within the range prescribed of norms. Specific water consumption is in the range of 2.28 m3/Mwh against the norms of 3.5 m3/Mwh. NOx emission will be complied before the time line issued and at present no proven technology is not available and actions are being initiated to explore BAT. Fly ash generated is 100% disposed to local fly ash brick manufacturers. In the additional 1 x 30 MW CPP which was installed in 2019 with air cooled condenser and the specific water consumption is about 0.3 m3/Mwh
xii.	The National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November 2009 shall be followed.	Being Complied: To meet the National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16th November 2009 Continuous Ambient Air Quality monitoring stations of four numbers are installed in the plant periphery. One station is installed to monitor PM10, PM2.5, SO2, NOx and CO and other 3 stations are installed to monitor PM10, PM2.5, SO_2 as per the CTO condition. The real time data are connected to Care Air Centre of TNPCB & CPCB. Apart from this, ambient air quality is monitored in the surrounding villages by TNPCB during the bi- annual survey and also monitored by a NABL accredited laboratory to the defined locations to the parameters issued by the Ministry vide G.S.R. No. 826(E) dated 16th November 2009. The monitored results (maximum, minimum & average) is enclosed in **Annexure 3**
xiii.	On-line ambient air quality monitoring and continuous stack monitoring facilities for all the stacks shall be provided and sufficient air pollution control devices viz. Electrostatic precipitator (ESP), and bag filters etc. shall be provided.	Continuous Ambient Air Quality monitoring stations of four numbers are installed in the plant periphery. One station is installed to monitor PM_{10}, $PM_{2.5}$, SO_2, NOx and CO and other 3 stations are installed to monitor PM_{10}, $PM_{2.5}$, SO_2, as per the CTO condition. The real time data are connected to Care Air Centre of TNPCB & CPCB. Online continuous monitoring systems are installed.

		in process and non-process stacks as per the CTO condition to monitor SPM, SO_2 & NOx. The real time data is connected with TNPCB & CPCB servers. Adequate Air Pollution Control measures are installed in the respective processes and to control the fugitive emissions secondary de-dusting systems are installed in BF & SMS. The details of APC measures installed are given in **Annexure 13**
xiv.	A statement on carbon budgeting including the quantum of equivalent CO2 being emitted by the existing plant operations, the amount of carbon sequestered annually by the existing green belt and the proposed green belt and the quantum of equivalent CO2 that will be emitted due to the proposed expansion shall be prepared by the project proponent and submitted to the Ministry and the Regional Office of the Ministry. This shall be prepared every year by the project proponent. The first such budget shall be prepared within a period of 6 months and subsequently it should be prepared every year.	A statement on carbon budgeting is prepared as per the condition and detailed report is submitted to Ministry dated on 15.02.2018, 11.06.2019, 23.09.2020, 01.11.2021, 30.06.2022, 29.11.2022 & 28.06.2023. The quantum of equivalent CO2 being emitted by the existing plant operations during FY23 is 28,10,308 MT/year. The amount of carbon sequestered in FY23 by the existing green belt is 5699 MT. The proposed green belt for FY24 is 11000 Nos. of tree saplings. The statement report for the financial year 2023 is attached herewith as **Annexure 9**
xv	For the employees working in high temperature zones falling in the plant operation areas, the total shift duration will be 4 hrs or less per day where the temperature is more than 50^{o}C. Moreover, the jobs of these employees will be alternated in such a way that no employee is subjected to working in high temperature area for more than 1 hr continuously. Such employees would be invariably provided with proper protective equipment, garments and gears such as head gear, clothing, gloves, eye protection etc. There should also be an arrangement for sufficient drinking water at site to prevent dehydration etc.	Employees working in high temperature zones are in the range of 45^{0}C and of those employees are swapped to other jobs and ensure that no employee is subjected to work in high temperature area for more than 1 hr continuously. They are provided with proper protective equipment, garments and gears such as head gear, clothing, gloves, eye protection, etc., and arrangements are made for sufficient drinking water, butter milk and lime juice to prevent dehydration.
xvi	In-plant control measures and dust suppression system shall be provided to control fugitive emissions from all the vulnerable sources. Dust extraction and suppression system shall be provided at all the transfer points, coal handling plant and coke sorting plant of coke oven plant. Bag filters shall be provided to hoods and dust collectors to coal and coke handling to control dust emissions. Water sprinkling system shall be provided to control secondary fugitive dust emissions generated during screening, loading, unloading, handling and storage of raw materials etc..	Dust suppression systems are provided to control fugitive emissions from all the vulnerable sources like raw material unloading and storage yards. Bag filters and Dry & Wet fog systems are provided in raw material transfer points, coal handling and coke sorting plant of coke oven. To control dust emission bag filters are provided in coal handling area of COP. Water sprinkler systems are provided in various locations to control secondary fugitive dust emissions generated during

		screening, loading, unloading, handling and storage of raw materials. A tyre washing unit is installed in the main gate entry to control vehicular movement dust emission
xvii	Gaseous emission levels including secondary fugitive emissions from all the sources shall be controlled within the latest permissible limits issued by the Ministry vide G.S.R. 414(E) dated 30th May, 2008 and regularly monitored. Guidelines / Code of Practice issued by the CPCB shall be followed.	The G.S.R. 414(E) dated 30th May, 2008 is related to sponge iron plant. In this connection, a representation is submitted to MoEF&CC dated 22.07.2017
xviii	Hot gases from DRI Kiln should be passed through dust settling chamber (DSC) to remove coarse solids and After Burning Chamber (ABC) to burn CO completely and used in Waste Heat Recovery (WHRB). The gas then shall be cleaned in ESP before dispersion out into the atmosphere through ID fan and stack. ESP shall be installed to control the particulate emission from WHRB.	The existing and expansion of the steel plant is following blast furnace route and there is no DRI process in our operations. In this connection, a representation is submitted to MoEF&CC dated 22.07.17.
xix.	Efforts shall further be made to use maximum water from the rain water harvesting sources. If needed, capacity of the reservoir shall be enhanced to meet the maximum water requirement.	Being Complied, Rain water harvesting ponds are provided near to township (East side) with the capacity of 17500 KL, West side of Township STP with the capacity of 33000 KL, Near RO plant area 15000 KL and plant guest house backside 4000 KL. Recently RWH capacity augmentation done by adding two ponds one at COP with capacity 2000 KL & other one near Paver Block unit of 350 KL capacity. The overall collection capacity is 71,850 KL. The collected rain water is recharged to mother earth, reused in steel plant wherever applicable for secondary applications. Capacity of the rain water harvesting ponds will be enhanced based on the needs and requirement.
xx.	Risk and Disaster Management Plan along with the mitigation measures shall be prepared and a copy submitted to the Ministry's Regional Office, SPCB and CPCB within 3 months of issue of environment clearance letter.	Complied: Study on Risk and Disaster Management Plan was conducted and the detailed report with summary is submitted to Ministry's Regional Office, SPCB, and CPCB on 01.02.2018 and the same is periodically reviewed and updated.
xxi.	All the blast furnace (BF) slag shall be granulated and provided to cement manufacturers for further utilization. Flue dust from sinter plant and SMS and sludge from BF shall be re-used in sinter plant. Coke breeze form coke oven plant shall be used	Being Complied: Blast Furnace Slag is converted to Granulated slag and now using in the GGBFS facility for value added product. Flue dust from blast furnace, sludge from BF & EOF, Coke breeze from coke oven plant are re-used in sinter plant.

	in sinter and pellet plant. SMS slag shall be given for metal recovery and properly utilized. All the other solid waste including broken refractory mass shall be properly disposed-off in environment-friendly manner.	Pellet plant is not installed in our process SMS slag is sent for metal recovery system and the crushed slag is reused in internal applications like sinter plant, EOF as hearth layer and cooling media respectively and to cement industries. Based on the R&D initiative crushed EOF slag is used produce paver which is used for internal road making. Refractories are selected to withstand high temperature whose self-life is longer and generation of used refractories are lesser. The same is recycled in downstream applications/disposed to recycling vendors.
xxii.	Coal and coke fines shall be recycled and reused in the process. The breeze coke and dust from the air pollution control system shall be reused in sinter plant. The waste oil shall be properly disposed of as per the Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016.	Being Complied: Coal and coke fines are recycled and reused in the Sinter plant and Blast Furnace. Coke breeze and dust from the air pollution control systems are collected and reused in the Sinter Plant. The waste oil generated from the process is being disposed to authorized vendor as per the Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016.
xxiii.	Green belt shall be developed in 33 % of plant area. Selection of plant species shall be as per the CPCB guidelines in consultation with the DFO.	Being complied. The existing greenbelt developed is around 268894 Nos with area cover of about 91.30 Ha of the total area which is about 34.07% and most of the sapling are planted native species in consultation with Forest department. Survival rate observed is around 85-90%. The tree plantation details are given in **Annexure 8**
xxiv.	All the recommendations made in the Charter on Corporate Responsibility for Environment Protection (CREP) for the Steel plants and Coke Oven Plants shall be implemented.	Complied. All the recommendations of the Charter on the Corporate Responsibility for the Environmental Protection (CREP) issued for the steel plants are implemented. Updated Compliance status report of CREP is enclosed vide **Annexure 4**
xxv.	At least 2.5% of the total cost of the project shall be earmarked towards the Enterprise Social Commitment based on Public Hearing issues, locals need and item-wise details along with time bound action plan shall be prepared and submitted to the Ministry's Regional Office. Implementation of such program shall be ensured by constituting a Committee comprising of the proponent, representatives of village Panchayat and District Administration. Action taken report in this regard shall be submitted to the Ministry's Regional Office.	Being Complied: As per the EC Specific condition ii, Rs.13 Crores is allotted towards ESC have been earmarked. Public Hearing issues, locals need and item-wise details along with time bound action plan is prepared and actions are being taken in a time bound manner. The expansion activity is planned in a phased manner (Viz Phase-I: 1.0 MTPA to 1.15 MTPA and Phase-II: 1.15 MTPA to 1.3 MTPA) at an estimated

		cost of Rs. 1025 Cr. Phase-I expansion activities were completed and the cost involvement is about Rs.650 Crs and till date the amount spent towards ESC is about 5.44 Crs. The phase-II expansion activity will be carried out within the time line of EC validity. Based on the local needs ESC spent heads are slightly modified and the same has been communicated to your good office via mail dated 26.09.2020. JSW assures that the commitments made shall be fulfilled. The details are attached in **Annexure 10**
xxvi	The proponent shall prepare a detailed CSR plan for every year for the next 5 years for the existing-cum-expansion project, which includes village-wise, sector-wise (Health, Education, Sanitation, Health, Skill Development and infrastructure requirements such as strengthening of village roads, avenue plantation, etc) activities in consultation with the local communities and administration. The CSR plan will include the amount of 2% retain annual profits as provided for in Clause 135 of the Companies Act, 2013 which provides for 2% of the average net profits of previous 3 years towards CSR activities for life of the project. A separate budget head shall be created and the annual capital and revenue expenditure on various activities of the plan shall be submitted as part of the compliance report to RO. The details of the CSR plan shall also be uploaded on the company website and shall also be provided in the Annual Report of the company. The plan so prepared shall be based on SMART (Specific, Measurable, Achievable, Relevant and Time bound) concept. The expenditure should be aimed at sustainable development and direct free distribution and temporary relief should not be included.	Complied: CSR plan for 5 years (from 2017 to 2022) is prepared as per condition and activities are completed. The updated report of CSR including Fy24 proposed commitment is attached as **Annexure 10**
xxvii	All the commitments made to the public during the Public Hearing /Public Consultation meeting shall be satisfactorily implemented and a separate budget for implementing the same shall be allocated and information submitted to the Ministry's Regional Office at Chennai.	Complied: Commitments made to the public during the Public Hearing is satisfactorily implemented.
xxviii.	Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, Safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.	Being complied: Now there is no expansion activity. Provisions will be made for the expansion project activities and as per the condition temporary structure will be removed after the completion of expansion activities.

B.	GENERAL CONDITIONS	
i.	The project authorities must strictly Adhere to the stipulations made by the concerned State Pollution Control Board and the State Government.	Being complied: Stipulations made by the Tamil Nadu Pollution Control Board and the State Government is strictly adhered to compliance.
ii	No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).	Being Complied: There is no further expansion or modification in the plant is carried out without prior approval of Ministry of Environment, Forests and Climate Change (MoEF&CC)
iii	At least four ambient air quality monitoring stations should be established in the downward direction as well as where maximum ground level concentration of PM10, PM2.5, SO2 and NOX are anticipated in consultation with the SPCB. Data on ambient air quality and stack emission shall be regularly submitted to this Ministry including its Regional Office at Chennai and the SPCB/CPCB once in six months.	Being Complied: With the consultation of TNPCB four numbers of Continuous Ambient Air Quality monitoring stations are installed in the plant premises where maximum ground level concentration of PM_{10}, $PM_{2.5}$, SO_2 and NO_x is taking place. Data on Ambient Air Quality and Stack emission reports are being submitted to Ministry, MoEF&CC, Regional Office at Chennai and the SPCB/CPCB once in six months.
iv	Industrial waste water shall be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19th May, 1993 and 31st December 1993 or as amended from time to time. The treated waste water shall be utilized for plantation purpose.	Being Complied: Industrial wastewater is being collected, treated and reused 100 % in the processes for cooling application and plantation purpose. Quality parameters are conformed to the prescribed standards under GSR 422 (E) dated 19th May, 1993 and 31st December 1993. The treated wastewater analysis report given by TNPCB & NABL accredited laboratory is given in **Annexure 5**
v.	The overall noise levels in and around the plant shall be kept well within the standards (85 dB(A)) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EPA Rules, 1989 viz. 75 dB(A) during day time and 70 dB(A) during night time.	Being Complied: Source and Ambient noise levels are measured in and around the plant areas on monthly basis and control measures like acoustic hoods, silencers, and enclosures are provided wherever required. The noise levels of source and ambient are well within the standards prescribed under EPA Rules, 1989. Apart from this visual display boards are displayed to wear earplug, ear muff as PPE wherever required. The noise monitoring results by NABL accredited laboratory is enclosed in **Annexure 7**
vi.	Occupational health surveillance of the workers shall be done on a regular basis and records maintained as per the Factories Act.	Being Complied: Health surveillance (Annual Health Check-up) is being conducted for all employees on yearly basis and records are being maintained in the Occupational Health Centre.

vii	The company shall develop rain water harvesting structures to harvest the rain water for utilization in the lean season besides recharging the ground water table.	Being Complied, Rain water harvesting ponds are provided near to township (East side) with the capacity of 17500 KL, West side of Township STP with the capacity of 33000 KL, Near RO plant area 15000 KL and plant guest house backside 4000 KL. Recently RWH capacity augmentation done by adding two ponds one at COP with capacity 2000 KL & other one near Paver Block unit of 350 KL capacity. The overall collection capacity is 71,850 KL. The collected rain water is recharged to mother earth, reused in steel plant wherever applicable for secondary applications. Capacity of the rain water harvesting ponds will be enhanced based on the needs and requirement
viii.	The project proponent shall also comply with all the environmental protection measures and safeguards recommend in the EIA/EMP report. Further, the company must undertake socio-economic development activities in the surrounding villages like community development programmes, educational programmes, drinking water supply and health care etc.	Complied: To comply the environmental protection measures and safeguards as per the recommendation of EIA/EMP report, dust suppression systems like water sprinklers and dry fog systems for control of fugitive emissions arising from material handling. Bag filters are provided in the Sinter plant for dust control during crushing of raw materials. ESPs are provided for dust control in the Sintering process and Coal based boiler. Cast house de-dusting systems are installed in both the Blast Furnace I & II for fugitive dust control in the casting process. Wet Gas cleaning systems are provided in Blast Furnace I and Dry Gas cleaning systems are provided in Blast Furnace II. Quenching tower with grit arrestor is provided to control emission during coke quenching (wet type). Secondary de-dusting system (bag filters) are provided in Energy Optimizing Furnaces I & II, Ladle Refining Furnaces. Apart from the above we undertake socio-economic development activities in the surrounding villages like community development programmes, educational programmes, drinking water supply and health care etc. The details are given **Annexure 10** in the six months' report of CSR.
ix.	Requisite funds shall be earmarked towards capital cost and recurring cost/annum for environment pollution control measures to implement the	Complied: For environment pollution control measures capital cost and recurring cost/annum for environment pollution

	conditions stipulated by the Ministry of Environment, Forest and Climate Change (MoEF&CC) as well as the State Government. An implementation schedule for implementing all the conditions stipulated herein shall be submitted to the Regional Office of the Ministry at Chennai. The funds so provided shall not be diverted for any other purpose.	control measures are being implemented to the completed projects. From April to September 2023 the cost of Rs.11.3 crores (approx.) has been spent for environment pollution control measures as capital cost. Recurring cost to the environment pollution control measures of Rs.10 crores (approx.) has been spent.
x	A copy of clearance letter shall be sent by the proponent to concerned Panchayat, Zila Parishad/ Municipal Corporation, Urban Local Body and the local NGO, if any, from whom suggestions/representations, if any, were received while processing the proposal. The clearance letter shall also be put on the website of the company by the proponent.	Complied: Copy of clearance letter is submitted to local administration on 14.07.2017. The copy of clearance letter is uploaded in our website.
xi.	The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of the MoEF&CC at Chennai. The respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; PM10, SO2, NOX (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the projects shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.	Complied: The compliance of the stipulated environment clearance conditions including results of monitored data is uploaded in our website once in six months. Simultaneously the compliance reports are being submitted (email) to the Regional Office of the MoEF&CC at Chennai and the Zonal Office of CPCB, Bangalore and the TNPCB, Chennai. The criteria pollutant levels namely; PM10, $PM_{2.5}$, SO_2, NO_X, CO (real time values) and stack emissions (manually monitored values) are displayed near both entrance of our company in the public domain.
xii.	The project proponent shall also submit six monthly reports on the status of the compliance of the stipulated environmental conditions including results of monitored data (both in hard copies as well as by e-mail) to the Regional Office of MoEF&CC, the respective Zonal Office of CPCB and the SPCB. The Regional Office of this Ministry at Chennai/CPCB/SPCB shall monitor the stipulated conditions.	Complied: Environmental conditions and compliance status report including results of monitored data is being submitted once in six months to the Regional Office of MoEF&CC, Chennai (by email), and Zonal Office of CPCB, Chennai and TNPCB, Chennai.
xiii.	The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of environmental conditions and shall also be sent to the respective Regional Office of the MoEF&CC at Chennai by e-mail.	Being Complied: As prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, the environmental statement for each financial year ending 31st March in Form-V and status of compliance of environmental conditions is being submitted to the Regional Office of the MoEF&CC at Chennai. For FY 2022-23 the report has been submitted on 27.09.2023

xiv	The project proponent shall inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the SPCB and may also be sent at website of the Ministry of Environment, Forests, and Climate Change (MoEF&CC) at http:/envfor.nic.in. This shall be advertised within seven days from the date of issue of the clearance letter, at least in two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned and a copy of the same should be forwarded to the Regional office at Chennai.	Complied: Environmental Clearance accorded from MoEF&CC dated on 07.07.2017 and the details have been advertised in Dinamani and The Indian Express on 14.07.2017. The same was advertised two local newspapers (Dinamani and The Indian Express) which are widely circulated in the region of which Tamil is the vernacular language of the locality concerned. A copy of the same is submitted to the MoEF&CC Regional office at Chennai on 15.07.2017.
xv	Project authorities shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of commencing the land development work.	Complied: Date of financial closure and land development work is informed to Regional Office vide letter dated 12.10.2017.

ANNEXURE 1

PRODUCTION & WASTE GENERATION DETAILS

Annexure 1

I. Production details for the period of April'23 to September’23.

Month	Steel Plant						CPP-II
	Products	By product				Intermediate product	Product
	Steel production	Ferrous Sulfate	Liquid Oxygen	Liquid Nitrogen	Liquid Argon	Pig Iron	Power generation
UoM	MT	MT				MT	MW (Avg load)
Apr-23	**61490.09**	71	173.0	0.0	72.0	760	47.97
May-23	**98547**	64	146.0	0.0	113.0	1048	64.43
Jun-23	**96350.56**	43	174.0	0.0	109.0	0	65.54
Jul-23	**81505.68**	57	110.0	0.0	175.0	753	64.51
Aug-23	**97899**	59	230.0	0.0	156.0	370	72.97
Sep-23	**94459.23**	53	264.0	0.0	134.0	0	71.51
Total	**530252**	347.0	1097.0	0.0	759.0	2931	64.5
Consented quantity per Annum	1150000	1200	15000	2000	8000	300000	90.0

Note:

- **MT – Metric Ton**
- **MW – Mega watt**

Annexure -1a

II. Waste generation details for the period of Apr'23 – Sep'23

Month	Steel Plant & CPP#2									
	Hazardous Waste	BF granulated Slag	SMS Slag	GCP sludge	Mill scale	Fly Ash	APC dust	E - waste	Bio medical waste	Battery waste
UoM	**MT/Month**							**Kg/Month**		
Apr-23	4.74	24150.11	13507	1079	945	585	329	165	1.005	910
May-23	29.75	37851.97	21658	2872	1399	899	567	3498	0.295	840
Jun-23	19.59	36085.65	21156	2561	1332	551	572	1260	0.265	1980
Jul-23	19.4	30020.56	17840	2081	1155	624	602	160	0.37	0
Aug-23	25.84	36818.39	21471	2319	1428	966	496	150	0.545	1020
Sep-23	15.83	34130.97	20767	1785	1320	884	605	100	0.325	0
Total	**115.2**	**199058**	**116400**	**12696**	**7579**	**4508**	**3169**	**5333.00**	**2.805**	**4750.00**

ANNEXURE 2

STACK EMISSION MONITORING REPORT OF TNPCB & NABL ACCREDITED LABORATORY

Annexure 2

Stack emission monitoring report of TNPCB & NABL accredited laboratory for the period Apr '23 to Sep '23.

I. Stack emission monitoring results of TNPCB					
Sl. No	Stack attached to	Discharge rate in (Nm^3/Hr)	Pollutants Concentration (mg/Nm^3)		
			PM	SO_2	NO_x
1	Sinter Plant - I - Sinter Machine	74842	66	-	-
2	Sinter Plant – I - Cooling System	74929	64	-	-
3	Sinter Plant – I Dedusting System	91091	36	-	-
4	Sinter Plant – I RMHS	15555	73	-	-
5	Sinter Plant - II - Sinter Machine	502914	62	-	-
6	Sinter Plant - II - Cooling & De-dusting System	421913	68	-	-
7	Sinter Plant - II - RMHS	79048	46	-	-
8	COP - Coke cutter	36574	34	-	-
9	Coke Oven - WHRB -I	39597	38	136	8
10	Coke Oven - WHRB -III	90228	46	171	7
11	Coke Oven - WHRB -IV	46795	42	160	8
12	Coke Oven - WHRB -V	55128	30	148	4
13	BF Gas Fired Boiler	25077	32	72	6
14	Blast Furnace - I - Hot stove	42101	35	48	22
15	Blast Furnace - I - Stock House & RMHS	47736	70	-	-
16	Blast Furnace - I - Cast House	205050	81	-	-
17	Blast Furnace - II - Hot stove	72744	26	32	17
18	Blast Furnace - II - Stock House & RMHS	222224	45	-	-
19	Blast Furnace - II - Cast House	327055	41	-	-
20	Blast Furnace - II - PCI	28629	39	-	-
21	Process Boiler	23806	32	117	72
22	Energy Optimizing Furnace -I	67068	66	-	-
23	Energy Optimizing Furnace -II	62961	61	-	-
24	EOF Secondary dedusting system I & II	348452	73	-	-
25	Ladle Refining Furnace - 1 & 4 primary & LRF 1 to 4 Secondary dedusting	340031	61	-	-
26	Ladle Refining Furnace - 2 & 3	70820	36	-	-
27	VD boiler	12288	32	72	38
28	CCM-I Steam Exhaust	17836	31	-	-
29	CCM-I ABGM - 1	21261	70	-	-
30	CCM-II Steam Exhaust - I & II	13661	42	-	-
31	CCM-II Cut fumes Exhaust	49766	68	-	-
32	CCM-II ABGM - 2	17990	62	-	-
33	CCM-III Steam Exhaust 1	17054	84	-	-
34	CCM-III Steam Exhaust 2	20492	86	-	-
35	CCM-III ABGM - 3	21678	59	-	-
36	BLM – Re Heating Furnace -I	29008	62	88	32
37	BLM – Re Heating Furnace -II	37766	34	64	36
38	BRM – Re Heating Furnace	69866	65	96	5
39	Pickling Plant - Acid Fumes Exhaust System Stack	18958	38		
40	Pickling Plant - Acid - Hot Water Generator Stack	1169	47		
41	Pickling Plant - MEE Thermic Fluid Stack	3330	41		
42	GGBFS Grinding Mill Stack	94026	8.5		
43	Batching Plant I Cement Silo vent stack	176	24		
44	DG Set (625 KVA) COP	492	25	19	5
45	DG Set (1250 KVA) Process Boiler.	1023	25	27	4.0
46	DG Set I (625 KVA) EOF 1	558	36	32	7
47	DG Set II (625 KVA) EOF 1	516	38	35	9
48	DG Set (1250 KVA) EOF 2	4411	44	40	12
49	DG Set (1250 KVA) CCM 3	6438	48	40	9
50	DG Set (650 KVA) BRM	2588	34	37	7
51	DG Set (400 KVA) Pickling Plant	2348	22	32	7
52	AFBC - Boiler	143611	23	192	18
53	COAL CRUSHER CPP 2	3498	66	-	-
54	CPP II COAL SCREENING SECTION	10096	55	-	-
55	DG Set (500 KVA) CPP 2	987	23	11	8

II. Stack emission monitoring report of NABL accredited Laboratory					
Stack No.	Source name	Stack emission Average (mg/Nm^3)			Discharge (Nm^3/hr)
		SPM	SO_2	NO_x	
1	Sinter Machine (Sinter Plant I)	135.7	55.2	53.1	91264
2	Cooling System (Sinter Plant I)	60.3	_	_	55313
3	Dedusting System (Sinter Plant I)	44.4	_	_	75636
4	Dust Extraction System For RMHS (Sinter Plant I)	40.0	_	_	11897
5	Sinter Machine (Sinter Plant II)	96.4	57.0	50.0	528906
6	Plant Dedusting and Cooling (Sinter Plant II)	60.9	_	_	265650
7	Crushing of Fuel & Raw Materials (Sinter Plant II)	53.3	_	_	63135
8	Coke Oven Chimney 1A & 1B (Coke Oven) -Emergency stack	_	_	_	_
9	Coke Oven Chimney II (Coke Oven) -Emergency stack	_	_	_	_
10	Coke Oven Chimney III (Coke Oven) -Emergency stack	_	_	_	_
11	Coke cutter dedusting system stack (Coke Oven)	40.2			27125
12	Coke Dryer dedusting system stack (Coke Oven)	12.5			40223
13	Waste Heat Recovery Boiler I (Coke Oven)	32.6	341.3	271.0	53750
14	Waste Heat Recovery Boiler II (Coke Oven)	33.2	339.5	269.1	54618
15	Waste Heat Recovery Boiler III (Coke Oven)	34.4	336.3	262.4	56974
16	Waste Heat Recovery Boiler IV (Coke Oven)	30.8	332.7	256.0	53874
17	Waste Heat Recovery Boiler V (Coke Oven)	30.6	327.6	248.2	51949
18	Hot Stove (Blast Furnace I)	25.8	49.2	46.1	44567
19	Stock House Dedusting System (Blast Furnace I)	58.9	_	_	48660
20	Cast House Dedusting System (Blast Furnace I)	43.7	_	_	164939
21	GCP Flare (Blast Furnace I) -Emergency stack	_	_	_	_
22	Hot Stove (Blast Furnace II)	25.9	51.6	51.0	66325
23	Stock House Dedusting & RMHS (Blast Furnace II)	57	_	_	155536
24	Cast House Dedusting System (Blast Furnace II)	50	_	_	301239
25	GCP Flare (Blast Furnace II) -Emergency stack	_	_	_	_
26	Pulverized Coal Injection (Blast Furnace)	60.7	_	_	21975
27	Process Boiler (1*25 TPH) and (1*8 TPH) (Common Stack)	23.5	29.4	29.5	15599
28	Energy Optimizing Furnace (Steel Melting Shop I)	59.4	53.0	48.1	38800
29	Energy Optimizing Furnace (Steel Melting Shop II)	58.7	53.1	48.5	41302
30	Secondary Dedusting System EOF I&II (Combined SMS II)	56.7	_	_	251725
31	Ladle Furnaces (Steel Melting Shop I)	50.3	35.5	31.6	23563
32	Ladle Furnaces(Common Stack) (Steel Melting Shop II)	53.3	42.0	38.0	48682
33	Ladle Furnaces -1 & 4(65 T/Heat Each) Primary & 1 to 4 Secondary Dedusting (Steel Melting Shop)	48.6	_	_	236273
34	Vacuum Degasing Unit (Boiler) (Steel Melting Shop II)	33.0	37.9	35.4	19974
35	Continuous Casting Machine (Steel Melting Shop I)	34.6	_	_	18652
36	Billet grinding machine stack - ABGM -1	44.6	_	_	15349
37	CCM#II Steam exhaust system -1	35.1	_	_	14940
38	CCM#II Steam exhaust system -2	37.0	_	_	15131
39	CCM#II Cut fumes Exhaust system	41.1	_	_	35668
40	Billet grinding machine stack -ABGM - 2	42.0	_	_	21607
41	CCM#III Steam exhaust system 1	31.3	_	_	18751
42	CCM#II Steam exhaust system stack #2	32.6	_	_	18914
43	Billet grinding machine stack -ABGM - 3	48	_	_	14322
44	Re-heating Furnace - Chimney- 1 (BLM	34	49.7	47.3	24959
45	Re-heating Furnace - Chimney- 2 (BLM)	33	43	41	25988
46	Reheating Furnace Chimney 1 & 2	33	47	47	72898
47	Pickling Plant- Acid - Hot water Generator Stack	27	25	38	1790
48	Picklig plant - ARP - Hot water Generator	_	_	_	_
49	Pickling plant - MEE – Thermic fluid Heater	35	17.2	31.4	4136.3
50	Pickling Plant- Acid Fumes exhaust system stack	13	_	_	11790.0
51	BF Slag Grinding mill stack	8	_	_	82977
52	BF Slag Grinding unit- Sinter waste Gas	_	_	_	_
53	BF Slag Grinding unit- Hot Air Generator	_	_	_	_
54	Batching plant#1 Cement silo vent stack	25	_	_	2050.0
55	Batching plant#2 Cement silo vent stack	5	_	_	295.9
56	BF Gas Fired Boiler	32	16.8	17.5	38049
57	AFBC Boiler	24	584	439	109224
58	Coal crusher	47	_	_	3232
59	Coal screening	46	_	_	8980
60	Raw Material Transfer and Discharge Point	39	_	_	933

ANNEXURE 3

ONLINE STACK EMISSION MONITORING & AMBIENT AIR QUALITY MONITORING REPORT

Annexure 3

Online stack emission monitoring & Ambient air quality monitoring report for the period Apr'23 to Sep'23

I. Online stack emission monitoring summary report (Apr '23 to Sep'23)

Stack No.	Source name	Parameter	UoM	Month					
		Month		Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
1	Sinter Machine (Sinter Plant I)	SPM	mg/Nm^3	86.0	78.7	63.5	25.2	65.8	80.3
		SO_2	mg/Nm^3	72.4	85.4	81.8	52.3	80.0	74.4
2	Cooling System (Sinter Plant I)	SPM	mg/Nm^3	53.5	50.7	47.4	25.5	44.4	31.4
3	Dedusting System (Sinter Plant I)	SPM	mg/Nm^3	33.9	41.2	33.4	16.0	19.0	21.9
4	Dust Extraction System For RMHS (Sinter Plant I)	SPM	mg/Nm^3	19.1	19.2	20.2	8.9	15.4	13.0
5	Hot Stove (Blast Furnace I)	SPM	mg/Nm^3	22.7	22.6	23.8	14.9	25.1	16.0
		SO_2	mg/Nm^3	74.8	73.3	78.6	41.4	73.2	56.0
		NOx	mg/Nm^3	42.04	42.02	55.55	26.77	41.97	40.52
		CO	ppm	1385.01	1965.49	1844.32	970.33	1757.32	2171.53
6	GCP Flare (Blast Furnace I) -Emergency stack	NA	NA	_	_	_	_	_	_
		NA	NA	_	_	_	_	_	_
7	Stock House Dedusting System (Blast Furnace I)	SPM	mg/Nm^3	6.82	7.36	14.22	11.27	24.64	25.37
		SO_2	mg/Nm^3	8.03	4.30	4.56	2.74	5.20	4.12
8	Dust Extraction System for RMHS (Blast Furnace I)	SPM	mg/Nm^3	0	0	0	0	0	0
		SO_2	mg/Nm^3	0	0	0	0	0	0
9	Cast House Dedusting System (Blast Furnace I)	SPM	mg/Nm^3	21.25	25.35	27.48	15.09	28.36	33.20
		SO_2	mg/Nm^3	25.40	13.92	4.61	1.92	6.63	7.30
10	CPP I Boiler 2 Nos of 25 TPH each (Common Stack)	SPM	mg/Nm^3	30.32	26.09	34.10	25.83	21.89	10.12
		SO_2	mg/Nm^3	22.42	22.77	16.37	26.69	28.78	37.02
11	Energy Optimizing Furnace (Steel Melting Shop I)	SPM	mg/Nm^3	13.64	72.84	64.84	47.71	85.80	57.80
12	Ladle Furnaces (Steel Melting Shop I)	SPM	mg/Nm^3	16.87	7.53	6.12	15.22	16.21	30.24
13	Continuous Casting Machine (Steel Melting Shop I)	SPM	mg/Nm^3	14.25	1.62	1.94	1.98	2.13	1.75
14	Energy Optimizing Furnace (Steel Melting Shop II)	SPM	mg/Nm^3	36.48	79.59	46.48	13.80	72.46	105.36
15	Secondary Dedusting System EOF I&II (Combined SMS II)	SPM	mg/Nm^3	20.96	41.14	25.68	15.06	23.41	25.86
16	Sec. Dedusting System of LRF IV(Common) (SMS II)	SPM	mg/Nm^3	15.72	26.17	21.63	14.17	8.02	25.92
17	Ladle Furnaces(Common Stack) (Steel Melting Shop II)	SPM	mg/Nm^3	11.19	12.75	14.93	13.80	1.80	2.64
18	Vacuum Degasing Unit (Boiler) (Steel Melting Shop II)	SPM	mg/Nm^3	32.36	22.45	34.90	40.24	34.40	32.51
19	Steam Exhaust System 1 (Bloom Caster	SPM	mg/Nm^3	3.40	5.28	7.05	6.47	2.22	0.63
19	Steam Exhaust System 2 (Bloom Caster	SPM	mg/Nm^3	3.26	5.11	6.96	6.24	2.69	0.43
20	Cut Fumes Exhaust System (Bloom Caster)	SPM	mg/Nm^3	0.41	0.54	1.97	0.63	1.47	5.45
21	Reheating Furnace (Furnace 1 No2 Chimney) (BLM)	SPM	mg/Nm^3	8.63	19.33	18.04	15.71	22.27	19.31
		SO_2	mg/Nm^3	15.03	31.48	29.77	25.09	14.82	28.18
22	Reheating Furnace (Furnace 1 No1 Chimney) (BLM)	SPM	mg/Nm^3	22.17	34.14	36.69	29.22	44.33	48.96
		SO_2	mg/Nm^3	17.12	32.78	33.00	31.46	36.24	31.94
23	Coke Oven Chimney I (Coke Oven) -Emergency stack	NA	NA	Emergency stack no flow					
		NA	NA						
24	Coke Oven Chimney II (Coke Oven) -Emergency stack	NA	NA						
		NA	NA						
25	Coke Oven Chimney III (Coke Oven) -Emergency stack	NA	NA						
		NA	NA						

Stack No.	Source name	Parameter	UoM	Month					
		Month		Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
26	Waste Heat Recovery Boiler I (Coke Oven)	SPM	mg/Nm^3	14.68	28.93	31.11	31.49	31.01	30.78
		SO_2	mg/Nm^3	122.93	179.49	161.67	183.19	198.99	187.42
27	Waste Heat Recovery Boiler II (Coke Oven)	SPM	mg/Nm^3	14.51	14.02	26.71	30.44	28.59	27.54
		SO_2	mg/Nm^3	107.38	130.99	169.53	196.80	235.46	237.75
28	Waste Heat Recovery Boiler III (Coke Oven)	SPM	mg/Nm^3	33.48	23.21	28.87	29.76	38.05	21.90
		SO_2	mg/Nm^3	225.16	227.83	201.26	140.02	188.31	282.07
29	Waste Heat Recovery Boiler IV (Coke Oven)	SPM	mg/Nm^3	_	_	_	_	_	_
		SO_2	mg/Nm^3	_	_	_	_	_	_
30	Waste Heat Recovery Boiler V (Coke Oven)	SPM	mg/Nm^3	_	_	_	_	_	_
		SO_2	mg/Nm^3	_	_	_	_	_	_
31	BF Gas Fired Boiler	SPM	mg/Nm^3	32.04	36.82	35.37	28.91	33.35	26.50
32	Reheating Furnace (Bar & Rod Mill)	SPM	mg/Nm^3	26.83	44.75	46.32	40.12	45.63	39.51
		SO_2	mg/Nm^3	42.41	50.12	45.12	31.06	40.24	49.06
33	Sinter Machine (Sinter Plant II)	SPM	mg/Nm^3	11.93	27.21	36.46	40.57	67.30	41.18
		SO_2	mg/Nm^3	16.03	56.71	119.11	124.43	126.12	99.16
34	Plant Dedusting and Cooling (Sinter Plant II)	SPM	mg/Nm^3	6.70	19.64	23.20	17.46	32.39	25.35
35	Crushing of Fuel & Raw Materials (Sinter Plant II)	SPM	mg/Nm^3	8.27	8.12	18.43	16.45	34.69	32.93
36	Hot Stove (Blast Furnace II)	SPM	mg/Nm^3	10.13	22.75	22.18	29.44	18.27	14.08
		SO_2	mg/Nm^3	14.95	23.46	30.89	38.69	41.84	30.56
		NOx	mg/Nm^3	10.55	20.81	22.83	11.10	42.93	15.98
		CO	ppm	341.53	619.00	1971.31	782.19	1093.17	1568.03
37	GCP Flare (Blast Furnace II) -Emergency stack	NA	NA	_	_	_	_	_	_
		NA	NA	_	_	_	_	_	_
38	Stock House Dedusting & RMHS (Blast Furnace II)	SPM	mg/Nm^3	7.94	23.37	23.01	24.34	22.00	23.03
		SO_2	mg/Nm^3	2.79	4.58	4.27	3.85	5.41	6.38
39	Cast House Dedusting System (Blast Furnace II)	SPM	mg/Nm^3	1.65	14.28	17.54	20.71	18.48	8.68
		SO_2	mg/Nm^3	3.29	6.23	5.60	3.48	4.49	3.64
40	Pulverized Coal Injection (Blast Furnace)	SPM	mg/Nm^3	24.22	37.44	21.93	45.37	39.50	16.79
		SO_2	mg/Nm^3	9.36	14.13	11.89	9.04	11.71	10.67
41	Steam Exhaust System - CCM-III	SPM	mg/Nm^3	CEMS NOT APPLICABLE					
		NA	NA						
42	CPPII-AFBC Boiler	SPM	mg/Nm^3	13.36	12.85	28.89	25.85	37.63	24.51
		SO_2	mg/Nm^3	135.05	199.44	338.19	288.92	409.63	362.68
		NOx	mg/Nm^3	171.18	297.21	319.59	280.95	338.39	242.86

II. Continuous Ambient Air Quality Monitoring Results (APR '23 to Sep'23)

Month	CAAQMS#1					CAAQMS#2		
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	CO	PM_{10}	$PM_{2.5}$	SO_2
UoM	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	mg/m^3	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
Apr-23	40	31	20	18	0.5	30	29	24
May-23	34	27	17	18	0.6	41.0	22	29
Jun-23	40	29	20	17	0.6	33	21	21
Jul-23	23	15	16	16	0.8	27	13	24
Aug-23	26	22	16	16	1	24	13	23
Sep-23	22	16	13	11	1	21	13	23

Month	CAAQMS#3			CAAQMS#4		
	PM_{10}	$PM_{2.5}$	SO_2	PM_{10}	$PM_{2.5}$	SO_2
UoM	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
Apr-23	60	31	30	39	23	17
May-23	43	26	25	31	20	18
Jun-23	46	17	34	27	18	32
Jul-23	36	14	35	36	11	33
Aug-23	49	18	36	33	16	36
Sep-23	33	13	34	24	14	34

Tolerance limit: PM10: 100 $\mu g/m^3$, PM2.5: 60 $\mu g/m^3$, NOx: 80 $\mu g/m^3$, SO_2: 80 $\mu g/m^3$, CO: 1 hr avg - 4 mg/m^3 , 8 hr avg - 2 mg/m^3

The results are well within the prescribed standards.

