Doc No: HMC/HAL/GM/MOEFCC-001

Date: 12h September, 2016

DR. SATISH C. GARKOTI
Director & Member Secretary
Ministry of Environment, Forest & Climate Change, Govt. of India
Indira Paryavaran Bhawan
Ali Ganj, Jor Bagh Road
New Delhi – 110 003

Subject: **Proposal expansion of Coke Oven Plant (Non-recovery type) (from 1.6 MTPA to 2.2 MTPA) at Haldia, District: Purba Medinipur in West Bengal**

Refer F. No.: J-11011/284/2007-IA.II (I)

Dear Sir,

This has reference to the minutes of 1st meeting of EAC (Industry-1) dated 18th November, 2015 of Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India, in which our project was placed for the appraisal for the grant of necessary Environmental Clearance. The honorable committee members raised certain queries in the said minutes. We are giving hereunder our clarifications against the respective queries:

QUERY–1: Total Water requirement for the project should be reassessed and submitted along with the permission obtained from the competent authorities for withdrawal of water for the project. The water balance calculations should also be prepared and submitted.

Reply: Please refer **"Annexure – I"**.

QUERY–2: Rainwater Harvesting Calculations and location demarcated on the layout plan should be submitted.

Reply: Please refer **"Annexure – II"**.

QUERY–3 : A letter from the State Forest Department should be submitted stating that there is no reserve forest, national park, wildlife sanctuary etc exists within 10 KM radius of the plant.

Reply: Please refer **"Annexure – III"**.

QUERY–4: The total area required for the storage of the raw material for the existing as well as proposed project should be submitted. Revised layout plan with connecting roads to the plant and internal circulation roads should be submitted along with a clear Google map.

Contd... Page 2

TATA STEEL LIMITED
Hooghly Met Coke Division
Patikhali P.O. Haldia Oil Refinery, Purba Medinipur Haldia 721 606 West Bengal India
Tel 03224 251333 Fax 03224 251305
Registered Office Bombay House 24 Homi Mody Street Fort Mumbai 400 001 India
Tel 91 22 6665 8282 Fax 91 22 66657724
Corporate Identity Number L27100MH1907PLC000260 Website www.tatasteel.com

Reply: Please refer **"Annexure – IV"**.

QUERY–5: Explore the possibility to achieve a stack emission level < 25 mg/Nm^3 and submit the plan to Ministry. In addition, efforts should also be explored to reduce SOx and NOx levels from the stacks and the proposed plan to be submitted.

Reply: Please refer **"Annexure – V"**.

QUERY–6 : Break-up of the land use indicating existing and proposed use should be provided. In addition, layout plan for old facilities vis-a-vis new proposed facilities should be prepared and submitted.

Reply: Please refer **"Annexure – VI"**.

QUERY–7 : Comparison of ambient air quality data collected for the project with SPCB data should be submitted.

Reply: Please refer **"Annexure – VII"**.

QUERY–8 : Vehicular traffic density in the exiting road and increase of the traffic due to proposed expansion should be carried out and proposed mitigation measures to combat vehicular emission should be submitted.

Reply: Please refer **"Annexure – VIII"**.

QUERY–9 : Green belt implementation plan, as per Compliance report of RO should be submitted.

Reply: Please refer **"Annexure – IX"**.

QUERY–10 : Focused CSR plan should be prepared based on the need of the villagers. The CSR plan should focus village as a unit in order to improve the livelihood of each family by adopting a few villages falling in the project area. This is expected to bring in economic empowerment of each family which in turn will facilitate environmental and social benefits.

Reply: Please refer **"Annexure – X"**.

Contd... Page 3

TATA STEEL LIMITED
Hooghly Met Coke Division
Patikhali P.O. Haldia Oil Refinery, Purba Medinipur Haldia 721 606 West Bengal India
Tel 03224 251333 Fax 03224 251305
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QUERY–11 : Explain specific TORs point no 1, 2, 4 and 6.

ToR Point 1 : Iron ore/coal linkage documents along with the status of environmental clearance of iron ore and coal mines.
ToR Point 2 : Quantum of generation of coal and iron ore from coal & iron ore mines and the projects they cater to.
ToR Point 4 : Recent land-use map based on satellite imagery. High-resolution satellite image data having 1m-5m spatial resolution like quickbird, Ikonos, IRS P-6 pan sharpened etc. for the 10 Km radius area from proposed site. The same shall be used for land used / land-cover mapping of the area.
ToR Point 6 : All stock piles will have to be on top of a stable liner to avoid leaching of materials to ground water.

Reply: Please refer **"Annexure – XI"**.

QUERY–12 : Reasons for non-feasibility of CDQ should be provided in detail.

Reply: Please refer **"Annexure – XII"**.

QUERY–13 : A note on non-compliance of stipulated environmental safeguards earlier accorded to this project, if any, should be provided along with the reasons for non-compliance.

Reply: Please refer **"Annexure – XIII"**.

QUERY–14 : Details regarding treatment of waste water before using for the coke quenching process.

Reply: Please refer **"Annexure – XIV"**.

We hope this will serve your purpose.

We hereby request you to take the necessary action so that the requisite Environmental Clearance could be issued for our proposed project.

Thanking you,

Yours Sincerely

S K Seth
General Manager

TATA STEEL LIMITED
Hooghly Met Coke Division
Patikhali P.O. Haldia Oil Refinery, Purba Medinipur Haldia 721 606 West Bengal India
Tel 03224 251333 Fax 03224 251305
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COMPLIANCE REPORT

On

Queries raised by Expert Appraisal Committee (Industry-1) of MoEF&CC, Govt. of India during its 1st Meeting, held during 18th – 20th November, 2015

(File No. J-11011/284/2007-IA.II (I))

for

PROPOSED EXPANSION OF COKE OVEN PLANT (NON-RECOVERY TYPE) FROM 1.6 MTPA TO 2.2 MTPA

at

Haldia, Dist. East Medinipur, West Bengal

TATA STEEL LIMITED

(HOOGHLY METCOKE DIVISION)

ANNEXURE-I

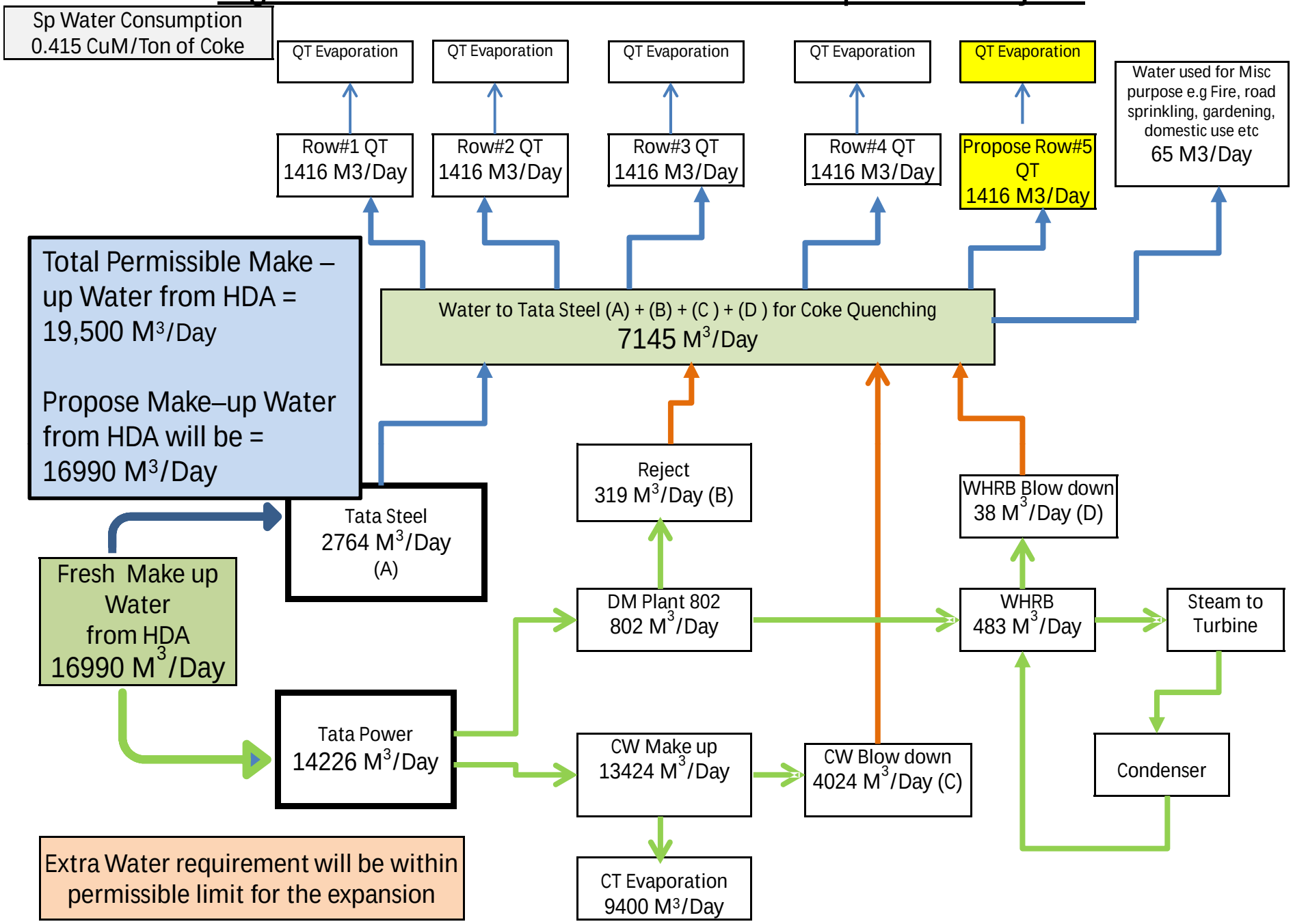
QUERY–1: Total Water requirement for the project should be reassessed and submitted along with the permission obtained from the competent authorities for withdrawal of water for the project. The water balance calculations should also be prepared and submitted.

REPLY: The raw water will be made available from the existing source i.e., Haldia Development Authority. The present make up water requirement of the existing plant is 10388 m^3/day (1588 m^3/day for Coke Oven Plant & 8800 m^3/day for Power Plant). There will an additional 6602 m^3/day water requirement after the implementation of the proposed project (1176 m^3/day for Coke Oven Plant & 5426 m^3/day for WHRB based Power Plant). Hence, the total make up water requirement of the plant after the proposed project will be 16990 m^3/day (2764 m^3/day for Coke Oven Plant & 14226 m^3/day for WHRB based Power Plant), which is within the allocated quantity of 19500 m^3/day by Haldia Development Authority (HDA).

The revised water balance for the overall plant after the implementation of the proposed expansion project has been presented in **Figure - 1.1**.

The water Agreement with HDA is attached as **Appendix - I**.

Figure-1.1: Water Balance after Proposed Project



पश्चिम बंगाल WEST BENGAL 04AA 789559

The Agreement made on the 1st day of March two thousand Seven BETWEEN **Haldia Development Authority,** constituted under the West Bengal Town and Country (Planning and Development) Act, 1979 **(hereinafter called the Authority)** of the ONE PART and **M/s. Hooghly Met Coke and Power Company Limited (hereinafter called the Consumer)** of the OTHER PART.

Whereas the Authority has decided to supply clear/filtered water to the consumer for the purpose of industrial use at HMCPCL, Haldia.

AND WHEREAS, the consumer has agreed to purchase water from the Authority on the terms and conditions hereinafter appearing;

NOW, THEREFORE, the parties hereto, hereby covenant with each other to observe and perform the following that is say :-

Chief Executive Officer
Haldia Development Authority

..2.

1. The Authority will supply filtered/cleared water to the consumer 19500 K.L. per day, at his plant premises at HMCPCL, Haldia for industrial use, @ ~~Rs.9.00~~ Rs. 11.00 (Rupees ~~Nine~~ eleven only) per K.L. and a monthly Meter rent of Rs.10/- (Rupees Ten only) will be charged by the Authority from the consumer as per the following schedule :

Upto 31.5.2007	-	400 KL per day
From 1.6.2007 to 30.9.2007	-	9,600 KL per day
From 1.10.2007 onwards	-	19,500 KL per day

2. Filtered/Clear water will be supplied to the underground reservoir to be constructed by the consumer within his premises. In no circumstances water will be drawn directly by pumping from the service connection;

3. Supply will be metered and meter rent @ Rs.10/- (Rupees Ten only) will be payable by the consumer.

4. A suitable water meter will be supplied and installed by the Haldia Development Authority and the same will be maintained by the Authority or its Agency.

5. Monthly bills will be raised against consumption of water at the rates mentioned in schedule hereunder for payment within the due date, and a penalty charge @ 5 paise per 1000 litres per day or at any other rate as may be revised by the Authority from time to time will be charged if the bill is not paid within the due date.

6. The Authority shall have the right to revise from time to time the rate of water charges and connection charges or penal rate mentioned in the schedule as and when considered necessary.

7. If the bill is not paid within 15 days from the due date, the water connection will be liable to be cut off with a prior notice and re-connection charges as given in the schedule will have to be borne by the consumer. The reconnection charges are also subject to revision from time to time.

..3.

Chief Executive Officer
Haldia Development Authority

8. If no water is consumed or water consumed is less than 50% of the sanctioned quantity, consumer will have to pay the minimum charge at the rate of 50% of the water charge for the quantity of water sanctioned to him at the rate fixed by the Authority from time to time. If requirement of water for any period becomes nil for any reason, prior intimation at least 7 days ahead should be given to Public Health Engineering Department.

9. Maximum 20% in excess of the sanctioned quantity may be drawn. But if the demand exceeds that limits, fresh application is to be given for sanction of additional quantity.

10. The Authority assumes no responsibility in case of failure of water supply due to power failures, major breakdown of supply system or any other reason which is beyond control of the Authority.