III. Ambient Air Quality Monitoring results of NABL Accredited laboratory

Month	AQ-1 (Unit - µg/m3)				AQ-2 (Unit - µg/m3)			
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2
Apr-23	67.94	27.30	11.06	22.85	65.12	25.94	10.94	23.74
May-23	66.69	26.17	11.51	24.61	64.64	24.11	10.31	23.47
Jun-23	62.57	24.26	10.66	22.94	60.11	22.12	9.48	21.43
Jul-23	58.00	22.49	9.88	21.27	55.72	20.50	8.79	19.87
Aug-23	61.07	23.68	10.41	22.40	58.68	21.59	9.25	20.92
Sep-23	55.57	22.26	9.57	20.83	53.40	20.30	8.51	19.46

Month	AQ-3 (Unit - µg/m3)				AQ-4 (Unit - µg/m3)			
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2
Apr-23	62.30	22.52	9.76	22.97	61.45	22.14	9.24	22.87
May-23	61.55	22.06	90.90	23.77	59.89	23.10	9.71	22.98
Jun-23	57.20	20.30	9.10	21.90	55.60	21.40	8.90	21.20
Jul-23	53.00	18.80	8.50	20.30	55.60	21.40	8.90	21.20
Aug-23	55.90	19.80	8.90	21.40	58.60	22.50	9.40	22.30
Sep-23	50.80	18.60	8.20	19.90	53.30	21.20	8.70	20.80

Month	AQ-5 (Unit - µg/m3)				AQ-6 (Unit - µg/m3)			
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2
Apr-23	64.03	23.89	10.11	23.90	63.47	25.83	9.67	25.83
May-23	64.37	24.12	10.05	23.41	63.02	25.18	9.71	25.77
Jun-23	59.60	22.30	9.50	21.70	58.60	23.60	9.10	24.20
Jul-23	55.30	20.70	8.80	20.10	54.30	21.90	8.40	22.40
Aug-23	58.20	21.80	9.20	21.10	57.20	23.00	8.80	23.60
Sep-23	53.00	20.50	8.50	19.70	52.10	21.60	8.10	22.00

Month	AQ-7 (Unit - µg/m3)				AQ-8 (Unit - µg/m3)			
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2
Apr-23	59.23	25.65	8.89	22.99	64.92	25.55	12.33	23.91
May-23	58.34	25.36	9.61	23.70	64.45	25.24	12.36	24.34
Jun-23	53.86	23.73	8.89	22.11	59.78	23.60	11.56	22.56
Jul-23	49.93	22.00	8.24	20.50	55.42	21.88	10.72	20.92
Aug-23	52.58	23.16	8.68	21.59	58.36	23.04	11.28	22.02
Sep-23	47.85	21.77	7.98	20.08	53.10	21.66	10.38	20.48

Month	AQ-9 (Unit - µg/m3)				AQ-10 (Unit - µg/m3)			
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2
Apr-23	63.54	26.67	11.51	25.04	66.1	27.68	12.71	26.21
May-23	63.95	24.85	11.10	24.82	65.59	27.37	12.76	25.71
Jun-23	59.20	23.20	10.40	23.00	60.90	25.30	12.00	23.50
Jul-23	54.90	21.50	9.60	21.30	56.40	23.50	11.10	21.80
Aug-23	57.80	22.70	10.10	22.40	59.40	24.70	11.70	23.00
Sep-23	52.60	21.30	9.30	20.80	54.10	23.30	10.80	21.40

Month	AQ-11 (Unit - µg/m3)				AQ-12 (Unit - µg/m3)			
	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2
Apr-23	64	25.38	9.22	24.59	64.25	24.21	10.31	25.44
May-23	64.42	24.69	9.74	24.97	63.60	24.38	10.11	24.35
Jun-23	59.50	22.60	8.70	23.30	59.30	22.70	9.20	22.90
Jul-23	55.20	21.00	8.10	21.60	55.00	21.10	8.50	21.20
Aug-23	58.10	22.10	8.50	22.70	57.90	22.20	9.00	22.40
Sep-23	52.90	20.80	7.80	21.10	52.70	20.80	8.20	20.80

Tolerance limit: PM10: 100 µg/m^3, PM2.5: 60 µg/m^3, NO_2: 80 µg/m3, SO_2: 80 µg/m^3

AAQ1: Mr.Murugesan - Pottaneri, AAQ2:Mr. Gopal - Malamannor, AAQ3:Mr.Surendran -Kavundanoor, AAQ4:Mr.Manivasagam - Soliyur, AAQ5:New Guest House - Township, AAQ6: Mr.Sellappan – Pudur

IV. Analysis of Ambient Air Quality Monitoring results

PM_{10} in µg/m^3

Location	AQ-1	AQ-2	AQ-3	AQ-4	AQ-5	AQ-6	AQ-7	AQ-8	AQ-9	AQ-10	AQ-11	AQ-12
Minimum	55.57	53.40	50.80	53.30	53.00	52.10	47.85	53.10	52.60	54.10	52.90	52.70
Maximum	67.94	65.12	62.30	61.45	64.37	63.47	59.23	64.92	63.95	66.10	64.42	64.25
Average	61.97	59.61	56.79	57.41	59.08	58.12	53.63	59.34	58.67	60.42	59.02	58.79
Standard deviation	4.81	4.70	4.57	3.08	4.58	4.57	4.51	4.75	4.55	4.82	4.63	4.59
98th Percentile	67.82	65.07	62.23	61.29	64.34	63.43	59.14	64.87	63.91	66.05	64.38	64.19

$PM_{2.5}$ in µg/m^3

Location	AQ1	AQ-2	AQ-3	AQ-4	AQ-5	AQ-6	AQ-7	AQ-8	AQ-9	AQ-10	AQ-11	AQ-12
Minimum	22.26	20.30	18.60	21.20	20.50	21.60	21.77	21.66	21.30	23.30	20.80	20.80
Maximum	27.30	25.94	22.52	23.10	24.12	25.83	25.65	25.55	26.67	27.68	25.38	24.38
Average	24.36	22.43	20.35	21.96	22.22	23.52	23.61	23.50	23.37	25.31	22.76	22.57
Standard deviation	2.01	2.20	1.64	0.75	1.54	1.71	1.64	1.64	2.07	1.87	1.90	1.51
98th Percentile	27.19	25.76	22.47	23.04	24.10	25.77	25.62	25.52	26.49	27.65	25.31	24.36

SO_2 in µg/m^3

Location	AQ-1	AQ-2	AQ-3	AQ-4	AQ-5	AQ-6	AQ-7	AQ-8	AQ-9	AQ-10	AQ-11	AQ-12
Minimum	9.57	8.51	8.20	8.70	8.50	8.10	7.98	10.38	9.30	10.80	7.80	8.20
Maximum	11.51	10.94	90.90	9.71	10.11	9.71	9.61	12.36	11.51	12.76	9.74	10.31
Average	10.52	9.55	22.56	9.14	9.36	8.96	8.72	11.44	10.34	11.85	8.68	9.22
Standard deviation	0.72	0.92	33.48	0.38	0.65	0.66	0.57	0.81	0.85	0.81	0.72	0.85
98th Percentile	11.47	10.88	82.79	9.68	10.10	9.71	9.54	12.36	11.47	12.76	9.69	10.29

NO_2 in µg/m^3

Location	AQ-1	AQ-2	AQ-3	AQ-4	AQ-5	AQ-6	AQ-7	AQ-8	AQ-9	AQ-10	AQ-11	AQ-12
Minimum	20.83	19.46	19.90	20.80	19.70	22.00	20.08	20.48	20.80	21.40	21.10	20.80
Maximum	24.61	23.74	23.77	22.98	23.90	25.83	23.70	24.34	25.04	26.21	24.97	25.44
Average	22.48	21.48	21.71	21.89	21.65	23.97	21.83	22.37	22.89	23.60	23.04	22.85
Standard deviation	1.35	1.79	1.50	0.94	1.71	1.63	1.40	1.55	1.76	1.99	1.56	1.79
98th Percentile	24.44	23.71	23.69	22.97	23.85	25.82	23.63	24.30	25.02	26.16	24.93	25.33

Tolerance limit: PM10: 100 µg/m^3, PM2.5: 60 µg/m^3, NO_2: 80 µg/m3, SO_2: 80 µg/m^3

AAQ1: Mr.Murugesan - Pottaneri, AAQ2:Mr. Gopal - Malamannor, AAQ3:Mr.Surendran -Kavundanoor, AAQ4:Mr.Manivasagam - Soliyur, AAQ5:New Guest House - Township, AAQ6: Mr.Sellappan – Pudur panakadu, AAQ7:Mr.Gandhi – Kuttapatti Pudur, AAQ8:Mr.Santhanam - Ervadi, AAQ9:Mr. Arunasalam - Ervadi, AAQ10:Mr.Thangavel – Amarathan Kadu, AAQ11:Mr. Mahalingam – Kattuvalavu, Pottaneri, AAQ12:Mr. Venkatesan – Pottaneri.

The results are within the norms prescribed by CPCB.

ANNEXURE 4

COMPLIANCE STATUS REPORT TO THE CREP CONDITIONS

Annexure 4

Compliance status report for the conditions prescribed in the Corporate Responsibility for Environmental Protection (CREP) to our plant

S.No	Condition	Compliance status/Action taken
1	**Coke Oven Plant:** To meet the parameters PLD (% leaking doors), PLL (% leaking lids), PLO (% leaking off take) of the notified standards under EPA. To rebuild at least 40% of the coke oven batteries* in next 10 years by December 2012.	Our COP Non-recovery type coke oven and this requirement is not applicable.
2	**Steel Melting Shop** **Fugitive Emission Status** To reduce 30% by March 2004 and 100% by March 2008 (including installation of secondary de-dusting facilities).	SMS comprises of an Energy Optimizing Furnace wherein a "wet scrubbing system" comprising of a Down comer, quench chamber, venturi scrubber and cyclone separator and the cleaned gas sent through a chimney. The secondary steel making unit viz. Ladle Furnace is already equipped with a dry scrubbing system comprising of bag filters, belt conveyors and dust silo. The dust is being collected and reused in the Sinter Plant. Dedicated secondary dedusting systems are installed in EOF & LRF and fugitive emissions are significantly reduced. Dedicated dust monitoirng systems are installed in the respective stacks and the real time parameters are connected with CAA,TNPCB
3	**Blast Furnace** - Direct inject of reducing agents in blast furnace.	Pulverized Coal injection system installed and commissioned along with bag filter as an air pollution control measures (bag filter with stack) to reduce emission during direct injection. The rate of pulverised coal injection is increased (to till 150 - 160 kg/THM) and the implementation resulted in reduction of coke consumption in BF which leads to energy saving.
4	**Solid Waste/Hazardous Waste Management** Utilization of Steel Melting Shop (SMS) / Blast Furnace (BF) slag as per the following. • By 2004 – 70% • By 2006 – 80% and • By 2007 – 100% **Hazardous Waste:** - Charge of tar sludge/ETP sludge to coke oven by June 2003. - Inventorization of Hazardous waste as per Hazardous waste (M & H) Rules, 1989 as amended in 2000 and implementation of the rules by December 2003. (Tar sludge, acid sludge, waste lubricating oil and type fuel fall in the category of HZ).	All the Blast Furnace Slag is converted to Granulated slag and sold to cement industries. Flue dust from sinter plant, BF, SMS, sludge from BF & EOF and coke breeze from coke oven plant is re-used in sinter plant. Pellet plant is not installed in our operation. SMS slag is sent for metal recovery system and after crushing reused internal applications & sent cement industries. A ready mix concrete unit is installed. A unique initiative, Paver block unit by using crushed EOF slag. Refractories are selected to withstand high temperature whose shelf life is longer and generation of used refractories are lesser. The same will be recycled in downstream applications and also sold to customers involved with recycling and the disposal is in environment friendly manner. Our coke oven plant is non-recovery type and hence Tar sludge & ETP sludge is not applicable. The waste oil and other hazardous wastes generated is being disposed to authorized vendors as per the Hazardous and
5	**Water Conservation / Water Pollution** - To reduce specific water consumption to 5 m3/ t for long products and 8 m^3/ t for flat products by December 2005.	We are presently manufacturing only long products and our specific water consumption is well within the prescribed limit
6	Installation of continuous stack monitoring	There are 29 nos. of Process stacks. Dust & Gaseous emission monitoring systems are installed as per CTO condition and the real time data of SPM, SO2 & NOx are transmitted to the Care Air Centre of TNPCB and CPCB servers. There are 26 nos. of Non-process stacks. Dust emission monitoring systems are installed as per CTO condition and the real time data of SPM are transmitted to the Care Air Centre of TNPCB and CPCB servers. Apart from the above, TNPCB is conducting bi-annual survey and Manual monitoring is being conducted by a NABL accredited external laboratory on monthly basis. The monitoring results are well within the permissible limits.

S.No	Condition	Compliance status/Action taken
7	The unit shall operate the existing pollution control equipment efficiently and to keep proper record of run hours, failure time and efficiency with immediate effect. Compliance report in this regard be submitted to TNPCB every three months.	The pollution control equipments are being operated efficiently and proper records are maintained for running hours, failure time and efficiency. Any failure leads to APC is resulted exceedance alarm from TNPCB server and justification along with corrective action reports are being submitted to TNPCB on monthly basis.
8	To implement the recommendations of Life Cycle Assessment (LCA) Study sponsored by MoEF by December 2003.	Being Complied.
9	The industry will initiate the steps to adopt the following clean technologies/measures to improve the performance of industry towards production, energy and environment.	
	✔ Energy recovery of top blast furnace (BF) gas.	Our BF gas pressure (plant capacity is 0.683 MTPA only) is not adequate to install TRT.
	✔ Use of tar-free runner linings.	Our coke oven plant is non-recovery type and hence not applicable.
	✔ De-dusting of cast house at tap holes, runners, skimmers ladle and charging points.	The de-dusting system commissioned at BF-I & II cast house covering tap holes, runners, skimmers ladles and charging points.
	✔ Suppression of fugitive emissions using nitrogen gas or other inert gas.	Water sprinkling system, Dry & Wet fog systems and the compressed air are used for suppression of fugitive emissions.
	✔ To study the possibility of slag and fly ash transportation back to the abandoned mines, to fill up the cavities through empty railway wagons while they return back to the mines and its implementation.	Since we are purchasing raw materials from outside sources, it is not applicable.
	✔ Processing of the waste containing flux & ferrous wastes through waste recycling plant.	The waste containing flux & ferrous waste is utilized to the maximum extent possible in the sinter plant. 100 % of waste containing flux and ferrous is utilized in the plant.
	✔ To implement rainwater harvesting.	Four rain water harvesting ponds are provided. Two are in the plant premises and two are in township.
	✔ Reduction of green house gases by,	Various initiatives and measures are being taken to reduce the GHG emissions and present level of GHG emission is 2.68 MT of CO2/TCS. Major focus are being given to maximise the waste heat utilisation, Renewable energy and resource conservation.
	• Reduction in power consumption.	To reduce the power consumption VFDs are being installed whereever possible. LED lights are installed to replace the sodium vapor lamps and many Kaizens are implemented to conserve power.
	• Use of by-products gases for power generation.	By product BF gas is being used as fuel in Power Plant for power generation.
	• Promotion of energy optimization technology including energy audit.	All the upcoming projects are wetted to the best energy consumption through selection of equipments. Energy audit is being carried out and implementations are done in phased manner to minimize the energy consumption of GCal.
	• To set targets for resource conservation such as raw material, energy and water consumption to match International Standards.	Raw material, Energy and water consumption targets are being fixed as a key performance indicator with reference to WSA guidelines and actions are being implemented to match the international standards through Best Available Technology.
	• Up-gradation in the monitoring and analysis facilities for air and water pollutants. Also to impact elaborate training to the manpower so that realistic data is obtained in the environmental monitoring laboratories.	A separate Environment cell is already available and full-fledged lab set up and need based training is being imparted to the monitoring personnels as and when required. Presently the monitoring and analysis being done through M/s G Lens Innovation Labs Pvt Ltd.
	• To improve over all house keeping.	5S system is being followed to maintain and improve housekeeping throughout the plant. Due to the implementation, saving in area, inventory control, retrieval time period and standardization practices are well improved.

ANNEXURE 5

ONLINE EFFLUENT MONITORING REPORT AND GROUND WATER QUALITY MANUAL MONITORING REPORT OF TNPCB & NABL ACCREDITED LABORATORY

Annexure 5

Online effluent monitoring report and effluent & ground water quality manual monitoring report of NABL accredited laboratory

I.Online effluent monitoring report

S.No	Description	UoM	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
1	Effluent Inlet flow	m^3	78079	86928	87249	80519	89956	77745
2	Treated effluent water reuse in process	m^3	76584	84462	86426	74891	91316	74289
3	ETP outlet discharge flow	m^3	0	0	0	0	0	0

Note; Consented Trade efflunet generation 2935 KLD

II.Treated trade effluent of Steel by NABL Accredited laboratory

S.No	Parameter	Unit	TNPCB Tolerance Limit	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
1	**$_{P}H$ @ 25^{o}C**	--	5.5 to 9.0	7.24	7.39	7.48	7.81	7.98	7.06
2	Total Suspended solids	Hazen	100	10	11	12	6	8	6
3	Total Dissolved solids (Inorganic)	--	2100	1969	1782	1666	1486	1516	1322
4	Sulphate as SO_4	--	1000	186.25	162.48	185.11	214.68	226	134
5	Chloride as Cl	^{o}C	1000	580.67	545.93	503	328	319	321
6	Oil & Grease	mg/l	10	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]
7	Ammonical Nitrogen as N	mg/l	50	0.87	1.07	1	1	0.91	0.47
8	COD	mg/l	250	32.38	33.63	32.35	31.2	34.25	12.47
9	BOD @ 27^{o}**C for 3 Days**	mg/l	30	7.02	8.19	8.03	8.06	7.57	3.06
10	Phenolic compounds as C_6H_5OH	mg/l	1	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
11	Cyanide as CN	mg/l	0.2	BLQ[LOQ-0.001]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]

III. Treated trade effluent of CPPII-Cooling tower water by NABL accredited laboratory

S.No	Parameter	Unit	TNPCB Tolerance Limit	Apr-23		May-23		Jun-23		Jul-23		Aug-23		Sep-23	
				TRADE EFLUENT Unit I &II 2 x 30 MW	TRADE EFLUENT Unit III 1 x 30 MW	TRADE EFLUENT Unit I &II 2 x 30 MW	TRADE EFLUENT Unit III 1 x 30 MW	TRADE EFLUENT Unit I &II 2 x 30 MW	TRADE EFLUENT Unit III 1 x 30 MW	TRADE EFLUENT Unit I &II 2 x 30 MW	TRADE EFLUENT Unit III 1 x 30 MW	TRADE EFLUENT Unit I &II 2 x 30 MW	TRADE EFLUENT Unit III 1 x 30 MW	TRADE EFLUENT Unit I &II 2 x 30 MW	TRADE EFLUENT Unit III 1 x 30 MW
1	Temperature	^oC	Shall not exceed 5 °C above the receiving water	27	27	27	27	27	27	27	27	27	27	27	27
2	$_pH$ @ 25^oC	--	5.5 - 9.0	7.54	7.16	6.92	6.84	6.97	6.78	6.69	6.85	6.92	6.56	6.63	7.34
3	Particle size of suspended solids	--	pass 850 u I.S Sieve	Test pass	Test Pass	Test Pass	Test Pass	Test Pass	Test Pass	Test Pass	Test Pass	Test Pass	Test Pass	Test Pass	Test Pass
4	Total Suspended solids	mg/l	100	8	6	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	6	BLQ[LOQ-5.0]	7	BLQ[LOQ-5.0]	6	8	8
5	Total Dissolved solids (Inorganic)	mg/l	2100	1904	1692	1854	1719	1892	1785	1540	1845	1480	1796	1498	1382
6	Free Residual chlorine	mg/l	1	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
7	Sulphate as SO_4	mg/l	1000	213.65	107.14	157.27	113.52	169.27	198.36	105.2	186.3	101.4	178.2	290	162
8	Sulphide as S	mg/l	2.0 (DL : 0.5)	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]
9	Chloride as Cl	mg/l	1000	441.71	344.89	471.49	352.37	559.93	550.36	363.04	380	354	369	203	236
10	Fluoride as F	mg/l	2.0 (DL : 0.1)	0.4	0.42	0.46	0.42	0.43	0.58	0.46	0.59	0.52	0.63	0.43	0.38
11	COD	mg/l	250	32.38	28.31	33.63	33.63	28.31	24.26	36.43	25.36	33.59	27.95	37.4	23.25
12	BOD @ 27^oC for 3 Days	mg/l	30	7.08	9.1	8.19	7.16	7.02	7.02	8.06	7.62	8.85	8.12	8.16	8.16
13	Oil & Grease	mg/l	10	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]
14	Ammonical Nitrogen as N	mg/l	50	0.63	0.62	0.61	0.59	0.73	0.38	0.55	0.41	0.51	0.48	0.62	0.68
15	Free ammonia as NH_3	mg/l	5.0	0.95	0.95	0.74	0.72	0.89	0.46	0.67	0.47	0.58	0.52	0.76	0.6
16	Total kjeldahl Nitrogen as N	mg/l	100	7.5	7.6	6.19	7.32	6.04	5.21	8.12	5.23	7.84	6.01	8.04	7.82
17	Phosphate as PO4	mg/l	5	0.45	1.91	0.37	0.28	0.31	0.26	0.44	0.32	0.49	0.39	0.86	0.24
18	Phenolic compounds as C_6H_5OH	mg/l	1.0 (DL : 0.01)	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
19	Cyanide as CN	mg/l	0.2 (DL : 0.01)	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]
20	Residual Sodium Carbonate	mg/l	--	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]
21	Percent Sodium	%	--	34.48	36.99	36.32	35.51	37.54	35.39	32.28	36.56	35.24	32.72	36.09	34.62
22	Copper as Cu	mg/l	3.0 (DL : 0.01)	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
23	Nickel as Ni	mg/l	3.0 (DL : 0.01)	0.23	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
24	Total Chromium as Cr	mg/l	2.0 (DL : 0.03)	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
25	Zinc as Zn	mg/l	1.0 (DL : 0.005)	0.41	0.51	0.29	0.48	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
26	Arsenic as As	mg/l	0.2 (DL : 0.005)	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
27	Lead as Pb	mg/l	0.1 (DL : 0.01)	0.5	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
28	Cadmium as Cd	mg/l	2.0 (DL : 0.001)	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
29	Selenium as Se	mg/L	0.05	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
30	Boron as B	mg/l	2.0 (DL : 0.1)	0.32	0.41	0.39	0.36	0.37	0.38	0.29	0.36	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
31	Mercury as Hg	mg/l	0.01	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
31	Hexavalent Chromium (Cr^{6+})	mg/l	0.1 (DL : 0.03)	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
33	Pesticides	mg/l	--	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]	BLQ[LOQ-0.00001]

III. Treated trade effluent of Steel Guard bond water by NABL accredited laboratory

S.No	Parameter	Unit	TNPCB Tolerance Limit	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
1	$_{P}H$ @ 25^{o}C	--	5.5 to 9.0	7.24	7.39	7.48	7.81	7.98	7.06
2	Total Suspended solids	Hazen	100	10	11	12	6	8	6
3	Total Dissolved solids (Inorganic)	--	2100	1969	1782	1666	1486	1516	1322
4	Sulphate as SO_4	--	1000	186.25	162.48	185.11	214.68	226	134
5	Chloride as Cl	^{o}C	1000	580.67	545.93	503	328	319	321
6	Oil & Grease	mg/l	10	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]	BLQ[LOQ-2.0]
7	Ammonical Nitrogen as N	mg/l	50	0.87	1.07	1	1	0.91	0.47
8	COD	mg/l	250	32.38	33.63	32.35	31.2	34.25	12.47
9	BOD @ 27^{o}C for 3 Days	mg/l	30	7.02	8.19	8.03	8.06	7.57	3.06
10	Phenolic compounds as C_6H_5OH	mg/l	1	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
11	Cyanide as CN	mg/l	0.2	BLQ[LOQ-0.001]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]

IV. Result of analysis of steel treated trade effluent by TNPCB									
S.No	**Parameter**	**Unit**	**TNPCB Tolerance Limit**	**Apr-23**	**May-23**	**Jun-23**	**Jul-23**	**Aug-23**	**Sep-23**
1	pH @ 25^{o}C	Number	5.5-9.0	7.21	8.38	8.14	7.73	7.41	7.62
2	TSS at 103°C - 105°C	mg/l	shall not exceed 5ºC above the receiving water temperature	4	4	4	4	16	8
3	Total Dissolved Solids at 180°C	mg/l	2100	1232	960	1296	1448	1076	1134
4	Chloride as Cl	mg/l	1000	310	390	520	440	475	468
5	Sulphates as SO4	mg/l	1000	89	100	69	95	16	24
6	Oil & Grease	mg/l	10	5	<3	<3	-	<3	
7	BOD (at 27°C for 3 days)	mg/l	30	<2	<2	<2	3.2	3	3
8	COD	mg/l	250	96	56	80	112	176	142
9	Phenolic compounds	mg/l	1	**…**	…	<0.01	<0.01	<0.01	
10	Ammonical Nitrogen as NH_3-N	mg/l	50	1.12	1.12	1.68	0.56	1.12	
11	Cyanide	mg/l	0.2	**…**	…	<0.008	<0.008	<0.008	
12	SAR	mg/l		3.9	6.52	5	5.18	-	_
IV. Result of analysis of CPPII- treated trade effluent by TNPCB									
S.No	**Parameter**	**Unit**	**TNPCB Tolerance Limit**	**Apr-23**	**May-23**	**Jun-23**	**Jul-23**	**Aug-23**	**Sep-23**
1	pH @ 25^{o}C	Number	5.5-9.0	7.45	8.74	7.43	7.25	**7.95**	
2	TSS at 103°C - 105°C	mg/l	shall not exceed 5ºC above the receiving water temperature	8.00	8	4.00	4.00	**8.00**	
3	Total Dissolved Solids at 180°C	mg/l	2100	1552.00	1196	1424.00	1548.00	**1448.00**	
4	Chloride as Cl	mg/l	1000	620.00	360	440.00	400.00	**310.00**	
5	Sulphates as SO4	mg/l	1000	219.00	276	130.00	110.00	**20.00**	
6	Oil & Grease	mg/l	10	5.00	<3	<3	-	<3	
7	BOD (at 27°C for 3 days)	mg/l	30	2.40	2.1	2.40	3.00	**3.00**	
8	COD	mg/l	250	72.00	48	88.00	104.00	**168.00**	
9	Phenolic compounds	mg/l	1	-	-	<0.01	<0.01	<0.01	
10	Ammonical Nitrogen as NH_3-N	mg/l	50	1.68	1.68	1.12	1.12	**0.56**	
11	Cyanide	mg/l	0.2	…	…	<0.008	<0.008	<0.008	
12	SAR	mg/l		2.90	4.7	4.00	4.18	-	

V.Result of analysis of ground water by NABL accredited laboratory

S.No	Parameter	Unit	Apr-23				May-23				Jun-23			
			GOVT BOREWELL KARAPPATTI	Mr. GOVINDARAJ KUTTAPATTI PUDUR	Mr. VELLEIYAN HOUSE OPENWELL MOURTHIPATTI	GOVT BOREWELL KAVUNDANUR	GOVT BOREWELL PARI NAGAR	GOVT BOREWELL MOOTHIPATTI	OPEN WELL MR.VENKATESAN POTTANERI	OPEN WELL TMT KALIYAMMAL TEACHER OPEN WELL POTTANERI	MOORTHIPATTI GOVT BOREWELL WATER	ERVADI GOVT BOREWELL WATER	POTTANERI OPEN WELL WATER	KAVADANUR GOVT BOREWELL WATER
1	Colour	Hazen	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	-	Disagreeable	Disagreeable	Disagreeable	Disagreeable	Disagreeable	Disagreeable	Disagreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	pH@25°C	-	7.38	7.51	7.58	7.57	7.45	7.45	7.63	7.69	8.74	7.89	7.96	8.74
5	ElectricalConductivity	mS/cm	3.68	3.65	3.72	3.78	3.74	3.76	3.56	3.88	2.17	3.28	2.53	2.28
6	Turbidity	NTU	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]
7	Total Suspened Solids	mg/L	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]
8	Total Dissolved Solids	mg/L	2528	2559	2617	2656	2632	2595	2784	2622	1519	2457	1723	1596
9	Free Residual Chlorine	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
10	Total Hardness as CaCO3	mg/L	1112.86	1045.12	1074.15	1093.3	1136.95	1056.92	1023.2	1014.3	776.1	1293.5	885.55	746.25
11	Calcium as Ca	mg/L	252.5	228.46	244.49	240.48	265.89	232.58	236.21	213.48	212.42	272.54	192.38	196.39
12	Magnesium as Mg	mg/L	105.44	104.71	101.27	108.61	109.44	109.17	100.63	112.61	176.17	150.76	99.72	63.39
13	Alkalinity	mg/L	602.55	587.1	592.25	612.85	612.33	581.31	559.2	601.85	705.6	499.8	431.2	661.5
14	Chloride as Cl	mg/L	625.34	640.23	630.3	645.19	636.34	642.11	636.18	656.69	488.15	746.58	521.65	502.5
15	Fluoride as F	mg/L	0.78	1.76	0.76	0.82	0.78	1.89	0.7	0.72	0.28	0.52	0.34	0.52
16	Sulphate as SO4	mg/L	238.22	221.42	208.21	229.34	245.22	246.8	209.63	236.34	168.77	253.14	179.25	177.33
17	HydrogensulfideasH2S	mg/L	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
18	TotalAmmonia	mg/L	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]
19	NitrateasNO3	mg/L	3.21	3.12	3.09	3.24	3.33	3.19	3.01	3.56	1.38	2.52	1.98	1.35
20	PhenolicCompoundsasC6H5OH	mg/L	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
21	CyanideasCN	mg/L	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.1]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
22	Iron as Fe	mg/L	0.18	0.18	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	0.21	0.22	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
23	Copper as Cu	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
24	ZincasZn	mg/L	0.16	0.17	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	0.19	0.19	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
25	ArsenicasAs	mg/L	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
26	CadmiumasCd	mg/L	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
27	ChromiumasCr	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
28	AluminumasAl	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
29	SeleniumasSe	mg/L	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
30	LeadasPb	mg/L	0.89	0.43	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	0.92	0.46	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]
31	ManganeseasMn	mg/L	0.1	0.08	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	0.12	0.07	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
32	NickelasNi	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
33	MercuryasHg	mg/L	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]
34	BoronasB	mg/L	0.64	0.68	0.66	0.73	0.56	0.7	0.7	0.77	0.36	0.46	0.29	0.32
35	MineralOil	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.001]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
36	Escherichiacoli	MPN/100ml	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

S.No	Parameter	Unit	Jul-23				Aug-23				Sep-23			
			GOVT BOREWELL KUTTAPPATTI PUDUR	ERVADI GOVT BOREWELL WATER	BALAN HOUSE-OPEN WELL WATER- PUDUR PANAKADU	RAJAMANI HOUSE OPEN WELL WATER-KUTTAPPATTI PUDUR	Open Well Mr.Venkatesan Pottaneri	Bore Well Mr.Kaliammal Teacher House Pottaneri	Mr. Selvam Bore well Karapaatti Pallam	Open Well Mr. Vellaiyan Moorthipatti	Govt Bore well Water – Ervadi village	Govt Bore well Water Parry Nagar	Mr. Vellaiyan Open Well Water Moorthipaati	Govt Bore well Water Kavundanoor
1	Colour	Hazen	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]	BLQ[LOQ-1.0]
2	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	pH@25°C	-	7.12	7.53	7.56	8.95	7.52	7.76	7.14	7.99	7.73	7.18	8.29	7.68
5	ElectricalConductivity	mS/cm	3.1	3.31	2.67	2.32	3.314	3.512	2.834	2.633	2580	2290	2010	2690
6	Turbidity	NTU	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]	BLQ[LOQ-0.5]
7	Total Suspened Solids	mg/L	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]	BLQ[LOQ-5.0]
8	Total Dissolved Solids	mg/L	2648.3	2632	1832.1	1623.14	1896.4	1987	1032	1468.9	1965	1603	1407	1983
9	Free Residual Chlorine	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
10	Total Hardness as CaCO3	mg/L	1245.68	1314.6	894.35	750.63	893.4	1172.4	946.08	1167.3	930.8	789.2	617.2	875.2
11	Calcium as Ca	mg/L	223.62	286.34	182.42	185.42	229.44	281.23	204.83	235.7	212.2	188.3	120.24	188.4
12	Magnesium as Mg	mg/L	186.94	146.26	94.43	66.34	189.2	162.48	87.69	69.71	96.5	76.75	76.6	97.7
13	Alkalinity	mg/L	492	478.8	446.3	674.6	354	436.4	414.72	513.7	466.4	486.8	271.6	476.4
14	Chloride as Cl	mg/L	488.15	712.38	534.62	510.52	474.25	684.2	511.24	585.73	615.6	531.4	362.3	625.34
15	Fluoride as F	mg/L	0.28	0.49	0.39	0.59	0.36	0.49	0.39	0.62	0.34	0.42	0.27	0.36
16	Sulphate as SO4	mg/L	168.77	234.14	180.36	179.36	186	233.05	173.5	196.4	197.3	124.5	278.5	209.27
17	HydrogensulfideasH2S	mg/L	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
18	TotalAmmonia	mg/L	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]	BLQ[LOQ-0.25]
19	NitrateasNO3	mg/L	1.38	2.37	1.85	1.47	1.67	2.11	1.46	1.76	2.52	2.28	1.39	2.46
20	PhenolicCompoundsasC6H5OH	mg/L	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
21	CyanideasCN	mg/L	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
22	Iron as Fe	mg/L	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
23	Copper as Cu	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
24	ZincasZn	mg/L	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)	BLQ[LOQ-0.01)
25	ArsenicasAs	mg/L	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
26	CadmiumasCd	mg/L	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
27	ChromiumasCr	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
28	AluminumasAl	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
29	SeleniumasSe	mg/L	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]	BLQ[LOQ-0.001]
30	LeadasPb	mg/L	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]	BLQ[LOQ-0.005]
31	ManganeseasMn	mg/L	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
32	NickelasNi	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
33	MercuryasHg	mg/L	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]	BLQ[LOQ-0.0005]
34	BoronasB	mg/L	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]	BLQ[LOQ-0.05]
35	MineralOil	mg/L	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]	BLQ[LOQ-0.01]
36	Escherichiacoli	MPN/100ml	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

VI. Result of analysis of ground water by TNPCB

S.No	Parameter	Unit	OPEN WELL - Tmt.Kaliammal teacher , Pottaneri	GOVT. Bore well , Kavundanoor	Selvam Bore Well Karapattipallam	BORE WELL Thiru Velliyan , Moorthipatti	GOVT BORE WELL - Moorthipatti	OPEN WELL - Thiru .Venkatesan, Pottaneri
			Jul-23					
1	Turbidity	NTU	0.12	0.12	0.1	0.14	0.12	0.12
2	Colour	Hazon	<5	<5	<5	<5	<5	<5
3	Conductivity at 25o C	µmhos/cm	1650	4590	4740	3590	4540	3450
4	pH at 25o C	Number	7.82	8.29	8.31	8.14	7.73	7.68
5	TSS at 25o C	mg/L	8	8	4	4	4	4
6	Total Dissolved Solids at 180o C	mg/L	992	2924	2884	2004	2872	2692
7	Chloride as Cl	mg/L	262	950	900	510	900	875
8	Sulphate as SO4	mg/L	29	206	213	162	204	155
9	BOD (at 27o C for 3 days	mg/L	1.8	1.5	1.8	2.1	1.8	1.5
10	COD	mg/L	32	24	32	24	24	24
11	Mangnese	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
12	Ammonical Nitrogen as NH3 -N	mg/L	1.12	1.12	1.12	1.12	1.12	0.56
13	Total Kjeldhal Nitrogen	mg/L	2.8	4.48	4.48	4.48	4.48	2.8
14	Fluoride as F	mg/L	1.36	1.017	0.317	0.778	0.995	0.6
15	Ph Compounds	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
16	% Sodium	%	46.00	57.00	55.90	66.96	49.00	53.00
17	Total Hardness as CaCO3	mg/L	500	970	980	580	1150	980
18	Alkalinity CaCO3	mg/L	284	468	492	580	356	456
19	Phosphate as PO4	mg/L	0.115	0.069	0.139	0.115	0.14	0.14
20	Hexavalent Chromium	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
21	Iron Total as Fe	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
22	SAR	mg/L	3.90	8.50	8.20	9.96	49.00	3.90
23	Total Chromium	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Copper	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
25	Zinc	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
26	Lead	mg/L	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
27	Cadmium	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
28	Cyanide	mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
29	Nickel	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
30	Ph. Alkalinity	mg/L	24.00	24.00	40.00	48.00	12.00	12.00
31	Nitrate Nitrogen as NO3	mg/L	0.043	0.04	0.043	0.065	0.065	0.065
32	Nitrite Nitrogen as NO2	mg/L	0.004	0.00	0.011	0.021	0.008	0.008
33	Calcium as Ca	mg/L	52.00	60.00	68.00	36.00	120.00	60.00
34	Magnesium as Mg	mg/L	90.00	199.00	197.00	119.00	207.00	202.00
35	Sodium as Na	mg/L	200.00	12.00	588.00	551.00	530.00	506.00
36	Potassium as K	mg/L	611.00	31.00	26.00	10.00	42.00	7.00
37	Free Ammonia	mg/L	1.370	1.370	1.370	1.370	1.370	0.680
38	Boron	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
39	Total Residule Chlorine	mg/L	<1	<1	<1	<1	<1	<1
40	Residule Sodium Carbonate	-	Negative	Negative	Negative	Negative	Negative	Negative
41	Dissolved Oxygen	mg/L	6.10	6.00	6.10	6.00	6.20	6.30
42	Feacal Coliform	MPN/100 ml	13.00	13.00	14.00	17.00	17.00	14.00
43	Total Coliform	MPN/100ml	22	27	33	22	22	27
44	Sulphide	mg/L	<1	<1	<1	<1	<1	<1

VI. Result of analysis of ground water by TNPCB

S.No	Parameter	Unit	OPEN WELL - Thiru .Rajamani, Kuttapatti Pudur	GOVT. BORE WELL Kuttapatti Pudur	OPEN WELL - Thiru .Balan, Pudur Panankadu	GOVT BORE WELL, ERVADI	GOVT BORE WELL, PARYNAGAR
			Jul-27				
1	Turbidity	NTU	0.14	0.16	0.19	0.1	0.12
2	Colour	Hazon	<5	<5	<5	<5	<5
3	Conductivity at 25o C	µmhos/cm	3500	3420	3050	2440	2320
4	pH at 25o C	Number	7.54	7.46	7.95	8.25	8.21
5	TSS at 25o C	mg/L	4	4	4	4	4
6	Total Dissolved Solids at 180o C	mg/L	2944	2688	2524	1504	1472
7	Chloride as Cl	mg/L	1000	825	825	310	300
8	Sulphate as SO4	mg/L	158	154	122	98	93
9	BOD (at 27o C for 3 days	mg/L	<2	<2	<2	<2	<2
10	COD	mg/L	16	16	16	24	24
11	Mangnese	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
12	Ammonical Nitrogen as NH3 -N	mg/L	1.12	1.12	1.12	1.12	0.56
13	Total Kjeldhal Nitrogen	mg/L	2.8	3.36	3.36	2.8	2.24
14	Fluoride as F	mg/L	0.517	0.678	0.067	0.300	0.283
15	Ph Compounds	mg/L	<0.001	<0.001	<0.01	<0.01	<0.01
16	% Sodium	%	33.00	25.00	12.00	41.00	42.00
17	Total Hardness as CaCO3	mg/L	1470	1470	1370	780	730
18	Alkalinity CaCO3	mg/L	208	228	188	484	484
19	Phosphate as PO4	mg/L	0.208	0.115	0.115	0.009	0.115
20	Hexavalent Chromium	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
21	Iron Total as Fe	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2
22	SAR	mg/L	3.84	2.62	1.06	4.13	3.90
23	Total Chromium	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
24	Copper	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
25	Zinc	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03
26	Lead	mg/L	<0.3	<0.3	<0.3	<0.3	<0.3
27	Cadmium	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
28	Cyanide	mg/L	<0.008	<0.008	<0.008	<0.008	<0.008
29	Nickel	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
30	Ph. Alkalinity	mg/L	12.00	12.00	12.00	56.00	64.00
31	Nitrate Nitrogen as NO3	mg/L	0.086	0.086	0.054	0.054	0.054
32	Nitrite Nitrogen as NO2	mg/L	0.009	0.009	0.001	0.009	0.011
33	Calcium as Ca	mg/L	208.00	208.00	172.00	44.00	40.00
34	Magnesium as Mg	mg/L	231.00	231.00	228.00	163.00	153.00
35	Sodium as Na	mg/L	338.00	230.00	90.00	265.00	254.00
36	Potassium as K	mg/L	46.00	20.00	51.00	35.00	31.00
37	Free Ammonia	mg/L	1.370	1.370	1.370	1.370	0.680
38	Boron	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
39	Total Residule Chlorine	mg/L	<1	<1	<1	<1	<1
40	Residule Sodium Carbonate	-	Negative	Negative	Negative	Negative	Negative
41	Dissolved Oxygen	mg/L	6.2	6.1	6.3	6.3	6
42	Feacal Coliform	MPN/100ml	11	14	12	14	11
43	Total Coliform	MPN/100ml	26	26	24	27	17
44	Sulphide	mg/L	<1	<1	<1	<1	<1

ANNEXURE 6

TREATED SEWAGE QUALITY MONITORING REPORT OF TNPCB & NABL ACCREDITED LABORATORY

Annexure 6

Treated sewage quality monitoring report of TNPCB & NABL accredited laboratory for the period of Apr'23 to Sep '23

Result of analysis of treated sewage by TNPCB (Plant STP)

S.No	Parameter	Unit	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
1	pH @ 25°C	Number	7.87	7.65	7.91	7.53	7.42	7.46
2	TSS at 103°C - 105°C	mg/l	8	4	4	4	4	8
3	BOD (at 27°C for 3 days)	mg/l	<2	<2	<2	2.7	3	3

Result of analysis of treated sewage by TNPCB (Township STP)

S.No	Parameter	Unit	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
1	pH @ 25°C	Number	7.49	7.66	7.64	8.18	8.7	8.3
2	TSS at 103°C - 105°C	mg/l	8	4	4	4	4	4
3	BOD (at 27°C for 3 days)	mg/l	<2	<2	<2	2.1	2.4	3

Result of analysis of treated sewage by NABL accredited laboratory (Plant STP)

S.No	Parameter	Unit	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
1	PH 25 C	--	STP Revamping	7.79	7.53	7.45	7.42	7.54
2	Total Suspended Solids	mg/l		7	6	8	6	7
3	Total Dissolved Solids	mg/l		683	770	755	782	764
4	Chemical Oxygen Demand	mg/l		37.84	32.35	38.06	37.8	33.25
5	BOD,3days@27°C	mg/l		8.19	8.85	4	3.98	8.16
6	Total Khjeldhal Nitrogen	mg/l		7.32	7.96	7.8	8.2	8.13
7	Ammoniacal Nitrogen (as N)	mg/l		0.83	0.69	0.73	0.72	0.78
8	Faecal Coliform	MPN/100ml		80	90	90	96	70

Result of analysis of treated sewage by NABL accredited laboratory (Township STP)

S.No	Parameter	Unit	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
1	PH @ 25oC	--	7.52	7.53	7.28	7.51	7.43	6.86
2	Total Suspended Solids	mg/l	7	6	4	7	8	9
3	Total Dissolved Solids		576	446	645	546	584	465
4	Chemical Oxygen Demand	mg/l	32.38	21.02	28.31	38.06	36.4	36.14
5	BOD,3days@27°C	mg/l	7.08	4	7.02	5	4.78	8.09
6	Total Khjeldhal Nitrogen	mg/l	6.92	7.55	7.2	6.41	7.3	6.92
7	Ammoniacal Nitrogen (as N)	mg/l	0.79	0.35	0.83	0.79	0.82	0.71
8	Faecal Coliform	MPN/100ml	80	80	80	65	78	90

ANNEXURE 7

AMBIENT NOISE LEVEL MONITORING REPORT OF NABL ACCREDITED LABORATORY

Annexure -7

Ambient Noise level monitoring report of NABL accredited laboratory for the period of Apr'23 to Sep '23

I. Ambient Noise Monitoring results (Apr'23 to Sep '23)

S.No	Location	Day Time Noise Level in dB(A)									
		Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Maximum	Minimum	Average	STD Deviation
1	New Land area JSW Boundary	67.3	67.3	66.1	65.3	66.9	69.5	69.5	65.3	67.1	1.4
2	Open field – Near thangamapuri stores, Malamanoor.	65.8	65.8	64.5	66.9	67.1	66.8	67.1	64.5	66.2	1.0
3	Nearby Mr.Chinnamuthu House, Malamanoor.	64.3	64.3	67.3	69.2	65.8	67.6	69.2	64.3	66.4	2.0
4	Near Madhayen Temple at Coconut Farm.	65.6	65.6	66.8	67.5	66.9	68.2	68.2	65.6	66.8	1.0
5	Eastern Gate of JSW.	67.4	67.4	69.7	68.6	67.8	65.1	69.7	65.1	67.7	1.5
6	Reservoir Premises.	65.9	65.9	66.2	65.1	63.2	69.7	69.7	63.2	66.0	2.1
7	Executive Staff Quarters, JSW.	66.3	66.3	67	66.3	66	61.7	67.0	61.7	65.6	1.9
8	Nearby Railway Crossing kuttappatti village.	63.2	63.2	64.9	65.9	68.1	65.9	68.1	63.2	65.2	1.9
9	Residential Area Ervadi Village.	62.8	62.8	63.5	64	65.9	67	67.0	62.8	64.3	1.7
10	At Coconut Farm, Nearby Railway crossing.	66.8	66.8	67.1	68.3	67.5	69.5	69.5	66.8	67.7	1.1
11	At Parrynagar Residential Area.	65.1	65.1	62.4	63.9	65.9	69.7	69.7	62.4	65.4	2.5
12	Over Head Tank	66.5	66.5	67.3	66.2	62.7	64.2	67.3	62.7	65.6	1.7
13	Opp. To Old Main Gate, Open Agricultural field.	67.2	67.2	65.2	66.2	65.1	66.1	67.2	65.1	66.2	0.9
14	Guest House Premises.	66.7	66.7	67.6	66.3	69.7	69	69.7	66.3	67.7	1.4
15	Open Field, Pottaneri Village.	66.8	66.8	65.8	66.5	65	62.4	66.8	62.4	65.6	1.7
16	Raw Material Storage Yard (Iron Ore).	65.8	65.8	66.9	67.2	68.3	69.7	69.7	65.8	67.3	1.5
17	In front of Occupational in Health Centre.	67.2	67.2	68.1	69.2	70.3	71.6	71.6	67.2	68.9	1.8
18	Near Pickling & Phosphating Plant 2 KLD ETP	65.8	65.8	62.7	63.6	66.9	68.9	68.9	62.7	65.6	2.2

S.No	Location	Night Time Noise Level in dB(A)									
		Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Maximum	Minimum	Average	STD Deviation
1	New Land area JSW Boundary	59.8	59.8	59.2	58.6	59.7	55.3	59.8	55.3	58.7	1.7
2	Open field – Near thangamapuri stores, Malamanoor.	57.4	57.4	56.2	55.3	56.8	56.7	57.4	55.3	56.6	0.8
3	Nearby Mr.Chinnamuthu House, Malamanoor.	54.1	54.1	55.1	56.2	55.7	56.2	56.2	54.1	55.2	1.0
4	Near Madhayen Temple at Coconut Farm.	51.8	51.8	52.8	53.4	55.9	56.2	56.2	51.8	53.7	2.0
5	Eastern Gate of JSW.	54.7	54.7	55.7	56.7	51.7	55	56.7	51.7	54.8	1.7
6	Reservoir Premises.	53.1	53.1	56.9	55.1	55.5	53.1	56.9	53.1	54.5	1.6
7	Executive Staff Quarters, JSW.	53.7	53.7	55.1	56.7	57.9	58.9	58.9	53.7	56.0	2.2
8	Nearby Railway Crossing kuttappatti village.	55.6	55.6	56.2	55.9	56.5	56.4	56.5	55.6	56.0	0.4
9	Residential Area Ervadi Village.	53.8	53.8	55.4	56.1	59.2	55.6	59.2	53.8	55.7	2.0
10	At Coconut Farm, Nearby Railway crossing.	54.6	54.6	55.9	54.1	57.9	58.1	58.1	54.1	55.9	1.8
11	At Parrynagar Residential Area.	55.9	55.9	56.1	55	58.5	59.3	59.3	55.0	56.8	1.7
12	Over Head Tank	56.7	56.7	57.2	56.8	51.7	53.5	57.2	51.7	55.4	2.3
13	Opp. To Old Main Gate, Open Agricultural field.	54.1	54.1	55.9	56.5	53.6	55.6	56.5	53.6	55.0	1.2
14	Guest House Premises.	55.2	55.2	56.4	55.8	57.4	58.1	58.1	55.2	56.4	1.2
15	Open Field, Pottaneri Village.	55.3	54.3	55.9	56.7	55.9	59.1	59.1	54.3	56.2	1.6
16	Raw Material Storage Yard (Iron Ore).	54.3	52.3	55.8	56.1	57	54.2	57.0	52.3	55.0	1.7
17	In front of Occupational in Health Centre.	52.3	53.6	55.1	56.9	58.5	59.1	59.1	52.3	55.9	2.7
18	Near Pickling & Phosphating Plant 2 KLD ETP	53.6	53.9	56.4	57.1	58.9	60.2	60.2	53.6	56.7	2.6

Standard limit for Ambient noise level at Daytime is 75 dB (A), Standard limit for Ambient noise level at Nighttime is 70 dB (A).
The ambient noise level monitoring results are within the CPCB norms.

ANNEXURE 8

DETAILS OF GREENBELT DEVELOPMENT

Annexure 8

Details of Greenbelt Development

Sl.No.	Period	Quantity
1	1997 - 99	30600
2	1999 - 00	15000
3	2000 - 01	20000
4	2001 - 02	4940
5	2002 - 03	10400
6	2003 - 04	13400
7	2004 - 05	100
8	2005 - 06	1100
9	2006 - 07	200
10	2007 - 08	4395
11	2008 - 09	5120
12	01.04.2009 to 30.06.2009	820
13	01.07.2009 to 31.12.2009	2240
14	01.01.2010 to 30.06.2010	5590
15	01.07.2010 to 31.12.2010	9250
16	01.01.2011 to 30.06.2011	4000
17	01.07.2011 to 31.12.2011	4930
18	01.01.2012 to 30.06.2012	3700
19	01.07.2012 to 31.12.2012	5500
20	01.01.2013 to 30.06.2013	2410
21	01.07.2013 to 31.12.2013	3300
22	01.01.2014 to 30.06.2014	6300
23	01.07.2014 to 31.12.2014	7300
23	01.01.2015 to 31.06.2015	9600
24	01.07.2015 to 31.12.2015	10000
25	01.01.2016 to 30.06.2016	1400
26	01.07.2016 to 31.12.2016	4600
27	01.01.2017 to 30.06.2017	700
28	01.07.2017 to 31.12.2017	3250
29	01.01.2018 to 30.06.2018	3650
30	01.07.2018 to 31.12.2018	11385
31	01.01.2019 to 30.06.2019	4490
32	01.07.2019 to 31.12.2019	5864
33	01.01.2020 to 30.06.2020	5660
34	01.07.2020 to 31.12.2020	14466
35	01.01.2021 to 30.06.2021	4449
36	01.07.2021 to 31.09.2021	5364
37	01.10.2021 to 31.03.2022	6692
38	01.04.2022 to 30.09.2022	3676
39	01.10.2022 to 31.03.2023	6580
40	01.04.2023 to 30.09.2023	6103
Total		**268524**

ANNEXURE 9

CARBON SEQUESTRATION REPORT

CARBON SEQUESTRATION STUDY REPORT

March -2023

for

M/s. JSW Steel Ltd,
Salem Works.

Site Location :
Pottaneri P.O.,Mecheri, Mettur Taluk,
Salem District-636 453, Tamil Nadu, India

by

Green Global Safety Systems
43/7b,Senthil Nagar,Chinna Kodungaiyur ,
Chennai -600051, Ph: 91-8248885428
A Lead Environmental Pollution Control and Prevention Consultants.

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PART - A

I. Preface

M/s. JSW Steel Ltd, Salem Works, Pottaneri P.O.,Mecheri, Mettur Taluk, Salem District-636 453, Tamil Nadu, India offered an opportunity to M/s. Green Global Safety Systems, Chennai to conduct the Carbon Sequestration Study to evaluate the Contribution of the trees for carbon Sequestration in their Steel Manufacturing facility. Upon the requirement and the Purchase order issued to us, a Comprehensive study was carried out and the final report is submitted.

Disclaimer

We have performed study on Carbon Sequestration by the Existing Green Belt and the report submitted is not deemed to be any undertaking, warranty or certificate.

Place : Chennai

Date : 24.06.2023

M.MEGANATHAN MIE, DIS, Ph.D Scholar–Safety

ME, Environmental Engineering , Lead Auditor –ISO 14001: 2015 , Accredited Safety Auditor by Govt of Tamilnadu & Kerala Chartered Engineer & International PHA Specialists.

II. Introduction

Carbon sequestration

What is Carbon Sequestration :- Carbon sequestration means capturing carbon dioxide (CO_2) from the atmosphere or capturing anthropogenic (human) CO_2 from large-scale stationary sources like power plants before it is released to the atmosphere. As Per CPCB ,India

Once captured, the CO_2 gas (or the carbon portion of the CO_2) is put into long-term storage. CO_2 sequestration has the potential to significantly reduce the level of carbon that occurs in the atmosphere as CO_2 and to reduce the release of CO_2 to the atmosphere from major stationary human sources, including power plants and refineries. There are two major types of CO_2 sequestration: terrestrial and geologic.

Terrestrial

Terrestrial (or biologic) sequestration means using plants to capture CO_2 from the atmosphere and then storing it as carbon in the stems and roots of the plants as well as in the soil.

Geologic

Geologic sequestration is the method of storage that is generally considered for carbon capture and storage (CCS) projects. CCS is the practice of capturing CO_2 at anthropogenic sources before it is released to the atmosphere and then transporting the CO_2 gas to a site where it can be put into long-term storage. (Pacala & Socolow 2004). The rapid urbanization of cities in India has led to over exploitation of natural resources, exponential increase in pollution, and accumulation of greenhouse gases in the atmosphere.

Carbon emission due to deforestation and use of fossil carbon has brought forests to the center-stage of climate change mitigation strategies. As per MoEF (2014), India has a spatial extent of the urban tree cover on 12,790 Km2 (16.40 %) out of the total urbanized area of 77,997 Km2 as on 2013. The National Forest Policy, 1988 envisions average forest and tree cover of 33 % for the plains and 66.66 % for the hilly areas of the country.

There is an urgent need for the planned development of the urban areas to present the picture of green and clean cities with adequate forest & tree cover, parks, lakes, wetlands, urban biodiversity, nature education centers, etc.

M/s. JSW Steel Ltd,Salem Works, Pottaneri P.O. ,Mecheri, Mettur Taluk, Salem District-636 453, Tamil Nadu, India have organized for the Carbon Sequestration by Plants and conducted by our team of M/s. Green Global Safety Systems, Chennai.

The detailed report of Carbon Sequestration by Plants is presented in this booklet for M/s. JSW Steel Ltd,Salem Works.

III. Study Team Profile

Lead Environmental Expert

1. NAME AND DESIGNATION:

- Name : M.MEGANATHAN. ME.,MIE.,AMIE.,DCT.,DIS.,BOC.,.
- ME –Environmental Engineering
- Designation : Lead Environment Expert
- ISO 14001:2015 Lead Auditor –Enironmental Management Systems
- Expert in Environment Dispersion Modeling –Internationally approved Software

2. RELEVANT QUALIFICATIONS:

- ME-Master of Environmental Engineering
- AMIE in Chemical Engineering
  Diploma in chemical Technology Diploma in Industrial safety
- Accredited safety auditor – Govt of India and Tamilnadu
- Competent person of Boilers – A CLASS
- Trained HAZOP Leader - Certified by China risk management
- Chartered Engineer by Institution Engineers India

3. WORK EXPERIENCE:

- Total Year of Industrial Experience : 23 years of Industrial Exposure in Various disciplines.

  M/S. Madras Chlor-Alkalis Ltd , Chennai.
  M/S. Southern Chlor-Alkali industries ltd, Manali
  M/S. Tamil Nadu petro Products ltd, TIDCO, Manali.
  M/S. Dalmia Cement Bharat Ltd , Trichy
  M/S. GE – Momentive performance materials India pvt Ltd (MNC)
  M/S. Piramal Pharmaceuiticals ,Ennore,Chennai -68.

4. RESPONSIBILITIES INCLUDED:

Environmental Studies, EIA ,Quantitative Risk Analysis as per the EIA Notification Guidance , Conducted Safety audits, Risk assessments, Training on Safe Handling Chlorine system, Construction safety system, Behavior Based Safety system a modern approach etc.

As Process Safety Specialist we have conducted PHA (Process Hazard Analysis) for two project- Plant erected and commissioned and running with full rated capacity.

4.1 PLANT SAFETY:

- Having Experience in water quality Analysis, Air quality, Confined Vessel Entry, Explosive atmosphere, Ventilation in Lab Hoods analytical equipments and techniques
- Experienced in Hydraulic testing of Chlorine cylinders and conducting physical and internal inspection of the cylinders and clearance for filling / Rejection.
- Hydraulic testing of Pipelines after erection and report preparation.
- Experienced in operation and maintenance of Belt conveyors, Screw convey, Bucket elevators ,Pipe conveyors and Pneumatic conveyors
- Working experience in Thermic fluid Heaters of make Thermax Ltd
- Experienced in Hydrogen fired Boiler of make Thermax Ltd.
- Having experience in Solvent separation unit in pharmaceuticals and specialty chemical plants
- Working Experience Operation and maintenance of Centrifugal machines

4.2 ENVIRONMENT SAFETY:

- Activities towards Compliance to the Environmental Statutory Requirements like
  1. Consent Order for Existing / Expansion Projects
  2. Environmental Clearance from MoEF&CC, CPCB, TNPCB.
  3. Environmental Impact Assessment (EIA),
     3.1 It Involves Prefeasibility study
     3.2 Quantitative Environmental Risk assessment
     3.3 Environmental report
     3.4 Socio Economic conditions
     3.5 Air & water quality modeling
     3.5.1 Gaussian Model
     3.5.2 Noise Level reports and mapping
     3.6 Climatic
     3.7 Human Interface study
     3.8 Evaluation of Env Impacts
     3.9 setting an Environment Management Plan
  4. Public Hearing
  5. Participation in MoEF & CC Meetings
  6. Hazardous and Non Hazardous Chemicals Management,
  7. Transportation of hazardous Chlor-Alkali substances
  8. Waste management of Solid, liquid and gaseous materials.
     8.1 Disposal methods of Haz waste and procedures
     8.2 Compliance requirements

5. SPECIFIC TOOLS AND EQUIPMENT USED:

Toolbox Talk, JSA, HAZOP, ENVID, Incident Investigation System, Gas Testing, PTW-Auditing, SCBA, Scaffolding Appreciation, Safe Journey Management, Safe Defensive Driving, Basic Life Support, Fire Warden on Emergency & Evacuation Drills, Fire Extinguisher, Fire Alarm, Fire Hydrant and Automatic Sprinkler system.

6. SPECIFIC STANDARDS USED:

IS 14489, Fact act -1948,Tamilnadu Factories rules 11950 MOEF, CPCB, TNPCB, OSHAs, EPA.,RCRA ,CERCELA, BIS. National Building Code,Tariff Advisory committee Etc..

7. PROCESS SAFETY MANAGEMENT RESPONSIBILITIES:

In charge of HSE Dept / Process Commissioning for Chlor alkali Plant, LPG, Benzene ,octane, heptane, Methanol, Diesel, and Furnace oil loading and unloading areas, Effluent Treatment Plant, Occupational Health & Training center HSE Achievements. Erection and Commissioning of Automatic Sprinkler system to 100 MT Storage of LPG Bullet (2 Nos) and Fire Hydrant System to petro-chemical and chlor alkali plant at given time schedule on Jan 2002.Basic HSE Induction Training to 2000 Manpower.

8. HSE ACHIEVEMENTS:

- Number accident free man days maintained up to 12 years continuously
- 5 star awards
- national safety awards
- consecutive national safety council awards
- British safety council awards
- ISO-9001 certificate
- ISO-14001 :2015 certificate – Lead Auditor
- Working with ISO 45001: 2018
- No of Internal safety audit conducted is approx 200.

9. HSE CERTIFICATES

- Ist Class Boiler Safety –Insp. Of Boilers-India
- HAZOP Leader – China –RISK MANAGEMENT SOLUTIONS
- DGFASLI – Govt of India Trained Safety auditor
- IRCA accredited LEAD AUDITOR FOR ISO 14001 -2004
- Certified Internal Auditor for ISO 9001
- First aid – St john Ambulance – Cent Govt of India

10. EHS SOFTWARE KNOWLEDGE:

- Process Hazard Analysis : HAZOP ,FMEA,FTA,SOP-Leader Software (ABS USA)
- Environmental Risk Assessments – 3MRA Software – EPA (USA)
- Noise mapping – Custics software –Spain
- Quantitative Risk estimation – ALOHA Software (EPA –USA)
- Piping – Pipe flow Expert Software –UK

11. OTHER CERTIFICATES:

- Safety Training Programme –By Insp.Of. Factories-Tamilnadu-India
- First Aider – St John Ambulance –India
- Ms-Office- 2000 – NIIT – India

12. PROFESSIONAL MEMBERSHIPS

- National Safety Council- Member-India
- Safety Engineers Association – Member-Tamilnadu
- Indian institute of Engineers (India)– Associate – Calcutta
- Safety Auditors Association of India -SAAI – Moderator
- Indian safety Engineers(ISE) – Member
- Chartered Engineer – In progress with IEI-India
- Industrial Waste management Association – Member -2010

Study Team Member ---------- 01

- Name : Mr. Vignesh .S - Environmental Specialist
- Designation : Study Team member of Green Global Safety System

Study team member ---------- 02

G.Balasubrmanian- Environment Assistant

Study Team Member ---------- 03

Mr. Prabhakaran p - Environmental Specialist

Study Team Member ---------- - 04

Mr. Gunasekaran.P -Environmental Specialist

IV .Executive Summary

- ✓ As part of comprehensive Carbon Sequestration by green belt Study Report, M/s. JSW Steel Ltd, Salem Works located at, Pottaneri P.O.,Mecheri, Mettur Taluk, Salem District-636 453, Tamil Nadu, India, have the commitment and attitude towards the Pollution Control and Prevention management system.
- ✓ Total Carbon Sequestration by the Green Belt is 5699 MT during FY 2022-23. There is an increase in quantity of carbon Sequestration when compared with last financial year and there is a considerable Contribution in carbon sequestration by Tree Plantations at JSW, Salem plant. However, scope for improvement in planting trees is existed.
- ✓ Total Carbon dioxide emission by the integrated steel plant operation in the year 2022-23 is about **28,10,308** MT (Steel Production 11,24,123 MT/year) .
- ✓ Total quantum Carbon Sequestration by the Existing Green Belt in the Year 2022-23 is 5699 MT.
- ✓ Proposed green belt to the FY 2023-24 is 11000 Tree saplings.
- ✓ Organization have been continually striving to control and prevent air pollution by effective implementation of Environmental Management Systems and JSW Salem unit is certified for ISO 14001:2015 standard.
- ✓ Plant have controls over Oxides of nitrogen and sulphur and to a much lesser extent fluorides and chlorides release as they are present in the materials being burnt.
- ✓ Plant have Pollution Prevention system even about 99% of the total fumes and dust generated in steel-making process escape as fugitive emissions whereas slags also lead to release of fumes in the form of iron oxide, kish (graphite), soot and silica.
- ✓ Effective Pollution Control over Coke ovens which are another major source of emissions have been taken care by the organization.

- ✓ Two types of cleaning systems, dry and wet cleaning from hard substances are practiced. In dry cleaning the following control systems are used, viz., inertial dust catchers, cyclones, electro-static precipitators and different types of cloth filters.

- ✓ While in wet cleaning scrubbers, wet cyclones and various kinds of venturis are used. Wet method of gas cleaning is used such production where the cleaning is done from gases containing explosive grade substances.

- ✓ Total Tree plantation as reported by JSW is around 2,62,421 trees since inception till March 2023.

TREES PLANTED DETAILS -Cumulative				
S.No.	Year	Opening (Nos.)	Tree planted (Nos.)	Cumulative (Nos.)
1	2004 - 05	94340	100	94440
2	2005 - 06	94440	1100	95540
3	2006 - 07	95540	200	95740
4	2007 - 08	95740	4395	100135
5	2008 - 09	100135	5940	106075
6	2009 - 10	106075	5120	111195
7	2010 -11	111195	14250	125445
8	2011 -12	125445	7535	132980
9	2012 - 13	132980	10120	143100
10	2013 - 14	143100	6645	149745
11	2014-15	149745	19065	168810
12	2015-16	168810	10000	178810
13	2016-17	178810	6050	184860
14	2017-18	184860	5000	189860
15	2018-19	189860	14165	204025
16	2019-20	204025	14830	218855
17	2020-21	218855	18130	236985
18	2021-22	236985	15,180	252165
19	2022-23	252165	10256	262421

Criteria for number of trees:

- ✓ Trees having height greater than 4 feet only is considered for sequestration calculation.

Tree Plantation -From April 2022 to March 2023				
S NO	**Date**	**Location**	**Number of Shadow Trees**	**Types of Trees**
1	5-Apr-22	Sinter Plant& Coke oven	30	Jamun Tree
2	6-Apr-22	BRM Tower Area	2	Idly flower,Guava Tree
3	6-Apr-22	Safety office	8	Nandiyavattam & Arika Paam Tree
4	8-Apr-22	WagonTipprer Road Side	25	Plam tree
5	8-Apr-22	Power Plant -II	40	Guava,Mango,Jack fruit,Nelly Tree
6	11-Apr-22	SINTER PLANT-II ROAD SIDE	13	Guava,Mango,Nelly Tree
7	21-Apr-22	WagonTipprer Road Side	25	Guava,Mango,Nelly Tree
8	22-Apr-22	COKE OVEN AREA	10	Nandiyavattam & Jack fruit Tree
9	29-Apr-22	Main Gate Road side	5	Guava Tree
10	2-May-22	NEW LAND AREA	300	Jamun Tree,Jack fruit,Pongam Tree,Mantharai Tree
11	3-May-22	NEW LAND AREA	400	Jamun Tree,Pongam Tree,Mantharai Tree
12	4-May-22	NEW LAND AREA	170	Jamun Tree,Pongam Tree
13	11-May-22	New Land Area	290	Jamun Tree,Pongam Tree,Pathani Tree
14	16-May-22	Admine	10	Yellow Ribbon,Round Aloe Vera
15	16-May-22	SinterPlant II	17	Croton,Jamun Tree,
16	20-May-22	Coke oven area & BRM	25	Jamun Tree
17	25-May-22	AUDITORIUM Road SIDE	20	Mango,Jack fruit,Nelly Tree
18	1-Jun-22	Sinter Plant-II Road Side	100	Jamun Tree,Jack fruit,Guava,Mango,Pathani Tree,Pipal Tree
19	4-Jun-22	BF2 office Road Side	45	Jamun Tree,Jack fruit,Mango,Pathani,Fig Tree
20	9-Jun-22	New Land	500	Jamun Tree,Pathani,Fig Tree,Pongam Tree
21	17-Jun-22	New R&D	3	Jamun Tree,Nelly Tree
22	17-Jun-22	BF2 Road Side	30	Yellow Ribbon,Jamun Tree,Teak tree
23	1-Jul-22	Coke oven area & Railway crossing	30	Borassus, Yellow Ribben
24	2-Jul-22	Sinter Plant area	20	Jamun Tree,Borassus, Croton
25	4-Jul-22	R.O plant	55	Arali flower,Hibiscus
26	6-Jul-22	BRM	20	Hibiscus,Borassus

27	11-Jul-22	Sinter Plant	50	Jamun Tree,Biscuot Hony Tree
28	14-Jul-22	Scrap Yard Area	20	Borassus
29	15-Jul-22	Power Plant II	50	Borassus,Saraca Indica
30	17-Jul-22	Security Paragon	30	Sembaruthi,Ashoka trees
31	18-Jul-22	BRM Road Side	40	Sembaruthi, Palm trees
32	20-Jul-22	Ro Water to ASP -II Raod side	90	Palm trees, Croton,Yellow Ribbon
33	27-Jul-22	Old R&D	15	Yellow Ribbon,mango tree,Sembaruthi,ixora flower
34	5-Aug-22	Sinter Plant II	53	Pathani Tree ,Jack fruit,Jamun Tree,Muntingia calabura Tree,Mango Tree
35	17-Aug-22	Cement Factory	100	Jamun Tree,Pongam Tree,Plam Tree
36	20-Aug-22	Main gate area	45	Croton
37	26-Aug-22	Cement Factory	300	Jamun Tree,Mango,Pala Tree,Biscuit Tree,Malanelli Tree
38	1-Sep-22	BRM	55	Mango Tree ,Jack fruit Tree
39	5-Sep-22	SP-2	100	Plam Tree, Jamun Tree
40	5-Sep-22	security paragon	20	Mango Tree ,Jack fruit Tree
41	12-Sep-22	Maingate to temple gate	100	Plam Tree, Jamun Tree,Arasa Maram,Nelli
42	18-Sep-22	Temple gate area	50	Jamun Tree, mango
43	19-Sep-22	BRM Road side	50	Plam Tree, Jamun Tree,Arasa Maram,Nelli
44	21-Sep-22	SINTER PLANT II	95	PANAM TREE, SEMBARUTHI
45	24-Sep-22	Scrap Yard Area	120	Guva,Mango,Jackfruit, nelli
46	26-Sep-22	Coke oven area	100	SEMBARUTHI& Jamun Tree,Mango Tree
47	3-Oct-22	BF-II & TEMPLE	22	Jamun Tree,Mango,Tree
48	6-Oct-22	CANTEEN	2	Yellow Ribbon & Arasa Maram Tree
49	7-Oct-22	NEW CANTEEN NARTH GATE ROAD SIDE	100	Panam Tree
50	10-Oct-22	Cokeoven	100	Plam Tree,Mango Tree,Ashokan Tree
51	10-Oct-22	BF -II Ground Haffer Road side	100	Plam Tree
52	11-Oct-22	Admin Road Side	50	Plam Tree
53	11-Oct-22	Cokeoven	156	Plam Trees,Yellow Ribbon, Pongamia tree,Neem Tree, Guava Tree, NellieTree, Sapota Tree, Pomegranate Tree
54	13-Oct-22	Ball mill Area	65	Round Aloevera ,Yellow Ribbon, Chibiscus,Idly flower,Arali ,Nandhiyavattam, Plam Tree
55	20-Oct-22	SMS Lad Area	20	Plam Tree,Paper Flower,Basil
56	27-Oct-22	EOF Road Side	12	Areca Palm
57	27-Oct-22	Power Pland -II	5	Jamun Tree

58	27-Oct-22	Power Pland -II	5	Pongamia Tree
59	2-Nov-22	Safety Office	4	Areca Palm Tree
60	4-Nov-22	BF 2	10	Palm Tree
61	8-Nov-22	TOWNSHIP	400	Jamun ,Pongam,Mango,Pathani Tree
62	10-Nov-22	Township	450	Palm Tree,Jamun,Pongam,Mango,Pathani,Lemon Tree
63	11-Nov-22	Township	225	Palm Tree,Jamun,Pongam,Mango,Pathani,Lemon Tree,Mahua Tree
64	14-Nov-22	Town Ship	200	Palm Tree,Jamun,Pongam,Mango Tree,Ashoka Tree
65	14-Nov-22	Cokeoven&Admin	100	Sembaruthi flower& Ashoka,Palm Tree,Lemon,Chaste Tree,
66	15-Nov-22	Ball mill Area & R&D	4	Yellow Ribbon & Chaste Tree
67	16-Nov-22	Ball mill Area	2	Yellow Ribbon,Sembaruthi, Oosi AloeVera,Nanthiya Vattai&Mango Tree
68	16-Nov-22	Town Ship	200	Jamun,Pongam,Pathani Tree
69	25-Nov-22	Temple	10	Sembaruthi flower& Lemon Tree,
70	25-Nov-22	BF 2	3	Croton,Sembaruthi,Allamanda Plant ,Coconut Tree
71	25-Nov-22	NEW LAND AREA	85	Jamun,Pongam,Mango Tree
72	26-Nov-22	Main Gate Road Side	20	Chaste Tree,
73	1-Dec-22	Main Gate &Tample Gate	57	Papaya Tree & Sembaruthi
74	2-Dec-22	Guest House	10	Papaya Tree
75	8-Dec-22	BF-II	150	Bamboo Tree
76	9-Dec-22	Wegon Tippler	65	Bamboo Tree
77	12-Dec-22	Temple Gate	6	Coconut Tree
78	13-Dec-22	Main Gate Pinex Area	102	Bamboo Tree
79	13-Dec-22	BF-II & Sinter Plant -II	53	Hibiscus,Arali,Bamboo Tree
80	19-Dec-22	BRM cooling Tower	58	Coconut Tree+Arali+Nanthiya Vattai+Hibiscus+Yellow Ribbon
81	20-Dec-22	BRM cooling Tower	15	Yellow Ribbon+Hibiscus+Arali+Nanthiya Vattai+Palm Tree
82	27-Dec-22	Power Plant	9	Lemon Tree+Hibiscus+Mango+Fetus+Narcissu mando+Hibiscus
83	29-Dec-22	Old R&D Road & OHC	75	Rose + Plam Tree +Coconut Tree
84	29-Dec-22	Sinter Plant	40	Narcissu mando+Guava Tree+Mango Tree
85	29-Dec-22	Anneling Road Side	130	Gooseberry Tree+Java Plum+Guava+Pathani+Great Fruit Tree
86	28-Dec-22	Main Gate Road Side New Land	150	Guava Tree+Gooseberry Tree+Pathani+Great Fruit Tree+Pongamia Tree

87	29-Dec-22	Town Ship	165	Pathani Tree+Gooseberry Tree+Guava Tree+Guava Tree+Great Fruit
88	02.01.2023	CPP2	150	Guava Tree+Amla+Pathani
89	03.01.2023	Sinter Plant	460	Badam Tree+Jamun+Mahogany
90	06.01.2023	BF	25	Mahogany Tree,Badam Tree,nelli
91	10.01.2023	Temple gate area	50	Pungan,nelli,jamun,
92	12.01.2023	R&D Road side	20	Pungan,nelli,jamun,
93	17.01.2023	Sinter plant II	80	mango,nelli,pungan
94	20.01.2023	Coke oven area	60	Guava Tree
95	23.01.2023	Main Gate	280	Pathani Tree,mango,nelli,jamun
96	25.01.2023	ANNEALING PLANT	55	Jamun Tree
97	27.01.2023	BLM	25	Pungan
98	01.02.2023	Blooming Mill	80	Guva,Sapotta,Gooseberry,Lemon,Mango,Jamun Fruit(Naval)
99	02.02.2023	Civil Office	43	Padam,Jamun Fruit(Naval),Mahogany
100	02.02.2023	Sinter Plant	45	Lemon,Jack Fruit
101	03.02.2023	Blooming Mill	40	PadamPanai (Borassus)
102	06.02.2023	CCM-3	85	Guva,Jamun Fruit(Naval),Panai (Borassus),Coconut
103	07.02.2023	BF-2	285	Bamboo,Guva,Jamun Fruit(Naval),Mahogany
104	08.02.2023	Main Gate	125	Jamun Fruit(Naval),Mahogany,Guva
105	09.02.2023	COP	595	Bamboo
106	17.02.2023	HR Office	30	Lemon,Banana Tree
107	20.02.2023	Blooming Mill	95	Arya Farm,Water Apple,Guva,Jack Fruit,Mango
108	21.02.2023	CPP-1	10	Guva
109	21.02.2023	BRM	35	Jamun Fruit(Naval),Padam,Pongan
110	25.02.2023	Blooming Mill	30	Goosberry
111	01.03.2023	New Land Area	25	Jamun Tree,Gooseberry Tree
112	04.03.2023	Main gate	20	Guava Tree
113	05.03.2023	Yard Area	75	Pathani Tree,Pungam,Mahogany Tree
114	10.03.2023	New HR Office	10	Jackfruit Tree
115	11.03.2023	SPP -II Area	15	Jamun Tree
116	13.03.2023	BRM	50	Gooseberry Tree,Mahogany Tree,Guava Tree
117	15.03.2023	Coke Oven	30	Jamun Tree,Guava Tree,Mahogany Tree
118	18.03.2023	New R&D	15	Lemon Tree,Sweet Lemon

119	19.03.2023	HR Office	5	Jackfruit Tree
120	21.03.2023	New Land Area	70	Jamun Tree,Gooseberry Tree,Pathani Tree
121	23.03.2023	COP	34	Pungam,Mahogany Tree
122	25.03.2023	SP	20	Guava Tree
125	29.03.2023	New Land Area	50	Pungam
126	30.03.2023	New Land Area	23	Gooseberry Tree
		Total Tree sapling for FY 23	**10256**	

GREEN BELT DEVELOPMENT WITH RESPECT TO AREA COVERAGE

Green Belt developed area in percentage			
Sl.no	Location	Green belt cover area in Hectares	Sapling in Nos (Approx)
1	JSW canteen beside area	10.96	34784
2	Old Guest House area	6.16	19065
3	Raw material Yard (BF & SP)	7.6	25975
4	Water Reservoir Area	11.72	35128
5	Wagon Tippler area	1.2	3307
6	Coal Yard area (COP)	0.27	825
7	Coal Yard area	0.32	803
8	Temple area	3.16	8546
9	Back side of canteen (New land area)	12.9	35129
10	Mills area	7.01	18630
11	Township	10.54	29907
12	Power plant (CPP#II)	7.36	20786
13	Miscellaneous	12.08	29536
	Total Area coverage by Green Belt	91.28	
	Total Area available (Ha)	268.08	
	Total plant area available (Ha) Steel * CPP#2	237.28	
	Greenbelt developed (%) total land area(268.08 ha)	34.05	
	Total planted trees as on March 2023		262421

V. Objective of the **Carbon Sequestration by Trees**

- To evaluate the amount of carbon sequestrated by the green belt in M/s. JSW Steel Ltd, Salem Works located at, Pottaneri P.O.,Mecheri, Mettur Taluk, Salem District-636 453, Tamil Nadu, India.
- To carry out a study on Carbon Sequestration by Trees

VI. Scope of the Study

Carbon dioxide (CO_2) is the prime cause of global warming. The levels of CO_2 in the earth's atmosphere are rising ever since the industrial revolution begun. Even today in India, most of the industries rely heavily on coal as their source of energy. Most of us are still concerned only with acquiring energy, irrespective of methodology involved. CO_2 produced in the form of flue-gases is released without appropriate treatment which is adversely affecting the environment. A range of actions that need to be undertaken includes Carbon Dioxide Capture and Sequestration (CCS) Technology. CCS is a process of separation of CO_2 from Large Point Sources (LPSs), transport to a storage location, followed by long-term isolation from atmosphere. A portion of desired depletion can be achieved by improving energy efficiency owing to technological advancements, and the remainder might be achieved by moving on to renewable energy resources. In India, along with population explosion, there is rise in temperature due to global warming and to cope with the levels of CO_2, we need to see what kind of technological options we have to solve the problem. The paper brings about the study of CCS, its advantages, cost effectiveness and related drawbacks in India.

Capturing CO_2 : CO_2 finds its way into the atmosphere in numerous ways. In India, most of it is emitted by large stationary sources and rest by mobile sources in comparatively smaller quantities. These emissions are mainly from the combustion of fossil fuels, dominantly coal, used for power generation, industrial processes, and the other fossils fuels used in transportation, residential and commercial buildings. CO_2 is also emitted during certain industrial processes like cement manufacture or hydrogen production and during combustion of biomass. The main purpose of capturing is to produce a concentrated stream of CO_2, so that it can be transported to storage sites at high pressures.

The reason for concentrating the CO_2 stream is to make it economically feasible. Transportation of CO_2 in dilute form would make it unrealistic and impractical in context of the required capital. The main application of CCS is at the large stationary sources as capturing CO_2 directly from small and mobile sources has so far proven to be very complicated and expensive too. The capture directly from atmosphere would not be discussed in the paper as the concentration is less in ambient air (around 380 ppm) by a factor of 100 times as compared to flue gases. Minimization of emissions from these large point sources can have a drastic impact towards lowering the CO_2 levels. Capture from industrial process streams

- Post-combustion capture
- Pre-combustion capture
- Oxy-fuel combustion capture

➢ To conduct the Carbon Sequestration by Plants in the M/s. JSW Steel Ltd,Salem Works located at,Pottaneri P.O.,Mecheri, Mettur Taluk, Salem District-636 453, Tamil Nadu, India and the general List of areas in the factory premises are as follows

➢ Boundaries of the plant

➢ Wagon tippler

➢ Water reservoir area

➢ JSW Power Plant

➢ R&D Blocks

➢ Admin Building

➢ Old Gust House Area

➢ Canteen area

➢ Plant units

- Road sides
- Temple Area
- Non Recovery Type Coke Oven Plant
- Sinter Plant
- Blast Furnace
- Steel Making
- Air Separation Plant
- Steel Refining
- Continuous Casting of Billets and Blooms
- Bar and Rod Mill
- Blooming Mill
- QAD
- Captive Power Plant (3 x 30 MW)
- Utilities – Boilers, Water treatment, ETP, STP, Cooling water, Air compressors etc.
- HR and Admin building
- Purchase and Logistics buildings
- Accounts and Finance building
- Occupational Health Center -building

VII. Methodology

The following sequence of the methodology is adopted to conduct the Carbon Sequestration by Plants

The given study is an amalgamation of the literature review, Site visits, qualitative and Quantitative analysis of the data on spatial coverage of the green cover in the study area and its respective carbon sequestration potential. Based on the above findings, the study recommends percentage achievable area under tree cover through appropriate policies, plans.

1.Pre Study

1.1 On the requests from M/s. JSW Steel Ltd,Salem Works located at, Pottaneri P.O.,Mecheri, Mettur Taluk, Salem District-636 453, Tamil Nadu, India., Our Study team sent a questionnaire.

1.2 Study plan was prepared and sent to the client.

2.Site Visit

2.1 Our team conducted a site visit after the opening meeting with the Environmental Department team.

2.2 Opening meeting happened in the presence of EHS Head

2.3 After the Opening meeting, site Study was conducted by our team at Site

2.4 Site Study of Carbon Sequestration by Plants was done as per the scope of work

3.Post Study

3.1 Closing meeting were conducted and inputs were taken for further Analysis and Study by our team. Report sent to the management

- This is the final report presented to M/s. JSW Steel Ltd,Salem Works located at Salem.

Methodology- Comprehensive

The rate of carbon sequestration depends on the growth characteristics of the tree species, the conditions for growth where the tree is planted, and the density of the tree's wood. It is greatest in the younger stages of tree growth, between 20 to 50 years. Further complicating the issue is the fact that far less research has been done on tropical tree species as compared to temperate tree species.

Nevertheless, we can roughly estimate the amount of CO_2 sequestered in a given tree, and if we divide by the tree's age, get a yearly sequestration rate.

We got this process from two educational websites who had conceived it as a learning activity for their students.

This is the process:

1. Determine the total (green) weight of the tree.
2. Determine the dry weight of the tree.
3. Determine the weight of carbon in the tree.
4. Determine the weight of carbon dioxide sequestered in the tree
5. Determine the weight of CO_2 sequestered in the tree per year

Determine the total (green) weight of the tree

Based on tree species, the algorithm to calculate the weight of a tree is:

W = Above-ground weight of the tree in pounds

D = Diameter of the trunk in inches

H = Height of the tree in feet

For trees with D < 11:

$W = 0.25D^2 H$

For trees with D >= 11:

$W = 0.15 D^2 H$

Depending on the species, the coefficient (e.g. 0.25) could change, and the variables D2 and H could be raised to exponents just above or below 1. However, these two equations could be seen as an "average" of all the species' equations.

The root system weighs about 20% as much as the above-ground weight of the tree. Therefore, to determine the total green weight of the tree, multiply the above-ground weight of the tree by 120%.

Determine the dry weight of the tree

This is based on an extension publication from the University of Nebraska. This publication has a table with average weights for one cord of wood for different temperate tree species. Taking all species in the table into account, the average tree is 80 % dry matter and 20 % moisture. Therefore, to determine the dry weight of the tree, multiply the weight of the tree by 80%.

Determine the weight of carbon in the tree

The average carbon content is generally 50% of the tree's total volume. Therefore, to determine the weight of carbon in the tree, multiply the dry weight of the tree by 50%.