11. If the water meter is out of order or do not function due to any reasons during any period, the bill for the said period will be prepared on the basis of average consumption **for three previous bills or other reasonable basis** as may be determined by the Authority and will be binding on consumer.

12. One month's advance water charges calculated on the basis of sanctioned quantity of water at the rate fixed by the Authority from time to time is to be paid as **Security Deposit.** In addition, for new connection, separate connection charges as mentioned in schedule fixed by the Authority from time to time is to be deposited before getting connection.

13. The Authority may, at its discretion, revise the terms and conditions regarding supply of water to its consumers, with prior intimation to them.

..4.

Chief Executive Officer
Haldia Development Authority

IN WITNESS WHEREOF THE Chief Executive Officer of the Haldia Development Authority for and on behalf of the Authority duly authorized by the Authority to sign these presents on the day, month and the year first above written.

(Signed by for and on behalf of the Authority)

Chief Executive Officer
Haldia Development Authority

Address:

(Signed by for and on behalf of the Consumer)

BINAY KUMAR SINGH.
Managing Director

Address:

Hooghly Met Coke & Power Co.Ltd.
43, Jawaharlal Nehru Road
Tata Centre, Kolkata – 700 071

1. Witness

Asstt. Executive Officer
HALDIA DEVELOPMENT AUTHORITY

Address:

1. Witness

Address: Hooghly Met Coke & Power Co.Ltd
43, Jawaharlal Nehru Road
Tata Centre, Kolkata - 700 071

2. Witness (BARUN DATTA)

Address: Accounts Clerk.
C/o. CEO/HDA.

2. Witness

Address: HOOGHLY MET COKE & POWER
43, J.N. ROAD, KOLKATA-71

Annexure-II

QUERY–2: Rainwater Harvesting Calculations and location demarcated on the layout plan should be submitted

REPLY: In the existing plant, Rainwater Harvesting Tank has been constructed with a dimension of 100 mt Length X 25 mt Width X 3.5 mt, Depth having capacity to store 8750 cu.m rain water.

The rain water from all nearby Buildings/areas like ADM buildings, Laboratory, Central Stores, Electrical substation building, Canteen and internal roads get collected to this storm water pond through storm water drains. The drain connectivity is also being provided to collect Tata Power's Cooling Tower blowdown water.

Rain Water harvesting potential of Roof Areas of different Buildings, Road Areas & Rain Water Harvesting Tank within the plant Premises

ROOF AREA OF DIFFERENT BUILDINGS IN SQ.M	
ROOF AREA DESCRIPTION	**AREA IN SQ.M**
ADM	570
ELECTRICAL SUB STATION	340
TPC PUMP HOUSE	350
LAB	465
STORE	680
TOILET@33SQ.M x25 NOS.	825
CCR	340
DG ROOM	130
CAPACITOR BUILDING	150
LCR	740
TPC ROOM	1240
CANTEEN	223
OHC	180
ENGG. SERVICE	150
CCSS	596
REST ROOM	276
CYCLE STAND	140
WORKERS CANTEEN	150
TOTAL	**7545 SQ.M**

BRAEKUP OF INTERNAL ROADS AREA		
ROAD DESCRIPTION	**ROAD DIMENSION**	**ROAD AREA IN SQ.M**
CENTRAL AVN.	15 M X 517 M	7755
HOOGHLY ROAD	7 M X 517 M	3619
HALDI ROAD	7 M X 517 M	3619
WESTERN AVN.	9 M X 836 M	7524
SOUTHERN AVN.	9 M X 517 M	4653
RIVER SIDE ROAD	9 M X 471 M	4239
EASTERN AVN.	9 M X 574 M	5166
ROAD BETWEEN BLENDING BUNKER & COAL YARD	15 M X 500 M	7500
ROAD BETWEEN EXISTING COAL YARD & PROPOSED COAL YARD	15 M X 500 M	7500
NORTHERN AVN.	10 M X 527 M	5270
TOTAL		**56845**
RAINWATER HARVESTING TANK AREA		2500

TOTAL CATCHMENT AREA DETAILS	
CATCHMENT AREA DESCRIPTION	**AREA IN SQ.M**
ROOF AREA OF DIFFERENT BUILDINGS	7545
INTERNAL ROAD AREAS	56845
RAINWATER HARVESTING TANK AREA	2500
TOTAL CATCHMENT AREA	**66890**

Total Catchment Area for rain water harvesting (different buildings Roof Areas + Road Areas + RWH Tank Area) - 66890 sq.m (6.69 hectare, which is around 9% of total plant area)

Average annual rain fall in the project area - 1500 mm

Average annual monsoon rain fall - 85% of 1500 mm = 1275 mm (say)

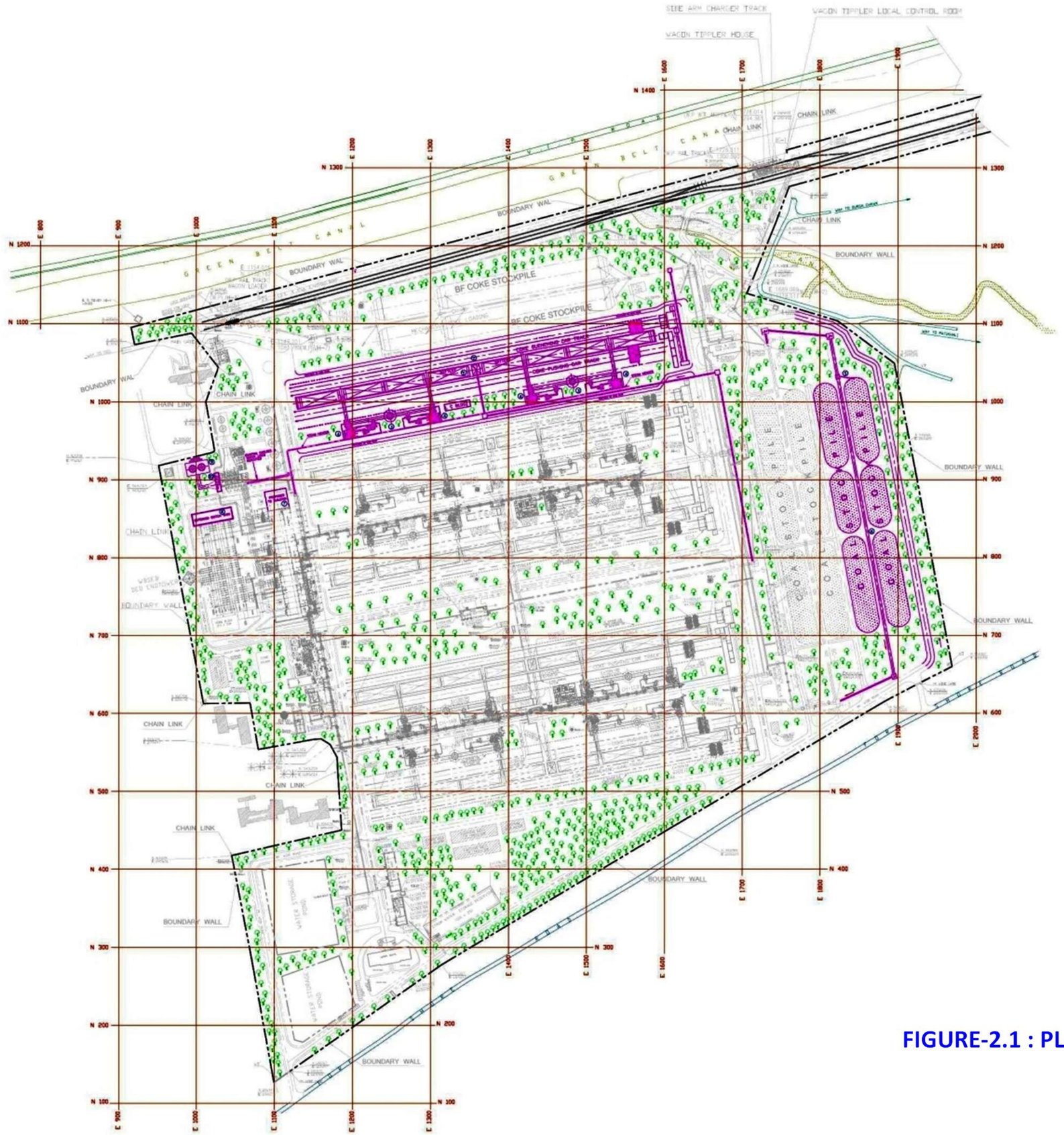
Volume of surface run off from total catchment area within the plant premises = 6.69 x 1.275 x 0.9 ham, = 7.676 ham say 0.07676 mcm

Rain water harvesting potential from total catchment area of the plant campus – 0.07676 mcm

100% run off is allowed to be harvested and stored suitably. Around 0.07676 mcm (i.e., 76760 cu.m) of water therefore, is conserved within the plant for the entire monsoon season (June to September). The capacity of the existing Rain Water Harvesting (RWH) Tank is 8750 cu.m.

Water from this rain water harvesting tank, is being utilized for coke quenching. For this purpose, pipe line of approx. 3 km. length has been laid along with commissioning of four number of pumps, each having capacity of 100 cu.m. per hour for pumping water to Quenching tower.

The location of the existing RWH Tank in the plant area is shown in the layout map as **Figure-2.1**. Different Buildings Roof, Roads & existing RWH Tank photographs is presented in **Figures-2.2, 2.3 & 2.4** respectively. Location of existing RWH Tank within the plant premises in Google Map is presented as **Figure-2.5**.



MAGNETIC NORTH

LEGEND :–

ITEM MKD.	DESCRIPTION
1.	COKE OVEN BATTERY
2.	COAL TOWER
3.	CHIMNEY
4.	WASTE HEAT BOILER
5.	STACKER & RECLAIMER
6.	COAL STOCK YARD
7.	PROPOSED TG BUILDING
8.	EXTENDED SWITCH YARD
9.	COOLING TOWER
10.	PROPOSED SUMP & PUMP

NOTE:–

1. EXPANSION FACILITIES:
2. ALL DIMENSIONS ARE IN METERS.
3. SCALE – 1:3

FIGURE-2.1 : PLANT LAYOUT

M. N. DASTUR & COMPANY (P) LTD.
CONSULTING ENGINEERS, KOLKATA

FOR : TATA STEEL LIMITED
HMC DIVISION, HALDIA

TECHNO–ECONOMIC FEASIBILITY REPORT FOR 0.44 MTPY EXPANSION OF COKE OVEN PLANT
LAYOUT

DRAWN	SAS	14.05.2013	11293–2–0001
APPROVED	SG	26.08.2013	

ADM. BUILDING

CONTRACTOR CANTEEN

CCR BUILDING

TPC BUILDING

COOLING TOWER

FIGURE – 2.2 : DIFFERENT BUILDINGS ROOF AREA

TG BUILDING

CONTRACTOR CANTEEN

ELECTRICAL SUB STSTION BUILDING

LAB. BUILDING

ENGINEERING STORE

FIGURE – 2.2 : DIFFERENT BUILDINGS ROOF AREA

FIGURE – 2.3 : ROADS INSIDE PLANT AREA

FIGURE – 2.4 : EXISTING RWH TANK

FIGURE 2.5 - EXISTING RWH TANK ON GOOGLE MAP

ANNEXURE-III

QUERY–3 : A letter from the State Forest Department should be submitted stating that there is no reserve forest, national park, wildlife sanctuary etc exists within 10 KM radius of the plant.

REPLY: **M/s Tata Steel Limited (Hooghly Metcoke Division)** has proposed to expand its existing Coke Oven Plant at Haldia, District Purba Medinipur in West Bengal. Its geographical coordinates are Latitude 22°0'15"N to 22°7'15"N and Longitude 88°03'51"E to 88°11'44"E with mean sea level 26 ft. The 10 km radius study area is located within Purba Midnapur and South 24 Parganas district in West Bengal.

There is no National Park, Wildlife Sanctuary & Reserve Forest existing within 10 km radius around the Project site. NOC Letters from DFO Office - Purba Medinipur Division & 24 Parganas (South) Division are enclosed. The 10 km radius Study area map is presented below:

10 KM RADIUS STUDY AREA

Government of West Bengal
Directorate of Forests
Office of the Divisional Forest Officer
Purba Medinipur Forest Division
Chak Kamina,Nimtala,Tamluk,Purba Medinipur
Phone No.: 03228-263036 & e-mail : dfopmfd@yahoo.co.in

Memo No.: 104 / 28 Dated Tamluk the 29.01.2016

To,

Sri Shailesh Verma,
General Manager – HMC,
TATA Steel Ltd.,
Hooghly Metcoke Division,
Patikhali,P.O.- Haldia Oil Refinery,
Haldia,Purba Medinipur,
Pin – 721606.

Subject : Declaration on " Non – existence of any Reserve Forest within 10 KM radius of M/S Tata Steel Ltd. Plant – Haldia" – regarding

Reference : Your Memo No.: HMC/GM/E&F/001 dated 14.01.2016

With reference to the subject mentioned above, this is to inform you that, as per available record, there is no Reserved Forest inside the Purba Medinipur Forest Division as well as District. But a 10 Km radius from your plant at Haldia includes the areas of South 24 Parganas District as well as South 24 Parganas Forest Division. So whether there exists any Reserved Forest in that area can only be certified by the authority of that District and that Division only.

This is for your information and taking necessary actions, please.

Divisional Forest Officer
Purba Medinipur Forest Division

Phone : (033) 2479-9032 (Office)

BY MESSENGER

GOVERNMENT OF WEST BENGAL
DIRECTORATE OF FORESTS
OFFICE OF THE DIVISIONAL FOREST OFFICER,
24-PARGANAS (SOUTH) DIVISION
NEW ADMINISTRATIVE BUILDING, 4TH FLOOR,
12, BIPLABI KANAILAL BHATTACHARJEE SARANI,
ALIPORE, KOLKATA – 700 027
E-mail : dfo24pgs@gmail.com

No. 236 /28- Dated, Alipore the 25 . 02 .2016

From :: The Divisional Forest Officer,
24-Parganas (South) Division

To :: Sri Shailesh Verma
General Manager-HMC
TATA Steel Ltd.,
Hoogly Metcoke Division,
Patkali, P.O. –Haldia Oil Refinery,
Haldia, Purba Medinapur,
Pin-721606

Sub :: Declaration on "Non- existence of any reserve Forest with in 10Km radius of M/s Tata Steel Ltd. Plant – Haldia"- regarding.