Determine the weight of carbon dioxide sequestered in the tree

CO_2 is composed of one molecule of Carbon and 2 molecules of Oxygen.

The atomic weight of Carbon is 12.001115.

The atomic weight of Oxygen is 15.9994.

The weight of CO_2 is C+2*O=43.999915.

The ratio of CO_2 to C is 43.999915/12.001115=3.6663.

Therefore, to determine the weight of carbon dioxide sequestered in the tree, multiply the weight of carbon in the tree by 3.6663

Determine the weight of CO_2 sequestered in the tree per year

Divide the weight of carbon dioxide sequestered in the tree by the age of the tree.

EXAMPLES

Estimated growth rates and sizes of agroforestry trees were taken from the World Agroforestry Centre's "Agrofores tree Database"

Let's see how much a Calliandra calothyrsus might sequester in a year. A 10-year-old Calliandra would probably grow about 15 feet tall with a trunk about 8 inches in diameter. Therefore:

$W = 0.25D^2 H = 0.25(8)^2(15) = 240$ lbs. green weight above ground.

240 lbs. * 120% = 288 lbs. green weight (roots included)

288 lbs. *80 = 230.4 lbs. dry weight

230.4 lbs. * 50% = 115.2 lbs. carbon

115.2 lbs * 3.6663 = 422.4 lbs. CO_2 sequestered

422.4 lbs / 10 years =42.2 lbs. CO_2 sequestered per year

Or consider a 10-year-old Grevillia robusta, 45 feet tall with a trunk 6 inches in diameter. Using the same calculations as above, the amount of CO_2 sequestered would be 71.3 lbs. per year.

Or a newly-planted Acacia angustissima, 2.5 years old, 15 feet tall with a trunk 3 inches in diameter: 23.8lbs. of CO_2 sequestered per year.

Or an Albizzia lebbek, 15 years old, 30 feet tall, with a 12 inch trunk: 76.0lbs. of CO_2 sequestered per year.

Note : Reference from the below site

This research and methodology is based on research papers, university publications, and other information freely available on the Internet. As we stated before, it is difficult to calculate the amount of carbon dioxide sequestered per tree per year due to the complexity of the variables involved, as well as the lack of research on tropical tree

species. If you have any information that could further refine or enhance our calculations, please let us know at info@treesftf.org.

Other methods

Another way to estimate the amount of CO_2 sequestered by a tree in a year is to estimate the amount sequestered in a hectare per year, and divide that amount by the number of trees per hectare. Scanning around on the Internet, it seems that the number of trees per hectare (in agroforestry and/or industrial plantations) ranges from under 500 to over 2,000.According to Myers and Goreau, tropical tree plantations of pine and eucalyptus can sequester an average of 10 tons of carbon per hectare per year. Therefore, the plantation can sequester an average of 20,000 lbs * 3.6663 = 73,326 lbs CO_2/ha/year, or, taking an average of 1,000 trees per hectare, 73.326 lbs CO_2/tree/year.

Of course, we heavily discourage the planting of pine and/or eucalyptus in our agroforestry systems. Our trees may not grow as fast or as straight as eucalyptus, but they are not invasive, and they do not destroy the water table and the soil!

Disclaimer

This research and methodology is based on research papers, university publications, and other information freely available on the Internet. As we stated before, it is difficult to calculate the amount of carbon dioxide sequestered per tree per year due to the complexity of the variables involved, as well as the lack of research on tropical tree species.

VIII. Standards

- As per the CPCB Guidelines, Green belt shall be developed in an area equal to 33% of the plant area with a native tree species in accordance with CPCB guidelines. The greenbelt shall inter alia cover the entire periphery of the plant.
- The project proponent shall prepare GHG emissions for the plant and shall submit the programme for the reduction of the same including carbon sequestration including plantation. The guideline is attached as Annexure –II of the report.

IX. Industry Profile

Manufacturing Process

1.0 Introduction

JSW Steel Limited, Salem Works is a continuous process industry. The Production capacity of finished products at present is 1.15 million TPA special alloy steel.

Iron complex consist of 2 nos of Blast Furnaces with the production capacity of 1.05 MTPA,1 no of 2 strand Pig Casting Machines and 2 nos of Sinter Plants with production capacity of 1.235MTPA and Coke Oven Plant of 0.5 MTPA capacity.

Steel Melting shop consisting of 2 nos of Energy Optimizing Furnaces (each 65 T/ladle), 4 nos of Ladle Furnaces (each 65 T/ladle), 2 no of Vacuum Degassing Unit, 2 nos. of 3 strand Continuous Billet Casters, 1 no of 3 strand Continuous Bloom casters. Steel finishing shop consisting of Bar and Rod Mill (BRM) with the capacity of 0.48 MTPA and Blooming Mill capacity of 0.48 MTPA. and wire rod block. BRM has downstream operations of Annealing, pickling and peeled & ground unit. The downstream operations are based on supplier needs.

In addition to the above plants, there are 2 nos of Air Separation Plants, 1 no 7 MW and 3 Nos of 30 MW (97 MW) Captive Power Plants , 1 no Pulverizing Coal Injection Plant, 1 no Lime Calcining Plant and MRSS, utilities are installed as support functions. The main products of the plants are pig iron, steel billets/steel blooms, steel bars rods and coil.

Raw Materials Storage

The raw materials, namely, iron ore, coke, manganese, limestone, dolomite and quartzite will come from different sources such as Bellary-Hospet area, Salem area, Sandur belt of Bellary-Hospet area by rail/road. Some raw materials are imported from Australia and /or china. They will be stacked in the raw material storage yard, transported by conveyor system to the storage bunkers. These materials shall be fed in required proportion for Sinter Making, Iron Making and Steel Making etc.

Wagon tippler

JSW Salem has installed a unique design of Wagon tippler first of its kind in Indian, which has the facility to form empty rake parallel to the loaded rake, with a uniquely designed Traverser which shifts empty wagon from inhaul to outhaul line.
The JSW Wagon tippler is designed by M/s Metso minerals India pvt.ltd. Wagon tippler is designed for handling 140 MT (includes wagon weight) with cycle time of 144 seconds per wagon. The installed capacity can evacuate material up to 1600MT per hour.

Wagon Tippler also has a specially designed side pad with articulated movement by which even the bulged wagons also can be handled.

Non Recovery Type Coke Oven Plant

The Coke Oven Plant will use stamp-charging technique to increase the bulk density of the coal, which will be charged to the oven. This will increase the yield and increase the strength of coke. The Coke Oven operation completely automatic and the process of carbonization of coal being controlled.

Carbonization of coal shall be completed in 65 hrs at temperature range of 1100-1300 C. On completion of the process the coke shall be discharged from the oven into the quenching car which will be quenched in the quenching tower. Subsequently the coke will be cut to the specified size, screened and transferred to Blast Furnace. The fines i.e. coke breeze shall be used in Sinter Plant for Sintering Making. The small amount of solid waste generation from the Coke Oven is being reused in the Sinter Plant. The waste heat of the flue gas will be fully utilized by Waste Heat Recovery Boilers for power generation.

Sinter Plant

The iron ore fines, coke fines, lime stone fines and other raw material fines dusts which cannot be used in the Blast Furnace are processed in the plant at a temperature of about 1200 C, by burning fuel. Sintering is a process of agglomeration of fines by incipient fusion in to porous lumps called Sinter which is an ideal input for Blast Furnace.

The sinter plant is essentially an assembly of pallets with grates moving with the help of sprocket wheel and chain table. The hearth layer passes through an ignition hood where it gets ignited by burning furnace oil/Blast Furnace Gas. Wind boxes are provided below

the sinter bed for suction of air to effect uniform burning of sinter bed along the cross section. The suction is maintained by fans. The strand is provided with necessary sealing to prevent air leakage between pallets and the machine.

The hot sinter cakes are broken by a sinter breaker and passed through sinter cooler strand where the hot sinter is subjected to cold air below. This cold sinter is crushed in roll crusher and screened in three stages. The sinter having size less than 5mm is conveyed to the sinter return bin in the stock house of sinter plant. Sinter of size 20-50mm is taken to the stock house of the blast furnace. Sinter of intermediate size of 10-20mm is taken to the sinter machine to serve as a bed layer.

Blast Furnace

In this furnace sintered iron ore, lump iron ore along with fluxes are reduced with metallurgical coke at a temperature of around 1400 C to produce hot metal and slag. The slag gets granulated while tapping. The hot metal tapped is ready for either steel making or making pig iron in a pig casting machine.

The blast is heated up by high-pressure air through hot blast stoves. As the burden descends, the hot gases rise upwards. During the process operation, chemical reactions take place at different levels, specific temperature and gas composition. The reactions are confined mainly to the oxides of iron and carbon wherein deposition begins at 250 C.

The product (hot metal) from the Blast Furnace is then transported to Steel Melting Shop to purification and if any downstream operations down then hot metal will be transferred to pig casting machine. The cold pig iron from the pig casting machine will be sent to the storage yard.

Steel Melting Shop

The Energy Optimizing Furnace (EOF) process is essentially oxygen steel making process in which oxygen is injected into the furnace both above and below the surface of the molten bath.

The oxygen that reacts with the carbon present in the hot metal produces carbon monoxide, which again gets oxidized to carbon dioxide with the liberation of heat by

burning with oxygen above the bath. The temperature in the bath will be maintained within 1650 -1700 C. Fuel heating provision is provided in case the bath gets cooled.

The hot metal from Blast Furnace will be transported to EOF in ladle by diesel loco operated hot metal transfer car. The hot metal will be received at the hot metal bay and then poured in the EOF with help of hot metal charging crane.

Processed scrap will be brought from scrap yard to EOF in scrap charging box (15-20 %) and then will be charged to EOF. Other fluxes and additives will be stored in over storage bunkers and will be added in EOF as per the process requirement.

The steel making operation, two other supporting plant facilities will be needed

(I) Lime Calcimining Plant – for providing burnt lime

(II) Air Separation Plant – for providing oxygen to the steel making furnace

Air Separation Plant

An air separation plants have been installed to provide oxygen for steel making furnace. The air separation plants have the provision to produce argon and nitrogen required for steel making/refining operation.

Steel Refining

From EOF, liquid steel will be tapped into steel teeming ladle placed on a self-propelled steel transfer car and the liquid steel in the ladle will be placed on steel vessel for processing in LRF.

Crude steel obtained from EOF will be taken to the Ladle Refining Furnace (LRF) for adjustment of steel chemistry by addition of Ferro-alloys. The LF has been provided with water-cooled hood and electric arc heating devices for the adjustment of steel chemistry in the LRF.

An online argon rinsing stand is provided in the secondary refining aisle and it is envisaged that all the plain C-steels (i.e. re-bars etc.) will be burged in the argon rinsing stand and then moved to the Continuous Casting Machine (CCM) for making billets. In the Ladle Furnace necessary secondary metallurgical treatments will be carried out to

take care of proper temperature and composition of steel required for the casting of different grades of steel as per product-mix. The LF has been equipped with a fume

extraction system consisting of ducts bag filters, chain conveyor and silo for necessary de-dusting.

Continuous Casting of Billets and Blooms

The refined steel is brought from Ladle Furnace in steel teeming ladle to continuous casting machine to make steel billets and blooms. The casters are provided with three strand casters with secondary water cooling system, auto-touch cut off unit, bottom bed dummy bar system, cooling bed, tundish, mould, and segment preparation facilities.

Bar and Rod Mill

The billets will be transported to rolling mill billet transfer car/crane to billet storage and conditioning Bay of bar and rod mill. Mild steel billets will be stored and the alloy steel billets will be conditioned (i.e. ground and inspected).

Billets will than be loaded in to billet charging grid of the bar and rod mill. From there, billets will proceed to 2 nos. of 45t/hr. rapid re-heating furnaces. After discharge from the furnace at a temperature of 1200-1300 C, the billets will be descaled in a descaler and will be rolled in a 3-high mill strand. After this, the billets will further rolled in 18-strands of bar mill for production of bars of 13-55mm diameter going to cooling bed and for rods 12-34mm diameter going to garret coilers.

With the help of another 4 strands, rods 5.5 -16 mm diameter will be produced and will be cooled in Eden borne coilers. From cooling bed, the rolled bars will proceed to a cold shear where these will be cut to commercial lengths and then collected for bundling and tying.

From coilers, the rod coils will proceed via flat conveyor and hook conveyor to coil collecting capstan. Finishing facilities like straightening, annealing, bright bar grinding, shot blasting, inspection benches etc. are provided for further treatment of rolled bars.

Blooming Mill

The Reversible Blooming Mill is designed to produce heavy rounds and square in the range of 60 - 180 mm as finished/semi-finished product for re-rolling.

The raw material as input to the mill shall be continuously cast blooms from Steel Melt Shop. The bloom sizes available will be:

i) 250 x 250 mm

ii) 340 x 400 mm

Depending on quality requirement of the customer, appropriate size of bloom shall be selected for each size of the product. The manufacturing process flow sheet is enclosed.

Captive Power Plant (1 x 7 MW and 3 x 30 MW)

The heat energy of the fuel on combustion used to generate super heat steam in the boilers. The steam is made to run the steam turbine, which coupled, to turbo generator. The rotation of the shaft of turbo generator, produces the current in the coil of the generator, which drawn out as energy.

As the whole, CPP have energy converting systems in series; starting with heat energy into electrical energy, as final end product and the CPP is for a total power generation capacity of 90 MW; will have five parallel units, each having 30 MW capacity.

The CPP (3x30 MW) have necessary utilities like Cooling Tower, Power house, Compressor, water treatment and transportation systems, transformer bay etc., as common for both the power generation units.

To generate 90 MW power, steam is getting through one number of AFBC boiler (127 TPH) using coal as fuel, Five numbers of WHRB (45 TPH 2 Nos,31.5 TPH 2 Nos and 25 TPH 1 No) using COP gas (sensible heat) and One number BFG boiler (32 TPH) using BF gas for combustion.

Coal Based boiler

Coal based (AFBC) boiler make use of imported coal for the reasons off low ash and content; If imported coal is not available, happen at times, then the coal is essentially a washed one at the source of mine, namely, beneficiated coal drawn from the mines of JSW, one of the major shareholder of JSW. The beneficiated coal is less in ash and having low sulphur (< 1 %) content.

The major unit operations are:

1. Atmospheric Fluidized Bed Combustion (AFBC) boiler.
2. Coal storage and handling system

The major, specific utility for this coal – based CPP is the coal handling mechanical systems for storage and transportation and closed Mechanical Conveyor systems for coal transfer to prevent fugitive dust emission during coal transfer had been installed.

The Fly ash handling systems are specifically designed for better collection of fly ash from ESP and bottom ash from furnace, to destinations, through dense phase Pneumatic conveying systems. The ash collection point has been provided with closed mechanical transfer system to load the ash in trucks for transportation.

AFBC Boiler

The atmospheric fluidized bed combustion is state of the art Clean-Coal combustion technology for ensuring the complete combustion of the coal.

The AFBC boiler for CPP has the following processes and characteristics

a) It is Bubbling Bed type
b) Gas temperature in the boiler is 820 to 840 deg C
c) Provision is available to project limestone into the furnace to capture sulphur and remove it as a dry by-product.
d) Reduces the level of NOx emission by 90-95 %

Steam generation will be 127 TPH at 88 bar atmospheric pressure and at 520 C of super heat temperature and provided with a tall RCC stack for 80m height with ID fan and Electrostatic Precipitator for emission control. Ash collection systems are provided at the bottom of the ESP facility.

Coke Oven Gas/Blast Furnace gas fired boilers

In gas based system the waste heat from coke oven flue gases (COFG) from the Coke Oven Plant and the excess Blast Furnace Gas (BFG) is utilized for power generation. The non-recovery type of coke ovens are environmentally safe and waste heat recovery from these coke oven is inherently uncertain and is not prevalent. In this project activity 243,277 Nm3/hr of coke oven flue gases generated from coke oven batteries at 1050 deg C is utilized for power generation by sensing/recovering the waste heat through the boilers natural circulation single drum Waste Heat Recovery Boilers having a main stream

pressure at 94 kg/cm2. In this Boiler there are three Economizers which help to recover the waste heat from the flue gas which in turn increase the efficiency of Boilers.

Also the Blast Furnace at Steel Plant, having a hot metal production capacity of 1.05 Million TPA will generate 36000 Nm3/hr of BF gas in excess, after in-house consumption. This excess BF gas which otherwise would have been flared will be utilized for power generation by installing a 32TPH single drum Blast furnace gas fired boiler having a main stream pressure at 94 kg/cm2.

The gas is burnt in the furnace of the boiler. The walls of this furnace are water tubes welded to each other. The water circulated through the water wall tubes absorb the heat and converted in to steam. The water – steam mixture goes to the steam drum where the steam is separated. The process of passing through super heater tubes arranged within the furnace leads to the super heating of the steam. This high pressure and high temperature steam is rooted to a steam turbine. The thermal energy is converted in to mechanical energy by expansion of steam (through reduction in its temp & press) in the turbine. This rotational energy is used drive the generator which produces electricity.

The combined steam from WHRB (5 nos.) and BF Gas fired boiler are taken through a main steam line and admitted to Steam turbine for power generation. A steam common header is provided (AFBC and other boilers steam is connected) before entering to steam turbines where is a flexibility to utilize steam to at both turbines invariable with steam generation at any boiler. In view of environmental prospective to minimize fossil fuel consumption power is being generated about 70 % through gas based by maximizing the utilization of COP, BF.

X. Study Team Selection

Our Study team is selected in such way that the competency level in hands on expertise in Carbon Sequestration Study of Iron and steel manufacturing operations and presenting suitable recommendations.

Our team comprises of

Mr.M.Meganathan	-	Lead Environment Expert
Mr. Kamalakannan	-	Team member
Mr. Vignesh	-	Team member
Mr. Sivnesh Mani	-	Team member
Mr. Desingraja	-	Team member

Lead Environmental Specialist have hands on Experience more than 15 years in Various Kinds of Industries in Environmental Pollution control departments .

We are recognized Auditors by the Central Government of India and notified accredited Safety Auditors under the Provisions of Manufacture storage, Import of Hazardous chemicals Rule 2000 (Mother Act - Environmental Protection Act 1986) by the Director of Industrial Health and Safety –Tamilnadu .

PART – B

XI. Site Visit

We performed Carbon Sequestration Study for the following areas

- Boundary's of plant
- Old gust house
- New gust house
- New plant area
- Temple area
- Wagon tippler
- Non Recovery Type Coke Oven Plant
- Sinter Plant
- Blast Furnace
- Steel Making
- Air Separation Plant
- Steel Refining
- Continuous Casting of Billets and Blooms
- Bar and Rod Mill
- Blooming Mill
- QAD
- Captive Power Plant (1 X 7 MW & 3 x 30 MW)
- Utilities – Boilers, Water treatment ,ETP ,STP ,Cooling water , Air compressors Etc.
- HR and Admin
- Purchase and Logistics
- Accounts and Finance office buildings
- Occupational Health Center

- New Land area

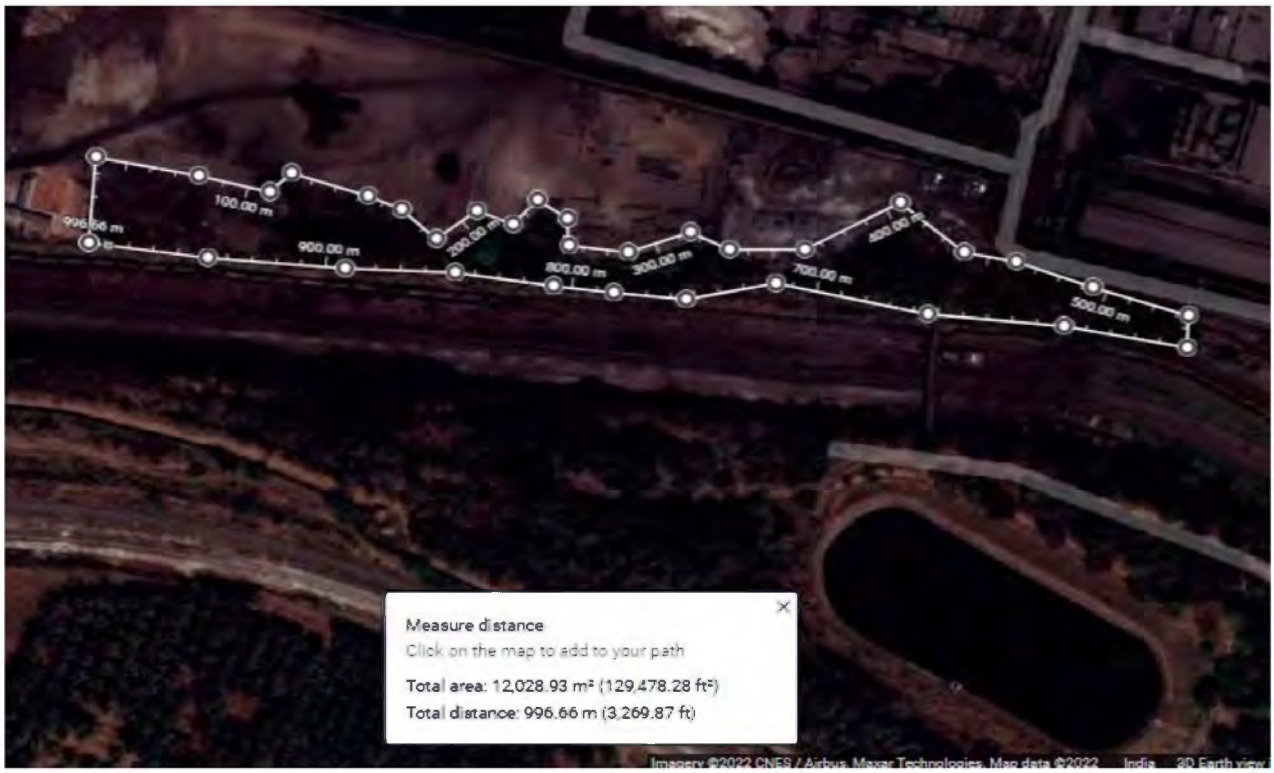
XII- GREEN BELT TOPO MAP

Topo Map:

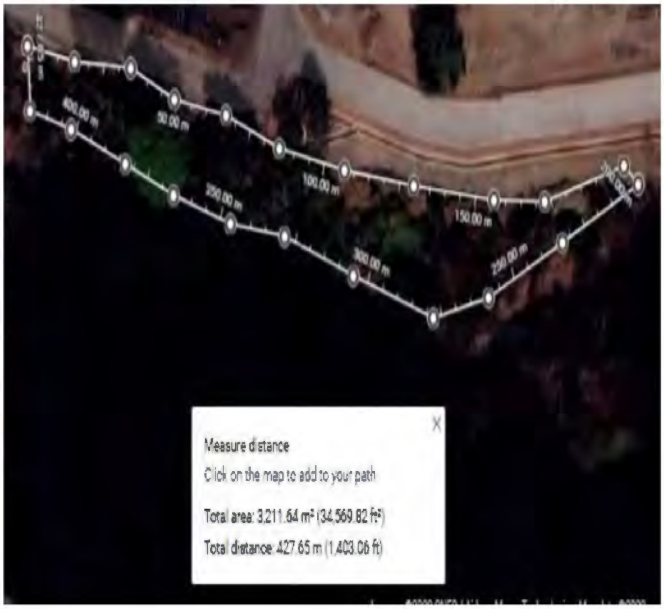
Topo map

Water Reservoir

Wagon to near by Water reservoir:



Coal storage area



Temple Area:

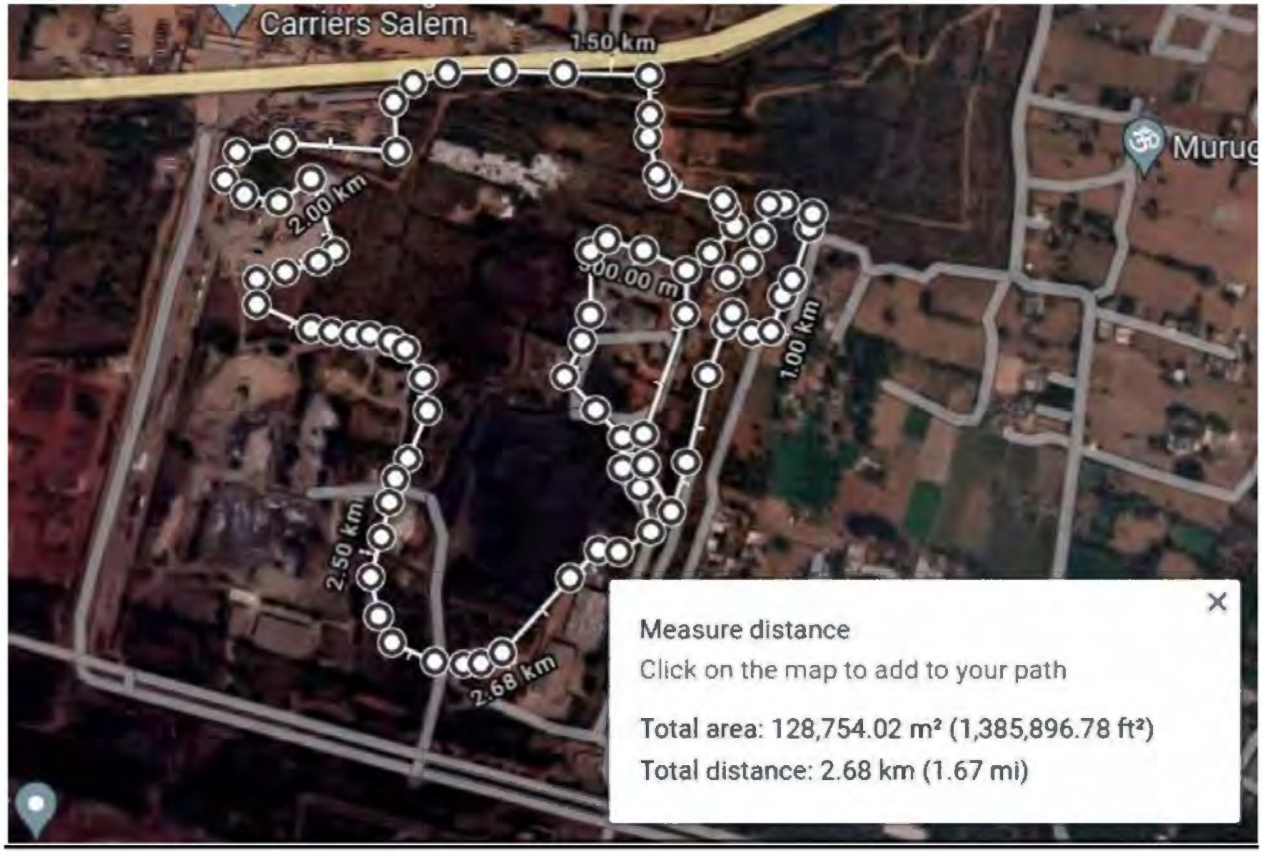
JSW Power plant Area:

Raw Material Yard (Admin Building)

Old Guest House Surrounding Area:

JSW Canteen:

JSW Canteen Back Side:



Mill Area:


JSW Occupational Health Center
JSW Work
1.0 m
3.0 km
km
Measure distance
Click on the map to add to your path
Total area: 70,118.46 m² (754,748.82 ft²)
Total distance: 3.46 km (2.15 mi)

Green Belt Development management

Carbon Sequestration Team - 2022

Carbon Sequestration study by GGSS team - 2022

XIII. Recommendations:

- ✓ **Scientific Long Term Planning**

  Plant green and tree cover should form an integral part of the development of the master plans of the plant and its successive long term management. Resource assessment with respect to water availability, soil type, existing tree species, their density & health, growth conditions, etc. should be done to minimize stressful conditions and ensure long term survival of the selected species. Use of modern scientific tool like GIS wherein the given area can be divided into 1 Km2 x 1 Km2 or 5 Km2 x 5 Km2 uniform grids for planning of afforestation schemes should be done to attain the uniform results.

- ✓ **Industrial Green Agglomerations**

  High quality clonal or tissue culture seedlings should be supplied to Gardeners for plantation e.g., Neem (Azadirachta indica), Ardusa (Ailenthus sp.), Mango (Mangifera indica), etc. Inclusion of trees in farming systems of inside the plant and periphery landscape can enhance productivity, profitability, diversity, and ecosystem sustainability.

- ✓ **Biodiversity Parks and Tree Tourism**

  Tree tourism has the potential to attract nature enthusiast and biodiversity lovers to map the biodiversity in the Industrial agglomerations of the plants for their ecological, educational and aesthetics purpose.

- ✓ **Raising of Tall Seedlings**

  Tall seedlings of ecologically and economically important species should be raised so that plantations grow fast within three years and the success rate of plantation is also improved.

- ✓ **Tree Plantation Campaign**

- ✓ Green JSW campaign should be undertaken by involving Workers society, schools, colleges, institutions, NGOs, tree lovers, and farmers to create mass movement for tree planting and their subsequent care.
- ✓ **Guidelines for Tree Felling, Looping, and Pruning in the plant Areas**
  Tree cutting should be strictly regulated , Prior permission from the top management is mandatory while planning for tree cutting .
- ✓ Land requirement for planting of trees is to be planned and marked in the plant layout as per the CPCB guidelines.
- ✓ Suggestions for Air Pollution control and Prevention which will supplement for carbon Sequestration before polluting atmosphere

Operations Control to Prevent Air Pollution

- ✓ Transport/Handling of Raw Materials:
- ✓ Raw material transport by rail, road and water, loading/unloading; belt transport; coal washing.
- ✓ Suggested Treatment:
- ✓ If material is received in moist condition, no precaution needed; For dry material, use water curtain or de-dusting by evacuation to a bag filter while unloading; Extensive enclosure of receiving hopper necessary;
- ✓ Minimum height of fall to avoid wind entrainment; Mobile equipment to be avoided, tired vehicle cause (salt and cement) may get contaminated. For proper care use bucket conveyor unloaders with water sprays; Chemical sealing if found suitable.
- ✓ 2. Bedding and Blending of Ore:
- ✓ Large beds for greater homogenization of composition; Blend recovered and placed on belt for storage; it aids in further blending.
- ✓ Suggested Treatment:
- ✓ Binding agent in the water may be necessary; Ensure proper wetting and use detergents, if need be; Large enclosures and evacuation at high rates at transfer points; Bag filters for cleaning gas; Spray installation at transfer points; Recovery of particulate – laden waters for treatment if necessary. Plantation in and around to arrest dust emission.

- ✓ 3. Sintering/Pelletizing of Iron and Steel:
- ✓ Suitability of fine ore in Blast Furnace; Pelletising with binder and rolled in drums/pans, Indurated at high temperature and cooled; for sintering blending of fines with coarser granular ores, flux mixed with coke breeze and heated; sizing.
- ✓ Important Consideration:
- ✓ Fines generated –
- ✓ (a) Crushing/grinding,
- ✓ (b) Grinding for pelletisation,
- ✓ (c) Cooling/crushing/screening sinter,
- ✓ (d) Cooling and screening pellets;
- ✓ Fugitive dust in pellet plant; Emission of gaseous and liquid fluorine compounds and oil as fuel, SO2/SO3; while fumes due to K2SO4/Na2SO4; Stack emissions may contain upto 1% CO and difficult to remove by incineration; If sintering materials contain lubricants/soluble oils (rolling mill waste), emissions will be visible and may contain hydrocarbon; Large fans create noise.
- ✓ Suggested Treatment:
- ✓ Fugitive dust (a) Recovery by suction hood installation and bag filters/electrostatic precipitation for dry material only, (b) Wet material requires no such precautions, (c) Energy saving by recycling clean heated air to ignition hood on sinter strand.
- ✓ Stack Emissions:
- ✓ (a) Normally not necessary to treat stack gases than to remove dust,
- ✓ (b) CaO/SiO2 ratio important. Low ratio may require desulphurisation of gases,
- ✓ (c) CaO/SiO2 > 2, difficult to apply electrostatic precipitators for fame removal,
- ✓ (d) High SOx – scrubbing with alkaline liquids (milk of lime). Expensive, fouling and disposal may create environmental problems. SO2 converted to gypsum (saleable),
- ✓ (e) High fluorine – wet scrubbing or contact with alumina/lime. High basicity leads to low emission,
- ✓ (f) NOx removal – catalytic converter (expensive),
- ✓ (g) Particulate removal by water scrubbing or electrostatic precipitators,
- ✓ (h) Cyclones for coarse grit removal,
- ✓ (i) Alkalies can cause problems with precipitators and tend to clog riddles and other mechanisms,

- ✓ (j) Dust to be dumped if recycles not possible,
- ✓ (k) Oily scale from rolling mills to be treated and not recycled to sinter plant.

PART C

XIV . Acknowledgments

We thank M/s. JSW Steel Ltd, Salem Works, Pottaneri P.O.,Mecheri, Mettur Taluk, Salem District-636 453, Tamil Nadu, India for offering an opportunity to carry out Carbon Sequestration by Plants Study at their facility. We extend our sincere thanks to Managing director / Occupier of the factory , Factory Manager , Dy.Manager- Environment , AM-Environment , Executive Environment ,Environment Assistants , all Employees and all Contract employees who contributed their Support to complete the Carbon Sequestration by Plants Study effectively.

The courtesy and cordiality extended to the carbon Sequestration Study team of Green Global Safety Systems is highly appreciated.

Lead Environment Expert

For Green Global Safety Systems

XV – Reference

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XVI. Annexure-I

Comprehensive study Report

M/s. JSW Steels Ltd , Salem Works

Carbon Sequestration by the Green Belt -April 22-March 2023

Calculation formula : 0.25 x (Dia)^2 x (Height) x (1.2 Wet weitht)x (0.8 dry weight) x (50% carbon content) x (3.6663 Co2 in Carbon) x 0.454 (Pounds to Kg) / 1000 (Kg to Ton)

Sl.no	Botonical Name	No of Trees	Location	Diameter in inches	Height in feet	^weight of Carbon in Kg	CO2 Sequestrn in MT	Age setted for calculation	CO2 Sequestrn in MT per Annum
1	Terminalia Catappa	19	5 S Red zone	9	21	1667.22	6.11	10	0.6
2	Fabaceae	26	5 S Red zone	11	21	3445.56	12.63	11	1.1
3	Melia azadirachta	18	5 S Red zone	11	21	2349.24	8.61	11	0.8
4	Fabaceae	98	5 S Red zone	11	23	15523.83	56.92	11	5.2
5	Bambusa arundinacea	1870	AAQMS-2	4	13	18267.00	66.97	2	32.7
6	Fabaceae	86	AAQMS-2	9	18	6452.82	23.66	11	2.1
7	Fabaceae	218	AAQMS-4 North	9	19	17230.04	63.17	8	7.8
8	Melia azadirachta	202	AAQMS-4 North	11	21	26311.54	96.47	11	8.7
9	Borassus flabellifer	12	AAQMS-4 North	14	49	6782.24	24.87	19	1.3
10	Tectona grandis	326	AAQMS-4 North	16	34	151934.09	557.04	19	29.2
11	Tectona grandis	2700	AAQMS-4 North	17	35	1429849.14	5242.26	19	275.2
12	Tectona grandis	1920	AAQMS-4 North	17	36	1046037.99	3835.09	19	201.3
13	Fabaceae	484	AAQMS-4 West	4	13	4725.03	17.32	2	8.5
14	Fabaceae	677	Admin Block East	11	22	92866.02	340.47	11	30.8
15	Fabaceae	216	Admin Block East	14	26	61817.60	226.64	12	18.8
16	Melia azadirachta	79	Admin Block East	14	30	27318.29	100.16	19	5.3
17	Eucalyptus	106	Admin Block East	22	36	103603.92	379.84	19	19.9
18	Pithecellobium dulce	55	Admin Block North	12	24	10013.96	36.71	11	3.3
19	Pithecellobium dulce	90	Admin Block North	14	26	26870.18	98.51	19	5.2
20	Saraca asoca	10	Admin Block North	14	35	3867.75	14.18	19	0.7
21	Eucalyptus	30	Admin Block North	23	45	40328.17	147.86	19	7.8
22	Fabaceae	37	Admin office Entrance	18	33	21376.58	78.37	19	4.1
23	Fabaceae	438	Admin office Entrance -East	9	14	26079.21	95.61	10	9.5
24	Fabaceae	840	Admin office Entrance -North	7	14	29530.87	108.27	4.6	23.8

25	Saraca asoca	91	Admin office Entrance -North	8	31	10471.98	38.39	8	4.8
26	Fabaceae	395	Admin office Entrance -North	14	20	85616.02	313.89	17	18.4
27	Fabaceae	1063	Admin office Entrance -South	5	15	19594.95	71.84	2.6	28.2
28	Fabaceae	895	Admin office Entrance -South	6	15	23526.94	86.26	3.6	24.3
29	Melia azadirachta	498	Admin office Entrance -South	7	15	18806.35	68.95	4.6	15.2
30	Fabaceae	440	Admin office Entrance -South	7	15	16631.16	60.97	4.6	13.4
31	Fabaceae	840	Admin office Entrance -South	9	14	50014.91	183.37	10	18.2
32	Mangifera indica	190	Admin office Entrance -south	9	16	12565.21	46.07	10	4.6
33	Acacia nilotica	467	Admin office Entrance -South	9	21	40754.15	149.42	10	14.9
34	Mangifera indica	175	Admin office Entrance -South	9	16	11610.89	42.57	11	3.9
35	Melia azadirachta	390	Admin office Entrance -South	9	21	34049.10	124.83	11	11.3
36	Albizia lebbeck	562	Admin office Entrance -South	9	21	49030.70	179.76	11	16.3
37	Tectona grandis	54	Admin office Entrance -South	14	33	20504.11	75.17	19	3.9
38	Fabaceae	46	Admin office Entrance -south	17	21	14212.37	52.11	19	2.7
39	Casuarina Tree	24	ANNEALING AREA	1	10	**12.153**	**0.045**	**2**	0.0217
40	Casuarina Tree	12	ANNEALING PLANT	1	10	**6.076**	**0.022**	**2**	0.0109
41	Casuarina Tree	60	ANNEALING PLANT	1	10	**30.382**	**0.111**	**2**	0.0543
42	Casuarina Tree	2	ANNEALING PLANT BACK SIDE	1	10	**1.207**	**0.004**	**2**	0.0022
43	Casuarina Tree	192	ANNEALING PLANT ROAD SIDE	1	10	**97.223**	**0.356**	**2**	0.1739
44	Casuarina Tree	120	ANNEALING PLANT ROAD SIDE	1	10	**60.764**	**0.223**	**2**	0.1087
45	Bambusa arundinacea	226	AQMS North	5	15	4157.84	15.24	2.6	6.0
46	Bambusa arundinacea	60	AQMS North	5	14	1263.49	4.63	3.6	1.3
47	Fabaceae	265	AQMS South	7	13	8631.69	31.65	4.6	7.0
48	Fabaceae	42	AQMS South	14	16	7394.82	27.11	17	1.6
49	Fabaceae	43	AQMS South	17	19	12081.98	44.30	19	2.3
50	Fabaceae	35	AQMS South	18	21	12487.92	45.78	19	2.4

51	Casuarina Tree	60	ASP AREA	1	10	**30.382**	**0.111**	**2**	0.0543
52	Casuarina Tree	84	ASP AREA	1	10	**42.535**	**0.156**	**2**	0.0761
53	Casuarina Tree	132	ASP AREA	1	10	**66.841**	**0.245**	**2**	0.1195
54	Casuarina Tree	367	ASP AREA	1	10	**185.939**	**0.682**	**2**	0.3325
55	Casuarina Tree	72	ASP AREA	1	10	**36.459**	**0.134**	**2**	0.0652
56	Casuarina Tree	120	ASP AREA	1	10	**60.764**	**0.223**	**2**	0.1087
57	Casuarina Tree	120	ASP AREA	1	10	**60.764**	**0.223**	**2**	0.1087
58	Casuarina Tree	144	ASP II AREA ROAD SIDE	1	10	**72.917**	**0.267**	**2**	0.1304
59	Casuarina Tree	36	ASP ROAD SIDE	1	10	**18.229**	**0.067**	**2**	0.0326
60	Casuarina Tree	72	ASP ROAD SIDE	1	10	**36.459**	**0.134**	**2**	0.0652
61	Fabaceae	34	ASP-1	9	14	2000.60	7.33	10	0.7
62	Melia azadirachta	30	ASP-1	9	20	2492.96	9.14	11	0.8
63	Eucalyptus	10	ASP-1	16	22	2846.90	10.44	19	0.5
64	Melia azadirachta	18	ASP-1 Back side	10	16	1485.17	5.45	11	0.5
65	Roystonea regia	32	ASP-1 Back side	11	14	2926.20	10.73	11	1.0
66	Albizia lebbeck	18	ASP-1 Back side	12	20	2667.44	9.78	11	0.9
67	Terminalia Catappa	24	ASP-1 Entrance	9	14	1429.00	5.24	10	0.5
68	Derris indica	18	ASP-1 Entrance	10	22	2050.80	7.52	11	0.7
69	Melia azadirachta	12	ASP-1 Entrance	14	22	2839.24	10.41	12	0.9
70	Fabaceae	6	ASP-1 Entrance	14	21	1391.68	5.10	17	0.3
71	Eucalyptus	5	ASP-1 Entrance	16	30	1969.55	7.22	19	0.4
72	Melia azadirachta	42	ASP-2 south	9	18	3136.79	11.50	11	1.0
73	Albizia lebbeck	38	ASP-2 south	10	22	4375.03	16.04	11	1.5
74	Fabaceae	47	ASP-2 south	11	21	6197.62	22.72	11	2.1
75	Melia azadirachta	19	ASP-2 south	11	21	2505.86	9.19	11	0.8
76	Melia azadirachta	36	Assembly point-1	18	35	21950.18	80.48	19	4.2
77	Tamarindus indica	14	Assembly point-2	14	36	5968.56	21.88	19	1.1
78	Albizia lebbeck	66	Assembly point-3	14	31	23530.35	86.27	19	4.5
79	Cocos nucifera	24	Assembly point-4	16	39	12826.47	47.03	19	2.5
80	Borassus flabellifer	12	Assembly point-5	13	38	4243.31	15.56	11	1.4
81	Fabaceae	426	ASV-2 North	5	16	10301.74	37.77	3.6	10.6
82	Fabaceae	306	ASV-2 North	5	14	6443.80	23.62	3.6	6.7
83	Fabaceae	300	ASV-2 North	7	14	10546.74	38.67	4.6	8.5