Ref :: Your memo no. HMC/GM/E & F/002 dated 03 February 2016

With reference to the subject mentioned above, this is to inform you that, as per available record, there is no Reserve Forest within 10 Km radius of the above mentioned plant inside the South 24 Parganas Division.

This is for your information and necessary action.

Divisional Forest Officer,
24-Parganas (South) Division

NOC received from DFO - 24 Parganas (South)

ANNEXURE-IV

QUERY–4: The total area required for the storage of the raw material for the existing as well as proposed project should be submitted. Revised layout plan with connecting roads to the plant and internal circulation roads should be submitted along with a clear Google map.

REPLY: Out of the total plant area of 72.5 hectare (180 acres), the area required for storage of raw materials for the existing as well as proposed project will be 11.6 Hectares as presented below:

Description	Existing	Proposed
Coal stack Yard Area	58,000 sq.m (5.8 Hectares)	58,000 sq.m (5.8 Hectares)
Coal holding capacity	60,000 Ton (as per design)	-

The plant layout on Google Map is shown as **Figure-4.1**. The main roads within the plant premises on Google Map are shown as **Figure-4.2**. Photographs of main roads within the plant premises are presented in **Figure-4.3**.

FIGUTRE – 4.1 : PLANT LAYOUT ON GOOGLE MAP

FIGURE – 4.2 : MAIN ROADS WITHIN THE PLANT AREA

FIGURE – 4.3 : OVERALL ROAD PHOTOGRAPH INSIDE PLANT AREA

FIGURE – 4.3 : ROAD PHOTOGRAPHS INSIDE PLANT AREA

ANNEXURE-V

QUERY–5: Explore the possibility to achieve a stack emission level < 25 mg/Nm^3 and submit the plan to Ministry. In addition, efforts should also be explored to reduce SOx and NOx levels from the stacks and the proposed plan to be submitted.

REPLY: In the heat-recovery coke making technology the stack emission is purely the outcome of gas combustion process. In order to maintain PM emission at low level, 100% combustion of gas evolving from coal that is being charged inside the oven is ensured. Two stage air supplies ensure complete combustion and the key indicator is O_2 level in waste gas. 6-8% O_2 level indicates around 20% excess air, which is ideal. This O_2 level in waste gas is being monitored regularly and it is very consistent.

Any oven draft variation impacting combustion is reflected in waste gas O_2 level.

Consistent and uninterrupted boiler operation is the key to control this draft. Though it is under control, an interlock arrangement is being introduced with the tunnel damper. If any variation in the draft happens the tunnel damper will operate automatically to maintain the draft.

When boiler goes for statutory shut-down / break-down, PM marginally increases due to less travel path of waste gas. This activity or break down is unavoidable.

Boiler break-down is minimized through daily management of various operating parameters.

With all these measures the standard deviation of stack emission will reduce. However, the net avg. stack emission will be lowered marginally, against the stipulated norm of 50 mg/NM^3. The actual monitored data during operation is much lower as shown in **Table- 5.1**.

SOx and NOx reduction

SOx & NOx level during operation is much lower than the stipulated norm of 800 mg/NM^3 for SOx and 500 mg/NM^3 for NOx. This level has been achieved by proper designing of the battery and selection of low sulphur coal.

Stack Emission data of PM, SO_2 & NOx (in mg/Nm^3) from all eight Stacks from February, 2016 to August, 2016 is shown in **Table- 5.1**.

TABLE-5.1 Stack Monitoring Report				
DATE OF SAMPLING	**STACK**	**PM**	**SO_2**	**NOx**
		mg/Nm^3		
11.04.2016	Chimney 1 AB	26	258.69	131.21
16.06.2016	Chimney 1 AB	23	214.64	141.39
23.08.2016	Chimney 1 AB	18	235.42	131.62
	AVERAGE	**22.33**	**236.25**	**134.74**
16.06.2016	Chimney 1 CD	20	209.97	126.06
23.08.2016	Chimney 1 CD	25	252.24	140.86
	AVERAGE	**22.50**	**231.11**	**133.46**
21.04.2016	Chimney 2 AB	23	247.98	134.4
17.05.2016	Chimney 2 AB	18	215.87	154.97
	AVERAGE	**20.50**	**231.93**	**144.69**
21.04.2016	Chimney 2 CD	29	238.64	118.72
17.05.2016	Chimney 2 CD	35	227.08	172.08
	AVERAGE	**32.00**	**232.86**	**145.40**
18.02.2016	Chimney 3 AB	29	221.76	129.34
07.07.2016	Chimney 3 CD	26	195.06	118.41
18.05.2016	Chimney 4 AB	12	220.06	172.24
18.05.2016	Chimney 4 CD	22	229.28	160.48

ANNEXURE-VI

QUERY–6 : Break-up of the land use indicating existing and proposed use should be provided. In addition, layout plan for old facilities vis-a-vis new proposed facilities should be prepared and submitted.

REPLY: Proposed project to be installed within the available land of the existing plant area of about 72.5 hectare (180 acres). No additional land shall be required. The land use statement of project area for both existing & future scenario is presented below:

S. N.	AREA DESCRIPTION	EXISTING AREA (IN SQ.M)	PROPOSED ADDITIONAL AREA (IN SQ.M)
1.	Battery Area – include Coke Ovens, Pusher & Quenching car track lines, Quenching stations, settling ponds, Boilers etc.	174684	66000
2.	Material Handling Area – include coal yard, coke yard, unloading and loading facilities etc.	67428	41557
3.	Plant Building Area – include control rooms, coal coke sub stations, TPC buildings (TG, CT, Admin etc), canteen, OHC, facility centres, administrative offices, store, laboratory , gate house etc.	63400	4500
4.	Roads	79468	7500
5.	Green Belt	176650	26313
6.	Miscellaneous - include Rain water harvesting pond, Fresh Make up water pond etc.	17500	-
TOTAL		579130	145870
GRAND TOTAL		7,25,000 SQ.M (72.5 Hectares)	

Plant layout indicating existing as well as proposed facilities is presented as **Figure-6.1**.

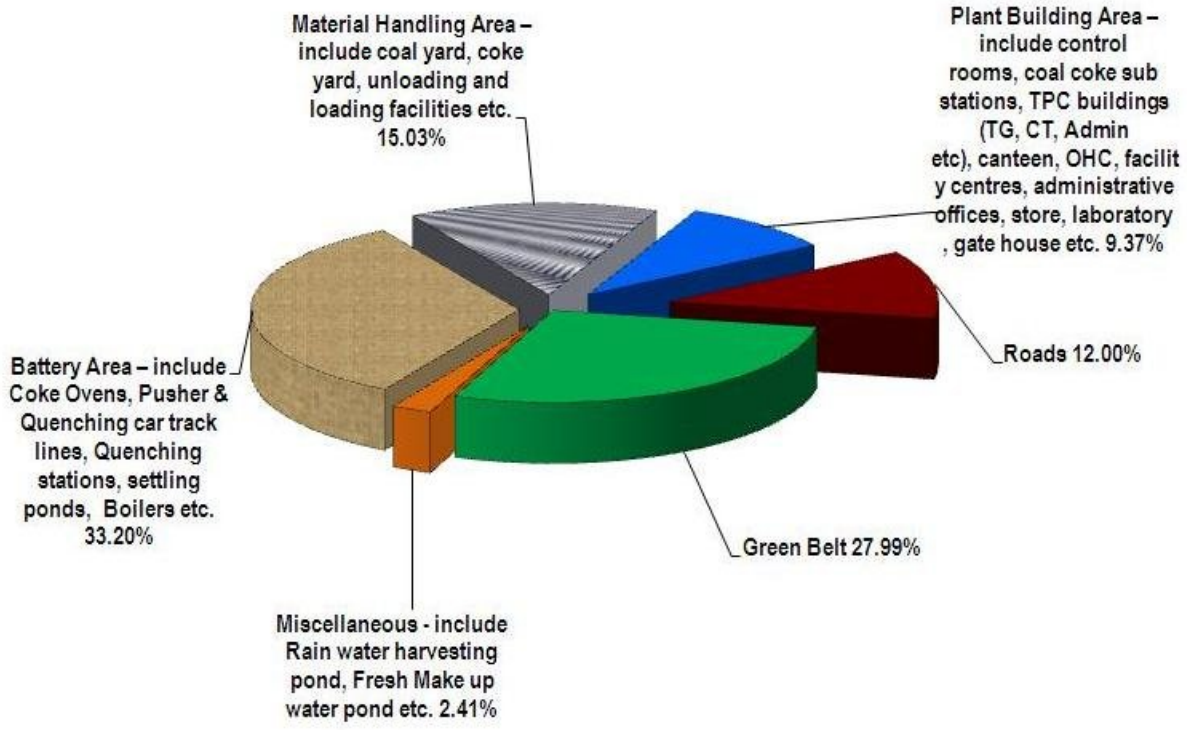
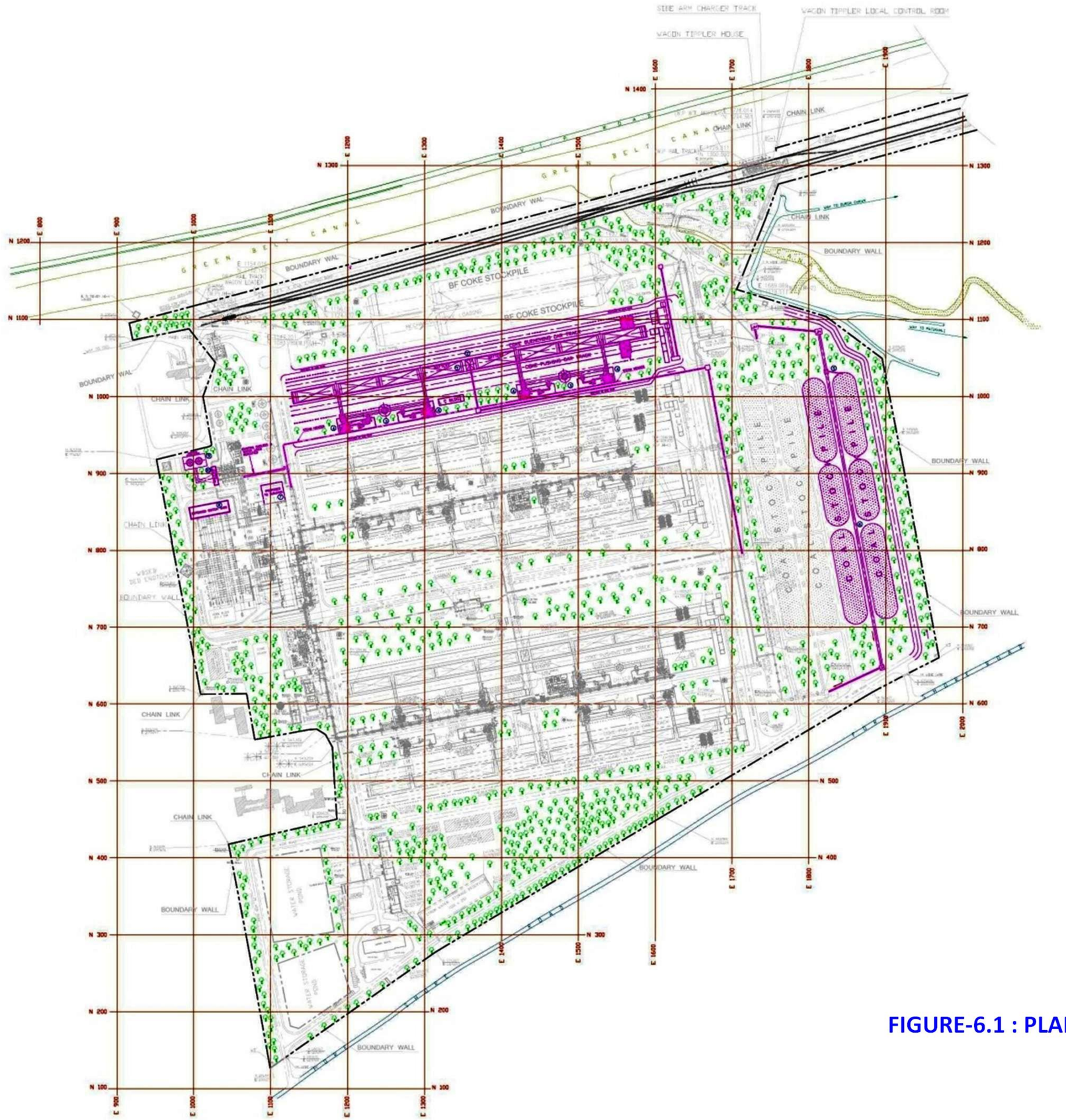


FIGURE – 6.2 : PIE CHART SHOWING LAND USE OF THE PROJECT SITE



N

MAGNETIC NORTH

LEGEND :–

ITEM MKD.	DESCRIPTION
1.	COKE OVEN BATTERY
2.	COAL TOWER
3.	CHIMNEY
4.	WASTE HEAT BOILER
5.	STACKER & RECLAIMER
6.	COAL STOCK YARD
7.	PROPOSED TG BUILDING
8.	EXTENDED SWITCH YARD
9.	COOLING TOWER
10.	PROPOSED SUMP & PUMP

NOTE:–

1. EXPANSION FACILITIES:
2. ALL DIMENSIONS ARE IN METERS.
3. SCALE – 1:3

FIGURE-6.1 : PLANT LAYOUT

M. N. DASTUR & COMPANY (P) LTD.
CONSULTING ENGINEERS, KOLKATA

FOR : TATA STEEL LIMITED
HMC DIVISION, HALDIA

TECHNO-ECONOMIC FEASIBILITY REPORT FOR 0.44 MTPY EXPANSION OF COKE OVEN PLANT
LAYOUT

DRAWN	SAS	14.05.2013	11293-2-0001
APPROVED	SG	26.08.2013	

ANNEXURE-VII

QUERY–7 : Comparison of ambient air quality data collected for the project with SPCB data should be submitted

Reply: For EIA study, Ambient Air Quality Monitoring was conducted at 8 locations in 10 km. radius area with respect to the project site. West Bengal Pollution Control Board has been undertaking ambient air quality monitoring (Manual) at one location at Haldia i.e., at WBIDC Office at Durgachak. In EIA study, out of eight monitoring locations, one is Durgachak. Although the monitored station at Durgachak considered in EIA study is around 0.6 km away from that, being operated by WBPCB, both are comparable to some extent. The corresponding data through WBPCB instrument at the said location have been compiled & presented in **Table- 7.1**. It would be relevant to mention here that WBPCB data are available only for PM_{10}, SO_2 & NO_2. Hence the comparison has been established only for these three parameters. The locations along with the Co-ordinates (latitude/longitude) of both the monitoring stations i.e. EEPL & WBPCB Stations are presented in **Figure- 7.1**.