84	Fabaceae	122	ASV-2 North	7	15	4622.28	16.95	4.6	3.7
85	Fabaceae	144	ASV-2 North	10	16	11881.35	43.56	11	3.9
86	Albizia lebbeck	18	Bar and rod mill entrance-east	8	25	1663.61	6.10	8	0.8
87	Derris indica	66	Bar and rod mill entrance-east	17	34	33946.18	124.46	19	6.5
88	Derris indica	66	Bar and rod mill entrance-South	5	14	1389.84	5.10	3.6	1.4
89	Fabaceae	12	Bar and rod mill entrance-South	9	18	896.23	3.29	10	0.3
90	Melia azadirachta	12	Bar and rod mill entrance-South	9	19	946.71	3.47	10	0.3
91	Albizia lebbeck	20	Bar and rod mill entrance-South	9	21	1781.03	6.53	11	0.6
92	Fabaceae	18	Bar and rod mill entrance-South	10	20	1862.25	6.83	11	0.6
93	Derris indica	18	Bar and rod mill entrance-South	10	22	2050.80	7.52	11	0.7
94	Albizia lebbeck	12	Bar and rod mill entrance-South	11	21	1566.16	5.74	11	0.5
95	Casuarina Tree	30	BF II	1	10	**15.191**	**0.056**	**2**	0.0272
96	Casuarina Tree	84	BF II AREA	1	10	**42.535**	**0.156**	**2**	0.0761
97	Casuarina Tree	120	BF II AREA	1	10	**60.764**	**0.223**	**2**	0.1087
98	Casuarina Tree	36	BF II GROUND OFFER	1	10	**18.229**	**0.067**	**2**	0.0326
99	Casuarina Tree	66	BF II GROUND OFFER	1	10	**33.420**	**0.123**	**2**	0.0598
100	Musa paradisiaca	120	BF North	5	11	1600.68	5.87	2.6	2.3
101	Albizia lebbeck	53	BF North	8	22	4239.23	15.54	8	1.9
102	Melia azadirachta	290	BF North	9	21	25353.48	92.95	11	8.4
103	Albizia lebbeck	18	BF North	11	21	2349.24	8.61	11	0.8
104	Roystonea regia	26	BF North	14	25	7575.88	27.78	19	1.5
105	Cocos nucifera	14	BF North	14	36	5968.56	21.88	19	1.1
106	Fabaceae	30	BF-1 Pump house	6	16	842.89	3.09	3.6	0.9
107	Terminalia Catappa	66	BF-1 Pump house	7	13	2148.16	7.88	4.6	1.7
108	Roystonea regia	66	Blast Furnace -1	5	14	1389.84	5.10	3.6	1.4
109	Terminalia Catappa	60	Blast Furnace -1	7	15	2265.83	8.31	4.6	1.8
110	Melia azedarach	12	Blast Furnace -1	9	19	946.71	3.47	10	0.3
111	Fabaceae	24	Blast Furnace -1	9	20	1994.37	7.31	11	0.7
112	Melia azadirachta	60	Blast Furnace -1	11	23	8634.79	31.66	11	2.9

113	Fabaceae	18	Blast Furnace Near to AIR compr	5	14	379.05	1.39	3.6	0.4
114	Terminalia Catappa	18	Blast Furnace Near to AIR compr	7	14	632.80	2.32	4.6	0.5
115	Melia azadirachta	18	Blast Furnace Near to AIR compr	9	20	1469.28	5.39	10	0.5
116	Fabaceae	96	BLM North	9	14	5715.99	20.96	10	2.1
117	Fabaceae	208	BLM North	9	21	18124.60	66.45	11	6.0
118	Swietenia Mahagoni	50	BLM North	10	20	5214.31	19.12	11	1.7
119	Fabaceae	18	BRM	9	19	1420.06	5.21	10	0.5
120	Melia azadirachta	18	BRM	11	22	2469.84	9.06	11	0.8
121	Casuarina Tree	60	BRM AREA	1	10	**30.382**	**0.111**	**2**	0.0543
122	Fabaceae	306	BRM Charge West	9	19	24140.98	88.51	10	8.8
123	Albizia lebbeck	18	BRM Pump house entrance East	11	23	2839.72	10.41	11	0.9
124	Derris indica	30	BRM Pump house entrance North	7	15	1132.91	4.15	4.6	0.9
125	Couroupita Guianensis	18	BRM Pump house entrance North	11	23	2839.72	10.41	11	0.9
126	Albizia lebbeck	12	BRM Pump house entrance North	14	24	3167.61	11.61	12	1.0
127	Cocos nucifera	12	BRM Pump house entrance North	14	49	6782.24	24.87	19	1.3
128	Fabaceae	12	BRM Pump house entrance West	9	19	946.71	3.47	10	0.3
129	Casuarina Tree	36	CANTEEN AREA	1	10	**18.229**	**0.067**	**2**	0.0326
130	Melia azadirachta	60	Canteen road view	9	21	5162.60	18.93	10	1.9
131	Fabaceae	24	Canteen road view	13	31	6913.11	25.35	11	2.3
132	Fabaceae	18	CC-1	9	18	1344.34	4.93	8	0.6
133	Casuarina Tree	12	CCM III	1	10	**6.076**	**0.022**	**2**	0.0109
134	Casuarina Tree	138	CCM III SCRAP YARD	1	10	**69.879**	**0.256**	**2**	0.1250

135	Casuarina Tree	18	CEMENT FACTORY	1	10	**9.115**	**0.033**	**2**	0.0163
136	Pithecellobium dulce	18	Center plant 1 Assembly point	7	15	679.75	2.49	4.6	0.5
137	Fabaceae	24	Center plant 1 Assembly point	8	21	1832.83	6.72	8	0.8
138	Terminalia Catappa	12	Center plant 1 Assembly point	9	19	946.71	3.47	10	0.3
139	Melia azadirachta	18	Center plant 1 Assembly point	11	23	2590.44	9.50	11	0.9
140	Cocos nucifera	12	Center plant 1 Assembly point	14	48	6386.16	23.41	17	1.4
141	Tectona grandis	20	Center plant 1 Assembly point	17	35	10803.30	39.61	19	2.1
142	Fabaceae	175	Chimney area	7	14	6159.30	22.58	4.6	5.0
143	Fabaceae	6600	Chimney area	2	11	10711.36	39.27	5.6	7.1
144	Melia azadirachta	276	Chimney area	8	22	22159.60	81.24	8	10.1
145	Cocos nucifera	67	Chimney area	14	34	26295.24	96.41	19	5.1
146	Cocos nucifera	288	Chimney area	14	36	119371.23	437.65	19	23.0
147	Tamarindus indica	60	Chimney area	19	36	43664.86	160.09	19	8.4
148	Cocos nucifera	12	Coal yard East	14	45	6225.80	22.83	19	1.2
149	Fabaceae	336	Coal yard north	7	14	11812.35	43.31	4.6	9.5
150	Fabaceae	312	Coil yard north	5	12	5595.36	20.51	3.6	5.8
151	Fabaceae	310	Coil yard north	6	15	8136.66	29.83	3.6	8.4
152	Fabaceae	98	Coil yard north	7	14	3459.33	12.68	4.6	2.8
153	Melia azadirachta	13	Coil yard north	9	21	1152.43	4.23	10	0.4
154	Melia azadirachta	13	Coil yard north	11	21	1722.78	6.32	11	0.6
155	Ficus religiosa	7	Coil yard north	14	26	2149.61	7.88	19	0.4
156	Casuarina Tree	60	COKE OVEN AREA	1	10	**30.382**	**0.111**	**2**	0.0543
157	Casuarina Tree	60	COKE OVEN AREA	1	10	**30.382**	**0.111**	**2**	0.0543
158	Casuarina Tree	120	COKE OVEN AREA	1	10	**60.764**	**0.223**	**2**	0.1087
159	Casuarina Tree	120	COKE OVEN NEAR LEMS SHED	1	10	**60.764**	**0.223**	**2**	0.1087
160	Fabaceae	1080	cook oven hopper	6	16	30343.88	111.25	3.6	31.3
161	Fabaceae	360	cook oven hopper	6	16	10114.63	37.08	3.6	10.4
162	Fabaceae	118	cook oven hopper	9	16	7793.61	28.57	10	2.8
163	Melia azadirachta	38	cook oven hopper	9	14	2286.40	8.38	11	0.8

164	Melia azadirachta	106	cook oven hopper	9	16	6998.34	25.66	11	2.3
165	Albizia lebbeck	36	cook oven plant East	5	15	814.33	2.99	3.6	0.8
166	Fabaceae	202	cook oven plant East	5	13	3930.40	14.41	3.6	4.1
167	Fabaceae	348	cook oven plant East	6	15	9145.86	33.53	3.6	9.4
168	Fabaceae	120	cook oven plant East	6	16	3371.54	12.36	3.6	3.5
169	Bambusa arundinacea	1380	cook oven plant East	6	16	38772.74	142.15	3.6	40.0
170	Bambusa arundinacea	432	cook oven plant East	7	15	16313.94	59.81	4.6	13.1
171	Melia azadirachta	180	cook oven plant East	7	15	6797.48	24.92	4.6	5.5
172	Fabaceae	173	cook oven plant East	7	15	6525.58	23.92	4.6	5.3
173	Tamarindus indica	17	cook oven plant East	9	14	1000.30	3.67	10	0.4
174	Albizia lebbeck	19	cook oven plant East	9	21	1676.26	6.15	10	0.6
175	Fabaceae	18	cook oven plant East	10	20	1862.25	6.83	11	0.6
176	Cassia tora	31	cook oven plant East	10	22	3554.72	13.03	11	1.2
177	Borassus flabellifer	14	cook oven plant East	13	48	6440.69	23.61	11	2.1
178	Fabaceae	66	cook oven plant East	14	22	15615.82	57.25	12	4.8
179	Melia azadirachta	58	cook oven plant East	14	16	10141.47	37.18	17	2.2
180	Bambusa arundinacea	864	cook oven plant West	5	15	19543.96	71.65	3.6	20.2
181	Bambusa arundinacea	794	cook oven plant West	7	13	25856.00	94.80	4.6	20.8
182	Fabaceae	348	cook oven plant West	7	14	12234.22	44.85	4.6	9.9
183	Bambusa arundinacea	792	cook oven plant West	7	15	29908.90	109.65	4.6	24.1
184	Derris indica	106	cook oven plant West	9	13	5821.16	21.34	10	2.1
185	Fabaceae	466	cook oven plant West	9	14	27722.55	101.64	10	10.1
186	Fabaceae	314	cook oven plant West	9	14	18719.87	68.63	11	6.2
187	Fabaceae	26	cook oven plant West	10	13	1811.85	6.64	11	0.6

188	Bauhinia purpurea	22	cook oven plant West	10	20	2234.71	8.19	11	0.7
189	Melia azadirachta	26	cook oven plant West	11	20	3327.64	12.20	11	1.1
190	Melia azadirachta	46	cook oven plant West	11	22	6329.67	23.21	11	2.1
191	Melia azadirachta	180	cook oven plant West	11	23	28397.25	104.11	11	9.4
192	Couroupita Guianensis	24	cook oven plant West	14	14	3785.68	13.88	17	0.8
193	Melia azadirachta	34	cook oven plant West	14	14	5299.95	19.43	17	1.1
194	Derris indica	36	cook oven plant West	14	16	6338.42	23.24	17	1.4
195	Tectona grandis	79	cook oven plant West	14	34	30990.82	113.62	19	6.0
196	Fabaceae	30	cookoven north	9	21	2581.30	9.46	10	0.9
197	Fabaceae	186	CPP 2 & AAQMS	7	15	7024.06	25.75	4.6	5.7
198	Fabaceae	32	CPP 2 & AAQMS	8	16	1732.00	6.35	6	1.0
199	Fabaceae	88	CPP 2 & AAQMS	10	20	9062.97	33.23	11	3.0
200	Fabaceae	29	CPP 2 & AAQMS	18	21	10334.83	37.89	19	2.0
201	Fabaceae	31	CPP 2 & AAQMS	21	24	18499.17	67.82	19	3.6
202	Casuarina Tree	180	CPP II AREA	1	10	**91.147**	**0.334**	**2**	0.1630
203	Casuarina Tree	120	CPP II AREA	1	10	**60.764**	**0.223**	**2**	0.1087
204	Casuarina Tree	60	CPP III AREA	1	10	**30.382**	**0.111**	**2**	0.0543
205	Melia azadirachta	25	CPP New	9	14	1500.45	5.50	10	0.5
206	Melia azadirachta	14	CPP New	10	18	1338.97	4.91	11	0.4
207	Melia azadirachta	22	CPP New	14	22	5110.63	18.74	12	1.6
208	Melia azadirachta	19	CPP New	17	24	6949.61	25.48	19	1.3
209	Terminalia Catappa	30	CPP-1 Entrance east	7	14	1054.67	3.87	4.6	0.8
210	Derris indica	18	CPP-1 Entrance east	9	20	1469.28	5.39	11	0.5
211	Melia azadirachta	30	CPP-1 Entrance east	11	23	4317.40	15.83	11	1.4
212	Eucalyptus	5	CPP-1 Entrance east	14	26	1433.08	5.25	19	0.3
213	Terminalia Catappa	120	CPP-1 Entrance North	7	15	4531.65	16.61	4.6	3.7
214	Eucalyptus	2	CPP-1 Entrance North	14	22	561.32	2.06	12	0.2
215	Fabaceae	4	CPP-1 Entrance North	14	24	930.08	3.41	12	0.3

216	Tectona grandis	67	CPP-1 Entrance North	14	52	39538.61	144.96	19	7.6
217	Tectona grandis	122	CPP-1 Entrance North	17	49	90931.14	333.38	19	17.5
218	Albizia lebbeck	72	CPP-1 Entrance North	18	21	25837.07	94.73	19	5.0
219	Fabaceae	150	CPP2 Transformer	5	15	2764.52	10.14	2.6	4.0
220	Fabaceae	22	CPP2 Transformer	9	18	1613.21	5.91	10	0.6
221	Melia azadirachta	14	CPP2 Transformer	9	16	954.32	3.50	11	0.3
222	Melia azadirachta	46	CPP2 Transformer - North	9	18	3405.66	12.49	10	1.2
223	Fabaceae	24	CPP2 Transformer - North	9	18	1792.45	6.57	11	0.6
224	Fabaceae	78	CPP2 Transformer - North	9	20	6481.70	23.76	11	2.2
225	Melia azadirachta	34	CPP2 Transformer - North	14	20	7286.47	26.71	17	1.6
226	Melia azadirachta	26	CPP2 Transformer - North	16	22	7828.97	28.70	19	1.5
227	Roystonea regia	60	CPP2 Transformer - North	16	45	37030.74	135.77	19	7.1
228	Fabaceae	146	Crusher way Bridge area	10	19	14379.60	52.72	11	4.8
229	Melia azadirachta	47	Crusher way Bridge area	10	22	5332.07	19.55	11	1.8
230	Terminalia Catappa	18	DM plant entrance	5	14	379.05	1.39	3.6	0.4
231	Melia azadirachta	30	DM plant entrance	12	22	4984.15	18.27	11	1.7
232	Ficus religiosa	12	DM plant entrance	17	28	5074.92	18.61	19	1.0
233	Albizia lebbeck	84	Entrance Gate Right side	6	14	2055.16	7.53	3.6	2.1
234	Bambusa arundinacea	66	Entrance Gate Right side	6	15	1734.56	6.36	3.6	1.8
235	Carica Papaya	18	Entrance Gate Right side	8	16	932.62	3.42	6	0.6
236	Albizia lebbeck	12	Entrance Gate Right side	9	16	795.27	2.92	10	0.3

237	Melia azadirachta	138	Entrance Gate Right side	9	21	12048.14	44.17	11	4.0
238	Albizia lebbeck	24	Entrance Gate Right side	10	20	2483.01	9.10	11	0.8
239	Albizia lebbeck	18	Entrance Gate Right side	11	21	2349.24	8.61	11	0.8
240	Albizia lebbeck	583	Entrance Gate Right side	11	28	103280.77	378.66	11	34.3
241	Melia azadirachta	60	Entrance Gate Right side	11	23	9465.75	34.70	11	3.1
242	Borassus flabellifer	30	Entrance Gate Right side	14	48	16607.83	60.89	19	3.2
243	Borassus flabellifer	94	Entrance Gate Right side	16	38	48732.47	178.67	19	9.4
244	Derris indica	24	EOF - 1	8	22	1926.92	7.06	8	0.9
245	Terminalia Catappa	18	EOF - 1	9	21	1571.50	5.76	10	0.6
246	Roystonea regia	34	EOF - 1	11	28	5950.33	21.82	11	2.0
247	Melia azadirachta	12	EOF - 1	14	24	3304.47	12.12	19	0.6
248	Eucalyptus	30	EOF - 1	16	39	16033.09	58.78	19	3.1
249	Terminalia Catappa	18	EOF - 2 & MCC-5 entrance	6	16	505.73	1.85	3.6	0.5
250	Melia azadirachta	18	EOF - 2 & MCC-5 entrance	9	16	1192.90	4.37	11	0.4
251	Roystonea regia	18	EOF - 2 & MCC-5 entrance	10	18	1673.71	6.14	11	0.6
252	Fabaceae	19	EOF - 2 & MCC-5 entrance	11	22	2665.12	9.77	11	0.9
253	Eucalyptus	4	EOF - 2 & MCC-5 entrance	14	24	930.08	3.41	12	0.3
254	Melia azadirachta	12	Fuel/Flux west	9	16	795.27	2.92	10	0.3
255	Thespesia populnea	23	Fuel/Flux west	9	19	1798.74	6.59	10	0.7
256	Fabaceae	588	Fuel/Flux west	9	20	47996.34	175.97	11	15.9
257	Terminalia Catappa	18	Furnace oil storage tank	8	16	962.22	3.53	6	0.6
258	Fabaceae	18	Furnace oil storage tank	9	16	1192.90	4.37	11	0.4
259	Fabaceae	26	Furnace oil storage tank	10	20	2731.31	10.01	11	0.9
260	Albizia lebbeck	216	Generator North	8	25	19963.29	73.19	8	9.1
261	Saraca asoca	12	Generator North	8	31	1377.89	5.05	8	0.6
262	Melia azadirachta	54	Generator North	9	25	5623.12	20.62	11	1.9
263	Ficus Religiosa	30	Generator North	11	22	4116.40	15.09	11	1.4
264	Albizia lebbeck	48	Generator North	11	28	8500.47	31.17	11	2.8
265	Albizia lebbeck	77	Generator North	14	30	25393.34	93.10	13	7.1

266	Albizia lebbeck	48	Generator North	14	31	17112.98	62.74	19	3.3
267	Eucalyptus	98	Generator North	14	34	38503.75	141.17	19	7.4
268	Fabaceae	12	Generator North	18	33	6895.67	25.28	19	1.3
269	Pithecellobium dulce	106	Generator North	21	38	99514.54	364.85	19	19.2
270	Casuarina Tree	12	GIVEN TO METTUR	1	10	**6.076**	**0.022**	**2**	0.0109
271	Casuarina Tree	24	HR OFFICE BACK SIDE	1	10	**12.153**	**0.045**	**2**	0.0217
272	Carica Papaya	101	Jsw Canteen to gate compound boundry	4	13	984.87	3.61	2	1.8
273	Acacia nilotica	60	Jsw Canteen to gate compound boundry	4	13	586.23	2.15	2	1.0
274	Musa paradisiaca	187	Jsw Canteen to gate compound boundry	5	13	2973.60	10.90	2.6	4.3
275	Bambusa arundinacea	2304	Jsw Canteen to gate compound boundry	5	13	36598.10	134.18	2.6	52.6
276	Albizia lebbeck	24	Jsw Canteen to gate compound boundry	6	15	630.75	2.31	3.6	0.7
277	Melia azadirachta	430	Jsw Canteen to gate compound boundry	8	16	22258.58	81.61	6	13.5
278	Melia azadirachta	382	Jsw Canteen to gate compound boundry	8	21	29142.06	106.84	8	13.3
279	Melia azadirachta	780	Jsw Canteen to gate compound boundry	8	21	59567.11	218.39	8	27.1
280	Albizia lebbeck	54	Jsw Canteen to gate compound boundry	9	18	4033.02	14.79	8	1.8
281	Albizia lebbeck	416	Jsw Canteen to gate compound boundry	9	16	27595.74	101.17	10	10.1
282	Fabaceae	324	Jsw Canteen to gate compound boundry	9	16	21472.19	78.72	10	7.8
283	Fabaceae	100	Jsw Canteen to gate compound boundry	9	16	6600.71	24.20	10	2.4

284	Melia azadirachta	432	Jsw Canteen to gate compound boundry	9	21	37715.93	138.28	10	13.8
285	Syzygium cumini	53	Jsw Canteen to gate compound boundry	9	21	4609.72	16.90	10	1.7
286	Melia azadirachta	146	Jsw Canteen to gate compound boundry	9	21	12596.75	46.18	10	4.6
287	Albizia lebbeck	720	Jsw Canteen to gate compound boundry	9	14	42869.93	157.17	11	14.2
288	Albizia lebbeck	348	Jsw Canteen to gate compound boundry	9	18	25990.54	95.29	11	8.6
289	Albizia lebbeck	185	Jsw Canteen to gate compound boundry	9	18	13801.87	50.60	11	4.6
290	Albizia lebbeck	78	Jsw Canteen to gate compound boundry	9	20	6366.86	23.34	11	2.1
291	Melia azadirachta	330	Jsw Canteen to gate compound boundry	10	22	37597.95	137.85	11	12.5
292	Melia azadirachta	540	Jsw Canteen to gate compound boundry	11	21	70477.33	258.39	11	23.4
293	Fabaceae	316	Jsw Canteen to gate compound boundry	11	21	41190.08	151.02	11	13.7
294	Fabaceae	173	Jsw Canteen to gate compound boundry	11	22	23710.47	86.93	11	7.9
295	Melia azadirachta	804	Jsw Canteen to gate compound boundry	11	22	120936.00	443.39	11	40.1
296	Borassus flabellifer	118	Jsw Canteen to gate compound boundry	13	45	49294.57	180.73	11	16.4
297	Borassus flabellifer	468	Jsw Canteen to gate compound boundry	14	48	249060.39	913.13	17	53.6
298	Cocos nucifera	84	Jsw Canteen to gate compound boundry	14	48	46501.93	170.49	19	8.9
299	Borassus flabellifer	138	Jsw Canteen to gate compound boundry	14	48	76396.04	280.09	19	14.7

300	Borassus flabellifer	114	Jsw Canteen to gate compound boundry	14	49	64431.32	236.22	19	12.4
301	Cocos nucifera	100	Jsw Canteen to gate compound boundry	14	49	56292.63	206.39	19	10.8
302	Borassus flabellifer	86	Jsw Canteen to gate compound boundry	17	48	62870.15	230.50	19	12.1
303	Ficus benghalensis	119	Jsw Canteen to gate compound boundry	17	30	53862.17	197.47	19	10.4
304	Cocos nucifera	103	Jsw Canteen to gate compound boundry	17	48	75094.90	275.32	19	14.5
305	Tectona grandis	103	Jsw Canteen to gate compound boundry	17	49	76667.44	281.09	19	14.8
306	Tamarindus indica	1800	Jsw Canteen to gate compound boundry	18	24	750138.05	2750.23	19	144.4
307	Fabaceae	709	JSW Power Plant East Boundry	5	14	14934.45	54.75	3.6	15.4
308	Albizia lebbeck	185	JSW Power Plant East Boundry	8	21	14112.82	51.74	6	8.6
309	Derris indica	187	JSW Power Plant East Boundry	9	18	13981.12	51.26	10	5.1
310	Melia azadirachta	508	JSW Power Plant East Boundry	9	19	40045.63	146.82	10	14.6
311	Fabaceae	12	JSW Power Plant East Boundry	9	14	714.50	2.62	11	0.2
312	Melia azadirachta	12	JSW Power Plant East Boundry	11	22	1665.70	6.11	11	0.6
313	Saraca asoca	58	JSW Power Plant East Boundry	13	33	17670.44	64.79	11	5.9
314	Borassus flabellifer	34	JSW Power Plant East Boundry	13	42	13140.06	48.18	11	4.4
315	Tectona grandis	312	JSW Power Plant East Boundry	14	35	125701.95	460.86	19	24.2
316	Tectona grandis	307	JSW Power Plant East Boundry	14	36	127329.31	466.83	19	24.5
317	Eccoliptics	43	JSW Power Plant East Boundry	16	30	17725.94	64.99	19	3.4
318	Bambusa arundinacea	5050	JSW Power Plant South Boundry	4	13	49337.32	180.89	2	88.2
319	Bambusa arundinacea	600	JSW Power Plant South Boundry	4	11	4922.86	18.05	2	8.8
320	Fabaceae	745	JSW Power Plant South Boundry	5	15	13734.16	50.35	2.6	19.7

321	Bambusa arundinacea	11400	JSW Power Plant South Boundry	5	14	240063.11	880.14	3.6	247.9
322	Melia azadirachta	780	JSW Power Plant South Boundry	7	14	27421.52	100.54	4.6	22.1
323	Melia azadirachta	304	JSW Power Plant South Boundry	7	15	11465.08	42.03	4.6	9.2
324	Fabaceae	720	JSW Power Plant South Boundry	9	16	47715.98	174.94	10	17.4
325	Albizia lebbeck	720	JSW Power Plant South Boundry	9	18	53773.54	197.15	10	19.6
326	Melia azadirachta	238	JSW Power Plant South Boundry	9	21	20743.76	76.05	11	6.9
327	Pithecellobium dulce	323	JSW Power Plant South Boundry	10	21	35087.03	128.64	11	11.6
328	Pithecellobium dulce	151	JSW Power Plant South Boundry	11	20	18720.64	68.64	11	6.2
329	Albizia lebbeck	292	JSW Power Plant South Boundry	11	20	36104.09	132.37	11	12.0
330	Saraca asoca	151	JSW Power Plant South Boundry	11	28	26776.50	98.17	11	8.9
331	Ficus religiosa	223	JSW Power Plant South Boundry	12	24	40491.24	148.45	11	13.4
332	Tectona grandis	307	JSW Power Plant South Boundry	13	33	94242.36	345.52	11	31.3
333	Fabaceae	461	JSW Power Plant South Boundry	14	22	107773.85	395.13	12	32.8
334	Cocos nucifera	190	JSW Power Plant South Boundry	14	35	76388.11	280.06	19	14.7
335	Tectona grandis	187	JSW Power Plant South Boundry	14	38	81931.56	300.39	19	15.8
336	Fabaceae	12	Lime Storage sheed south	9	14	714.50	2.62	10	0.3
337	Eucalyptus	12	Lime Storage sheed south	14	36	4973.80	18.24	19	1.0
338	Terminalia Catappa	120	load center substation-4	4	11	984.57	3.61	2	1.8
339	Pongamia pinnata	180	load center substation-4	5	12	3228.09	11.84	3.6	3.3
340	Eucalyptus	14	load center substation-4	14	16	2535.37	9.30	17	0.5
341	Pithecellobium dulce	32	load center substation-4	23	25	24090.58	88.32	19	4.6
342	Casuarina Tree	7	Main Canteen	1	10	**3.646**	**0.013**	**2**	0.0065
343	Casuarina Tree	23	MAIN GATE	1	10	**11.545**	**0.042**	**2**	0.0206
344	Casuarina Tree	150	MAIN GATE AREA	1	10	**75.956**	**0.278**	**2**	0.1358

345	Casuarina Tree	120	MAIN GATE AREA	1	10	**60.764**	**0.223**	**2**	0.1087
346	Casuarina Tree	48	MAIN GATE AREA	1	10	**24.306**	**0.089**	**2**	0.0435
347	Casuarina Tree	16	MAIN GATE AREA	1	10	**7.899**	**0.029**	**2**	0.0141
348	Casuarina Tree	156	MAIN GATE AREA	1	10	**78.994**	**0.290**	**2**	0.1413
349	Casuarina Tree	50	MAIN GATE ROAD SIDE	1	10	**25.521**	**0.094**	**2**	0.0456
350	Fabaceae	547	MRSS EAST	6	16	15374.23	56.37	3.6	15.9
351	Fabaceae	175	MRSS EAST	7	13	5702.38	20.91	4.6	4.6
352	Fabaceae	34	MRSS EAST	9	16	2226.75	8.16	10	0.8
353	Melia azadirachta	54	MRSS EAST	10	18	5021.13	18.41	11	1.7
354	Cocos nucifera	10	MRSS EAST	14	44	4869.35	17.85	19	0.9
355	Casuarina Tree	8	NEW CANTEEN AREA	1	10	**4.254**	**0.016**	**2**	0.0076
356	Casuarina Tree	204	New Land	1	10	**103.299**	**0.379**	**2**	0.1847
357	Casuarina Tree	396	New Land area	1	10	**200.523**	**0.735**	**2**	0.3586
358	Casuarina Tree	210	New Land area	1	10	**106.338**	**0.390**	**2**	0.1902
359	Casuarina Tree	618	New Land area	1	10	**312.937**	**1.147**	**2**	0.5597
360	Melia azadirachta	1800	New land deep inside	3	12	8643.23	31.69	2	15.5
361	Fabaceae	1080	New land deep inside	3	12	5101.30	18.70	2	9.1
362	Fabaceae	5400	New land deep inside	2	12	9823.24	36.01	3	11.8
363	Acacia nilotica	190	New land deep inside	5	13	3696.44	13.55	3.6	3.8
364	Musa paradisiaca	43	New land deep inside	7	14	1518.73	5.57	4.6	1.2
365	Bambusa arundinacea	77	New land deep inside	9	14	4572.79	16.77	10	1.7
366	Albizia lebbeck	170	New land deep inside	9	21	14876.84	54.54	10	5.4
367	Melia azadirachta	79	New land deep inside	9	21	6914.59	25.35	10	2.5
368	Melia azadirachta	50	New land deep inside	9	21	4336.59	15.90	10	1.6
369	Albizia lebbeck	18	New land deep inside	10	20	1862.25	6.83	11	0.6
370	Melia azadirachta	106	New land deep inside	11	21	13782.23	50.53	11	4.6
371	neam	3778	New land deep inside	1	12	3230.27	11.84	10	1.2

372	Melia azadirachta	148	New land deep inside	11	21	19263.80	70.63	11	6.4
373	Cocos nucifera	18	New land deep inside	13	33	5522.01	20.25	11	1.8
374	Cocos nucifera	19	New land deep inside	14	34	7201.77	26.40	15	1.8
375	Cocos nucifera	40	New land deep inside	14	39	17790.74	65.23	19	3.4
376	Ficus benghalensis	22	New land deep inside	17	26	8476.58	31.08	19	1.6
377	Cocos nucifera	96	New land deep inside	17	39	56690.36	207.84	19	10.9
378	Fabaceae	67	New R&D entrance	6	15	1766.10	6.48	3.6	1.8
379	Fabaceae	22	New R&D entrance	9	16	1431.48	5.25	11	0.5
380	Derris indica	23	New R&D entrance	10	16	1881.21	6.90	11	0.6
381	Melia azadirachta	20	New R&D entrance	12	21	3186.68	11.68	11	1.1
382	Roystonea regia	192	New R&D entrance	14	13	27364.61	100.33	11	9.1
383	Fabaceae	212	New R&D North	5	14	4472.75	16.40	3.6	4.6
384	Derris indica	98	New R&D North	9	16	6521.18	23.91	11	2.2
385	Melia azadirachta	113	New R&D North	11	20	13966.19	51.20	11	4.6
386	Cocos nucifera	19	New R&D North	16	48	12644.16	46.36	19	2.4
387	Tectona grandis	76	New R&D North	17	48	55011.38	201.69	19	10.6
388	Casuarina Tree	60	New RESERVOIR	1	10	**30.382**	**0.111**	**2**	0.0543
389	Casuarina Tree	180	New Reservoir	1	10	**91.147**	**0.334**	**2**	0.1630
390	Fabaceae	150	Newland opposite	5	14	2573.61	9.44	2.6	3.7
391	Albizia lebbeck	170	Newland opposite	9	22	15414.45	56.51	10	5.6
392	Borassus flabellifer	74	Newland opposite	14	36	29560.41	108.38	16	6.8
393	Albizia lebbeck	672	Newland opposite	14	22	161500.81	592.11	19	31.1
394	Melia azadirachta	114	Newland opposite	14	24	31392.46	115.09	19	6.0
395	Borassus flabellifer	110	Newland opposite	14	35	44479.15	163.07	19	8.6
396	Casuarina Tree	68	OHC AREA	1	10	**34.636**	**0.127**	**2**	0.0619
397	Terminalia Catappa	18	OHC Entrance	11	20	2228.65	8.17	11	0.7

398	Fabaceae	12	OHC Entrance	14	25	3300.96	12.10	12	1.0
399	Saraca asoca	18	OHC Entrance	16	48	11853.90	43.46	19	2.3
400	Melia azadirachta	6	OHC Entrance south	16	26	2130.97	7.81	19	0.4
401	Fabaceae	2	OHC Entrance south	18	35	1463.35	5.37	19	0.3
402	Saraca asoca	19	Old guest house	13	48	8587.58	31.48	11	2.8
403	Saraca asoca	12	Old guest house	14	49	6519.89	23.90	17	1.4
404	Cocos nucifera	43	Old guest house	14	39	19408.08	71.16	19	3.7
405	Fabaceae	1279	Old gust house East	5	13	24939.30	91.43	3.6	25.8
406	Melia azadirachta	194	Old gust house East	9	18	14518.85	53.23	10	5.3
407	Saraca asoca	79	Old gust house East	11	25	13713.57	50.28	11	4.6
408	Eucalyptus	54	Old gust house East	13	33	16566.04	60.74	11	5.5
409	Carica Papaya	31	Old gust house Front	7	23	1747.81	6.41	4.6	1.4
410	Mangifera indica	720	Old gust house Front	8	35	93426.34	342.53	8	42.6
411	Melia azadirachta	180	Old gust house Front	11	31	35322.40	129.50	11	11.7
412	Saraca asoca	180	Old gust house Front	11	44	50253.41	184.24	11	16.7
413	Saraca asoca	54	Old gust house Front	11	23	8519.17	31.23	11	2.8
414	Saraca asoca	41	Old gust house Front	14	38	17166.14	62.94	16	3.9
415	Fabaceae	56	Old gust house Front	14	26	16838.65	61.74	19	3.2
416	Cocos nucifera	86	Old gust house Front	14	42	41820.97	153.33	19	8.0
417	Fabaceae	4200	Old gust house North	4	11	34460.04	126.34	2	61.6
418	Fabaceae	2866	Old gust house North	5	13	55867.76	204.83	3.6	57.7
419	Derris indica	186	Old gust house North	5	13	3626.26	13.29	3.6	3.7
420	Albizia lebbeck	1800	Old gust house North	9	20	149577.74	548.40	11	49.6
421	Tamarindus indica	180	Old gust house North	10	19	17679.83	64.82	11	5.9
422	Fabaceae	211	Old gust house North	12	22	35088.39	128.64	11	11.6
423	Cocos nucifera	48	Old gust house North	14	35	18537.83	67.97	15	4.5

424	Saraca asoca	113	Old gust house North	14	38	47324.36	173.51	16	10.8
425	Melia azadirachta	190	Old gust house North	14	16	33382.34	122.39	17	7.2
426	Fabaceae	2074	Old gust house West Boundry line	5	13	40426.93	148.22	3.6	41.8
427	Albizia lebbeck	734	Old gust house West Boundry line	9	18	54849.01	201.09	10	20.0
428	Fabaceae	504	Old gust house West Boundry line	9	20	41881.77	153.55	11	13.9
429	Melia azadirachta	220	Old gust house West Boundry line	10	20	22719.50	83.30	11	7.5
430	Ficus religiosa	14	Old gust house West Boundry line	11	22	1998.84	7.33	11	0.7
431	Cocos nucifera	101	Old gust house West Boundry line	14	35	40611.40	148.89	19	7.8
432	Roystonea regia	30	P 2 belt conveyor west	9	18	2240.56	8.21	11	0.7
433	Fabaceae	103	PCTL Entrance	6	15	2712.22	9.94	3.6	2.8
434	Melia azadirachta	20	PCTL Entrance	7	14	717.18	2.63	4.6	0.6
435	Fabaceae	336	PCTL Entrance	7	16	13147.62	48.20	4.6	10.6
436	Fabaceae	18	PF -1 East	9	16	1192.90	4.37	10	0.4
437	Melia azadirachta	30	PF -1 East	11	22	4164.26	15.27	11	1.4
438	Tectona grandis	60	PF -1 East	17	39	35431.47	129.90	19	6.8
439	Tectona grandis	18	PF -1 south	16	38	9371.63	34.36	19	1.8
440	Ficus religiosa	1	PF -1 south	25	19	783.70	2.87	19	0.2
441	Fabaceae	456	PF -1 West	5	12	8177.84	29.98	3.6	8.4
442	Fabaceae	97	PF -1 West	9	16	6441.66	23.62	11	2.1
443	Melia azadirachta	53	PF -1 West	10	22	6015.67	22.06	11	2.0
444	Casuarina	246	PF 2 ground hopper	4	11	2018.37	7.40	2	3.6
445	Fabaceae	180	PF 2 ground hopper	6	15	4730.62	17.34	3.6	4.9
446	Fabaceae	518	PF 2 ground hopper	8	16	26859.52	98.48	6	16.3
447	Melia azadirachta	30	PF 2 ground hopper	8	21	2291.04	8.40	8	1.0
448	Fabaceae	120	PF 2 hopper east	5	13	1906.15	6.99	2.6	2.7
449	Pithecellobium dulce	300	PF 2 hopper east	5	13	5848.80	21.44	3.6	6.0
450	Fabaceae	62	PF 2 hopper east	6	15	1639.95	6.01	3.6	1.7
451	Saraca asoca	24	PF 2 hopper east	11	42	7009.51	25.70	11	2.3

452	Fabaceae	2702	plant south side compount	5	14	56907.59	208.64	3.6	58.8
453	Ficus benghalensis	1	plant south side compount	36	39	3271.75	12.00	19	0.6
454	Fabaceae	25	PM - 2 Hopper south	9	19	1988.08	7.29	10	0.7
455	Pithecellobium dulce	40	PM - 2 Hopper south	9	20	3290.71	12.06	11	1.1
456	Fabaceae	20	PM - 2 Hopper south	9	20	1665.18	6.11	11	0.6
457	Saraca asoca	19	PM - 2 Hopper south	16	34	8937.30	32.77	19	1.7
458	Fabaceae	456	PTCL Office	5	13	7243.37	26.56	2.6	10.4
459	Manilkara Zapota	31	PTCL Office	5	13	608.28	2.23	3.6	0.6
460	Terminalia Catappa	65	PTCL Office	5	13	1263.34	4.63	3.6	1.3
461	Terminalia Catappa	22	PTCL Office	6	14	528.47	1.94	3.6	0.5
462	Albizia lebbeck	480	PTCL Office	6	14	11743.79	43.06	3.6	12.1
463	Fabaceae	420	PTCL Office	6	15	11038.11	40.47	3.6	11.4
464	Albizia lebbeck	720	PTCL Office	8	16	37304.88	136.77	6	22.6
465	Fabaceae	551	PTCL Office	8	16	28538.24	104.63	6	17.3
466	Fabaceae	420	PTCL Office	8	16	21761.18	79.78	6	13.2
467	Melia azadirachta	60	PTCL Office	8	21	4582.09	16.80	8	2.1
468	Melia azadirachta	306	PTCL Office	9	19	24140.98	88.51	10	8.8
469	Melia azadirachta	79	PTCL Office	9	19	6248.25	22.91	10	2.3
470	Albizia lebbeck	82	PTCL Office	9	14	4858.59	17.81	10	1.8
471	Fabaceae	430	PTCL Office	9	20	35699.22	130.88	10	13.0
472	Albizia lebbeck	480	PTCL Office	9	20	39887.40	146.24	10	14.6
473	Albizia lebbeck	36	PTCL Office	9	21	3142.99	11.52	10	1.1
474	Albizia lebbeck	240	PTCL Office	9	20	19943.70	73.12	11	6.6
475	Melia azadirachta	460	PTCL Office	11	21	59984.04	219.92	11	19.9
476	Tectona grandis	60	PTCL Office	11	22	8232.80	30.18	11	2.7
477	Albizia lebbeck	34	PTCL Office	11	22	4610.37	16.90	11	1.5
478	Fabaceae	301	PTCL Office	11	33	69007.82	253.00	11	22.9
479	Cocos nucifera	587	PTCL Office	14	38	256823.94	941.59	19	49.4
480	Cocos nucifera	816	PTCL Office	14	38	357137.59	1309.37	19	68.7
481	Ficus benghalensis	23	PTCL Office	17	30	10337.18	37.90	19	2.0

482	Ficus benghalensis	120	PTCL Office	18	31	64746.16	237.38	19	12.5
483	Casuarina Tree	12	PTCL OFFICE	1	10	**6.076**	**0.022**	**2**	0.0109
484	Casuarina Tree	24	PTCL OFFICE	1	10	**12.153**	**0.045**	**2**	0.0217
485	Casuarina Tree	180	PTCL OFFICE	1	10	**91.147**	**0.334**	**2**	0.1630
486	Casuarina Tree	240	PTCL OFFICE	1	10	**121.529**	**0.446**	**2**	0.2173
487	Casuarina Tree	144	PTCL OFFICE	1	10	**72.917**	**0.267**	**2**	0.1304
488	Casuarina Tree	60	PTCL OFFICE	1	10	**30.382**	**0.111**	**2**	0.0543
489	Casuarina Tree	102	PTCL OFFICE	1	10	**51.650**	**0.189**	**2**	0.0924
490	Casuarina Tree	120	PTCL OFFICE	1	10	**60.764**	**0.223**	**2**	0.1087
491	Casuarina Tree	162	PTCL OFFICE	1	10	**82.032**	**0.301**	**2**	0.1467
492	Casuarina Tree	72	PTCL ROAD SIDE	1	10	**36.459**	**0.134**	**2**	0.0652
493	Fabaceae	458	QAD south	5	13	8936.97	32.77	3.6	9.2
494	Fabaceae	34	QAD West	9	19	2650.77	9.72	10	1.0
495	Melia azadirachta	12	QAD West	11	21	1566.16	5.74	11	0.5
496	Casuarina Tree	74	R O Plant, Guard Pond	1	10	**37.674**	**0.138**	**2**	0.0674
497	Terminalia Catappa	18	Railway gate opposite site	8	16	932.62	3.42	6	0.6
498	Albizia lebbeck	66	Railway gate opposite site	9	20	5484.52	20.11	10	2.0
499	Pithecellobium dulce	50	Railway gate opposite site	9	20	4188.18	15.36	10	1.5
500	Albizia lebbeck	18	Railway gate opposite site	9	21	1571.50	5.76	10	0.6
501	Albizia lebbeck	25	Railway gate opposite site	11	22	3497.98	12.82	11	1.2
502	Saraca asoca	18	Railway gate opposite site	11	45	5140.20	18.85	11	1.7
503	Melia azadirachta	12	Railway gate opposite site	11	23	1893.15	6.94	11	0.6
504	Cocos nucifera	18	Railway gate opposite site	14	36	7151.71	26.22	15	1.7
505	Cocos nucifera	12	Railway gate opposite site	14	39	5391.13	19.77	19	1.0
506	Cocos nucifera	18	Railway gate opposite site	14	42	8712.70	31.94	19	1.7
507	Tamarindus indica	60	Railway gate opposite site	17	24	21717.55	79.62	19	4.2

508	Ficus benghalensis	12	Railway gate opposite site	17	30	5440.62	19.95	19	1.0
509	Tectona grandis	132	Railway gate opposite site	17	35	69903.74	256.29	19	13.5
510	Tectona grandis	60	Railway gate opposite site	17	35	31774.43	116.49	19	6.1
511	Tamarindus indica	36	Railway gate opposite site	18	24	15002.76	55.00	19	2.9
512	Fabaceae	595	Raw Material Yard North	5	15	10969.63	40.22	2.6	15.8
513	Melia azadirachta	720	Raw Material Yard North	9	19	56802.32	208.25	10	20.7
514	Albizia lebbeck	344	Raw Material Yard North	10	20	35631.13	130.63	11	11.8
515	Saraca asoca	222	Raw Material Yard North	14	31	75869.60	278.16	13	21.3
516	Tectona grandis	211	Raw Material Yard North	14	38	92435.61	338.90	19	17.8
517	Eucalyptus	175	Raw Material Yard North	16	35	83968.94	307.86	19	16.2
518	Fabaceae	1068	Raw Material Yard South	5	15	19683.41	72.17	2.6	28.3
519	Pithecellobium dulce	499	Raw Material Yard South	5	15	9200.34	33.73	2.6	13.2
520	Fabaceae	811	Raw Material Yard South	5	13	15815.16	57.98	3.6	16.3
521	Derris indica	319	Raw Material Yard South	6	15	8388.96	30.76	3.6	8.7
522	Terminalia Catappa	264	Raw Material Yard South	7	13	8592.63	31.50	4.6	6.9
523	Melia azadirachta	551	Raw Material Yard South	7	15	20800.28	76.26	4.6	16.8
524	Melia azadirachta	576	Raw Material Yard South	7	15	21751.92	79.75	4.6	17.5
525	Ficus religiosa	223	Raw Material Yard South	9	21	19486.56	71.44	10	7.1
526	Saraca asoca	67	Raw Material Yard South	12	28	14243.75	52.22	11	4.7
527	Cocos nucifera	106	Raw Material Yard South	14	33	38436.28	140.92	13	10.8
528	Tectona grandis	144	Raw Material Yard South	14	33	54677.62	200.46	19	10.5
529	Saraca asoca	104	Raw Material Yard West	9	25	10871.37	39.86	11	3.6
530	Fabaceae	598	Raw Material Yard West	10	18	55567.23	203.73	11	18.4
531	Tectona grandis	26	Raw Material Yard West	11	31	5180.62	18.99	11	1.7

532	Saraca asoca	67	Raw Material Yard West	11	31	13187.03	48.35	11	4.4
533	Melia azadirachta	395	Raw Material Yard West	14	19	82748.06	303.38	17	17.8
534	Tectona grandis	54	Raw Material Yard West	14	34	21130.11	77.47	19	4.1
535	Casuarina Tree	108	RO PLANT AREA	1	10	**54.688**	**0.201**	**2**	0.0978
536	Casuarina Tree	78	RO PLANT AREA	1	10	**39.497**	**0.145**	**2**	0.0706
537	Casuarina Tree	13	RO PLANT ROAD SIDE	1	10	**6.684**	**0.025**	**2**	0.0120
538	Casuarina Tree	72	RO PLANT ROAD SIDE	1	10	**36.459**	**0.134**	**2**	0.0652
539	Fabaceae	14	Safety & environment entrance	9	16	954.32	3.50	10	0.3
540	Mangifera indica	18	Safety & environment entrance	10	22	2050.80	7.52	11	0.7
541	Tectona grandis	19	Safety & environment entrance	14	24	5097.11	18.69	19	1.0
542	Cocos nucifera	8	Safety & environment entrance	14	39	3773.79	13.84	19	0.7
543	Terminalia Catappa	12	Safety & environment south	7	15	453.17	1.66	4.6	0.4
544	Fabaceae	30	Safety & environment south	9	18	2240.56	8.21	10	0.8
545	Fabaceae	18	Safety & environment south	11	21	2349.24	8.61	11	0.8
546	Melia azadirachta	24	Safety & environment south	11	23	3786.30	13.88	11	1.3
547	Roystonea regia	60	Safety & environment south	14	16	10280.76	37.69	11	3.4
548	Melia azadirachta	7	Safety & environment south	14	24	1860.16	6.82	12	0.6
549	Fabaceae	17	Safety & environment south	14	26	5015.77	18.39	19	1.0

550	Tectona grandis	10	Safety & environment south	14	39	4312.91	15.81	19	0.8
551	Cocos nucifera	12	Safety & environment south	14	49	6782.24	24.87	19	1.3
552	Terminalia Catappa	24	Scrap yard cooling tower	9	16	1641.01	6.02	8	0.7
553	Albizia lebbeck	8	Scrap yard cooling tower	14	22	1964.63	7.20	12	0.6
554	Albizia lebbeck	10	Scrap yard cooling tower	14	26	2866.15	10.51	19	0.6
555	Terminalia Catappa	34	sinter Machine North	9	19	2650.77	9.72	10	1.0
556	Melia azadirachta	12	sinter Machine North	9	21	1047.66	3.84	10	0.4
557	Fabaceae	31	sinter Machine North	9	20	2546.74	9.34	11	0.8
558	Fabaceae	36	sinter Machine North	11	21	4698.49	17.23	11	1.6
559	Fabaceae	49	Sinter Machine plant 2 North	7	15	1857.98	6.81	4.6	1.5
560	Melia azadirachta	18	Sinter Machine plant 2 North	8	21	1374.63	5.04	6	0.8
561	Fabaceae	52	Sinter Machine plant 2 south	14	21	11968.45	43.88	17	2.6
562	Terminalia Catappa	18	Sinter plant	9	21	1548.78	5.68	10	0.6
563	Fabaceae	30	Sinter plant	9	21	2619.16	9.60	11	0.9
564	Casuarina Tree	240	SINTER PLANT	1	10	**121.529**	**0.446**	**2**	0.2173
565	Casuarina Tree	78	SINTER PLANT	1	10	**39.497**	**0.145**	**2**	0.0706
566	Casuarina Tree	84	Sinter Plant-II	1	10	**42.535**	**0.156**	**2**	0.1
567	Bambusa arundinacea	864	Slag Crushing mining plant	4	10	6412.51	23.51	2	11.5
568	Fabaceae	18	Slag Crushing mining plant	11	22	2498.55	9.16	11	0.8
569	Melia azadirachta	18	Slag Crushing mining plant	12	21	2811.78	10.31	11	0.9
570	Fabaceae	22	SP East	10	22	2460.96	9.02	11	0.8
571	Fabaceae	37	SP south	11	22	5104.34	18.71	11	1.7
572	Melia azadirachta	18	SP south	11	21	2349.24	8.61	11	0.8
573	Casuarina Tree	240	TEMPLE	1	10	**121.529**	**0.446**	**2**	0.2173
574	Casuarina Tree	180	TEMPLE	1	10	**91.147**	**0.334**	**2**	0.1630
575	Casuarina Tree	552	TEMPLE AREA COMPUND SIDE	1	10	**279.516**	**1.025**	**2**	0.4999

576	Casuarina Tree	420	TEMPLE AREA COMPUND SIDE	1	10	**212.675**	**0.780**	**2**	0.3804
577	Fabaceae	511	Temple East	5	16	12362.09	45.32	3.6	12.8
578	Fabaceae	462	Temple East	7	14	16241.98	59.55	4.6	13.1
579	Terminalia Catappa	410	Temple East	7	15	15498.25	56.82	4.6	12.5
580	Melia azadirachta	353	Temple East	9	16	24122.88	88.44	8	11.0
581	Bauhinia purpurea	18	Temple East	9	14	1071.75	3.93	10	0.4
582	Tectona grandis	54	Temple East	9	19	4260.17	15.62	10	1.6
583	Albizia lebbeck	182	Temple East	9	18	13622.63	49.94	11	4.5
584	Melia azadirachta	218	Temple East	9	18	16311.31	59.80	11	5.4
585	Pithecellobium dulce	61	Temple East	10	20	6331.66	23.21	11	2.1
586	Fabaceae	191	Temple East	10	22	21738.45	79.70	11	7.2
587	Albizia lebbeck	170	Temple East	10	22	19414.21	71.18	11	6.4
588	Tectona grandis	108	Temple East	11	33	22571.69	82.75	11	7.5
589	Tectona grandis	106	Temple East	11	38	27887.24	102.24	11	9.3
590	Melia azadirachta	330	Temple East	12	22	54825.61	201.01	11	18.2
591	Saraca asoca	347	Temple East	14	34	130082.03	476.92	13	36.5
592	Tectona grandis	720	Temple East	14	42	335027.06	1228.31	16	76.5
593	Ficus religiosa	34	Temple East	14	24	8919.94	32.70	19	1.7
594	Cocos nucifera	194	Temple East	14	38	85082.78	311.94	19	16.4
595	Tectona grandis	366	Temple East	17	45	249593.96	915.09	19	48.0
596	Fabaceae	548	Temple South	4	12	4928.83	18.07	2	8.8
597	Fabaceae	443	Temple South	5	16	10708.00	39.26	3.6	11.1
598	Terminalia Catappa	163	Temple South	5	12	2926.80	10.73	3.6	3.0
599	Derris indica	233	Temple South	5	12	4175.00	15.31	3.6	4.3
600	Roystonea regia	89	Temple South	5	14	1869.97	6.86	3.6	1.9
601	Tectona grandis	288	Temple South	5	14	6064.75	22.24	3.6	6.3
602	Fabaceae	577	Temple South	9	18	43108.45	158.05	10	15.7
603	Melia azadirachta	474	Temple South	9	18	35400.91	129.79	10	12.9
604	Albizia lebbeck	240	Temple South	9	18	17924.51	65.72	10	6.5
605	Bauhinia purpurea	55	Temple South	9	18	4122.64	15.11	11	1.4

606	Melia azadirachta	338	Temple South	12	22	55575.08	203.75	11	18.4
607	Albizia lebbeck	54	Temple South	14	24	13951.21	51.15	12	4.2
608	Tectona grandis	139	Temple South	14	33	50666.00	185.76	13	14.2
609	Eucalyptus	58	Temple South	14	36	23874.25	87.53	19	4.6
610	Tectona grandis	47	Temple South	16	39	25011.62	91.70	19	4.8
611	Ficus religiosa	18	Temple South	19	45	16396.84	60.12	19	3.2
612	Casuarina Tree	336	TOWNSHIP AREA	1	10	**170.140**	**0.624**	**2**	0.3043
613	Casuarina Tree	300	TOWNSHIP AREA	1	10	**151.911**	**0.557**	**2**	0.2717
614	Casuarina Tree	204	TOWNSHIP AREA	1	10	**103.299**	**0.379**	**2**	0.1847
615	Casuarina Tree	120	TOWNSHIP AREA	1	10	**60.764**	**0.223**	**2**	0.1087
616	Casuarina Tree	120	TOWNSHIP AREA	1	10	**60.764**	**0.223**	**2**	0.1087
617	Casuarina Tree	180	TOWNSHIP AREA	1	10	**91.147**	**0.334**	**2**	0.1630
618	Casuarina Tree	120	TOWNSHIP RESERVIOR	1	10	**60.764**	**0.223**	**2**	0.1087
619	Terminalia Catappa	120	wagon loco office	5	13	2339.52	8.58	3.6	2.4
620	Fabaceae	18	wagon loco office	10	22	2050.80	7.52	11	0.7
621	Albizia lebbeck	26	wagon loco office	11	21	3445.56	12.63	11	1.1
622	Melia azadirachta	30	wagon loco office	12	16	3609.47	13.23	11	1.2
623	Fabaceae	30	wagon loco office	14	22	7098.10	26.02	12	2.2
624	Cocos nucifera	12	wagon loco office	14	35	4634.46	16.99	15	1.1
625	Roystonea regia	14	wagon loco office	14	14	2277.87	8.35	17	0.5
626	Albizia lebbeck	22	wagon loco office	14	22	5191.10	19.03	19	1.0
627	Casuarina Tree	120	WAGON TIPPLER	1	10	**60.764**	**0.223**	**2**	0.1087
628	Fabaceae	415	Water Reservoir south Boundary	5	13	6595.28	24.18	2.6	9.5
629	Bambusa arundinacea	4200	Water Reservoir south Boundary	5	12	75322.18	276.15	3.6	77.8
630	Fabaceae	1080	Water Reservoir south Boundary	5	14	22742.82	83.38	3.6	23.5

631	Fabaceae	631	Water Reservoir south Boundary	5	14	13291.92	48.73	3.6	13.7
632	Fabaceae	499	Water Reservoir south Boundary	6	16	14025.62	51.42	3.6	14.5
633	Fabaceae	295	Water Reservoir south Boundary	8	16	15295.00	56.08	6	9.3
634	Fabaceae	3600	Water Reservoir south Boundary	8	16	186524.41	683.85	6	113.0
635	Fabaceae	938	Water Reservoir south Boundary	9	14	55873.80	204.85	10	20.4
636	Fabaceae	830	Water Reservoir south Boundary	9	18	62018.81	227.38	10	22.6
637	Fabaceae	180	Water Reservoir south Boundary	9	20	14957.77	54.84	10	5.5
638	Cassia fistula	18	Water Reservoir south Boundary	9	20	1495.78	5.48	10	0.5
639	Fabaceae	300	Water Reservoir south Boundary	9	20	24487.93	89.78	10	8.9
640	Melia azadirachta	227	Water Reservoir south Boundary	9	20	18846.80	69.10	11	6.3
641	Melia azadirachta	90	Water Reservoir south Boundary	10	22	10253.99	37.59	11	3.4
642	Melia azadirachta	180	Water Reservoir south Boundary	11	21	23492.44	86.13	11	7.8
643	Fabaceae	295	Water Reservoir south Boundary	11	21	38527.61	141.25	11	12.8
644	Melia azadirachta	226	Water Reservoir south Boundary	11	21	29443.86	107.95	11	9.8
645	Fabaceae	370	Water Reservoir south Boundary	11	22	51303.65	188.09	11	17.0
646	Melia azadirachta	182	Water Reservoir south Boundary	11	22	25318.68	92.83	11	8.4
647	Melia azadirachta	342	Water Reservoir south Boundary	11	20	42344.30	155.25	11	14.0
648	Melia azadirachta	52	Water Reservoir south Boundary	11	21	6734.50	24.69	11	2.2
649	Neolamarckia cadamba	52	Water Reservoir south Boundary	11	21	6734.50	24.69	11	2.2
650	Tamarindus indica	107	Water Reservoir south Boundary	14	30	35312.62	129.47	13	9.9
651	Fabaceae	301	Water Reservoir south Boundary	14	34	112977.82	414.21	15	27.5
652	Saraca asoca	67	Water Reservoir south Boundary	14	42	31269.19	114.64	16	7.1
653	Borassus flabellifer	48	Water Reservoir south Boundary	14	45	23939.90	87.77	17	5.1
654	Borassus flabellifer	30	Water Reservoir south Boundary	14	48	15965.41	58.53	17	3.4

655	Borassus flabellifer	40	Water Reservoir south Boundary	14	48	21074.34	77.26	17	4.5
656	Tectona grandis	343	Water Reservoir south Boundary	14	42	166122.17	609.05	19	32.0
657	Cocos nucifera	31	Water Reservoir south Boundary	14	45	16187.08	59.35	19	3.1
658	Borassus flabellifer	8	Water Reservoir south Boundary	14	49	4747.57	17.41	19	0.9
659	Saraca asoca	101	Water Reservoir south Boundary	14	49	56970.85	208.87	19	11.0
660	Cocos nucifera	55	Water Reservoir south Boundary	14	49	31198.32	114.38	19	6.0
661	Cocos nucifera	396	Water Reservoir south Boundary	16	44	238941.85	876.03	19	46.0
662	Tectona grandis	288	Water Reservoir south Boundary	16	44	173775.89	637.11	19	33.4
663	Tectona grandis	102	Water Reservoir south Boundary	16	45	62952.25	230.80	19	12.1
664	Ficus religiosa	94	Water Reservoir south Boundary	17	30	42436.86	155.59	19	8.2
665	Tectona grandis	144	Water Reservoir south Boundary	18	33	82748.06	303.38	19	15.9
666	Tectona grandis	828	Water Reservoir south Boundary	18	45	650118.50	2383.53	19	125.1
667	Tectona grandis	696	Water Reservoir south Boundary	18	35	424370.21	1555.87	19	81.7
		175003		Existing trees carbon sequestration per annum					**5686**
	Planted 2022-2023	10256		Last year trees carbon sequestration					12.3
	Total	**185259**		Total Carbon Sequestered per annum					**5699**

Annexure- II

CPCB guidelines for Green Belt development

VII. Green Belt

i. Green belt shall be developed in an area equal to 33% of the plant area with a native tree species in accordance with CPCB guidelines. The greenbelt shall inter alia cover the entire periphery of the plant

ii. The project proponent shall prepare GHG emissions inventory for the plant and shall submit the programme for reduction of the same including carbon sequestration including plantation.

Ref : Annexure II III and IV.

F. No. 22-34/2018-IA.III
Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

Annexure- III

Environment Celebration Activities by M/s.JSW

Tree Sapling 2022-2023

Tree Sapling -2022-2023

Annexure-IV

List of Recommended species for further improvement **

1. Acacia albida
2. Acacia aunculiformis
3. Acacta catechu
4. Acacia holosericea
5. Acacia nilottca
6. Acacia senegal
7. Albizia amara
8. Albizra lebbeck
9. Azadirachta rndtca
10. Oalberg1a SISSOO
11. Eucalyptus hybrid
12. Erythrina vanegata

13. Gliricidia sepium
14. Grewia tenax
15. Hardwickia binata
16. Leucaena latisiliqua
17. Pithecellobium dulce
18. Ztzyphus nummulan

** Ref : PAOBES/75/1999-2000
CENTRAL POLLUTION CONTROL BOARD
(Ministry of Environment & Forests, Govt. of India) Parivesh Bhawan, East Arjun Nagar Delhi -110 032,India.

ANNEXURE 10

ESC FUND ALLOCATION & SPENT FOR THE PERIOD

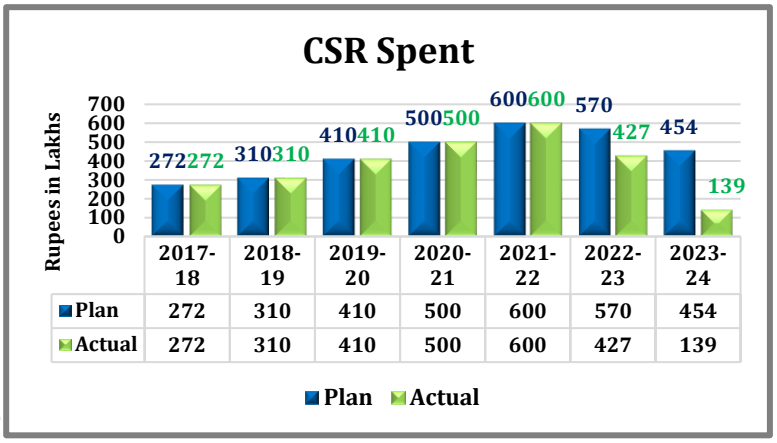
APRIL 2023 TO SEPTEMBER 2023

CSR REPORT FOR THE PERIOD OF APRIL 2023 TO SEPTEMBER 2023

Background

JSW is deeply conscious of its vision and responsibilities to the community around the plant. Empowering citizen with better health, education and employment opportunities is JSW's mission.JSW is committed to improve the quality of life of surrounding community through Corporate Social Responsibility (CSR) programmes. We have well laid down community development program under CSR.Our focus is on

- Health
- Education
- Environment
- Women Empowerment
- Sports and
- Rural Infrastructure Development.



People in Pottaneri, M.Kalipatti, Kuttapatti, Viruthasampatti, Gonur Panchayats and Mecheri Town are covered under CSR projects. Our commitment towards CSR spending for the financial year 2023-24 is Rs. 4.54 Crores.

AGRI-LIVELIHOOD – JSWF inked MoU with TNAU

JSW – CSR in a significant move aligning with Schedule VII of the Companies Act, 2013. JSW Foundation has entered into a pioneering Memorandum of Understanding (MoU) with Tamil Nadu Agricultural University (TNAU) in Coimbatore. This collaboration signifies a shared commitment to uplift the farmer's livelihoods through an Integrated Farming System Project. Under this ground breaking pact, the focus is on empowering farmers in the region through various transformative initiatives. Farmer producer groups are being sensitized and equipped with knowledge in diverse agricultural interventions and allied practices tailored to local farming systems. Moreover, lead resource persons are being trained to act as catalysts for change and workshops, discussions and seminars are being conducted to facilitate knowledge exchange. Crucially, the partnership provides need-based technical support to farmers, ensuring that they receive assistance tailored to their unique challenges and requirements. Furthermore, the collaboration is committed to fostering innovation in the agriculture sector, introducing novel inventions and cutting-edge technologies that will revolutionize farming practices.

EDUCATION – Inaugurated Mettur ITI Civil Work

JSW – CSR handed over renovated bore well to the Government Mettur Industrial Training Institute (ITI). In this ITI 540 students are pursuing their professional courses, and those who are admitted in this institution are students who come from socio-economically backward conditions from the interior parts of Mettur region. In order to create good learning atmosphere to students, we have contributed in possible ways to develop the institution's infrastructure. This year we have renovated bore well and motor room to ensure sufficient and regular drinking water to the students. The worth of this intervention is Rs.412000/-

SANITATION - Inaugurated Sanitation Block at GOVT High School, Malligundam

JSW – CSR has supported to construct school sanitation blocks in nearby surrounding government schools in order to ensure hygienic practices among students in this school. Through this intervention 450 students are availing the benefits. The project value is Rs.1200000/-

SANITATION - INNAGURATED SANITATION BLOCK, PUTHUSAMPALLI

JSW – CSR has supported to construct school sanitation blocks in nearby surrounding government schools in order to ensure hygienic practices among students in this school. Through this intervention 450 students are availing the benefits. The project value is Rs.1400000/-

EDUCATION – Renovated Science Lab

JSW – CSR renovated the science lab at Kullamudayanoor Government Higher Secondary School. Though the school had science equipment there were no adequate laboratory space for the students to access and utilize the equipment. Through our intervention we have developed a good adequate space and atmosphere for the enhancement of scientific skillsets of the students in this school. The project value is Rs.900000/-

RURAL DEVELOPMENT- DRAINAGE CONSTRUCTION

JSW - CSR constructed drainage and graveyard compound wall at Pottaneri Panchayat for the benefit of community members. In this panchayat 2000 families are residing, and there is no sufficient and proper place for the community members to bury. Also there are no drainage facilities in main panchayat to access, especially during the rainy seasons. To avoid conditions of overflowing and stagnation of water, we have constructed drainage adjacent to the graveyard compound wall. Through this intervention nearly 2000 families are getting benefit and the project value is Rs.2600000/-

EDUCATION – JSW ASPIRE PROGRAM

In order to improve life skills among young generation. We have initiated life skill training program, through this initiatives targeted 1500 students from 7 government schools within radiation of 5 km. Through this initiative enhancing skills of children's life skills, carrier counsiling, problem solving & critical thinking. This initiative is not only targeted schools children but also educating their parents on importance of education and conducting activities to create awarness among parents. Also established Community Learning Center (CLC) at community level to reach children as well their parents.

Also encouraged children to participate National days such as National Girl child day, Children's Day, Ocean Day, Nutrition day and so on.

SPORTS – SILAMBAM ART

JSW – CSR initiated Silambam art activity in surrounding 5 government schools. We have trained 200 students on Silambam art, and also these students participated in World Record Event and showcased their potential in Silambam art.

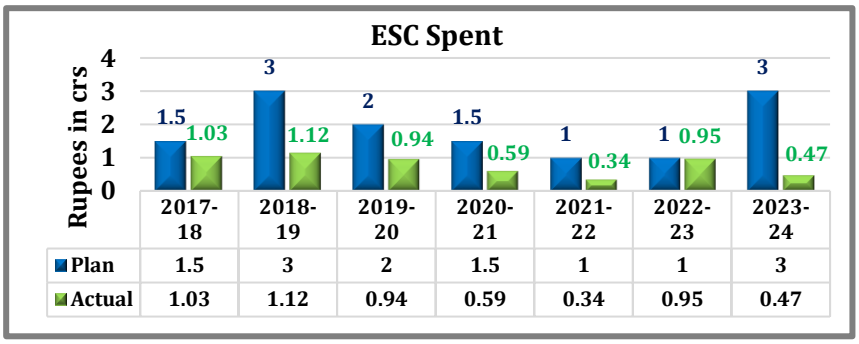
Table 1 : CSR committed & spent details for the period April – March 2023 (Fy24)

Sl.No.	Activitiy	Committed in lakhs(INR) for FY 24	Spent in lakhs(INR) till Sep 2023	Remarks
1	Climate resilient agri program	70.00	15.48	On-going
2	Support to JSW Shakti BPO	10.00	0	On-going
3	Water body rejuvenation	15.00	5.7	On-going
4	Community Development initiatives	25.00	0	On-going
5	Increasing Green Cover	30.00	20.62	On-going
6	JSW Aspire Project	44.00	22.52	On-going
7	JSW Udaan Scholarship	75.00	0	On-going
8	School Infrastructure Project	104.00	73.3	On-going
9	Health Outreach Activities	47.00	0	On-going
10	Rural infrastructure	25.00	0	On-going
11	Environment Education	3.67	1.83	On-going
12	Program Support-Sports	5.00	0	On-going
	Total	**453.67**	**139.45**	

ENVIRONMENT SOCIAL COMMITMENT : HYR FOR APRIL 23 TO SEPTEMBER 2023

JSW steel Ltd., Salem works is the only Integrated steel plant in Tamil Nadu and presently operating with production capacity of 1.15 MTPA. JSW Steel Limited, Salem works is highly committed to protect the environment with distinctive focus on Triple bottom growth for sustainable development. The organization has always maintained Statutory and Regulatory compliances and believes in maintaining harmony with all the stake holders and contributes to societal support activities like:

- Water shed programmes
- Supplying drinking water
- Sanitation facilities
- Road repair/constructions
- Health camps
- Education activities, etc.



	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
Plan	1.5	3	2	1.5	1	1	3
Actual	1.03	1.12	0.94	0.59	0.34	0.95	0.47

EARLY CHILDHOOD CARE & EDUCATION - DISTRIBUTED ALMIRAHS

We have given 10 Almirahs to nearby 10 Anganwadi Centres based on their need. With nearly 195 students attending these Anganwadis, teachers find the almirahs very useful to store the teaching materials and other records.

ENVIRONMENT - CLOTH BAGS

We have distributed cloth bags to the surrounding communities in order to arrest the usage of plastics. Distributed 20000 cloth bags to 4 panchayats and 20 villages. Along with that we have educated the community members about disadvantages in using plastics and advantage of using the cloth bags.

We have taken effort to reduce the usage of plastics by providing the eco - friendly bags to the community (DIZ) to protect the surrounding environment. Through this intervention we have reduced unhealthy practices among communities and have promoted safe environment.

SPORTS – ZONAL SPORTS

We have provided support for conducting the Zonal Sports meet at Omalur. After COVID – 19, this is the initial zonal sports meet. Hence the organizers were requested to support food facilities to 700 students for two days.

RURAL DEVELOPMENT- LAKE DEEPENING

As part of JSW – CSR's water initiatives, a massive clean-up drive was organized to get rid of weeds and trashes in the Water body at Vellakkalpatti in Salem district. Currently, there are no proper bund, inlet, and outlet channel facilities in this lake. During the rainy season, the rainwater stagnates on the road. The public and school children find it difficult to pass this area. We have cleaned and deepened the channel while renovating the waterbody. The renovated area is 2.69 Hec. Through this intervention, we've supported to increase the groundwater levels at this location for the benefit of surrounding farmers. It helped canal to enhance its storage capacity of recharging the groundwater level. The project value is Rs. 2500000/-

HEALTH – PERMANENT COVID CARE CENTER

Salem district is reporting more number of Covid cases and the district administration is taking all efforts to control the spread and treat every COVID affected patient with utmost care. To tackle the present scenario, we have supported district administration for setting up of permanent 1000 bedded Covid Care Center at Salem District. This intervention is immensely supportive to treat Covid affected patients equally regardless of their economic status. Also this center is helping to mitigate COVID-19 spread.

Enterprise Social Commitment (ESC) comitmemt submitted during Environment Impact Assessment(EIA) Study 2017 to MoEF&CC is given in Table 2

Table 2 : Fund Allocation for Enterprise Social Commitment (ESC) as per EC dated 07.07.2017 (Rs. In Crs)

Sl.No	Description of activities	No's of facility	Amount committed in five years (Rs. In Crs)					Total Rs in Crs
			Year I	Year II	Year III	Year IV	Year V	
1	Toilets	2000	0.5	0.75	0.75	0.5	0.5	**3**
2	Health center	1	0.25	0.25	0.25	0.25	0	**1**
3	Community hall	2	0	0.5	0.5	0	0	**1**
4	Hospital	1	0.5	0.5	0.5	0.25	0.25	**2**
5	Modern school New with GYM and Play ground	1	0	0	1	0.5	0.5	**2**
6	Watershed program	1	0	0.25	0.25	0.25	0.25	**1**
7	Water body strengthening/ Drinking water bore well drilling		0	0.25	0.25	0.25	0.25	**1**
8	Drainage		0.25	0.25	0.25	0.25	0	**1**
9	Government school improvement	1	0	0.25	0.25	0.25	0.25	**1**
Total			**1.5**	**3**	**4**	**2.5**	**2**	**13**

The actual amount spent on ESC till June 2020 is given in Table 3

Table 3 : The actual amount spent on ESC till June 2020 (Rs. In Crs)

Sl. No	Description of activities	No's	Year I (Jul'17 to Dec'17)		Year II (Jan'18 to Dec'18)		Year III (Jan'19 to Dec'19)		Year IV (Jan'20 to Jun'20)		Total Rs . (in Crs)	
			Committed	Spent	Committed	Spent	Committed	Spent	Committed	Spent	Committed	Spent
1	Toilets	2000	0.5	0.32	0.75	0.19	0.75	0.04	0.5	0	3	0.55
2	Health center	1	0.25	0	0.25	0	0.25	0.22	0.25	0.21	1	0.43
3	Community hall	2	0	0	0.5	0	0.5	0	0	0	1	0
4	Hospital	1	0.5	0	0.5	0	0.5	0	0.25	0.25	2	0.25
5	Modern school New with GYM and Play ground	1	0	0	0	0	1	0	0.5	0	2	0
6	Watershed program	1	0	0.24	0.25	0	0.25	0.21	0.25	0	1	0.45
7	Water body strengthening/ Drinking water bore well drilling		0	0	0.25	0.2	0.25	0.2	0.25	0.11	1	0.51
8	Drainage		0.25	0	0.25	0.39	0.25	0.1	0.25	0	1	0.49
9	Government school improvement	1	0	0.47	0.25	0.34	0.25	0.17	0.25	0.02	1	1
Total			**1.5**	**1.03**	**3.0**	**1.12**	**4.0**	**0.94**	**2.5**	**0.593**	**13.0**	**3.68**

Enterprise Social Commitment (ESC) revised comitmemt submitted to MoEF&CC dated 26.09.2020 is given in Table 4

Table 4 : Revised Fund Allocation for ESC as per letter submitted to MoEFCC (Rs. In Crs)

Sl.No	Sectors	Details	Total Rs in Cr Commitment
1	Health	Health & Eye Camps to public and school students , Hospital improvement	1.22
2	Education	School library support , career guidance , sports support , Anganvadi support , class toppers prize to school students, School Technology improvement	1.22
3	Infrastructure Development	School and Educational institution infrastructure improvement , village infrastructure improvement , toilet construction in schools and villages , village library support , Drainage improvement , road improvement , water body improvement , desilting of channels, pond and reservoir	4.7
4	Livelihood support	Need based training (Eg Tailoring , ARI , Zardoshi) to women , Spoken English training to unemployed youth to increase their employability level, organic training to farmers , agricultural inputs to Farmers , exposures trips to farmers , sponsorship to farmers for various training	1.18
5	Others	Waste Management support , sports related support in schools and Villages, awareness creation programs in schools and villages and other need based activities	1
Total in Rs. Crs (shall be spent)			**9.32**
Total spent Crs. Till June 2020			**3.68**
Total in Rs. Crs (as the commitment made)			**13.00**

Total Amount spent on Enterprise Social Commitment (ESC) from July 2020 to March 2022 is given in Table 5

Table 5 ESC spent from July 2020 to March 2022

Sl. No.	Description of activities	ESC fund Rs. in Crs	
		Committed	Spent
1	Health	0.13	0.14
2	Education	0.23	0.01
3	Infrastructure Development	0.63	0.19
4	Livelihood support	0.00	0.00
5	Others	0.00	0.00
	Total in Crs.	**0.99**	**0.34**

Total Amount spent on Enterprise Social Commitment (ESC) from April 2022 to Sep 2023 is given in Table 6

Table 6: ESC spent details from April 22 to Sep 23

Sl. No.	Description of activities	April – September 22		October – March 23		April – September 23		Total spent in Crs from July 2017 onwards to till Sep 23
		Committed (Rs in Crs)	Spent (Rs in Crs)	Committed (Rs in Crs)	Spent (Rs in Crs)	Committed (Rs in Crs)	Spent (Rs in Crs)	(Rs. in Crs)
1	Health	0	0	0.25	0.08	0.3	0.2	0.28
2	Education	0.5	0.5	0.15	0.01	0.25	0.06	0.57
3	Infrastructure Development	0	0	0.15	0.08	0.5	0.15	0.23
4	Livelihood support	0	0	0.2	0	0	0	0
5	Others	0	0	0.25	0.28	0.5	0.06	0.34
	Total in Crs	**0.5**	**0.5**	**1**	**0.45**	**1.55**	**0.47**	**1.42**
	ESC spent from 2017 onwards to till March 23	**Total ESC spent Rs. in Crs till Sep 23 (3.68+0.34+1.42)**						**5.44**

ANNEXURE11

COPY OF ADVERTISEMENT IN LOCAL NEWSPAPER FOR EC DATED- 10.02.2020

Annexure -11

Copy of advertisement in local newspaper for EC dated. 10.02.2020

THE NEW INDIAN EXPRESS TAMIL NADU

05 DHARMAPURI FRIDAY 14.02.2020

NOTICE

We would like to inform you that the Ministry of Environment, Forest and Climate change accorded Environmental Clearance vide letter no. F.No. J-11011/281/2006-IA. II (I) Dated 10.02.2020 for the installation of 0.8 MTPA slag grinding unit and new facilities related to value addition and technological upgradation within the existing 1.3 MTPA capacity Integrated Steel Plant at JSW Steel Limited, Salem. The copy of Environmental Clearance is available at State Pollution Control Board and at MoEF&CC website: http://environmentclearance.nic.in.

This is issued as per the directives of MoEF&CC.

JSW Steel Limited, Salem

வெள்ளிக்கிழமை, 14 பிப்ரவரி 2020 ★★ தினமணி தருமபுரி 3

அறிவிப்பு

தி/வா. ஜே.எஸ். டபுள்யூ ஸ்டீல் லிமிடெட் நிறுவனத்திற்கு 0.8 MTPA ஸ்லாக் அரைக்கும் அலகு நிறுவுதல் மற்றும் மதிப்பு கூட்டல் தொடர்பான புதிய வசதிகள் மற்றும் தொழில்நுட்ப மேம்பாடு வசதிகளை தற்போதுள்ள 1.3 MTPA திறன் ஒருங்கிணைந்த எஃகு ஆலைக்குள் நிறுவ சுற்றுச்சூழல், வனம் மற்றும் பருவநிலை மாற்ற அமைச்சகம் கடித எண். (F.No. J–11011/281/2006–IA. II (I) 10.02.2020 தேதியிட்டது) அனுமதி வழங்கி உள்ளது. மேற்காணும் விபரத்தை தமிழ்நாடு மாசுக்கட்டுப்பாடு வாரியம் மற்றும் இணையத்தளம் http://environmentclearance.nic.in மூலம் தெரிந்து கொள்ளலாம்.

MoEF&CC அறிவுறுத்தலின் பேரில் இந்த அறிவிப்பு வெளியிடப்படுகிறது.

ஜே.எஸ். டபுள்யூ. ஸ்டீல் லிமிடெட், சேலம்

ANNEXURE 12
COPY OF ACKNOWLEDGEMENT OF EC COPY SUBMISSION TO HEADS OF LOCAL BODIES & PANCHAYATS

Annexure -12

Copy of acknowledgement of EC copy submission to Heads of local bodies & Panchayats

JSW Steel Limited

JSW Steel

20th Feb 2020

The District Collector

Salem District

Dear sir,

We enclose herewith the environmental clearance letter dated 10-02-2020 issued by the Environment, Forest and Climate change (Impact Assessment Division), Government of India for the installation of 0.8 MTPA Slag grinding unit and new facilities related to value addition and Technological upgradation within the existing 1.3 MTPA Integrated Steel Plant premises by M/s JSW Steel Limited for your information please .

Thanking you,

Yours Truly,

For JSW Steel Ltd, Salem Works,

Brigadier S .Thakur (Rtd)

AVP (PR, Admin and Security)

Encl : EC for Slag Grinding Unit

மாவட்ட ஆட்சித்தலைவர் அலுவலகம் சேலம் 30 MAY 2020

Salem Works
P.O. Pottaneri, Mecheri,
Mettur - Tk, Salem - Dt. Pin : 636 453
Tamilnadu, India.
CIN No L27102MH1994PLC152925
T +91 4298 272000
www.jsw.in

Registered Office
JSW Centre
Bandra Kurla Complex
Bandra East, Mumbai 400 051
T +91 22 4286 1000
F +91 22 4286 3000

JINDAL
O P Jindal Group

JSW Steel Limited
Salem Works : P.O.Pottaneri,
Mecheri, Mettur - Tk,
Salem - Dt. Pin : 636 453
Tamilnadu, India.
CIN No : L27102MH1994PLC152925
GSTIN : 33AAACJ4323N1ZN
Phone : +91 4298 272000
Fax : +91 4298 272272
Website : www.jsw.in

20th Feb 2020

The President

Pottaneri Panchayath

Pottaneri 636453

Dear Madam,

We enclose herewith the environmental clearance letter dated 10-02-2020 issued by the Environment, Forest and Climate change (Impact Assessment Division), Government of India for the installation of 0.8 MTPA Slag grinding unit and new facilities related to value addition and Technological upgradation within the existing 1.3 MTPA Integrated Steel Plant premises by M/s JSW Steel Limited for your information please .