Table- 7.1

AMBIENT AIR QUALITY MONITORING AT HALDIA (WBPCB DATA) LOCATION: WBIDC (DURGACHAK)			
DATE	**PM_{10}**	**SO_2**	**NO_2**
	($\mu g/m^3$)	**($\mu g/m^3$)**	**($\mu g/m^3$)**
04/12/2014	114.97	11.18	37.12
07/12/2014	125.86	14.9	42.34
10/12/2014	134.45	15.44	46.69
13/12/2014	127.97	11.72	42.05
16/12/2014	129.61	11.72	46.11
19/12/2014	131.55	10.81	41.18
22/12/2014	139.04	12.54	40.31
27/12/2014	115.39	11.27	41.47
31/12/2014	143.27	15.81	46.69
03/01/2015	107.32	13.36	41.47
06/01/2015	129.45	10.19	32.98
09/01/2015	117.52	13.67	42.44

14/01/2015	146.79	15.07	54.68
17/01/2015	121.55	12.37	38.45
19/01/2015	121.16	17.58	48.7
22/01/2015	130.84	15.44	47.56
27/01/2015	147.25	21.86	64.08
30/01/2015	129.11	19.81	55.25
01/02/2015	127.06	14.88	39.87
04/02/2015	140.47	17.3	48.7
12/02/2015	136.72	20	61.52
17/02/2015	158.53	23.25	70.06
20/02/2015	129.16	15.07	50.98
25/02/2015	157.26	16.28	48.13
28/02/2015	94.02	11.24	35.03

AMBIENT AIR QUALITY MONITORING DATA (AS IN EIA STUDY BY EEPL) LOCATION: DURGACHAK			
(Period: DECEMBER, 2014 - FEBRUARY, 2015)			
DATE	**PM_{10}**	**SO_2**	**NO_2**
	($\mu g/m^3$)	**($\mu g/m^3$)**	**($\mu g/m^3$)**
08.12.2014	99	15	48
11.12.2014	93	16	30
15.12.2014	110	19	49
18.12.2014	121	21	33
22.12.2014	97	15	42
25.12.2014	106	17	49
05.01.2015	94	22	31
08.01.2015	89	18	52
12.01.2015	77	24	37
15.01.2015	124	18	43
19.01.2015	99	13	39

22.01.2015	114	21	36
26.01.2015	95	18	33
29.01.2015	98	15	41
03.02.2015	104	17	44
06.02.2015	86	14	40
10.02.2015	74	24	36
13.02.2015	81	12	40
17.02.2015	77	17	32
20.02.2015	89	20	35
24.02.2015	114	15	41
27.02.2015	94	12	32

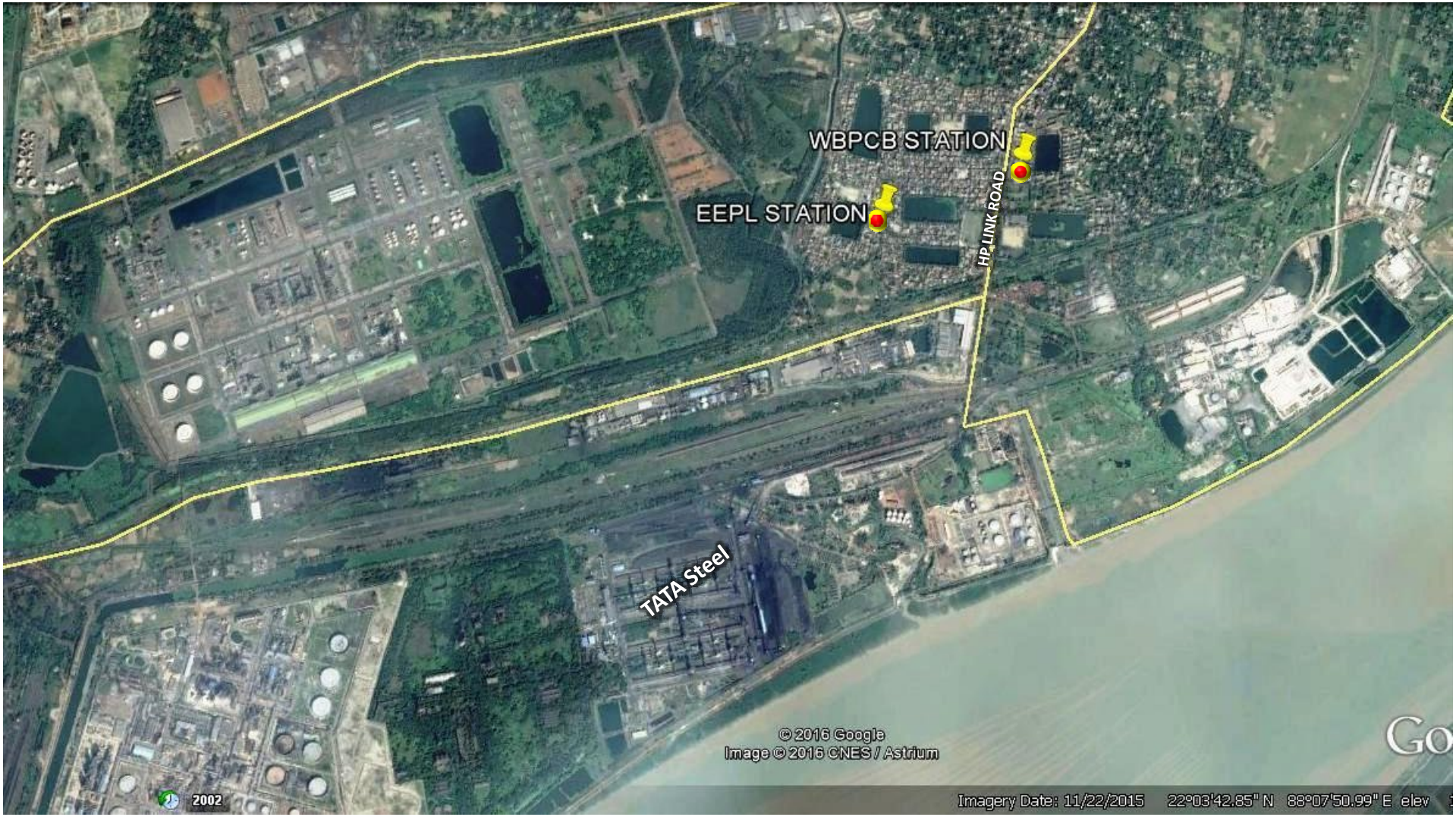
STATISTICAL ANALYSIS RESULTS OF POLLUTANTS
(Period: December, 2014 – February, 2015)

PARAMETER	EEPL DATA (AS IN EIA STUDY)			WBPCB DATA		
	MIN	MAX	AM	MIN	MAX	AM
PM_{10}	74	124	97.0	94.0	158.5	130.3
SO_2	12	24	17.4	10.2	23.3	14.9
NO_x	30	52	39.2	33.0	70.1	46.6
All figures are in $\mu g/m^3$						

Conclusion:

While going through the statistical analysis of pollutants, PM_{10} values, reported at WBPCB location were in the range of 94.0 to 158.5 $\mu g/m^3$. The corresponding range for the monitoring location considered in the EIA study is 74 to 124 $\mu g/m^3$. The corresponding ranges for SO_2 are 10.2 to 23.3 $\mu g/m^3$ for WBPCB location & 12 to 24 $\mu g/m^3$ as per EIA report. Similarly the ranges for NO_2 values are in the ranges of 33.0 to 70.1 $\mu g/m^3$ as per WBPCB data and 30 to 52 $\mu g/m^3$ as per EIA study. WBPCB data are on slightly higher side w.r.t PM_{10} & NO_2. It is important to note that the location at Durgachak as considered in EIA study is away (around 500 m) from the commercial area as well as the main road. On the other hand, the WBPCB location is close (around 65 m) to the main road & commercial area.

FIGURE – 7.1 : WBPCB & EEPL STATIONS ON GOOGLE MAP



Distance between WBPCB station & HP Link Road – 65 m
Distance between EEPL Station & HP Link Road – 500 m
Distance between EEPL & WBPCB Station– 600 m

EEPL STATION CO-ORDINATE: 22° 4'8.95"N & 88° 7'57.18"E
WBPCB STATION CO-ORDINATE: 22° 4'16.62"N & 88° 8'17.62"E

ANNEXURE-VIII

QUERY–8 : Vehicular traffic density in the exiting road and increase of the traffic due to proposed expansion should be carried out and proposed mitigation measures to combat vehicular emission should be submitted

REPLY: Present Traffic Load

Traffic density was monitored at IOCL Gate bus stop, Haldia (Refer **Figure- 8.1**) on the road connecting TATA Steel to NH-41. The data were recorded once for a day in the month of January, 2016, for continuous 24 hours in a day, under three different vehicle categories i.e., Heavy, Medium and Light. The heavy vehicles included trucks, buses, cranes etc. The medium vehicles included mini buses; matadors etc. while cars, jeeps, two wheelers, auto rickshaws & trekker were considered under the light vehicles category. The relevant account has been gathered in **Table – 8.1**.

TABLE – 8.1
NAME OF THE LOCATION : IOCL GATE BUS STOP, HALDIA
DATE OF SAMPLING : 06.01.2016

HOUR	HEAVY	MEDIUM	LIGHT	TWO WHEELERS	TOTAL
0700 - 0800	67	12	108	97	284
0800 - 0900	52	15	174	138	379
0900 - 1000	61	9	136	144	350
1000 - 1100	49	14	108	131	302
1100 - 1200	40	6	113	106	265
1200 - 1300	48	8	122	102	280
1300 - 1400	60	11	96	124	291
1400 - 1500	39	6	107	115	267
1500 - 1600	73	10	118	119	320
1600 - 1700	64	8	103	104	279
1700 - 1800	53	14	146	133	346
1800 - 1900	40	8	133	125	306
1900 - 2000	38	11	95	96	240
2000 - 2100	29	6	92	89	216
2100 - 2200	38	-	76	102	216
2200 - 2300	37	2	88	93	220

2300 - 0000	33	-	83	68	184
0000 - 0100	18	6	69	63	156
0100 - 0200	27	4	63	44	138
0200 - 0300	21	2	44	16	83
0300 - 0400	24	5	57	27	113
0400 - 0500	29	4	52	36	121
0500 - 0600	35	6	96	69	206
0600 - 0700	44	8	111	63	226

NOTE :
HEAVY : Truck, Bus, Cranes
MEDIUM : Minibus, Matador
LIGHT : Car, Jeep, Two wheelers, Auto Rickshaw, Trekker

Additional Traffic due to plant operation of TATA Steel

Both the raw material and product shall be transported by rail. However, there will be some additional traffic load due to movement of medium / light vehicles carrying employees of the company to the plant site, the details of which are presented below:

Type of Vehicle	Existing Scenario	Future scenario after expansion
Mini Bus	40 trips per day	44 trips per day
Car	90 trips per day	98 trips per day
Motor Cycle / Scooter	90 trips per day	108 trips per day

Such additional traffic load due to the man power movement will be added to the present traffic load of the area.