Thanking you,

Yours Truly,

For JSW Steel Ltd, Salem Works,

JSW STEEL LTD. POTTANERI SALEM(DT)

Authorized Signatory,

Copy Received

Registered Office : JSW Centre
Bandra Kurla Complex,
Bandra (East), Mumbai - 400 051.
Phone : +91 22-4286 1000
Fax : +91 22-4286 3000

Part of O.P. Jindal Group

ANNEXURE 13

DETAILS OF APC MEASURES PROVIDED IN STEEL & CPPII

Annexure -13

Details of Air Pollution Control measures provided in Steel & CPPII

Stack No	Stack attached to	Stack Type	Air Pollution Control Equipment (APC)
1	SP#1 - Sinter machine waste gas fan stack	Process	ESP with stack
2	SP#1 - Cooling system stack	Non- Process	Multicyclone with stack
3	SP#1 - Dedusting system stack	Non- Process	Bag Filters with stack
4	SP#1 - RMHS dust extraction system	Non- Process	Bag Filters with stack
5	BF#1 - Hot stove stack	Process	Stack
6	BF#1 - GCP flare stack (Emergency stack)	Non- Process	Venturi Scrubber with stack
7	BF#1 - Stock house dedusting	Non- Process	Bag Filters with stack
8	BF#1- Cast house dedusting system stack	Non- Process	Bag Filters with stack
9	Process Boilers (1 x 25 TPH & 1 X 8 TPH)	Process	Common Stack
10	EOF#1- Primary dedusting system stack	Process	Venturi Scrubber with stack
11	CCM#3 -Billet grinding machine stack	Non- Process	Bag Filters with stack
12	CCM#1 Steam exhaust system stack	Non- Process	Stack
13	EOF#2 - Primary dedusting system stack	Process	Venturi Scrubber with stack
14	EOF#1&2 - Secondary dedusting system stack	Non- Process	Bag Filter with stack
15	LRF#1 - Primary & LRF#1 to 4 secondary dedusting system stack	Non- Process	Bag Filter with stack
16	LRF#2,3,4 - Primary dedusting system stack	Process	Bag Filter with stack
17	Vacuum degassing boiler#1 & #2 stack	Process	Stack
18	CCM#2 Steam exhaust system stack #1 & #2	Non- Process	Stack
19	CCM#2 - Cut fumes exhaust system stack	Non- Process	Stack
20	BLM - Reheating furnace stack #1	Process	Stack
21	BLM - Reheating furnace stack #2	Process	Stack
22	Coke Quenching Tower	Non- Process	Grit Arrester stack
23	COP - Coke oven battery #1 emergency stack# 1A & 1B	Process	Stack
24	COP - Coke oven battery#2 emergency stack	Process	Stack
25	COP - Coke oven battery#3 emergency stack	Process	Stack
26	COP - Waste Heat Recovery Boiler # 1 stack	Process	Stack
27	COP - Waste Heat Recovery Boiler # 2 stack	Process	Stack
28	COP - Waste Heat Recovery Boiler # 3 stack	Process	Stack
29	COP - Waste Heat Recovery Boiler # 4 stack	Process	Stack
30	COP - Waste Heat Recovery Boiler # 5 stack	Process	Stack
31	BF Gas Fired Boiler	Process	Stack
32	Limekiln(Not in Operation)	Non- Process	Not in operation
33	BRM- Reheating furnace stack #1 & 2	Process	Stack
34	SP#2 - Sinter machine waste gas fan stack	Process	ESP with stack

35	Stack attached to	Stack Type	Air Pollution Control Equipment (APC)
36	SP#2 - Dedusting and cooling system stack	Non- Process	ESP with stack
37	SP#2 - Crushing of fuel and raw materials dedusting stack	Non- Process	Bag Filters with stack
38	BF#2- Hot stove stack	Process	Stack
39	BF#2 - GCP flare stack (Emergency stack)	Non- Process	Bag Filters with stack
40	BF#2 - Stock house dedusting & RMH system stack	Non- Process	Bag Filters with stack
41	BF#2 - Cast house dedusting system stack	Non- Process	Bag Filters with stack
42	BF - Pulverised Coal Injection unit	Non- Process	Bag Filters with stack
43	COP-DG Set -625 KVA Stack	Non- Process	Acoustic enclosures with Stack
44	EOF#1 - DG Set -625 KVA stack	Non- Process	Acoustic enclosures with Stack
45	EOF#1 - DG Set -625 KVA stack	Non- Process	Acoustic enclosures with Stack
46	CCM#3 - Steam exhaust system stack #1	Non- Process	Stack
47	Process Boilers area - DG set -1250 KVA stack	Non- Process	Acoustic enclosures with Stack
48	Pickling Plant- Acid Fumes exhaust system stack	Non- Process	Wet scrubber with stack
49	Pickling Plant- Acid bath - Hot water Generator Stack	Process	Stack
50	Pickling Plant- ARP - Hot water Generator Stack	Process	Stack
51	Pickling Plant- MEE – Thermic fluid Heater Stack	Process	Stack
52	BF Slag Grinding mill stack	Non- Process	Bag Filters with stack
53	BF Slag Grinding unit-Sinter waste Gas- Emergency stack	Non- Process	Damper with vent stack
54	BF Slag Grinding unit- Hot Air Generator - Emergency stack	Non- Process	Damper with vent stack from HAG
55	CCM#1 -Billet grinding machine stack	Non- Process	Stack
56	CCM#2 -Billet grinding machine stack	Non- Process	Stack
57	EOF#2 - DG Set - 1250 KVA Stack	Non- Process -Emergency stack	Acoustic enclosures with stack
58	CCM#3 - DG Set - 1250 KVA stack	Non- Process -Emergency stack	Acoustic enclosures with stack
59	EOF#1 - DG Set -275 KVA Stack	Non- Process -Emergency stack	Acoustic enclosures with stack
60	EOF#2 - DG Set - 275 KVA Stack	Non- Process -Emergency stack	Acoustic enclosures with stack
61	BRM - DG set - 650 KVA - stack	Non- Process -Emergency stack	Acoustic enclosures with stack
62	Pickling plant - DG Set - 400 KVA - stack	Non- Process -Emergency stack	Acoustic enclosures with stack
63	Batching plant#1 Cement silo vent stack	Non- Process	Bag Filters with stack
64	Batching plant#2 Cement silo vent stack	Non- Process	Bag Filters with stack
65	COP - Coke cutter dedusting system stack	Non- Process	Bag Filters with stack
66	CCM#3 - Steam exhaust system stack #2	Non- Process	Stack
67	Coal fired boiler (127 T/HR)	Process	ESP with stack
68	Coal crusher house	Non- Process	Bag Filters with stack
69	Coal screening section	Non- Process	Bag Filters with stack
70	Raw material transfer and discharge point	Non- Process	Bag Filters with stack
71	Fly ash storage silo	Non- Process	Bag Filters with stack
72	Bottom ash storage silo	Non- Process	Bag Filters with stack
73	Diesel generator set – 500 KVA	Non- Process -Emergency stack	Stack
74	Diesel generator set – 275 KVA	Non- Process -Emergency stack	stack

ANNEXURE 14

HEAT STRESS ANALYSIS

HEAT STRESS EXPOSURE ASSESSMENT

Report prepared for

JSW Steel Limited, Salem

January, 2020

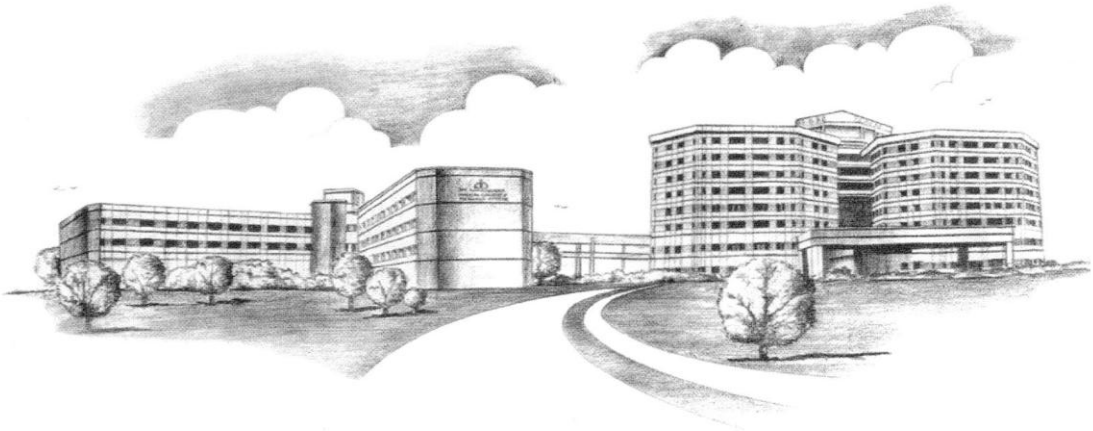
By

Department of Environmental Health Engineering

Sri Ramachandra

Institute of Higher Education & Research (Deemed to be University)

Porur, Chennai – 600 116



DISCLAIMER

This report has been prepared by DEHE-SRIHER (Department of Environmental Health Engineering - Sri Ramachandra Institute of Higher Education & Research (Deemed to be University) with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporating Industrial Hygiene Standard Practices and Conditions of Business and taking account of the manpower and resources devoted to it by agreement with the client.

EHE-SRIHER disclaims any responsibility to the client and others in respect of any matters outside the scope of the above.

This report is confidential to the client and EHE-SRIHER accepts no responsibility of whatsoever nature to third parties whom this report, or any part thereof, is made known. Any such party relies upon the report at their own risk.

The underlying measurements and preparation of this report have been accomplished using recognized standards and to our best knowledge. No claims shall be raised from this report.

The measurements have been carried out on the day (s) specified. Therefore, these results reflect a single exposure situation and cannot be extrapolated for other prevailing conditions. Errors within acceptable margins cannot be excluded.

CONTACT INFORMATION

Dr. VidhyaVenugopal
Professor
Email: vvidhya@ehe.org.in

Department of Environmental Health Engineering

Sri Ramachandra Institute of Higher Education & Research

(Deemed to be University)

Porur, Chennai - 600 116

India

www.srmc-ehe.org.in

Phone : (044) 4592 8547

Fax : (044) 2476 7008

Email : ih@ehe.org.in

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INTRODUCTION

SCOPE OF THE WORK

In January, 2020, **Dr. J. Vishnumohan**, Chief Factory Officer, **JSW Steel Ltd.** requested Department of Environmental Health Engineering, Sri Ramachandra Institute of Higher Education & Research to carry out the Heat Stress exposure assessment in their facility located at Mecheri, Salem, Tamilnadu.

The scope of this work includes Heat Stress Exposure Assessment within the factory premises.

The results of the exposure were assessed in compliance with the **Permissible Limits of Exposure (PLEs)**prescribed by The Factories Act, 1948, in conjunction with the Tamil Nadu Factories Rules, 1950 and **Threshold Limit Values (TLVs)**recommended by the American Conference of Governmental Industrial Hygienists (ACGIH), USA**.**

MODE OF IMPLEMENTATION

TIMEFRAME

Request from JSW Steel Ltd.	December, 2019
Heat Stress exposure assessment conducted	06th , 07th , 08th January 2020
Report Submission by SRIHER	January ,2020

PROJECT TEAM

The following members of the Department of Environmental Health Engineering were involved in the monitoring exercise and the preparation of the final report.

Name	Field of Specialization
Dr. Vidhya Venugopal Professor	Certified Industrial Hygienist (BOHS)
Mrs. PK. Latha Research Associate	Environmental Engineering
Mrs. S. Rekha Senior Research fellow	Occupational Health Nursing
Mr. K. Manikandan Research fellow	Bio-Technology
Mr. K. Ragavan Technical Assistant - EHS	Environmental Science
Mr.R. Bala krishnnan Project Fellow	Industrial Hygiene and Safety
Miss. B. Kanmani Project Fellow	B.Com

EXECUTIVE SUMMARY

In January, 2020, The Department of Environmental Health Engineering (EHE), received Industrial hygiene study request from JSW Steel Limited., Salem to evaluate occupational exposures to physical hazards heat stress at their facility located in Salem. Heat stress assessments were made after an last year (2019) summer session survey showed that measured area heat stress in,**55 locations** viz ., in various zones of the industry by trained Industrial hygienists using internationally accepted instruments (WBGT monitor) for worker exposure monitoring. The survey showed that measured area heat stress in **8 locations** viz., in Coke Oven (CO)-2, EOF-2, Continuous Casting Machine (CCM)-3, Blast Furnace (BF)-1, were above the **Permissible Limit Exposure (PLEs)** prescribed by The Factories Act, 1948, in conjunction with the Tamil Nadu Factories Rules, 1950. **35 locations** viz., Coke Oven (CO)-7, Power Plant (PP)-4, Energy Optimizing Furnace (EOF)-9, Continuous Casting Machine (CCM)-5, Bar and Rod Mill (BRM)-3, Blast Furnace (BF)-5, Sinter Pant (SP)-2 exceeded the **American Conference of Governmental Industrial Hygienist (ACGIH), USA standard.** General recommendations to reduce heat exposures to the workers are provided along with specific recommendations to avert heat exposures in the area exceeding the limits are provided that includes engineering, administrative and PPEs.

LITERATURE REVIEW

GENERAL

Excess heat exposures are not only an environmental threat but also an occupational hazard for a large worker population engaged in hard manual labour in tropical setting (Kovats RS, Hajat S, 2008). The thermal environment in industry is a direct result of the advances in the mechanization of the production process and differs greatly from the ambient weather-dependent climatic conditions (Eissing, 1995). Since all humans are susceptible to the stresses of exposure to heat, knowledge of the magnitude of the environmental heat load would enable the consequences of the exposure to be predicted (Belding and Hatch, 1955). Workers with prolonged heat exposures in many jobs, in hot indoor environments, are subjected to heat stress with resultant heat strain (Parsons K, 2014). Workers in high-heat industries such as iron and steel, foundries, smelters, glass and rubber, bakeries, commercial kitchens, mining and outdoor workers are subjected to high heat exposures on a day-to-day basis and have high potential for heat-related illness like heat exhaustion, heat cramps, heat stroke, and death (Kjellstrom T, 2009; Dutta P, Chorsiya V, 2013; Wesseling C, 2014). Physiological changes in the body which have direct implications on the health of the workers (NIOSH, 1986).

ISO DEFINITION OF HEAT STRESS

"Heat stress to which a person exposed to a hot environment is subjected, in particular, is dependent upon the production of heat inside the body as a result of physical activity and the characteristics of the environment governing heat transfer between the atmosphere and the body."

Belding and Hatch expanded upon the basic parameters that influence heat and described 13 parameters which they divided into 2 subgroups:

FACTORS DETERMINING IMPOSED HEAT

Temperature of the air, of walls etc, of the skin, water vapor pressure, air velocity, metabolic heat production, body surface area exposed and postural attitude, and finally clothing.

FACTORS DETERMINING RESULTING STRAINS

Heat tolerance and consequences of increased deep body temperature, exposure duration, skin wittedness which leads to sweating, vasodilatation of blood vessels at the skin and resultant increase in blood flow to the skin.

PHYSIOLOGICAL RESPONSE TO HEAT

The human systems play, to greater or lesser extent, a role in adapting to extreme temperatures to maintain body temperature homeostasis. Thermoregulation is a fundamental capacity of the autonomic nervous system to respond to cold and heat stress conditions (Chesire WP, 2016). Thermoregulatory physiology main goal is to keep a Tc within a degree or two of 37 °C and it works because of a coordinated set of autonomic responses to maintain equilibrium between heat production (produced by metabolism primarily) and its dissipation. This physiological characteristic preserves people's health by enabling normal cellular function (Bouchama A, Knochel JP, 2002).

Working in hot conditions puts stress on our body's cooling system. When the heat is combined with other stresses such as physical labor, loss of fluids, fatigue or preexisting medical conditions, it may lead to heat-related illness, disability and even death. This can happen to even the physically fit and healthy age group. The body is always generating heat and passing it to the environment. The harder the body is working, the more heat it has to lose.

The temperature of the human body is an important indicator of the state or condition that it is in. Leitheid and Lind (1964) recalled work by Claude Bernard in 1878,

who proposed the concept of the "milieu interior" where an effective thermoregulation mechanism helps maintain the mechanisms of the internal body organs.

DEEP BODY TEMPERATURE

Deep body temperature (core temperature) can rise to 39°C in controlled conditions (NIOSH 1986). Hyperthermia is "a rise in body temperature above the hypothalamic set point when heat-dissipating mechanisms are impaired (by drugs or disease) or overwhelmed by external (environmental or induced) or internal (metabolic) heat"(Bouchama A, Knochel JP, 2002). According to Cheshire, it is clinically manifested by "sweating, flushing, tachycardia, fatigue, light-headedness, headache, paraesthesia, muscle cramps, oliguria, nausea, agitation, hypotension, syncope, confusion, delirium, seizures, and finally, coma". It is not therefore a foregone conclusion that a worker will become a heat stress casualty when their core temperature reaches 38°C or even 39°C. According to NIOSH, 38°C provides a "modest safety margin" because as core temperature exceeds 38°C, so the risks of heat stress occurring increases.

METABOLIC RATE

Since heat is produced in proportion to the work rate, deep body temperature has been found to be more closely related to metabolic rate than to the rate at which body heat had to be eliminated (Nielsen, 1967). Therefore, metabolic rate is a major contributor to heat stress even when environmental conditions would suggest that worker is not at risk.

CARDIAC OUTPUT

Work under heat stress conditions results in a competition for cardiac output because less blood is returned to the deep body due to vasodilatation of the blood vessels in the skin (NIOSH). The blood therefore is not only carrying oxygen to the muscles but it is also acting as a cooling fluid.

As a result, heart rate increases to maintain the same cardiac output and at a sub-maximum work rate, thermoregulatory requirements override the working muscle's

requirements for oxygen. Consequently, heart rate increases during heat stress compared to the same work rate in neutral conditions. Cardiac output increases during whole-body heating but does not significantly change during whole-body cooling (Johnson JM, Proppe DW, 1996; Wilson TE et al., 2002; Wilson TE, Sauder CL, Kearney ML, et al. 2007; Wilson TE, Tollund C, Yoshiga CC, et al., 2007).

SWEATING

The action of sweating itself does not contribute to the loss of heat. Rather, it is the evaporation of the sweat from the skin that drives cooling and in hot environments the evaporation of sweat is the dominant mechanism for maintaining a steady core temperature for a given metabolic rate. Individuals routinely have sweating rates of 1 liter per hour when working in hot environments. Rodahl and Guthe (1988) state that "prolonged exposure to heat and/or prolonged exercise almost always causes hypohydration" Whole-body sweat rate is often normalized to the body surface area to minimize interindividual variability (Sean R. Notley, Joonhee Park et al., 2016). Sweat rates might be reduced by prescribing work intensities.

PERSONAL PROTECTIVE EQUIPMENT AND HEAT TRANSFER:

Personal Protective Equipment (PPE) used for protecting from various hazards other than heat stress is discussed here. The very nature of PPE means that it interferes with the body's ability to lose heat from the skin to the environment because of the insulation provided by the clothing and the micro-climate within the garment (Parsons, 2004; Bernard and Metheen, 1999).

Evaporation of heat for humans under warm or hot working environments provides a powerful cooling mechanism. "Clothing both inhibits evaporation by producing a humid microclimate and diminishes the cooling effect of the evaporation that does take place" (Nunnely, 1989). This means that heat stress in wearers of protective clothing occurs at lower environmental temperature and humidity values than for those of nude subjects.

Duggan (1988) suggested that when estimating metabolic rate for wearers of PPE (Dorman and Havenith; 2005), the extra metabolic heat production caused by the PPE needs to be considered and the practical implications of this concerns job design.

HEAT STRESS INDICES:

"An optimal heat stress index should provide an accurate prediction of the worker's physiological state at any time of exposure, thus allowing the occupational hygienist to assess the permissible duration of exposure and the duration of rest breaks. This objective implies that the index value at a given time takes proper account of the characteristics of past exposure and the response-time constant of the physiological variable considered. This feature of the index variation can only be studied in well controlled conditions where both the input parameters (metabolic rate, climatic parameters) and the output variables (sweat rate, body temperature, heart rate) are measured with accuracy," Mariaux and Malchaire, 1995.

TYPES OF HEAT STRESS INDICES

There are generally three types of methods used for the assessment of hot environments:

Empirical: Data from laboratory studies provided data that makes it possible to predict the likely effects an environment will have on a human, (i.e. Physiological responses);

Direct: Standardized measuring instruments are used to measure environmental parameters such as globe temperature;

Rational: Calculations of the heat exchanges between the human and the environment provide a method to predict the human responses.

These methods all have the same criteria in common, in that their purpose is to define or establish the physiological responses of humans to their environment.

Many attempts have been made over the years to develop an index which, through a single figure, is able to provide an indication of the risk of heat stress (Kerslake, 1972). However, a thermal index has yet to be developed which can accurately predict a person's physiological strain to all environments (NIOSH, 1986).

WBGT INDEX

The WBGT index is an empirical index which represents the heat stress to which an individual is exposed. It was developed during the 1950s by US military as part of an applied program to reduce heat stress casualties in the US Marine Corps and was evaluated by Yaglou and Minard (1957) as a climatic index to replace the Corrective Effective Temperature (CET). The purpose of the WBGT was to provide a method that could be easily used in an industrial setting allowing a fast diagnosis.

It is widely recognized that this has been done as a compromise between the need for a precise index and the need to be able to easily control measurements in an industrial setting (Parsons, 1994). This need for an easy to use method meant that the adoption of the WBGT as an International Standard was heavily influenced by the Threshold Limit Values (TLVs) set out by the ACGIH.

A consequence of this compromise between ease of use and accuracy is that it applies to the evaluation of the mean effect of the heat during the period of the worker's activity. It does not however apply to those occasions when the worker may be exposed only for short periods, or where the heat stress limits are close to the zone of comfort.

It also makes no provisions for estimating the effect of PPE. Therefore, the WBGT index is to be used to estimate whether or not a problem exists, by identifying whether the reference values are exceeded. If this occurs, the more advanced Standard (ISO 7933) is to be used to provide a more accurate estimation of stress.

The WBGT-index combines the measurement of two derived parameters; natural wet-bulb temperature (tnw) and globe temperature (tg), and a direct parameter air temperature (ta). These measures are applied using the following equations:

Inside buildings and outside buildings without solar load:

$$\mathbf{WBGT = 0.7tnw - 0.3tg}$$

Outside buildings with solar load:

$$\mathbf{WBGT = 0.7tnw + 0.2tg + 0.1ta}$$

The measurements are inputted into the equations above to obtain a WBGT value. The WBGT value is then compared to the reference values provided in the standard for the appropriate metabolic rate and state of acclimation of the worker. The standards refer to conditions where 95% of the working population can be repeatedly exposed to heat stress with no adverse health effects (ACGIH, 1989; Dukes-Dobos and Henschel, 1973).

It is important to note that these reference values correspond to a given situation where the worker is physically fit, and in good health. The workers are also "normally clothed, with adequate salt and water intake and, if conditions stay within limits, are able to work effectively without exceeding a body core temperature of 38°C" (WHO, 1969; ACGIH, 1989).

Griefahn (1994; 1997) reported finding that under conditions of thermally induced heat stress the WBGT provided a suitable predictor of heat stress. A number of limitations have been reported. The estimation of metabolic rate causes a high variability in reference values (Hill, 1985; Ramsey and Chai, 1983) which may be compounded by the difficulty of interpreting the results when small deviations in the reference values are observed;

MEASUREMENT USING WBGT METER

The WBGT Index is the "**Gold standard**" because it is an indicator of workplace heat stress that factors in the effects of air temperature, humidity, air movement and radiant energy. It provides a single number measure of "perceived heat".

The WBGT uses three sensors (sensor array) to take measurements which compute the WBGT index; wet bulb thermometer, globe temperature, and dry bulb thermometer.

The **Wet Bulb Thermometer** gives an indication of the effects of humidity on an individual. Relative humidity and wind speed are taken into account by measuring the amount of evaporative cooling taking place at a thermometer covered with a moistened wick.

The **Globe Thermometer** gives an indication of radiant heat exposure to an individual due to either direct light or hot objects in the environment. This is accomplished by placing a temperature sensor inside a blackened copper sphere and measuring the temperature rise.

The **Dry Bulb Thermometer** measures the ambient air temperature. This measurement is used in the outdoor WBGT calculation when a high solar radiant heat load may be present.

The WBGT uses the wet bulb and globe temperatures readings to monitor the indoor environment. Outdoor measurements include the dry bulb temperature reading where a high solar radiant heat load may be present.

METHODOLOGY

HEAT STRESS EXPOSURE ASSESSMENTS

Area heat stress was measured in **55** locations under **8** departments Viz., Coke oven (CO), Power Plant (PP), Energy Optimizing Furnace (EOF), Continuous Casting Machine (CCM), Bar and Rod Mill (BRM), Blast Furnace (BF), Sinter plant (SP) and Blooming Mill

(BLM) in different work areas where the workers were exposed to throughout the Industry. The quantitative heat measurements were measured according to the protocols recommended by NIOSH, USA. Locations for measurements were selected based on the initial survey results; these included indoor and outdoor locations with process-generated heat exposure. Since most of the workplace locations were not air-conditioned, and therefore likely to be influenced by outside temperature and time of day/season, measurements were always made during the hottest part (11:00–14:30) of the day. In every location, two reading were taken and an average value is presented in the results.

In the assessment of heat stress, the Wet-Bulb Globe Temperature (WBGT) recommended by ACGIH, was used. The WBGT combines the effect of the four main thermal components affecting heat stress: air temperature, humidity, air velocity and radiation, as measured by the dry bulb, wet bulb, and globe temperatures. The Heat Stress area measurements were carried out using an area heat stress monitor, Model QuesTemp°34 (Quest Technologies, USA) has an accuracy level of ±0.5°C between the range of 0°C and 120°C dry bulb temperatures and ±5% between the range of 20% and 95% relative humidity (RH). The instruments were calibrated at the start and end of each measurement day and the calibration certificate is enclosed (Annexure I). To measure the WBGT of a workplace, the QuesTemp°34 was mounted at a height of 3.5 feet (1.1 m) for standing individuals and 2 feet (0.6 m) for seated individuals using a tripod stand. It was also ensured that the QuesTemp°34 was placed away from any barriers that might block radiant heat or flow, and workers were the requested to stand away from the instrument to minimize variations in temperature and radiant heat.

The wet bulb temperature was used to assess compliance with the Permissible Limits of Exposures **(PLE**) [Wet bulb temperature limit corresponding to the measured dry bulb temperature] prescribed by The Factories Act, 1948, in conjunction with The **Tamil Nadu Factories Rules, 1950 (TNFR 1950).** The Tamil Nadu Factories Rule 17A stipulates wet bulb temperature limits in relation to the current dry bulb temperature. Provided that the wet bulb temperature outside in the shade does not exceed 27ºC, the maximum

permissible wet bulb temperature in workrooms is 300ºC. For further understanding refer to Annexure II.

Figure 1: Heat Stress Monitor, Model Questemp°34

The necessary information on workload, clothing worn, worker's time-activity pattern, and acclimatization was collected on-site, to make appropriate adjustments to the measured WBGT value. The threshold limit value (TLV) **(Annexure III)** was computed by taking spot readings throughout the work-shift and by worker description of workload, using a "clo" factor of 3 for Workers in coke oven. For workers in all others locations the "clo" factor contributes to a WBGT correction factor of 0°C **(Annexure III)**. The work category of the workers was based on the judgment by a trained Industrial Hygienist based on ACGIH guidelines and by observations were compared with the ACGIH, USA. Screening limits.

Work Category and its Example#:

Work Category	Examples
Rest	Sitting
Light	Sitting with light manual work with hands or hands and arms, and driving. Standing with some light arm work and occasional walking
Moderate	Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work, or light pushing and pulling. Normal walking
Heavy	Intense arm and trunk work, carrying, shoveling, manual sawing; pushing and pulling heavy loads; and walking at a fast pace
Very Heavy	Very intense activity at fast to maximum pace

#: Thermal Stress - Threshold Limit Values & Biological Exposure Indices - prescribed by American Conference of Governmental Industrial Hygienists, USA.

The monitoring location covered in the study is listed below:

S/NO	SECTION	LOCATION
1.	CO	Coke oven quenching Service plat
2.		Coke oven OS#1 Battery Area
3.		Oven top
4.		WHARF Area
5.		WHARF operating area
6.		Pushing charging Car-II
7.		Coke Oven Workers resting area
8.		Discharge Area
9.		Discharge Area (Coal Cleaning time)
10.	PP-1	PP - II Turbine Area
11.		AFBC Boiler Area
12.		BFG Boiler Area
13.		WHR - 3 Boiler Area

S/NO	SECTION	LOCATION
14.	PP-1	Power Plant - 1 Turbine Area
15.		Power Plant - 1 Boiler Area
16.	EOF-1	Furnace Front Side (Near Control Room)
17.		Furnace Front Side operator area
18.		Furnace control room
19.		Furnace Back Side Area
20.		Furnace control room
21.	EOF-2	Furnace Front Side area
22.		Furnace Right Side Area
23.		LF 1
24.		LF 2
25.		LF 3
26.		LF 4
27.	CCM	CCM – 01
28.		CCM Top 1
29.		CCM – 02
30.		CCM Top 2
31.		CCM 3
32.	BRM	Furnace Discharging Side
33.		GC tag fixing area
34.		GC Sample Area
35.		Coil Automated painting area
36.	BLM	Furnace Discharging Side
37.		Furnace Discharging Right Side
38.		Cooling bad area
39.		Cooling bad area Top side
40.		Hot Saw 2
41.		Hot Saw 3
42.	BF	Stove Area (Hot Blast)
43.		Stove Area (Gas Combustion)
44.		Cast house Area
45.		Cast house metal runner spot

S/NO	SECTION	LOCATION
46.		Cast house drilling machine
47.		Cast house rest room area
48.		Slag Area (Metal Runner)
49.	SP – I	Sinter machine field operator control Area
50.		Sinter machine field operator working Top Area
51.		Sinter machine field operator working Area
52.	SP – II	Circular cooler Plat form
53.		Control Room
54.		Sinter machine field operator control Area – Top Area
55.		Sinter machine field operator control Area

RESULTS

The results of the heat stress exposure assessment are given in the Table 1& 2

Table 1: Results of heat stress exposure monitoring in comparison with Permissible Limits of Exposure (PLE) prescribed by Tamil Nadu Factories Rules, 1950.

Date of Monitoring: (06, 07& 08/01/2020)

Sl.No	Location	Measured Dry Bulb Temp (in ^{0}C)	Measured Relative Humidity (%)	Measured Wet Bulb Temp (in ^{0}C)	Calculated PLE (in ^{0}C)	Comments
Coke Oven						
	Ambient temperature	28.8	65	24.2	-	-
	Ambient temperature	29.2	60	23.3	-	-
1.	Coke oven quenching service platform	41.3	34	34.1	27.9	**Above the PLE limit**
2.	Coke oven OCS#1 battery area	30.0	45	24.0	29.0	Below the PLE limit
3.	Oven top	37.5	35	28.0	28.2	Below the PLE limit
4.	WHARF Area	31.8	55	26.9	28.8	Below the PLE limit
5.	WHARF operating area	33.7	40	27.2	28.6	Below the PLE limit
6.	Pushing charging Car-II	30.4	42	23.9	29.0	Below the PLE limit
7.	Coke Oven workers resting area	32.0	39	24.2	28.8	Below the PLE limit
8.	Discharge Area	32.0	43	25.5	28.8	Below the PLE limit
9.	Discharge Area (Coal Cleaning time)	34.8	37	29.1	28.5	**Above the PLE limit**
Power plant -2						
	Ambient temperature	30.9	39	23.8	-	-
	Ambient temperature	32.9	48	26.1	-	-
10.	PP - II Turbine Area	34.5	47	26.5	28.5	Below the PLE limit
11.	AFBC Boiler Area	35.3	42	26.0	28.5	Below the PLE limit

SI.No	Location	Measured Dry Bulb Temp (in ^{0}C)	Measured Relative Humidity (%)	Measured Wet Bulb Temp (in ^{0}C)	Calculated PLE (in ^{0}C)	Comments
12.	BFG Boiler Area	33.7	40	26.3	28.6	Below the PLE limit
13.	WHR - 3 Boiler Area	36.7	37	27.7	28.3	Below the PLE limit
Power Plant -1						
	Ambient Temperature	30.4	47	24.1	-	-
14.	Power Plant - 1 (Turbine Area)	31.6	47	24.7	28.8	Below the PLE limit
15.	Power Plant - 1 (Boiler Area)	30.6	49	24.6	28.9	Below the PLE limit
Energy Optimism Furnace-1						
	Ambient temperature	29.2	58	23.6	-	-
16.	Furnace Front Side (Near Control Room)	34.1	51	26.6	28.6	Below the PLE limit
17.	Furnace Front Side (Operator area)	30.8	61	25.3	28.9	Below the PLE limit
18.	Furnace control room	26.3	46	19.9	nil	Below the PLE limit

SI.No	Location	Measured Dry Bulb Temp (in ^{0}C)	Measured Relative Humidity (%)	Measured Wet Bulb Temp (in ^{0}C)	Calculated PLE (in ^{0}C)	Comments
19.	Furnace Area (Back Side)	34.8	45	26.9	28.5	Below the PLE limit
20.	Furnace control room top side	34.5	44	27.0	28.5	Below the PLE limit
Energy Optimism Furnace-2						
	Ambient temperature	32.5	42	25.8	-	-
21.	Furnace Front (Side area)	33.7	41	26.8	28.6	Below the PLE limit
22.	Furnace Right (Side Area)	35.1	40	26.3	28.5	Below the PLE limit
23.	Laddle Furnace 1 (LF)	38.7	31	29.3	28.1	**Above the PLE limit**
24.	Laddle Furnace 2 (LF)	35.7	30	28.9	28.4	**Above the PLE limit**
25.	Laddle Furnace 3 (LF)	36.1	31.0	26.7	28.4	Below the PLE limit
26.	Laddle Furnace 4 (LF)	32.2	31	28.0	28.8	Below the PLE limit
Continuous Casting Machine						

SI.No	Location	Measured Dry Bulb Temp (in ^{0}C)	Measured Relative Humidity (%)	Measured Wet Bulb Temp (in ^{0}C)	Calculated PLE (in ^{0}C)	Comments
	Ambient temperature	30.3	46	22.7	-	-
27.	Continuous Casting Machine - 01	39.2	34	25.3	28.1	Below the PLE limit
28.	Continuous Casting Machine Top 1	40.4	30	27.9	28.0	Below the PLE limit
29.	Continuous Casting Machine - 02	41.8	32	29.0	27.8	**Above the PLE limit**
30.	Continuous Casting Machine Top 2	41.8	32	29.2	27.8	**Above the PLE limit**
31.	Continuous Casting Machine 3	41.3	30	28.3	27.9	**Above the PLE limit**
Bar and rod mill						
	Ambient temperature	32.0	37	23.5	-	-
32.	Furnace Discharging Side	32.3	38	24.8	28.8	Below the PLE limit
33.	GC Tag fixing area	34.0	38	25.7	28.6	Below the PLE limit
34.	GC Sample Area	34.3	38	25.5	28.6	Below the PLE limit
35.	Coil Automated painting area	34.7	40	25.8	28.5	Below the PLE limit

SI.No	Location	Measured Dry Bulb Temp (in ^{0}C)	Measured Relative Humidity (%)	Measured Wet Bulb Temp (in ^{0}C)	Calculated PLE (in ^{0}C)	Comments
Blooming mill						
	Ambient temperature	29.3	45	22.3	-	-
36.	Furnace Discharging Right Side	29.1	45	22.6	nil	Below the PLE limit
37.	Furnace Discharging Side	30.5	41	23.6	28.9	Below the PLE limit
38.	Cooling bedtoparea	30.2	42	22.9	29.0	Below the PLE limit
39.	Cooling bed area	30.4	43	22.7	29.0	Below the PLE limit
40.	Hot saw - 2	30.1	52	23.5	29.0	Below the PLE limit
41.	Hot saw - 3	29.9	50	24.1	nil	Below the PLE limit
Blast furnace						
	Ambient temperature	28.7	39	21.3	-	-
42.	Stove area (Hot Blast)	34.1	27	28.9	28.6	**Above the PLE limit**
43.	Stove area (Gas Combustion)	35.5	25	26.3	28.4	Below the PLE limit

SI.No	Location	Measured Dry Bulb Temp (in ^{0}C)	Measured Relative Humidity (%)	Measured Wet Bulb Temp (in ^{0}C)	Calculated PLE (in ^{0}C)	Comments
44.	Cast house area	34.4	35	25.2	28.6	Below the PLE limit
45.	Cast house metal runner spot	33.3	40	25.8	28.7	Below the PLE limit
46.	Cast house drilling machine	32.6	33	24.2	28.7	Below the PLE limit
47.	Cast house rest room area	30.8	34	22.4	28.9	Below the PLE limit
48.	Slag area (Metal Runner)	36.0	31	24.1	28.4	Below the PLE limit
Sinter plant – I						
49.	Sinter machine field operator control Area	30.9	41.0	22.6	28.9	Below the PLE limit
50.	Sinter machine field operator working Top Area	30.2	44.0	22.5	29.0	Below the PLE limit
51.	Sinter machine field operator working Area	30.4	44.0	24.1	29.0	Below the PLE limit
Sinter plant – II						

SI.No	Location	Measured Dry Bulb Temp (in ^{0}C)	Measured Relative Humidity (%)	Measured Wet Bulb Temp (in ^{0}C)	Calculated PLE (in ^{0}C)	Comments
52.	Circular cooler Platform	31.5	38.0	25.9	28.9	Below the PLE limit
53.	Control Room	26.8	40.0	19.1	nil	Below the PLE limit
54.	Sinter machine field operator control Area – Top Area	33.7	54.0	25.5	28.6	Below the PLE limit
55.	Sinter machine field operator control Area	30.0	56.0	23.9	29.0	Below the PLE limit

PLE: Temperature Limit (Wet bulb temperature limit corresponding to the measured dry bulb temperature) prescribed by The Factories Act, 1948, in conjunction with The Tamil Nadu Factories Rules, 1950; Rule 17A. Copy of reference enclosed as Annexure -II.

Table 2: Results of heat stress exposure monitoring in comparison with Threshold Limit Value (TLV) recommended by American Conference of Governmental Industrial Hygienists (ACGIH).

Date of Monitoring: 06, 07& 08/01/2020.

SI.No	Location	Measured Dry Bulb Temp ^{0}C)	Measured Wet Bulb Temp ^{0}C)	Measured Globe Temp (^{0}C)	Measured WBGT (in ^{0}C)	Recommended TLV^{0}C)	Comments
Coke oven							
	Ambient temperature	28.8	24.2	32.1	26.2	-	-
	Ambient temperature	29.2	23.8	33.2	26.2	-	-
1.	Coke oven form quenching, Service platform	41.3	34.1	79.2	44.1	29.0	**Above the TLV limit**
2.	Coke oven OCS#1 Battery area	30.0	24.0	37.5	27.9	29.0	Below the TLV limit
3.	Oven top	37.5	28	54.1	34	29.0	**Above the TLV limit**
4.	WHARF area	31.8	26.9	34.5	29.1	29.0	**Above the TLV limit**

SI.No	Location	Measured Dry Bulb Temp ^{0}C)	Measured Wet Bulb Temp ^{0}C)	Measured Globe Temp (^{0}C)	Measured WBGT (in ^{0}C)	Recommended TLV^{0}C)	Comments
5.	WHARF operating area	33.7	27.2	45.2	31.6	29.0	**Above the TLV limit**
6.	Pushing charging Car-II*	30.4	23.9	33.4	29.4	29.0	**Above the TLV limit**
7.	Coke Oven Workers resting area	32.0	24.2	32.5	26.7	29.0	Below the TLV limit
8.	Discharge Area*	32.0	25.5	39.1	31.9	29.0	**Above the TLV limit**
9.	Discharge Area (Coal Cleaning time)*	34.8	29.1	52.0	37.4	29.0	**Above the TLV limit**
Power plant -2							
	Ambient Temperature	30.9	23.8	34.8	26.6	-	-
	Ambient Temperature	32.9	26.1	35.2	28.6	-	-
10.	PP - II Turbine Area	34.5	26.5	36.4	29.4	29.0	**Above the TLV limit**
11.	AFBC Boiler Area	35.3	26.0	38.2	29.7	29.0	**Above the TLV limit**

SI.No	Location	Measured Dry Bulb Temp ^{0}C)	Measured Wet Bulb Temp ^{0}C)	Measured Globe Temp (^{0}C)	Measured WBGT (in ^{0}C)	Recommended TLV^{0}C)	Comments
12.	BFG Boiler Area	33.7	26.3	33.4	29.1	29.0	**Above the TLV limit**
13.	WHR - 3 Boiler Area	36.7	27.7	43.1	31.8	29.0	**Above the TLV limit**
Power Plant -1							
	Ambient temperature	30.4	24.1	31.1	26.1	29.0	Below the TLV limit
14.	Power Plant - 1 Turbine Area	31.6	24.7	32.5	27.1	29.0	Below the TLV limit
15.	Power plant - 1 boiler area	30.6	24.6	31.5	26.6	29.0	Below the TLV limit
Energy Optimism Furnace -1							
	Ambient temperature	29.2	23.6	30.5	25.5	-	-
16.	Furnace front side (Near control room)	34.1	26.6	40.6	30.8	29.0	**Above the TLV limit**
17.	Furnace front side operator area	30.8	25.3	34.9	28.5	29.0	Below the TLV limit

SI.No	Location	Measured Dry Bulb Temp ^{0}C)	Measured Wet Bulb Temp ^{0}C)	Measured Globe Temp (^{0}C)	Measured WBGT (in ^{0}C)	Recommended TLV^{0}C)	Comments
18.	Furnace control room	26.3	19.9	25.8	21.7	29.0	Below the TLV limit
19.	Furnace back side area	34.8	26.9	40.1	30.7	29.0	**Above the TLV limit**
20.	Furnace control room top side	34.5	27	36.9	30.0	29.0	**Above the TLV limit**
Energy Optimism Furnace -2							
	Ambient Temperature	32.5	25.8	43.5	30.1	-	-
21.	Furnace front side area	33.7	26.8	43.8	32.1	29.0	**Above the TLV limit**
22.	Furnace Right Side Area	35.1	26.3	42.8	32.1	29.0	**Above the TLV limit**
23.	Laddle Furnace 1 (LF)	38.7	29.3	50	35.4	29.0	**Above the TLV limit**
24.	Laddle Furnace 2 (LF)	35.7	28.9	53.6	36.4	29.0	**Above the TLV limit**
25.	Laddle Furnace 3 (LF)	36.1	26.7	44.7	32.3	29.0	**Above the TLV limit**

SI.No	Location	Measured Dry Bulb Temp ^{0}C)	Measured Wet Bulb Temp ^{0}C)	Measured Globe Temp (^{0}C)	Measured WBGT (in ^{0}C)	Recommended TLV^{0}C)	Comments
26.	Laddle Furnace 4 (LF)	32.2	28.0	47.0	33.5	29.0	**Above the TLV limit**
Continuous Casting Machine							
	Ambient temperature	30.3	22.7	31.4	25.2	29.0	Below the TLV limit
27.	Continuous Casting Machine - 01	39.2	25.3	42.6	36.4	29.0	**Above the TLV limit**
28.	Continuous Casting Machine Top 1	40.4	27.9	47.1	33.7	29.0	**Above the TLV limit**
29.	Continuous Casting Machine - 02	41.8	29.0	49.9	35.1	29.0	**Above the TLV limit**
30.	Continuous Casting Machine Top 2	41.8	29.2	51	35.7	29.0	**Above the TLV limit**
31.	Continuous Casting Machine 3	41.3	28.3	47.3	34.0	29.0	**Above the TLV limit**
Bar and rod mill							

SI.No	Location	Measured Dry Bulb Temp ^{0}C)	Measured Wet Bulb Temp ^{0}C)	Measured Globe Temp (^{0}C)	Measured WBGT (in ^{0}C)	Recommended TLV^{0}C)	Comments
	Ambient temperature	32.0	23.5	32.0	26.0	-	-
32.	Furnace discharging Side	32.3	24.8	36.4	28.4	29.0	Below the TLV limit
33.	GC tag fixing area	34.0	25.7	38.7	29.4	29.0	**Above the TLV limit**
34.	GC sample area	34.3	25.5	39.4	29.7	29.0	**Above the TLV limit**
35.	Coil automated painting area	34.7	25.8	39.9	30.0	29.0	**Above the TLV limit**
Blooming mill							
	Ambient temperature	29.3	22.3	31.0	24.7	-	-
36.	Furnace discharging right side	29.1	22.6	30.2	24.9	29.0	Below the TLV limit
37.	Furnace discharging side	30.5	23.6	33.3	26.6	29.0	Below the TLV limit

SI.No	Location	Measured Dry Bulb Temp ^{0}C)	Measured Wet Bulb Temp ^{0}C)	Measured Globe Temp (^{0}C)	Measured WBGT (in ^{0}C)	Recommended TLV^{0}C)	Comments
38.	Cooling bad area top side	30.2	22.9	32.5	25.7	29.0	Below the TLV limit
39.	Cooling bad area	30.4	22.7	32.7	26.7	29.0	Below the TLV limit
40.	Hot saw 2	30.1	23.5	30.5	25.6	29.0	Below the TLV limit
41.	Hot saw 3	29.9	24.1	30.1	26.1	29.0	Below the TLV limit
Blast furnace							
	Ambient Temperature	28.7	21.3	29.2	23.7	-	-
42.	Stove area (hot blast)	34.1	28.9	61.9	38.8	29.0	**Above the TLV limit**
43.	Stove area (gas combustion)	35.5	26.3	49.6	33.3	29.0	**Above the TLV limit**
44.	Cast house Area	34.4	25.2	45.7	31.3	29.0	**Above the TLV limit**
45.	Cast house metal runner spot	33.3	25.8	51.7	33.6	29.0	**Above the TLV limit**

SI.No	Location	Measured Dry Bulb Temp ^{0}C)	Measured Wet Bulb Temp ^{0}C)	Measured Globe Temp (^{0}C)	Measured WBGT (in ^{0}C)	Recommended TLV^{0}C)	Comments
46.	Cast house drilling machine	32.6	24.2	38.9	28.7	29.0	Below the TLV limit
47.	Cast house rest room area	30.8	22.4	33.5	25.9	29.0	Below the TLV limit
48.	Slag area (Metal Runner)	36	24.1	55.5	33.9	29.0	**Above the TLV limit**
Sinter plant – I							
49.	Sinter machine field operator control Area	30.9	22.6	32.5	25.6	29.0	Below the TLV limit
50.	Sinter machine field operator working area top area	30.2	22.5	31.3	25.1	29.0	Below the TLV limit
51.	Sinter machine field operator working Area	30.4	24.1	32.6	26.6	29.0	Below the TLV limit
Sinter plant – II							

SI.No	Location	Measured Dry Bulb Temp ^{0}C)	Measured Wet Bulb Temp ^{0}C)	Measured Globe Temp (^{0}C)	Measured WBGT (in ^{0}C)	Recommended TLV^{0}C)	Comments
52.	Circular cooler Plat form	31.5	25.9	49.4	33.2	29.0	**Above the TLV limit**
53.	Control Room	26.8	19.1	26.1	21.2	29.0	Below the TLV limit
54.	Sinter machine field operator control Area- Top Area	33.7	25.5	39.3	30.6	29.0	**Above the TLV limit**
55.	Sinter machine field operator control Area	30	23.9	32.6	26.5	29.0	Below the TLV limit

Note: TLV: Threshold Limit Value (WBGT limits including clothing factor) recommended by American Conference of Governmental Industrial Hygienist (ACGIH), 2018. Reference enclosed as Annexure II (For Moderate work Load, 75% work – 25 % rest – Clothing factor 0 for all locations except for three locations* in Coke oven Clothing factor 3 was used, the TLV is 29.0 ^{0} C).