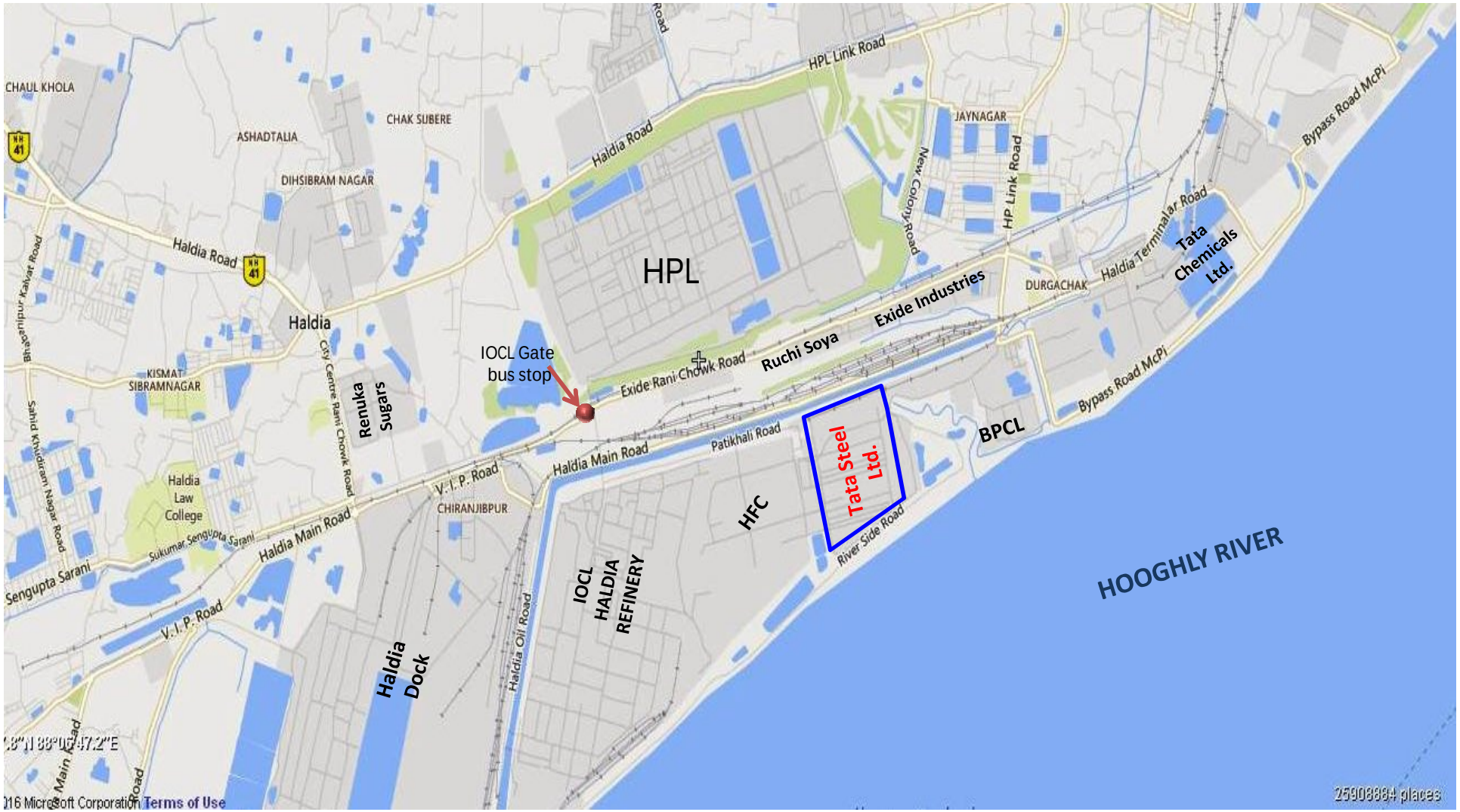
Mitigation Measures

With strict traffic management system and various environmental management practices, contribution of pollutants in the ambient air will be kept under control so as to create minimum disturbances in the neighbourhood.

The vehicular traffic plying in and out of the project site will also be one of the significant sources of air pollution. It will be mitigated by properly regulating the traffic and by following strict and disciplined vehicular movement and operation in

the project site. Adequate and planned road network will be set up in the proposed project for smooth movement of the vehicles.

FIGURE – 8.1 : ROAD MAP OF CLOSE VICINITY



ANNEXURE-IX

QUERY–9 : Green belt implementation plan, as per Compliance report of RO should be submitted

REPLY: Out of the total plant area of 72.5 hectares, 20.3 hectares shall be covered under greenbelt after the implementation of the proposed project. The relevant details are presented in the following sections:

Existing Green Belt

- Total Number of Trees as on date = 28264 nos
- Total existing green belt area = 176650 Sq. Mt
  (Each tree area = 6.25 Sq. Mt) = 17.67 Hectares

Proposed Green Belt

- Total Number of Tree proposed = 4210 nos
- Total proposed green belt area = 26313 Sq. Mt
  (each tree area = 6.25 Sq. Mt)
  = 2.63 Hectares

Total Green Belt Area (Existing + Proposed) **=** 20.3 **Hectares**
= 28% of total plant area (Approx.)

The details of the existing & proposed trees in different parts of the plant area along with the future plantation schedule are presented in the Table below:

Sl. No.	Location	Existing numbers	Proposed numbers	Proposed Plantation Programme				
				Year 1	Year 2	Year 3	Year 4	Year 5
1	Tippler Side along the boundary wall	326	305	91	76	61	46	30
2	Patikhali canal - both side	1423	91	27	23	18	13	9
3	Wagon Loader - Across boundary wall	1253	609	183	152	122	91	61
4	Simplex Gate	1558	244	73	61	49	37	24
5	Back side of Scrap yard	230	366	110	91	73	55	37
6	Coke Yard	2553	30	9	8	6	5	3
7	Central Avenue surrounding	1397						

8	**CCR surrounding area**	**1252**	**15**	**5**	**4**	**3**	**2**	**2**
9	**Patikhali Main gate to watch tower & east boundary wall**	**465**	**198**	**59**	**49**	**40**	**30**	**20**
10	**Near TPC ADM building**	**87**						
11	**Hooghly Road**	**187**						
12	**TPC surrounded area**	**1700**	**152**	**46**	**38**	**30**	**23**	**15**
13	**Back side of new ADM building**	**235**	**30**	**9**	**8**	**6**	**5**	**3**
14	**Western Avenue Road both side, south side wall and in front of CCSS**	**1500**	**21**	**6**	**5**	**4**	**3**	**2**
15	**Around Storm water pond**	**367**	**15**	**5**	**4**	**3**	**2**	**2**
16	**"Green Haldia : Clean Haldia" project**	**1000**	**305**	**91**	**76**	**61**	**46**	**30**
17	**Trees planted near weigh bridge / across the road at the southern part of the plant**	**327**	**15**	**5**	**4**	**3**	**2**	**2**
18	**Boiler surrounding area in all 4 rows**	**3300**	**244**	**73**	**61**	**49**	**37**	**24**
19	**Chimney surrounded area**	**1200**	**91**	**27**	**23**	**18**	**14**	**9**
20	**Row#2 and 3 Quenching souurounded area**	**5200**						
21	**Back side of Cantten / OHC / rest room**	**900**	**107**	**32**	**27**	**21**	**16**	**11**
22	**Water Storage Tank surrounded area**	**418**	**168**	**50**	**42**	**34**	**25**	**17**
23	**End of CL#4 & Surrounding**	**223**	**76**	**23**	**19**	**15**	**11**	**8**
24	**South side boundary wall**	**1163**	**366**	**110**	**91**	**73**	**55**	**37**
25	**Row#5 Quenching souurounded area**		**762**	**229**	**191**	**152**	**114**	**76**
26	**East wall side adjacent to fresh water pond**							
27	**Green Park near Simplex gate**		**Will be done in FY'17**					
TOTAL		28264	4210	1264	1052	842	631	421

LIST OF TREES FOR PLANTATION	
TREE SPECIES	**COMMON NAME**
Pongamia pinnata	Karanj
Mimusops elengi	Bakul
Butea monosperma	Palash
Cassia fistula	Amaltas
Dalbergia sissoo	Sissoo
Neolamarckia cadamba	Kadam
Ficus benghalensis	Banyan
Ficus religiosa	Peepal
Oleander	Peeli Kaner / Karomori
Acacia auriculiformis	Akashmoni
Moringa oleifera	Sajina
Terminalia arjuna	Arjun
Azadirachta indica	Neem
Shorea robusta	Malaysian Sal
Mangifera indica	Mango
Albizia lebbeck	Siris
Artocarpus heterophyllus	Jackfruit
Cocos nucifera	Coconut
Polyalthia longifolia	Debdaru
Alstonia scholaris	Chatim
Swietenia mahagoni	Mehogini
Betel Nut	Supari
Alastonia macrophylla	Chatim
Silver Oak	Rupashi

ANNEXURE-X

QUERY–10 : Focused CSR plan should be prepared based on the need of the villagers. The CSR plan should focus village as a unit in order to improve the livelihood of each family by adopting a few villages falling in the project area. This is expected to bring in economic empowerment of each family which in turn will facilitate environmental and social benefits.

REPLY: Tata Steel's vision is "to be a global benchmark in value creation and corporate citizenship". The company has always endeavoured to conduct its business responsibly, mindful of its social accountability, respecting applicable laws and with regard for human dignity. The company's long-term CSR objective is "to improve the quality of life of the communities we serve globally through long term value creation for all stakeholders", which is in alignment with the Tata Group Core Purpose.

At Tata Steel Limited, corporate social responsibility (CSR) has been the corner-stone of success right from inception. Corporate Social Responsibility has always been an integral part of the company's vision.

Company defines Corporate Social Responsibility as making socially responsible products, engaging in socially responsible employee relations and making a commitment to the community around it. For Tata Steel Ltd., Corporate Social Responsibility is not just a duty; it's a way of life.

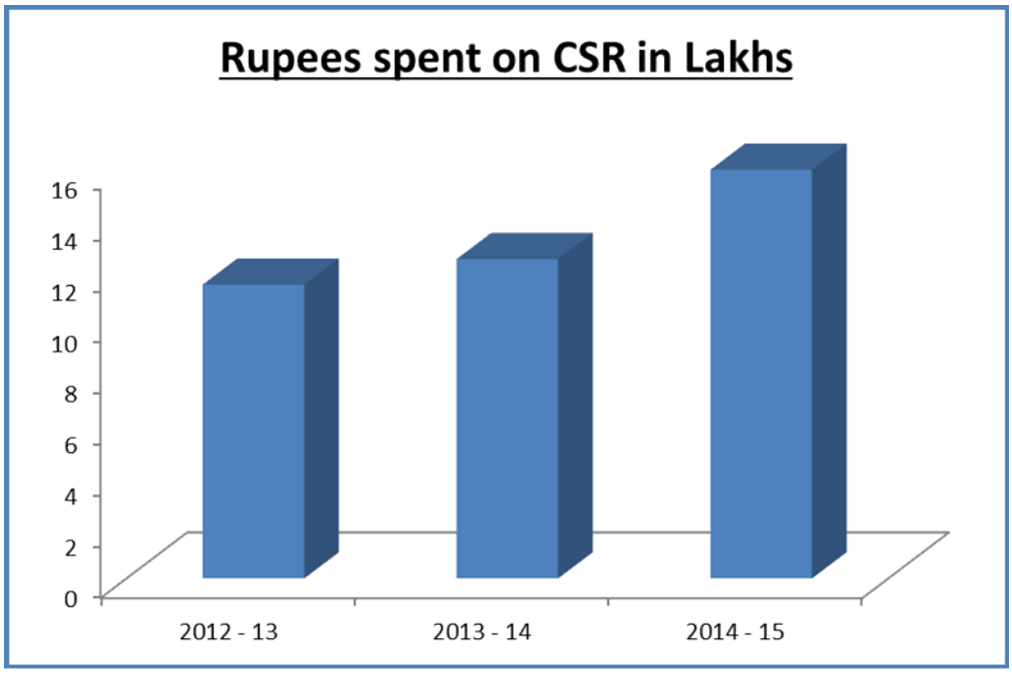
Tata Steel Ltd., Hooghly Metcoke Division begins CSR (Corporate Social Responsibility) with a humanitarian approach to their employees and taking care of their welfare and then moved beyond employees to the communities and to the society at large -- in an 'inside-out' approach. The initiative to extend its services in the field of CSR is in line with the philosophy of the Tata Group Company.

The Division also adopted the Group's "Affirmative Action Policy" Nearly 250 local people have been given employment and approx 500 people work as contractual workers for non-core activities like housekeeping, temporary civil construction jobs etc.

The Hooghly Metcoke division has started the CSR activity from 2012 for community development.There is a dedicated committee to look after the planning as well as the execution process pertaining to the CSR activities under the various categories. The committee reviews the activities from time to time. The CSR committee recommends the Annual Plan for CSR activities and plans the budget for the year on the basis of "Rupee 1 per ton of Coke produced". The unit's focus areas for the developmental activities are mainly in Haldia Municipality area as well as in the nearby rural areas of the district. The activities under different categories and corresponding amount spent for CSR by the unit for the past 3 years are as below:

DETAILS OF DIFFERENT CATAGORIES OF CSR ACTIVITIES

Education		Teaching / Learning aid to Schools
		Furniture to Schools
		Awareness on Environment at Schools / Saplings distribution.
		Inter school quiz competition
		Camp for school children on extracurricular activity / creativity
		Drinking water facilities to local schools
		Awareness on safe drinking water / water conservation / Energy conservation / general hygiene .
Health		Medical camp for School children.
		Eye camp for locality.
		Ambulence to Vivekananda Mission Eye Hospital
Environment Protection and Beautification		Plantation in the surrounding locality / schools
		Distribution of Seeds / Organic Manure / pesticide etc
		Associated with Haldia Municipality on "GREEN HALDIA : CLEAN HALDIA" project
		Distribution of Cotton Bags in order to promote "NO PLASTIC" amongst neighbour hood people



EXISTING CSR PHOTOGRAPHS

Distribution of Winter Garments to 220 Blind students
at Vivekanada Mission Ashram

Distribution of saplings along with
Cotton Bags on World Environment Day

Free Eye Check Up with Vivekananda Mission Ashram
Eye Care for Below Poverty Level

Plantationof tree on evert of Environmental Awareness
at Jawahar Naboday Vidyalaya

Volustary Blood Camp on Birth Anriversary of
Jamsetji Nusserwanji Tata on 3rd March

Free Medical Check Up Camp for BPL (Below Poverty Level) at Patikhali

Free Medical Health Check Up for stucents of
Patikhal Vidyasagar Prathamik Sikhya Viketan

Support to the flood affected

Tree Plantation (170 nos.) my employees of
HMC Division of **TATA VOLUNTEERING WEEK**

The Long Term Plan on CSR :

In line with the proposed expansion of Hooghly Metcoke Project, the company proposes to invest 38.5 Crores on the CSR activities, which is 5% of the total project cost (Rs. 769.45 Crores). This amount shall be utilized over a period of 10 years.

The focus of the interventions will be on socio-economic development of the community around; with time bound plan. The company will work on “Focus Area” approach by adopting Villages / Panchayats / Home and building up “Model Villages” so that the Socio – economic development can be visible.

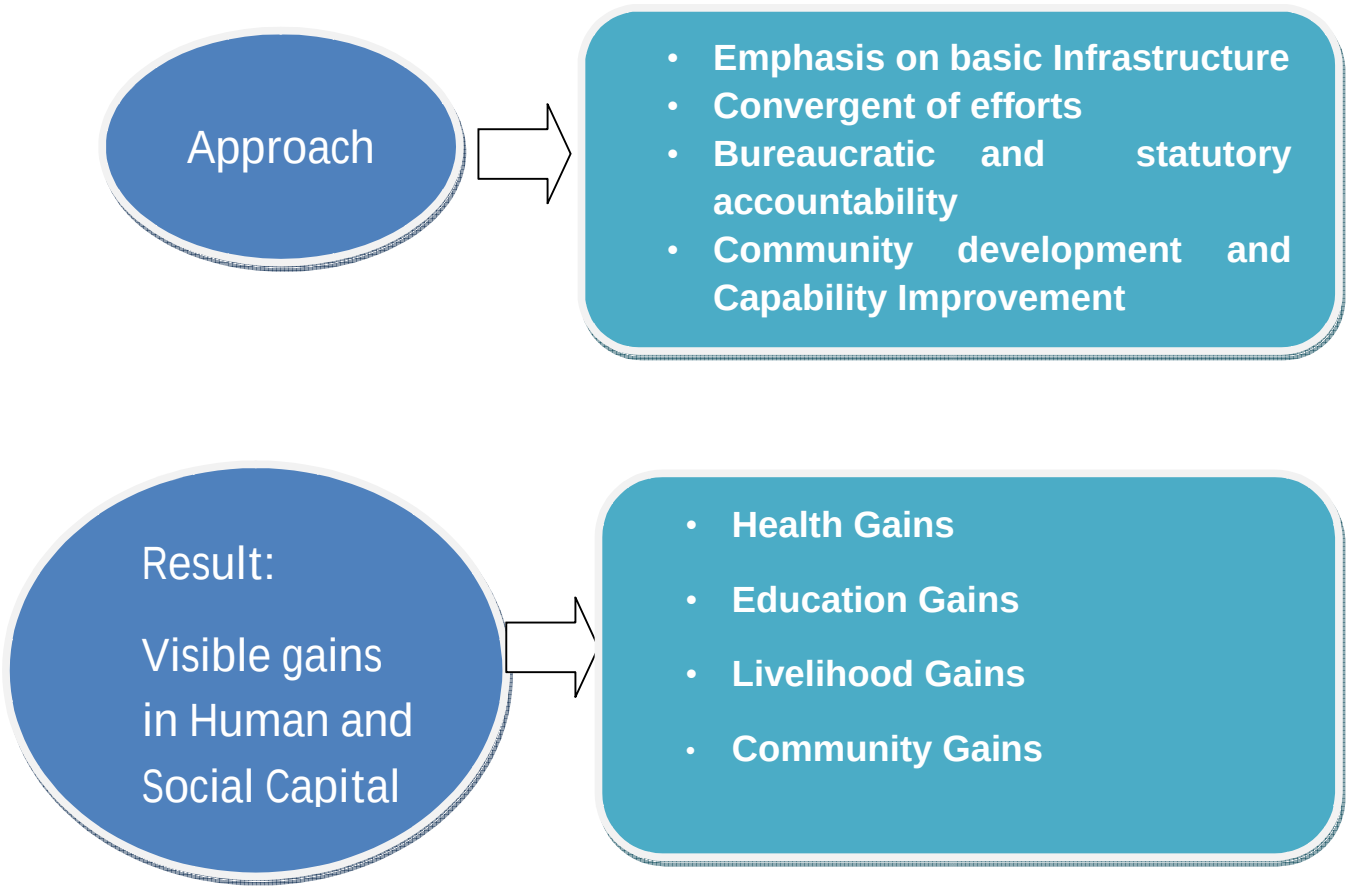
There are a huge number of well organised Self-Help groups at & around Haldia, which are undertaking various activities for the progress of their respective localities. Tata Steel has decided to invest a considerable portion of money against CSR activities through these Self-Help groups.

A study has been conducted Under Haldia Block, wherein there are 4 Gram Panchayats namely Baruttarhingli, Chakdwipa, Debhog & Deulpota. The details are as below:

Block	Total Population = 98000				No of Mauza	No of GP	Area Under Cultivation
Haldia	% of SC	% of ST	% of OBC	% Minority			
	6.67	0.33	10.66	22	23	4	7500 hac

The block has over 700 Self-Help Groups with around 9500 members. It offers a great opportunity to Tata Steel to participate in the local community development through these self-help groups, which will ultimately contribute significantly in improving the existing livelihood of the local people.

Holistic Development of 1-2 Gram Panchayats closer to project area is based on SAGY guidelines. The Pathway of Development could be as follows:



The existing CSR team has done a baseline study and identified a village under Deulpota Panchayat named “SABAR Village”, where the “Sabar People”, one of the schedule tribes lives. All of them are economically very poor. Nearly 100 families stay in this village, whose main occupation is snake catching. They conduct Snake Charming at various public gatherings and sell the poison for medication purpose.

It has been observed that the infrastructural facility in this village is extremely poor. Health and education facilities are also poor. The company may adopt this village along with the entire Panchayat and develop proper sanitation, drainage, drinking water facility, education facility, medical support etc. over a period of time so that the improvement in the Socio – economic status of the people could be achieved.

“Focus Area” Initiatives : :

Health

- Specialised Medical Camp
- Mobile Medical Van
- Eye Operation
- Providing hearing aids to deaf people
- Focus on Mother and Child Health
- Provide Ambulance

Education

- School infrastructures e.g. building construction / repairing, drinking water and sanitation facilities, electricity
- Scholarship Programme
- Provide teachning aids
- Instituting Awards / endowments
- Supporting sports activity

Capability Development

- Vocational Training
- Capacity Building programme
- Promoting Digitisation by commissioning “Computer KIOSKS”

Basic Infrastructure

- Drinking Water facility by installing Bore wells at different places
- Installation of water purifiers to provide pure water to all families
- Improve drainage system
- Constructing toilets / community toilets for the people
- Waste Management Facility
- Rain water harvesting facility
- Upgrading infrastructure by installing Solar Energy system

The company may also participate in the "Adopt a Home" programme, initiated by the "Ministry of Women & Child Development", Government of India. Under this programme, the company will provide support to the Children Homes, set up under Juvenile Justice (Care and Protection) Act, 2015. The said programme comprises activities that have been selected from Schedule VI and VII, Section 135 of the Companies Act 2013. This support may be sought by signing a Memorandum of Understanding (MOU) between District Magistrate, Purba Medinipore where the Home is located. The company has already visited few homes and studying the gaps existing facilities and scope of improvement under CSR programme.

ANNEXURE-XI

QUERY–11 : Explain specific TORs point no 1, 2, 4 and 6.

ToR Point 1 : Iron ore/coal linkage documents along with the status of environmental clearance of iron ore and coal mines.

REPLY: The coal for the proposed expansion of Coke Oven Plant of Tata Steel Ltd. will be sourced from the captive coal mine i.e., West Bokaro Opencast Coal Mine at village Bharagutu, Tehsil Ghatotand, District Hazaribagh, Jharkand. The copy of the Environmental Clearance from MoEF is enclosed as **Appendix-II**.

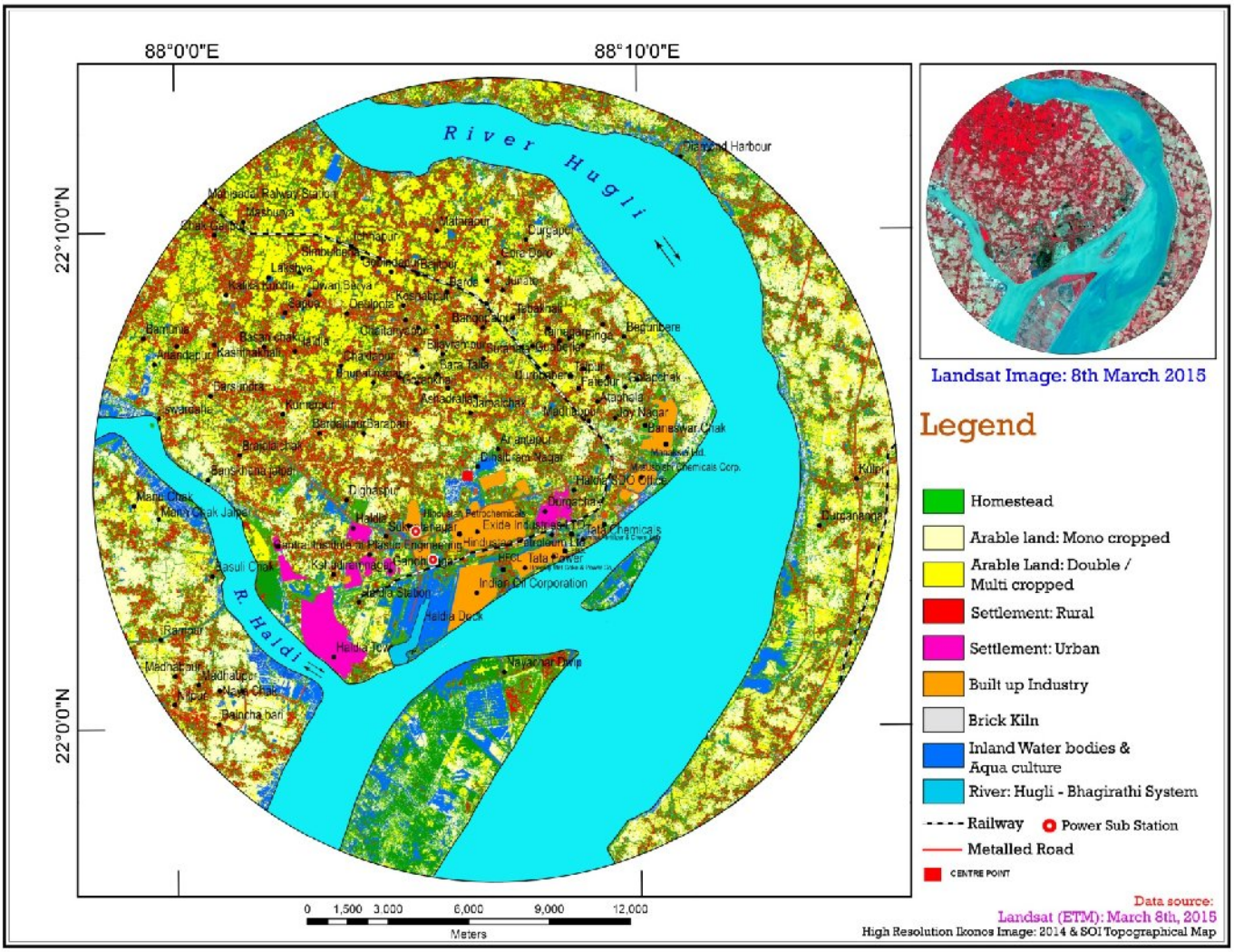
ToR Point 2 : Quantum of generation of coal and iron ore from coal & iron ore mines and the projects they cater to.

REPLY: Not Applicable.

ToR Point 4 : Recent land-use map based on satellite imagery. High-resolution satellite image data having 1m-5m spatial resolution like quickbird, Ikonos, IRS P-6 pan sharpened etc. for the 10 Km radius area from proposed site. The same shall be used for land used / land-cover mapping of the area.

REPLY:

PRESENT LANDUSE - LAND COVER MAP: 15 km Buffer Zone around Haldia: West Bengal



LAND USE PATTERN OF THE 10 KM RADIUS STUDY AREA

LULC	AREA (IN SQ KM)	AREA (IN PERCENTAGE)
River Hugli & Bhagirathi system	**223.29**	**31.80**
Inland water bodies and aquaculture	**34.32**	**4.89**
Settlement (Rural)	**69.3**	**9.87**
Settlement (Urban)	**6.29**	**0.90**
Industrial	**11.25**	**1.60**
Arable (DC)	**96.76**	**13.78**
Arable (MC)	**100.09**	**14.25**
Vegetation	**158.4**	**22.56**
Brick Kiln	**2.56**	**0.36**
Total	**702.26**	**100.00**

ToR Point 6 : All stock piles will have to be on top of a stable liner to avoid leaching of materials to ground water.

REPLY: In the existing plant all stock piles are placed on concrete base. The same practice shall be adopted after the implementation of the proposed project.

ANNEXURE-XII

QUERY–12 : Reasons for non-feasibility of CDQ should be provided in detail.

REPLY: A study on Techno-commercial Feasibility of installation of Coke Dry Quenching (CDQ) in Heat Recovery Type Coke Oven Plant of Tata Steel (Hooghly Met Coke Division) was conducted by Central Institute of Mining and Fuel Research, Dhanbad (Council of Scientific & Industrial Research).

The salient conclusions of the study are as follows:

- Although conversion from wet quenching to coke dry quenching required significant capital investment, characteristics of the coke dry quenching process is attractive, when it is used in a by-product coke plant available with the integrated steel plant like TATA STEEL, Jamshedpur. However coke dry quenching unit may allow the toxic inert gases, which are used as the cooling medium, to leak in a manner similar to coke ovens themselves. But for satisfactory operation and desired coke quality after quenching in a non recovery coke plant with CDQ system, lot of design changes to be incorporated in existing design of coke quenching system because the quantity and size of coke lump pushed from an oven or carbonization chamber .
- Analysis of coal and coke data of by – product coke plant, with wet and dry quenching and non-recovery coke plant with wet quenching reveals that CDQ system is technically not feasible for merchant non recovery come making units like Hooghly Metcoke, Haldia, where inert gas is not readily available and no scope of utilizing steam, generated out of CDQ system
- It has been reported that by-products coke making CDQ technology accounts for **carbon loss** of about 1.7 ton/hour of coke, whereas, in case of wet quenching same is zero or negligible. **More coke fines are generated in CDQ chamber** during descent of coke lump by gravity
- The detail cost analysis of CDQ technology with respect to wet quenching for non-recovery coke plant reveals that **annual financial loss** estimated by use of CDQ system is more than the cost of a wet quenching setup for coke quenching in non recovery coke ovens.