Table 3: Locations exceeding the PLEs and ACGIH TLV limit (2020):

S.No	Section/Department	Locations exceeding the PLEs	Locations exceeding the ACGIH TLV
1.	**Coke Oven**	➢ Coke oven form quenching Service plant ➢ Discharge Area (Coal Cleaning time)Pushing charging Car-II	➢ Coke oven form quenching, Service platform ➢ Oven top ➢ WHARF Area ➢ WHARF operating area ➢ Pushing charging Car-II ➢ Discharge Area ➢ Discharge Area (Coal Cleaning time)
2.	**Power plant**	➢ nil	➢ Power Plant - 1 Boiler Area ➢ PP - II Turbine Area ➢ AFBC Boiler Area ➢ BFG Boiler Area
3.	**EOF**	➢ LF 1 (plant II) ➢ LF 2 (plant II)	➢ Furnace Front Side (Near Control Room ➢ Furnace Back Side Area ➢ Furnace control room top side ➢ Furnace Right Side Area ➢ Furnace Front Side area ➢ LF 1, LF 2,LF 3&LF 4
4.	**CCM**	➢ CCM – 02 ➢ CCM Top 2 ➢ CCM 3	➢ CCM – 01 ➢ CCM Top 1 ➢ CCM – 02 ➢ CCM Top 2 ➢ CCM 3
5.	**BRM**	➢ nil	➢ GC tag fixing area ➢ GC Sample Area ➢ Coil Automated painting area
6.	**BLM**	➢ nil	➢ Nil
7.	**BF**	➢ Stove Area (Hot Blast)	➢ Stove Area (Gas Combustion ➢ Stove area (hot blast) ➢ Cast house Area ➢ Cast house metal runner spot ➢ Slag Area (Metal Runner)

8.	**Sinter Plant**	➢ nil	➢ Circular cooler Plat form ➢ Sinter machine field operator control Area- Top Area

Table 4: Comparative results of heat stress measurements conducted during summer 2019 and winter 2020 using Quest temp WBGT monitor.

S.NO	Location	WBGT (°C)		Difference in WBGT (°C)
		2019 (Summer)	2020 (Winter)	
Coke Oven				
1.	Coke oven form quenching, Service platform	37.5	44.1#	6.6
2.	Coke oven OCS#1 Battery Area	35.6	27.9	7.7
3.	Oven top	37.3	34	3.3
4.	WHARF Area	31	29.1	1.9
5.	WHARF operating area	30.2	31.6#	1.4
6.	Pushing charging Car-II*	48.9	29.4	19.5
7.	Coke Oven Workers resting area	28.7	26.7	2.0
8.	Discharge area*	39.8	31.9	7.9
9.	Discharge area (Coal Cleaning time)*	36.7	37.4#	0.7
Power Plant - II				
10.	PP - II Turbine area	29.9	29.4	0.5
11.	AFBC Boiler area	31.1	29.7	1.4

12.	BFG Boiler area	32.3	29.1	3.2
13.	WHR - 3 Boiler area	27.8	31.8#	4.0
Power Plant - I				
14.	Power Plant - 1 Turbine area	30.3	27.1	3.2
15.	Power Plant - 1 Boiler area	30.2	26.6	3.6
Energy Optimism Furnace-1				
16.	Furnace front side (Near Control Room)	33.1	30.8	2.3
17.	Furnace front side operator area	30.0	28.5	1.5
18.	Furnace control room	29.4	21.7	7.7
19.	Furnace Back Side area	29.7	30.7#	1.0
20.	Furnace control room top side	23.9	30#	6.1
Energy Optimism Furnace -2				
21.	Furnace front side area	32.2	32.1	0.1
22.	Furnace right side area	35.6	32.1	3.5
23.	LF 1	37.9	35.4	2.5
24.	LF 2	37.2	36.4	0.8
25.	LF 3	36.2	32.3	3.9
26.	LF 4	37.3	33.5	3.8
Continuous Casting Machine				
27.	Continuous casting machine - 01	32.7	36.4#	3.7
28.	Continuous casting machine Top 1	35.2	33.7	1.5

29.	Continuous casting machine - 02	32.3	35.1#	2.8
30.	Continuous casting machine Top 2	32.7	35.7#	3.0
31.	Continuous casting machine 3	29.0	34#	5.0
Bar And Rod Mill				
32.	Furnace discharging side	31.9	28.4	3.5
33.	GC Tag fixing area	37.3	29.4	7.9
34.	GC sample area	33	29.7	3.3
35.	Coil automated painting area	29.8	30#	0.2
Blooming mill				
36.	Furnace discharging right side	30.3	24.9	5.4
37.	Furnace discharging side	30.7	26.6	4.1
38.	Cooling bedtoparea	32.4	25.7	6.7
39.	Cooling bed area	31.6	26.7	4.9
40.	Hot saw - 2	32.1	25.6	6.5
41.	Hot saw - 3	28.2	26.1	2.1
Blast Furnace				
42.	Stove Area (Hot Blast)	32.5	38.8#	6.3
43.	Stove Area (Gas Combustion)	32.7	33.3#	0.6
44.	Cast house Area	43.4	31.3	12.1
45.	Cast house metal runner spot	36.9	33.6	3.3
46.	Cast house drilling machine	32.1	28.7	3.4

47.	Cast house rest room area	29.8	25.9	3.9
48.	Slag area (Metal Runner)	31.9	33.9#	2.0
Sinter Plant – I				
49.	Sinter machine field operator control Area	28	25.6	2.4
50.	Sinter machine field operator working Top Area	29.2	25.1	4.1
51.	Sinter machine field operator working Area	29	26.6	2.4
Sinter Plant – II				
52.	Circular cooler Platform	35.3	33.2	2.1
53.	Control Room	31.6	21.2	10.4
54.	Sinter machine field operator control Area – Top Area	29.1	30.6#	1.5
55.	Sinter machine field operator control Area	29	26.5	2.5

Note #Locations with higher measured WBGT during summer compared to in winter. The measured WBGT was very high in Location 1 during winter as we have taken it very close to the heat source where the workers was actually in work, however during winter monitoring at the monitoring time, we were not allowed so close due to safety issues.

On an average, the maximum WBGT difference was observed between summer and winter in CCM plant (2.6 °C) which may be due to the difference in process heat load at the time of monitoring (Figure 2). When compared to summer (Globe temp -43.2 and ambient temperature), during winter monitoring, the WBGT measurement was taken at the peak process heat (Globe temp - 47.5°C& ambient temperature 41 °C).

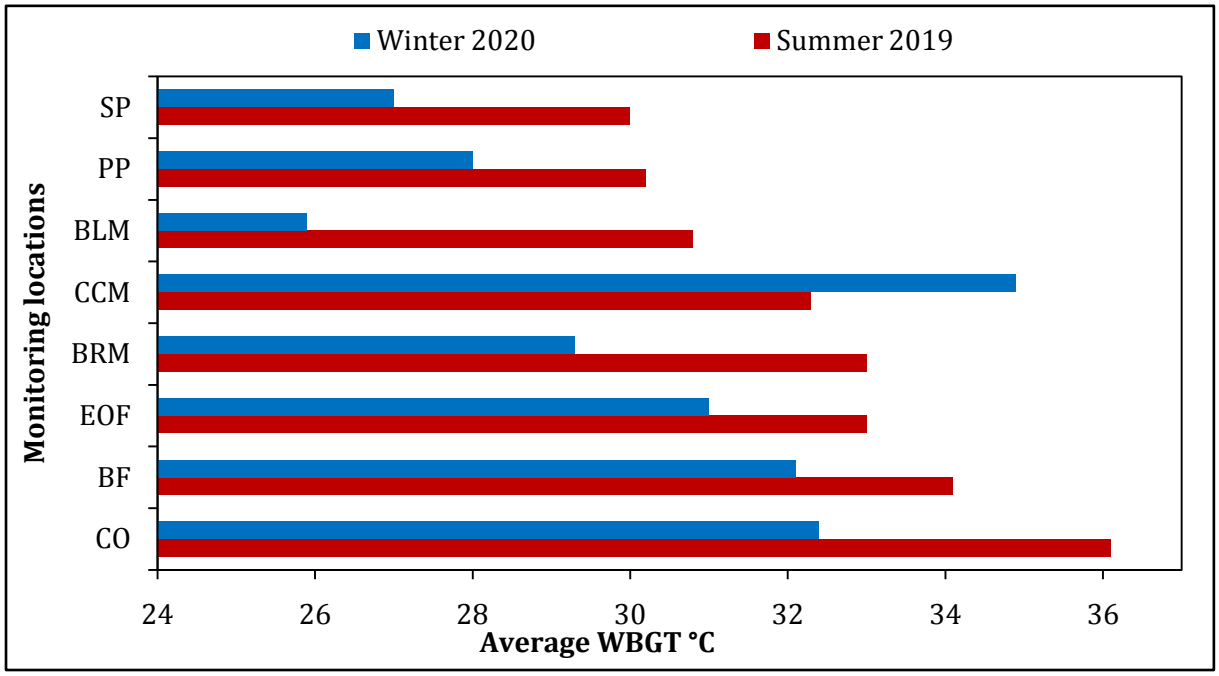


Figure 2: Seasonal difference in average WBGT in study locations

CONCLUSIONS

Area heat stress measurement was monitored in **55** locations. The locations were similar to the location chosen for the previous study conducted during summer in 2019 in the industry. The result of the area heat stress measurement showed that **in 11-study locations including the ambient temperature, the heat exposure (WBGT) in 8 locations exceeded** the **PLEs** prescribed by the Factories act, 1948 in conjunction with Tamil Nadu Factories Rules, 1950 for 8-hour exposure. Similarly **35 study locations exceeded** the **recommended TLV** prescribed by the American Conference of Governmental Industrial Hygienist (ACGIH), USA. The lists of locations exceeding the PEL & TLV in 2020 are tabulated in table 3. The comparative results (table 4) show that in all location there is increase in WBGT exposure in summer (2019) compared to in winter (2020) and maximum increase in WBGT was observed in Coke oven section however in CCM, the winter WBGT exceeded 2.6 times compared to in summer.Though the differences were minor most areas in the industry were high risk areas with regard to heat stress and intervention is mandatory. Recommendations provided below can be implemented in a phased manner to avert future heat exposures and related adverse health consequences.

BASIS FOR INTERPRETATION OF RESULTS:

As a guide to the evaluation of the hazards posed by workplace exposures, EHE-IH staff employs environmental evaluation criteria for the assessment of physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or hypersensitivity (allergy). These combined effects are often not considered in the evaluation criteria.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),6 (2) the American Conference of Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),7 and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) and 4) The Factories Act, 1948, in conjunction with The Tamil Nadu Factories Rules, 1950. The results of the exposure were compared with the Permissible Limits of Exposure (PLEs) prescribed by The Factories Act, 1948, in conjunction with The Tamil Nadu Factories Rules, 1950, Threshold Limit Values (TLVs) recommended by the American Conference of Governmental Industrial Hygienists (ACGIH), USA.

Heat stress is not specifically regulated clearly under the Factories act, but the ACGIH has established screening criteria for Heat Stress Exposure. The ACGIH Heat Stress values prove to be a useful reference when managing the issue of heat stress in a consistent manner. The ACGIH document identifies Criterion values based on the type of work performed in relation to the WBGT. The result is a standard that identifies heat stress conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effects. This does not mean that work performed in conformance with the Heat stress value will be free from risk of heat stress or consequent health impacts. Individual susceptibility / personal health issues may make workers more at risk than others.

- The summer interventions for reducing exposures should be followed for most of the locations (table5) in winter season, as the heat exposures are much higher than the safe working limits to avoid adverse health outcomes

Table 5: Locations exceeding WBGT ACGIH TLV in winter 2020

S.No	Section/Department	Locations
1.	**Coke Oven**	➢ Coke oven form quenching, Service platform ➢ Oven top ➢ WHARF Area ➢ WHARF operating area ➢ Pushing charging Car-II ➢ Discharge Area ➢ Discharge Area (Coal Cleaning time)
2.	**Power plant**	➢ Power Plant - 1 Boiler Area ➢ PP - II Turbine Area ➢ AFBC Boiler Area ➢ BFG Boiler Area
3.	**EOF**	➢ Furnace Front Side (Near Control Room ➢ Furnace Back Side Area ➢ Furnace control room top side ➢ Furnace Right Side Area ➢ Furnace Front Side area ➢ LF 1, LF 2,LF 3&LF 4
4.	**CCM**	➢ CCM – 01 ➢ CCM Top 1 ➢ CCM – 02 ➢ CCM Top 2

		➢ CCM 3
5.	**BRM**	➢ GC tag fixing area ➢ GC Sample Area ➢ Coil Automated painting area
6.	**BF**	➢ Stove Area (Gas Combustion) ➢ Stove area (hot blast) ➢ Cast house Area ➢ Cast house metal runner spot ➢ Slag Area (Metal Runner)
7.	**Sinter Plant**	➢ Circular cooler Plat form ➢ Sinter machine field operator control Area-Top Area

RECOMMENDATIONS

Specific Recommendations for Locations exceeding TLV & PELs

The measurements were conducted in January, which is considered as winter part of the year (2020). Here are specific recommendations for the areas where the **WBGT** has exceeded the **TLV** and **PLE** limit (table 3).

Location 1: Coke Oven

Observations:

In this location the workers in oven top area, though they were provided with PPEs they were not using it as they felt it too hot for them to wear. Since coke oven is out-door, the workers are exposed to radiation heat from furnace and also from environment. The following recommendations are listed.

Recommendations:

1. For the workers to **rest in shade** a small resting room with air cooler/fan can be provided. Air conditioned/cooled cabins have to be provided to the workers those who are working near the heat source, where they can rest during tea and lunch breaks, preferably close to their work spot. Receding to these cooler cabins while resting will help them being constantly exposed to environmental heat throughout the shift

2. **Ventilation:** In push carts, mechanical ventilation by high power fans or air coolers can be provided for the workers. And also in the push cart the access to drinking water is far away and this can be localized for the worker to drink water frequently.

   Installing High Volume Low Speed Fans (HVLS): High-volume, low-speed (HVLS) fans can be installed as a complement to HVAC systems. HVLS fans can significantly improve employee comfort and health while saving substantial amounts of energy by making existing heating and ventilation systems more efficient in buildings. They can even contribute to earning Leadership in Energy and Environmental Design (LEED®) credits. A single HVLS fan is energy-efficient. A 24-ft.-diameter fan uses 1,500 watts per hour for cooling, and as little as 100 W per hour for destratification.

High Volume Low Speed Fans

3. **Job rotation:** Workers working in frank hot zones eg., (Quenching site, Slag handling area, Furnace front side) must be posted in various cooler zones within over a shift to avoid high heat exposure load. Job rotation is a simple and cheap administrative control that does not cost the industry but has given proven results across the globe.

4. **Hydration:** Cool (50°-60°F) water should be made available to workers at regular intervals. They must be encouraged to drink small amounts frequently, e.g., one cup every ½ hour. Ample supplies of liquids should be placed close to the work area (but away from chemical contaminants). Presence of toilets with wash facilities close to the workplace also encourages workers to drink more fluids and cool themselves by splashing water over various body parts.

5. **Training** on hydration and mounting urine colour charts in all the bathrooms will help the employees to know their hydration status which will improve the fluid intake significantly (S. A. Kavouras et al, 2011)

6. **PPE:** In specific in WHARF area the workers should be encouraged to wear cooling vest or jacket. For workers exposed to frank heat like from the molten metal and furnaces, cooling vests have been found to be an effective method in preventing/reducing heat stress and also a good method of cooling the body. (Bennett et al., 1993; Kim et al., 2011; Nishihara, 2002; Duffield et al.,2003; Arngrïmsson et al., 2004; Lopez et al., 2008).

Ice pack cooling west	Cooling vest
	

7. **Arm immersion cooling system** can be arranged in the pushing charging carts where a maximum WBGT of 49 °C was recorded for immediate cooling of the workers body temperature. A small arm immersion tub can be build for the workers close to the

work area where immersion in chill water for 10 min can reduce the Core body temperature.

Prototype Arm Immersion Cooling Systems

Location 2: EOF

Observations:

This area is fully closed furnace area and near the working process, two ventilation fans were fitted at a height of 5 to 7 feet. The operating workers was wearing a fully covered Aluminum foil coat to protect them from heat and were exposed to high heat for only 30-60 seconds. Though they spray water after each charging process, the radiation heat and evaporation heat from the cleaning process is high and this impact on the worker will be high on prolonged exposure even after few years.

Recommendations:

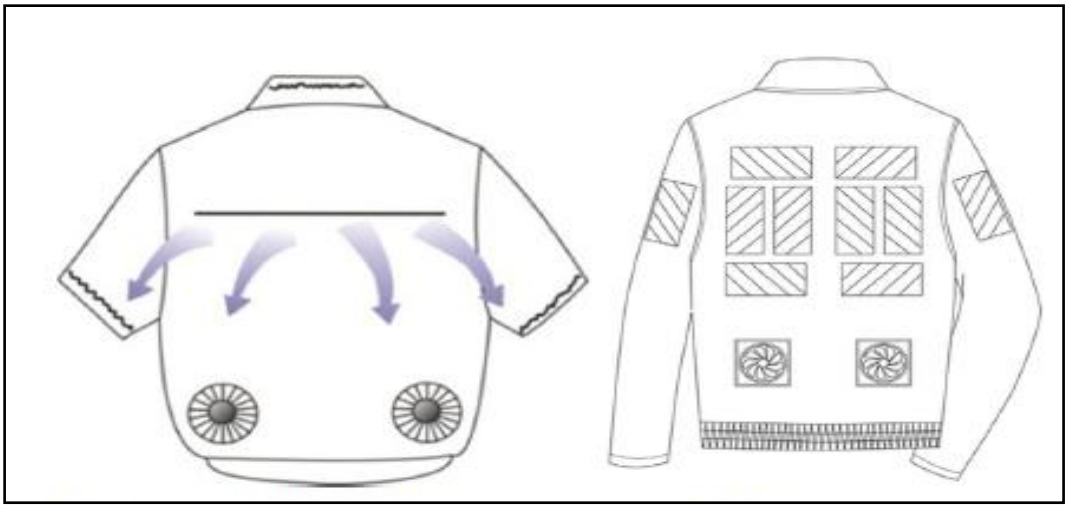
8. **Radiation Reflective surfaces**: Controlling emission of heat radiation by installing a reflective barrier in the main workstation**. Light-colored external surfaces and reflective paint coating** on the roofs and walls are recommended options to minimize the surface temperature and the heat load of the building.

9. **Ventilation**: It is recommended that the supply of external air inside the plant by mechanical systems followed by the air purifier will reduce the heat stress exposure to the worker. A recent approach to thermal modelling has shown that

electric fans increase the critical air temperature limit by approximately 3–4 °C for both young and older people and in occupational settings (Jay et al. 2015). And installing HVLS as discussed in coke oven session is also an energy efficient and efficient way to improve indoor comfort.

10. Provide **roof insulators** and **wall insulation** in this location that will enhance the heat absorption inside the plant

11. Choosing an **efficient cooling vest** is important for the heat exposed workers. Other than the worker operating the furnace other workers assisting them can use thermal regulated clothing with electric fan and PCMs make that alleviates heat strain to the workers (Gao 2014). A number of studies on personal cooling using PCMs showed its effectiveness in alleviating heat strain in occupational settings (Choi et al. 2008; Chouet al. 2008; Reinertsen et al. 2008; Gao et al. 2011a), Similarly a cool coat from M/s Yamuna Industries, Noida, was found to be an efficient one in reducing the core body temperature of worker in a steel industry (Parameswarappa and Narayana, 2017)



Ventilated clothing with integrated fans and opening in the back

Ventilated Aluminized Carbon Kevlar Coat

12. **Use of alternative building materials:** Materials with lower thermal conductivity, thermal diffusivity and absorptivity may be suitable as envelopes for building, especially workspaces that are occupied primarily during the day. Certain materials like *Vacuum insulation panel*, *Shape Memory Polymers, Phase change materials,* window glazing, polymer skin, with good thermal properties with a potential to be incorporated in different parts of the building envelope near the furnace area to reduce indoor heat from process heat.

13. **Technological cooling solution approaches:** There are several commercially available portable cooling devices, such as the KoreKooler™ rehab chair and the Rapid Thermal Exchanger (RTX) device marketed by AVACore Technologies. Use of the KoreKooler rehab chair reduced thermal sensation from "hot" to "neutral (Kuennen, 2010). Here the workers after their work can be made to sit in this chair for cooling their body temperature.

Core Kooler ® Rehab Chair (Rs. 9000)

14. **Self pacing:** Cool (50°-60°F) water or any cool liquid (butter milk or electrolytic beverages except drinks with caffeine, alcohol, or large amounts of sugar must be avoided) should be made available to workers at regular intervals. They must be encouraged to drink small amounts frequently, e.g., one cup every ½ hour. Ample supplies of liquids should be placed close to the work area (but away from chemical contaminants). Presence of toilets with wash facilities close to the workplace also encourages workers to drink more fluids and cool themselves by splashing water over various body parts.

15. **Job rotation:** Workers working in frank hot zones eg. (Quenching site, Slag handling area, Furnace front side must be posted in various cooler zones within over a shift to avoid high heat exposure load. Job rotation is a simple and cheap administrative control that does not cost the industry but has given proven results across the globe.

Location 3: Power plant

Observations:

In this location, the workers were wearing PPE but only few workers were engaged in work at this area. Here the source of heat was from the heat loss from the boiler water transport pipe.

Recommendations:

16. Since only few workers were engaged at work and also not for long period, the workers are recommended to use the **PPE like cooling vest**. Water-cooled vest and pre-frozen jackets will provide protection physiologically equivalent to removing the entire environmental heat stress, even at high temperatures. These garments have the potential to restore productivity losses caused by heat stress due to the comfort they provide to the body.
17. **Mechanical ventilation** can be increased to dissipate the indoor heat to the surrounding.
18. **Existing Insulations** have to be checked and maintained at regular intervals to prevent heat loss to the environment from the unit operations.

Location 4: CCM

Observations:

This location was well ventilated with three fan and also air cooler available and used. All the workers were wearing the given PPEs but the worker who was working in top area of the CCM was exposed to high heat.

Recommendations:

19. Though the average WBGT in this area was observed to be 36.4 °C, the work place was facilitated with good cooling provisions for the workers with good access to drink water facility. Though the worker in the top of CCM is exposed to heat only for 15 minutes for every half an hour, it is highly recommend to use **cooling vest under** the Aluminum coveralls to avert acute heat exposures.
20. **Job rotation** can be done and hot jobs should be scheduled for the cooler part of the day, and routine maintenance and repair work in hot areas should be scheduled for the cooler seasons of the year.

Location 5: BRM

Observations:

This location was only few workers were engaged based on the production on that particular day. The main source of heat was from the iron hot metal rod and the workers were wearing all the PPEs given by the management

Recommendations:

21. **Local cooling cabins** can be provided near the working area or few air coolers can be installed for the workers to rest intermittently.
22. Drinking water station can also be provided closer to the workers working area.
23. The workers should be provided with any cool liquid (butter milk or electrolytic beverages except drinks with caffeine, alcohol, or large amounts of sugar must be avoided) at regular intervals.

Location 6: BLM

Observations:

The WBGT was high only in one or two location and also the workers were not exposed to heat continuously. They work only for 10 min when the load comes otherwise no worker was present in the location.

Location 7: Sinter Plant

Observations:

Though this area had WBGT above the ACGIH limit, heat was not a major impact on the workers they work only for 10 min per day. The exposures were rather from the coal dust and limited from the heat. Nearby cooler room facility available in the sinter plant area.

Specific Recommendations for all hot zones in the industry (with WBGTs above 30°C)

24. **Wetted clothing:** Wetted clothing is another simple and inexpensive personal cooling technique. It is effective when reflective or other impermeable protective clothing is

worn. The clothing may be wetted terry cloth coveralls or wetted two-piece, whole-body cotton suits. This approach to auxiliary cooling can be quite effective under conditions of high temperature and low humidity, where evaporation from the wetted garment is not restricted.

25. **Water-cooled garments:** Water-cooled garments range from a hood, which cools only the head, to vests and "long johns," which offer partial or complete body cooling. Use of this equipment requires a battery-driven circulating pump, liquid-ice coolant, and a container. Although this system has the advantage of allowing wearer mobility, the weight of the components limits the amount of ice that can be carried and thus reduces the effective use time. The heat transfer rate in liquid cooling systems may limit their use to low-activity jobs; even in such jobs, their service time is only about 20 minutes per pound of cooling ice. To keep outside heat from melting the ice, an outer insulating jacket should be an integral part of these systems.
26. **Circulating air:** Circulating air is the most highly effective, as well as the most complicated, personal cooling system. By directing compressed air around the body from a supplied air system, both evaporative and convective cooling are improved. The greatest advantage occurs when circulating air is used with impermeable garments or double cotton overalls.
27. **Water sprays with fans:** Another way to reduce heat stress is to increase the airflow or convection using fans in the work area (as long as the air temperature is less than the worker's skin temperature). Changes in air speed can help workers stay cooler by increasing both the convective heat exchange (the exchange between the skin surface and the surrounding air) and the rate of evaporation because this method does not actually cool the air, any increases in air speed must affect the worker directly to be effective. Fans combined with sprays/mists of cool water that can be applied on the workers by mechanical means by spray guns having a mini fanning air turbine mechanism. This cheap cost-effective mechanism provides immediate cooling and individual portable hand-held manual mist spray air cooler can also be provided to the workers before larger coolers are set-up in the worker areas. Facial cooling (FC) increases cerebral blood flow (CBF) at rest and during exercise/work (Miyazawa et al, 2012) and help in increasing worker productivity.

Water sprays with fans

28. **Local body cooling by ice gel packs**: Local body cooling packs made of refrigerant cooling Gel or non-toxic polymer ice gel can be used by the workers for immediate cooling. For example, the pack with refrigerant cooling gel that is flexible can be placed between the head towel and the helmet while working and also around the neck region to protect against acute heat stress. The package is cheap and reusable and it can be customized for shape and/or size according to the requirement of the body part that needs to be cooled.

Ice Gel packs for local body cooling

GENERAL RECOMMENDATIONS

Engineering Controls

- **GENERAL VENTILATION** is used to dilute hot air with cooler air (generally cooler air that is brought in from the outside) in closed spaces. This technique clearly works better in cooler climates than in hot ones. Alternately the outside air can be cooled before dilution which can be very energy intensive. A permanently installed ventilation system usually handles large areas or entire buildings.

- **LOCAL AIR COOLING** can be effective in reducing air temperature in specific areas. Two methods have been used successfully in industrial settings. One type, cool rooms, can be used to enclose a specific workplace or to offer a recovery area near hot jobs. The second type is a portable blower with built-in air chiller. The main advantage of a blower, aside from portability, is minimal set-up time.

- Indoor heat can be reduced by installing evaporating cooling devices and by altering the roof pattern for natural ventilation.

- **Automation**: Heat reduction can also be achieved by using power assists and tools that reduce the physical demands placed on a employee. However, for this approach to be successful, the metabolic effort required for the employee to use or operate these devices must be less than the effort required without them.

- **Air conditioned/cooled cabins** have to be provided to the workers those who are working near the heat source, where they can rest during tea and lunch breaks, preferably close to their work spot. Receding to these cooler cabins while resting will help them being constantly exposed to environmental heat throughout the shift.

Administrative Controls and Work Practices

1) **ACCLIMATIZATION:** A properly designed and applied acclimatization program decreases the risk of heat-related illnesses. Such a program basically involves exposing employees to work in a hot environment for progressively longer periods. NIOSH (1986) says that, for workers who have had previous experience

in jobs where heat levels are high enough to produce heat stress, the regimen should be 50% exposure on day one, 60% on day two, 80% on day three, and 100% on day four. For new workers who will be similarly exposed, the regimen should be 20% on day one, with a 20% increase in exposure each additional day. This method is mostly useful to protect new employees.

2) **JOB SCHEDULES:** Hot jobs should be scheduled for the cooler part of the day, and routine maintenance and repair work in hot areas should be scheduled for the cooler seasons of the year.

3) **FLUID REPLACEMENT**: Cool (50°-60°F) water or any cool liquid (butter milk or electrolytic beverages but drinks with caffeine, alcohol, or large amounts of sugar must be avoided) should be made available to employees to encourage them to drink small amounts frequently, e.g., one cup every ½ hour. Ample supplies of liquids should be placed close to the work area (but away from chemical contaminants).

4) **TRAINING AND AWARENESS:** Training is the key to good work practices. Unless all employees understand the reasons for using new, or changing old, work practices, the chances of such a program succeeding are greatly reduced. NIOSH (1986) states that a good heat stress training program should include at least the following components:

   - Knowledge of the hazards of heat stress which largely aids in self-protection;
   - Recognition of predisposing factors, signs and symptoms that helps employees in helping themselves and their co-workers;
   - Employee responsibilities in avoiding heat stress; a knowledge that is lacking in most workplaces and will reduce accidents and illnesses due to heat
   - Dangers of using drugs, including therapeutic ones, and alcohol in hot work environments;

- Use of protective clothing and equipment appropriate to the work location, profile and kind of work. Examples of PPE for heat stress reduction include ice vests, cooled neck wraps, cooled head gears etc.,

- Purpose and coverage of environmental and medical surveillance programs and the advantages of worker participation in such programs.

5) **WORKER MONITORING PROGRAMS**: Every worker who works in extraordinary conditions that increase the risk of heat stress should be personally monitored. These conditions include wearing semi permeable or impermeable clothing (protective clothing) at high temperatures, working at extreme metabolic loads (greater than 500 kcal/hour), etc. ***This program should be done in consultation with an Occupational Physician.***

- Personal monitoring can be done by checking the heart rate, recovery heart rate, oral temperature, or extent of body water loss.

- To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period.

- Oral temperature can be checked with a clinical thermometer after work but before the employee drinks water. If the oral temperature taken under the tongue exceeds 37.6°C, shorten the next work cycle by one third.

- Body water loss can be measured by weighing the worker on a scale at the beginning and end of each work day. The worker's weight loss should not exceed 1.5% of total body weight in a work day. If a weight loss exceeding this amount is observed, fluid intake should increase.

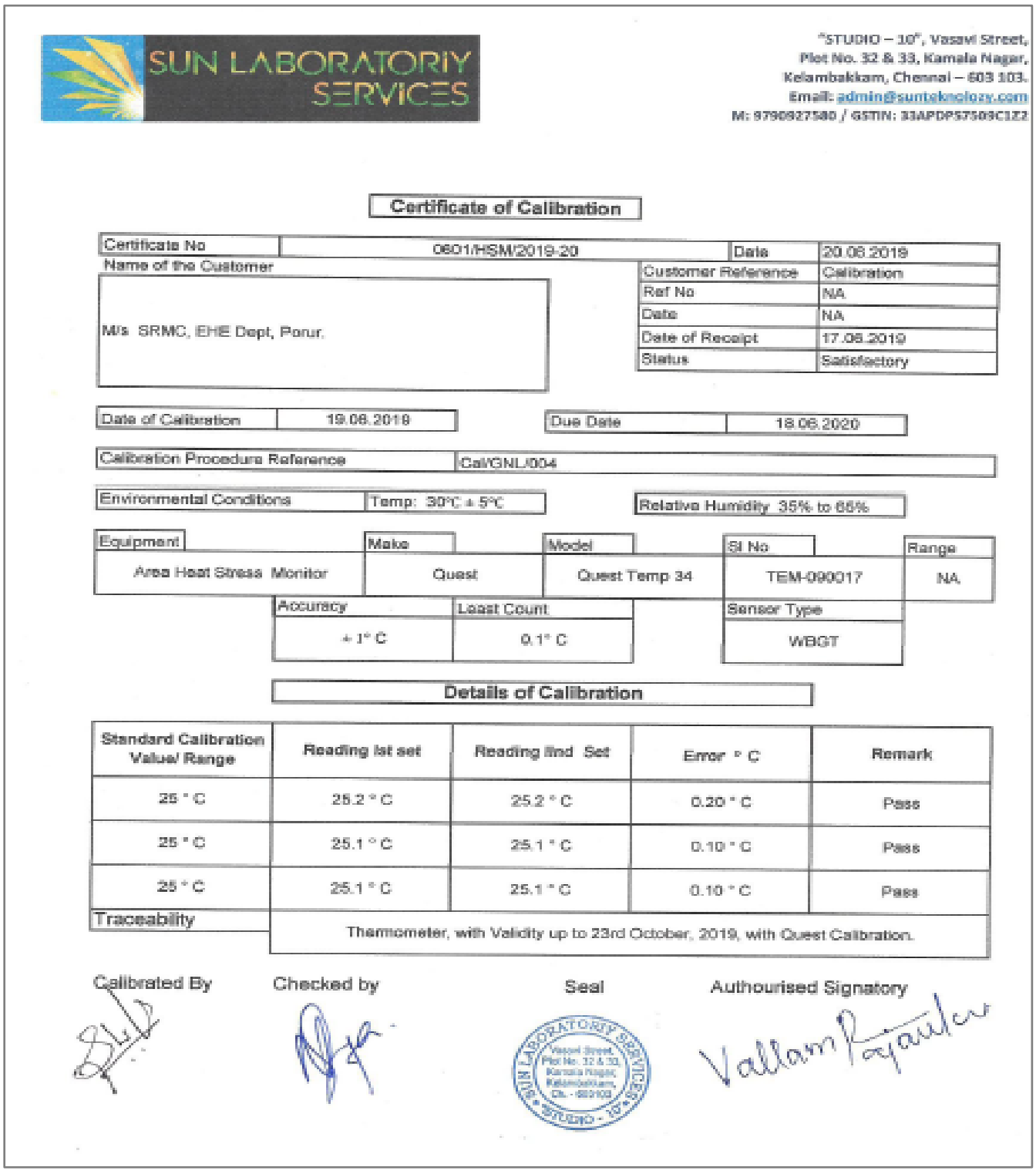
Other Administrative Controls

The following administrative controls can be used to reduce heat stress:

1. For workers with high physical workload, reduce the physical demands of work, e.g., excessive lifting or digging with heavy objects
2. Provide recovery areas, e.g., air-conditioned enclosures and rooms;
3. Use shifts, e.g., early morning, cool part of the day, or night work for physiologically intensive work and work that involves being in open sun light;
4. Use intermittent rest periods with water/fluid breaks, preferably electrolytes;
5. Use relief workers or assign extra workers for physically demanding jobs;
6. Assign extra workers and limit worker occupancy, or the number of workers present, especially in confined or enclosed spaces.
7. Training must be conducted periodically (especially during hot seasons) and bring about awareness on signs and symptoms of heat related illness that can be pictorially posted in problem locations and in common areas as a preventative approach.

ANNEXURE-I

CALIBRATIONCERTIFICATES-1



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Certificate of Calibration

Certificate No	0601/HSM/2019-20	Date	20.06.2019
Name of the Customer		Customer Reference	Calibration
M/s SRMC, EHE Dept, Porur.		Ref No	NA
		Date	NA
		Date of Receipt	17.06.2019
		Status	Satisfactory

Date of Calibration	19.06.2019	Due Date	18.06.2020
Calibration Procedure Reference	Cal/GNL/004		
Environmental Conditions	Temp: 30°C ± 5°C	Relative Humidity 35% to 65%	

Equipment	Make	Model	Sl No	Range
Area Heat Stress Monitor	Quest	Quest Temp 34	TEM-090017	NA

Accuracy	Least Count	Sensor Type
± 1° C	0.1° C	WBGT

Details of Calibration

Standard Calibration Value/ Range	Reading Ist set	Reading IInd Set	Error ° C	Remark
25 ° C	25.2 ° C	25.2 ° C	0.20 ° C	Pass
25 ° C	25.1 ° C	25.1 ° C	0.10 ° C	Pass
25 ° C	25.1 ° C	25.1 ° C	0.10 ° C	Pass
Traceability	Thermometer, with Validity up to 23rd October, 2019, with Quest Calibration.			

Calibrated By | Checked by | Seal | Authourised Signatory

ANNEXURE-II

TNFR 17A :

The Tamil Nadu Factories Rules, 1950 (Extract)

A. Ventilation and temperature: 1. Limits of temperature and air movement.- In any factory the maximum wet bulb temperature of air in a workroom at a height of 1.5 meters (5 feet) above the floor level shall not exceed 30°C (86°F) and adequate air movement of at least 30 metres per minute (100 feet per minute) shall be provided; and in relation to dry bulb temperature the wet bulb temperature in the workroom at the said height shall not exceed that shown in the schedule, or as regards a dry bulb reading intermediate between the two dry bulb readings that specified in relation to the higher of these two dry bulb readings. The Schedule

Dry Bulb Temperature	Wet Bulb Temperature
30	29.0
31	28.9
32	28.8
33	28.7
34	28.6
35	28.5
36	28.4
37	28.3
38	28.2
39	28.1
40	28.0
41	27.9
42	27.8
43	27.7
44	27.6
45	27.5
46	27.4
47	27.3

ANNEXURE-III

ACGIH

The TLV will be calculated according to the following equation:

TLV = "Screening criteria WBGT value" (Table 8) +"TLV WBGT correction factor" (Table 9)

Screening criteria for heat stress exposure according to ACGIH - Acclimatized personnel

Work demands	WBGT value in °C			
	Light	Moderate	Heavy	Very heavy
100 % work	31.0	28.0	-	-
75 % work25 % rest	31.0	29.0	27.5	-
50 % work50 % rest	32.0	30.0	29.0	28.0
25 % work75 % rest	32.5	31.5	30.5	30.0

TLV WBGT correction factors for clothing in °C

Clothing Type	WBGT Correction
Work clothes (long sleeve shirt and pants)	0
Cloth (Woven material) coveralls	0
Double-layer woven clothing	3
Poly propylene coveralls	0.5
Polyolefin coveralls	1
Limited-use vapour-barrier coveralls	11

WBGT Values are calculated using the following equations:

1**. with direct exposure to sunlight**:

$WBGT_{out} = 0.7\ T_{wb} + 0.2\ T_g + 0.1\ T_{db}$

2. **without direct exposure to sunlight**:

$WBGT_{in} = 0.7\ T_{wb} + 0.3\ T_g$

Where:

T_{wb} = wet bulb temperature

T_g = globe temperature

T_{db} = dry bulb (air) temperature

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