On the bases of present study, it is concluded that Coke Dry Quenching is not feasible because of its larger break down hours, excess man power requirement,

greater power consumption etc. and detail cost analysis of CDQ with respect to wet quenching, it is recommended to use wet quenching only for HMC, Haldia's non-recovery coke making units.

The detail report on Techno Commercial feasibility study of coke dry quenching in heat recovery type coke oven is attached as **Appendix-III.**

Report On

Techno Commercial Feasibility Study of Coke Dry Quenching in Heat Recovery type Coke Oven

for

TATA STEEL LIMITED

Hooghly Met Coke Division

HALDIA, WB

April, 2015

Submitted by

CENTRAL INSTITUTE OF MINING AND FUEL RESEARCH DHANBAD

(Council of Scientific & Industrial Research)

DHANBAD- 828108, JHARKHAND

Project Completion Report

1. Project Title

Techno Commercial Feasibility Study of Coke Dry Quenching in Heat Recovery type Coke Oven.

2. Sponsored by

Tata Steel Limited, Hoogly Met Coke Division, Haldia, WB.

3. Objective

To study techno commercial feasibility for installation of CDQ (Coke Dry Quenching) in the heat recovery type coke oven plants in the proposed expansion of Hoogly Met Coke, Haldia

4. Duration

Two Months

5. S &T inputs being provided by client

The client will provide the required data regarding the existing wet process of coke quenching, and other relevant data required for preparation of Techno Commercial Feasibility report.

6. Work Plan

- Site visit (as and when required) by CSIR-CIMFR officials for inspection of current coke quenching operations.
- Collection of required relevant data from Coke Plant (detail requirement of data to be discussed during visit of CSIR-CIMFR officials and meeting with coke plant officials).
- Data Analysis and techno commercial feasibility study.
- Report Preparation.

1. Introduction

Metallurgical grade coke production completes in different operational steps. Coke making operation starts with selection of coal and beneficiation of coal followed by formulation of coal blend and charging the blend composition in coke oven for thermal treatment at desired temperature. Coal blend charging is routed through top or stamp charging process. For a complete coke making cycle, transmission of heat is the prime consideration, therefore it largely depends on the design of coke oven. On completion of the thermal treatment, the red hot coke is discharged from the ovens.

The next stage involves the cooling of the incandescent red hot coke produced prior to further processing. Variation in coke cooling techniques comprise of use of different cooling mediums or different operating processes. Most widely used technique wet quenching (which uses water as cooling media) that may be compared with another quenching process known as coke dry quenching technique where inert gas is used as cooling medium.

Coke dry quenching (CDQ) technology is currently considered as a technology, which saves considerable energy in the coke plants, owing to its many advantages such as energy saving, pollution reduction and quality improvement. Variation arising due to their different characteristic processes and media used reflects on the coke quality attained.

Process of Coke Dry Quenching is the alternative to wet quenching method of incandescent coke discharged from coke ovens is, and hereinafter referred to as CDQ.

Dry quenching of coke is a proved, reliable process. Shortly after World War I, a dry quenching technology was developed by the Sulzer brothers. More than 70 coke plants in gas works and steel mills used dry quenching prior to 1950, but most of the gas-works installations were closed when natural gas became readily available.

In 1960 the Soviet Union commissioned its first commercial dry quenching pilot plant at Cherepovets Integrated Iron and Steel Works. Because of the success of the pilot project, coke dry quenching has been expanded until, in 1973, more

than 40 towers in the Soviet Union dry quench approximately 15,000,000 tons of coke/year.

With the increase in energy costs outstripping general inflation, the estimated returns on investment in CDQ improved very significantly. Since then the position has not changed materially (costs and credits have increased roughly in parallel), but the twin pressures remain and, with a convincing economic case now demonstrable in many specific plant circumstances, the future wider adoption of CDQ seems certain.

However, as per the wide literature survey carried out for preparation of the report, use of CDQ in Non Recovery coke ovens has not been reported anywhere.

2. *General Principles of Coke Dry Quenching*

In CDQ the coke from the ovens is transferred in one oven batches to a chamber where it is cooled counter currently by direct heat exchange to a continuous stream of inert gas. The gas thence passes to a waste heat boiler where the heat taken up from the coke is recovered by the generation of stream at conditions appropriate to its subsequent mode of utilization. The cooled coke (at about 200^0C.) is discharged in discrete batches from the chamber and passed directly to the screening plant.

A CDQ module consists of the following main components: a cooling chamber, with arrangements for admission and discharge of coke without the admission of air or the discharge of gas and solid particles; arrangements for the removal of coarser particles from the heated gas leaving the chamber; a waste-heat boiler; arrangements for the removal of dust from the cooled gas leaving the boiler; and a blower returning the cooled gas to the chamber. The principle of operation of CDQ is illustrated in Figure 1 and 2.

A CDQ installation consists of one or more modules, usually arranged side by side, with one or more hoists to elevate the skips containing hot coke to the top of the installation for discharge of the coke batches into the cooling chamber(s). The number of modules and the rated throughput of each (all modules in the installation being identical) may be selected so as to minimize the capital investment, taking into account the necessity for the installation to be able to continue to handle the total coke make of the ovens which the installation serves

while (at least) one module is out of service, essentially for the necessary annual inspection and overhaul. A one-module installation, such as might be applied to a coke make of say, 0.5 Mt/a, necessarily requires that reserve wet quenching be available.

3. *Advantages of Coke Dry Quenching*

The most obvious advantages of this process is the recovery of energy that in contrast simply dissipated when coke is quenched through wet process. In broad terms, the sensible heat of the hot coke discharged from the ovens amounts to about on half of the energy input to the ovens from the under firing gas; in CDQ, about 80 percent of this sensible heat is recovered, a saving, therefore equivalent to about 40 percent of the under firing input.

The energy recovered by CDQ is in the form of high grade steam. Wide flexibility of steam characteristics is available through appropriate variation of the boiler design: actual practice may embrace conditions (bar/^{0}C) ranging from 10/300 to 40/450. The quantitative yield of steam depends upon the CDQ design, the type (mainly the ash percentage) and temperature of the hot coke and (to a slight degree) the steam characteristics adopted: the range is may be 0.4 – 0.5 t/t of coke and an average steam generation rate of 0.44 t/t of coke cooled may be adopted for evaluation purpose on the basis of the demonstrated performance of existing CDQ installations. The steam may be used for power and/or process purposes and the achievement of the maximum economic benefit depend upon the attainment of the highest possible steam utilization level and the highest possible efficiency of utilization. In practice, a utilization level of 80 percent should be achievable, while the efficiency of utilization will depend upon both the areas of utilization and the quality of plant practice. These considerations are particularly relevant to proposals to use the energy recovered in CDQ for coal preheating, either with or without initial steam generation.

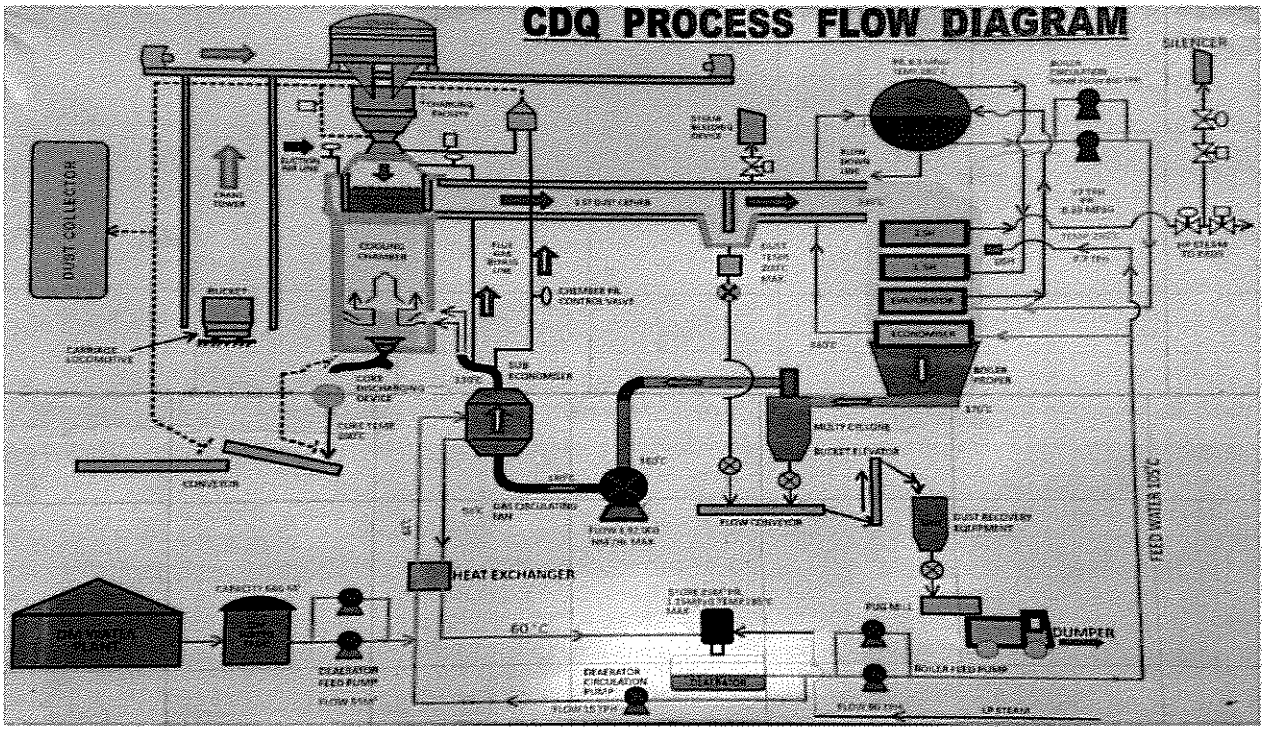


Figure 1: Coke Dry Quenching Process Flow Diagram

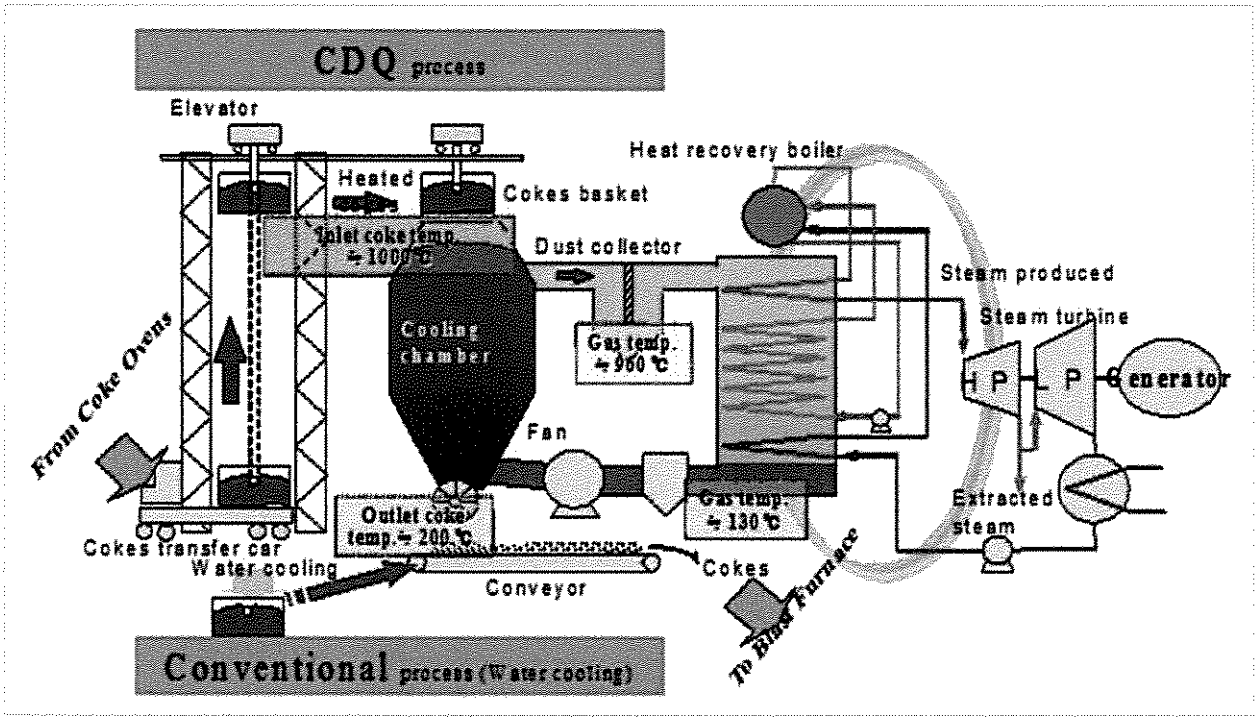


Figure 2: Coke Dry Quenching Process Flow Diagram

The other main advantage of CDQ is the contribution which it makes to the mitigation of the coking industry's atmospheric pollution problem and thereby to the improvement of the environment, both within and outside the works. CDQ eliminates virtually all the atmospheric and quenching water pollution problems associated with the wet quenching of coke, while being itself pollution free in good modern practice. Granted that quenching towers today are normally fitted with arrestors for grit and dust, the amount by which the emission of these materials from the coking plant would be reduced by the introduction of CDQ is not tremendous, but it is significant. Moreover, so far as local residents are concerned, the quenching plume is usually the most obvious source of emission and, therefore, usually one which causes the most comment.

Additionally, drizzle from the condensation of the plume is a cause of corrosion within the works and a source of complaint if it falls outside the plant boundary. There is also some reason to believe that the quenching plume can contribute to the incidence of fog in the vicinity of the coking plant. Certainly, under some conditions, the elimination of the quenching plume can be a significant aid to improved visibility. The introduction of CDQ can make easier the control of the atmospheric pollution arising from the pushing of coke ovens, this effect being a consequence of the smaller exposed surface area of coke in the receptacles, which are deeper than the bed in a coke car and which, ideally, constitute a one spot device. The smaller exposed surface also reduces pollution in transit to the cooling station and makes easier its elimination by means of a lid. Where pushing pollution control is affected by means of a hood/duct/land-based washer system, there may be scope for some capital saving through the use of a common washer for the foul bleed from CDQ and the ducted fumes from the pushing operation.

In some circumstances, and in view of increasing pressure for progress in the environmental area, it seems possible that these benefits could be the factor dictating a move towards CDQ. CDQ is the only coking plant anti-pollution measure (and a major one at that) which at least pays for itself; if it does no more than that, the case for its adoption (taking into account also its contribution to energy conservation) remains very strong indeed.

4. Coke Dry Quenching vis-a-vis Wet Quenching

By several industrialized countries Coke Dry Quenching of incandescent coke has been reported to be superior to Wet Quenching after it has been pushed from the coking ovens because CDQ eliminates air and water pollutants emitted during wet quenching and improves working environment along saving of substantial amounts of energy in usable forms.

5. Impact of Coke Quenching Methods in By-product Type Coke Plant

One of the technological operations in coke making is coke quenching, done in wet or dry way quenching methodology. For comparative study of impact of coke quenching methods on coke quality and subsequent effect on blast furnace operation, data of coal blends as charged in TATA STEEL's by product type coke ovens and coke data were analyzed. Coke data was collected for coke quenched using wet as well as dry quenching process.

Typical coal blend analysis is presented in Table 1. As per the coal blend characterization shown in Table 1 the coal blend data found to be well in the range of good coking coal for metallurgical grade coke making.

Various operating parameters for wet quenching and dry quenching being used with by-product type coke ovens at TATA STEEL, Jamshedpur are shown in Table 2. Coking temperature, Coking Cycle, coke discharge temperature remains same, whether the quenching process be wet or dry, because quenching is the process of which is done only after pushing the hot coke. As shown in Table 2, coke temperature after dry quenching is about 30° C higher than wet quenching. Composition of circulating gas in CDQ process is depicted in Table 4. Presence of 2-3% CO and 17 -18% CO_2 in CDQ circulating gas and the relatively higher temperature of coke after quenching is an indication of coke burning losses which is obvious from Table 2 in which solution (carbon) loss has been shown as 1.7 tons/hr, whereas, in case of wet quenching, same is negligible or zero. Circulating gases contains hydrogen also, therefore, CDQ facilities present potential explosion hazards and somewhat comparable to those associated with pulverized coal boilers or with gas or oil steam generators.

Table 1: Test results of Tata Steel coal blend sample used for coke making in by product type coke oven

PROXIMATE ANALYSIS (db), %		**ASH CONSTITUENTS (db), %**	
Ash	11.22	Fe (T)	0.41
Volatile Matter	22.60	CaO	0.23
Inherent Moisture	1.48	SiO_2	6.28
ALKALIES ANALYSIS (db), %		P	0.053
Na_2O	0.090	MgO	0.095
K_2O	0.120	MnO	0.002
ELEMENTAL ANALYSIS (adb), %		Al_2O_3	2.82
C	79.79	TiO_2	0.23
H	3.95	**HGI and GCV**	
N	1.53	HGI	84.52
S	0.709	GCV, kcal/kg	7371
RHEOLOGICAL PROPERTIES			
CSN	7	LTGK	G1
GIESELER PLASTOMETER		**AUDIBERT-ARNU DILATOMETRY**	
Max. Fluidity, ddpm	111	Max. Contraction, %	21
Temp. range at 1 ddpm, °C	406-479	Max. Expansion, %	6
Temp. range at 5 ddpm, °C	429-473		
PETROGRAPHIC ANALYSIS			
MACERALS ANALYSIS, %		**VITRINITE DISTRIBUTION, %**	
Vitrinite	55.5	V6	1
Semi-Vitrinite	0.5	V7	1
Exinite / Liptinite	1.1	V8	1
Inertinite	36.3	V9	6
Mineral Matter	6.6	V10	15
		V11	24
Vitrinite Reflectance, %		V12	25
Ro	**1.19**	V13	21
		V14	5
		V15	1

As per result for hot and cold strength of coke produced and quenched through wet & dry process depicted in Table 6, no significant differences have been observed. Result of proximate, ultimate, and other chemical analysis of coke depicted in Table 5 showed no deviation in the characteristic property, because these properties are dependent on coal quality as well as carbonization process. As mentioned in Table 7, there is no significant difference between arithmetic mean size (AMS) of coke after applying the wet and dry quenching technology for quenching the coke. Blast furnace coke rate for coke produced at TATA STEEL, Jamshedpur, which a mix of wet and dry quenched coke is 370 to 390 kg/ton of hot metal, as given in Table 3 and the same for HMC coke, which is produced only by using wet quenching is 380 to 400 kg/ton of hot metal. So, about 10 kg/ton reduction in blast furnace coke rate was found using CDQ process and as mentioned above solution (carbon) loss of 1.7 tons/hr was observed using CDQ process. Therefore gain of 10 kg/ton of hot metal in coke rate accounted for 1.7 tons/hr loss solution (carbon) in case of CDQ.

As recorded in Table 3 TATA STEEL, Jamshedpur is recovering 77 tons/hr of steam having temperature 485^{o} C and pressure 6.28 Mpa from CDQ process, which is equivalent to about 72 MWh of thermal energy. TATA STEEL, Jamshedpur is using this steam in different process units. However, this steam may be used for power generation. The amount of energy which is produced using CDQ is the main attraction and this recovers the huge investment incurred in CDQ installation.

Table 2: Operating parameter of Wet Quenching and Dry Quenching units for quenching incandescent coke being used with By Product Coke Making Plant

Operating Parameters	Wet Quenching	Dry Quenching
Coking Temperature, °C	1290-1320	1290-1320
Coking Cycle, hrs	20	20
Coke discharge temp., °C	990-1030	990-1030
Coke temperature after quenching, °C	110	130
Coke Yield (Gross), %	75-76%	75-76%
Coke production/day	2700 TPD (BF+Nut)	
Coke production capacity (gross), MTPA	1.1	1.1
Quenching Power consumption, kW h/Annum	--	--
Break down hours/Annum	0.5 hr/month	7.5 hrs/month
Tentative cost of wet quenching setup, Crs.	-	NEDO project
Solution (Carbon) loss	Negligible	1.7 t/hr max. (at 135 TPD)
Man Power Requirement/day	Operation (6) and wharf attender (9)	Operation [12(CDQ) +10(Boiler) +3(Battery)] + Mechanical [9(CDQ) + 6(Boiler)]+IEM[7]
Maintenance cost	Low	High

Table 3: Operating parameters of Dry Quenching unit being used with By Product type coke plant at TATA STEEL

Plant capacity	135 TPD
Coke charge temp.	990-1050 °C
Coke output temp.	110-120 °C
Gas inlet temp.	130 °C
Gas out let temp.	930 °C
Steam generation	77 TPH
Steam Pressure	6.28 Mpa G
Steam temp.	485 °C
Total gas vol.	192000 Nm3/hr
Electricity generation	NA
Coke rate to BF, kg/t HM	370-390

Table 4: Composition of circulating gas in Dry Quenching Unit

Constituents	Proportions
Co	2.0 - 3.0%
H2	0.0 - 1.0 %
CO2	17.0-18.0 %

Table 5: Test results of Tata Steel Coke sample as produced in by product type coke oven

Proximate Analysis		**Ultimate Analysis**		**Chemical Analysis**	
IM (db), %	0.3	C (adb), %	86.4	Fe(T) (db), %	1.1
Ash (db), %	15.34	H (adb), %	0.276	CaO (db), %	0.45
VM (db), %	0.74	N (adb), %	1.04	SiO2 (db), %	8.58
FC (db), %	83.62	S (adb), %	0.653	Al2O3 (db), %	3.08
Alkalis		O (adb), %		MnO (db), %	0.006
Na2O (db), %	0.095	**GCV of Coke**		TiO2 (db), %	0.21
K2O (db), %	0.192	**GCV**	6904	P (db), %	0.087

Table 6: Hot and Cold Strength of Coke as produced in by product type coke oven

Properties	**Wet Quenching**	**Dry Quenching**
Coke CSR	64.91	64.96
Coke CRI	26.49	26.38
Coke M40	83.13	84.9
Coke M10	5.13	4.8

6. Technical Feasibility of CDQ in Non Recovery Type Coke Oven

Non-recovery stamp charge coke making technology was introduced in Tata Steel in 2008. This is the single largest non-recovery coke plant with 1.6 million tons per annum (MTPA) of metallurgical coke production from adopted advance **Heat Recovery** (HR) coke making technology in India. The plant also generates 120 MW of electric power, utilizing the sensible heat of hot flue gas from coke oven with the help of WHRB (Waste Heat Recovery Boilers). In this plant, there are four rows; each row having eight batteries (0.4 MTPA each row or 1100 tons of coke per day). Total 46 to 48 ton of blended coal on dry basis is charged in each oven of each battery. The coking cycle at HMC varied in the range of 64-66 hrs. After completion of carbonization/coking the quenching car receives hot coke (as cake form) from respective oven and travels to quenching station (Figure 3). A typical coal blend characteristic of one of the coal blend charged at HMC is given in Table 7. The properties of coal blend being charged at HMC, Non-recovery type coke ovens is almost similar to the coal blend charged at TATA STEEL, Jamshedpur By-product Coke Plant.

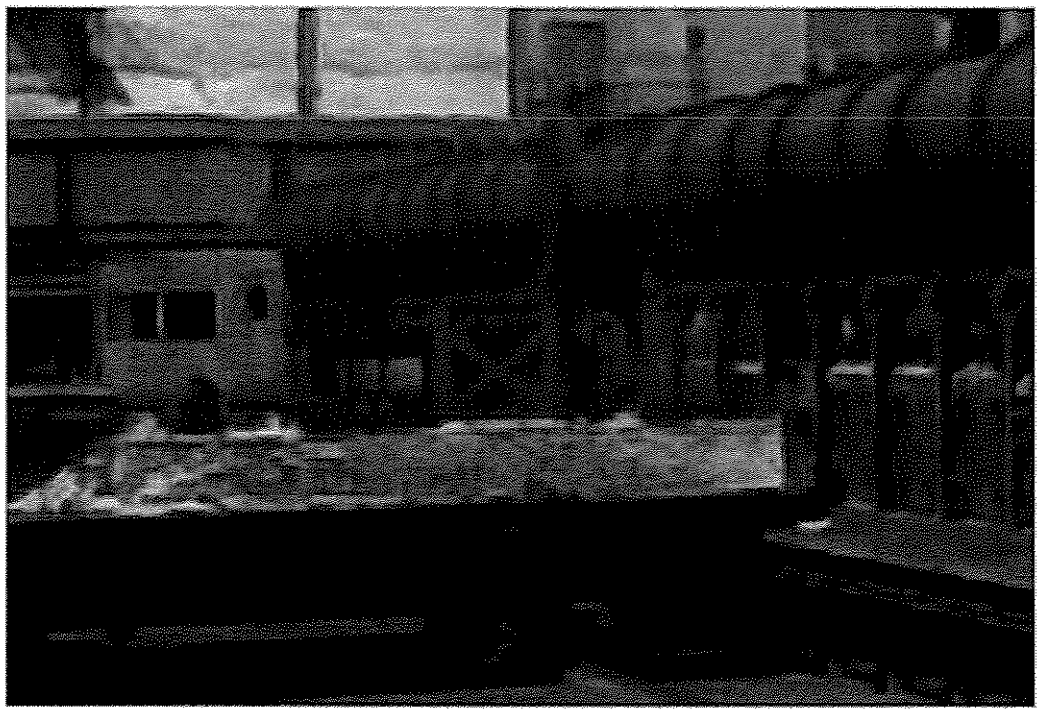


Figure 3: Quenching car along with hot coke cake

Table 7: Test results of HMC coal blend sample used for coke making in Non-recovery type coke oven

PROXIMATE ANALYSIS (db), %		**ASH CONSTITUENTS (db), %**	
Ash*	12.95	Fe (T)	0.43
Volatile Matter**	22.53	CaO	0.17
Inherent Moisture	1.27	SiO_2	6.64
ALKALIES ANALYSIS (db), %		P	0.130
Na_2O	0.100	MgO	0.28
K_2O	0.230	MnO	0.001
ELEMENTAL ANALYSIS (adb), %		Al_2O_3	2.93
C	72.30	TiO_2	0.175
H	3.87	**HGI and GCV**	
N	1.47	HGI	80.98
S	0.71	GCV, kcal/kg	7165
RHEOLOGICAL PROPERTIES			
CSN	7	LTGK	G2
GIESELER PLASTOMETER		**AUDIBERT-ARNU DILATOMETRY**	
Max. Fluidity, ddpm***	732	Max. Contraction, %	25
Temp. range at 1 ddpm, °C	408-487	Max. Expansion, %	27
Temp. range at 5 ddpm, °C	422-477		
PETROGRAPHIC ANALYSIS			
MACERALS ANALYSIS (vol.), %		**VITRINITE DISTRIBUTION, %**	
Vitrinite	54.8	V6	1
Semi-Vitrinite	0.6	V7	4
Exinite / Liptinite	1.5	V8	4
Inertinite	35.4	V9	8
Mineral Matter	7.7	V10	22
		V11	35
Vitrinite Reflectance, %		V12	14
Ro	**1.11**	V13	5
		V14	6
		V15	1

Operating parameters of Non recovery coke plant with wet quenching process at HMC, Haldia is shown in Table 8. From Table 8, it is evident that there is not much difference in coking temperature, coke discharge temperature for both recovery and non-recovery type coke making process. But significant difference can be observed when the effect of quenching process is considered. Coke temperature after quenching is less in case of wet quenching. No or negligible solution (carbon) loss was observed during wet quenching, even in case of coke making using by product ovens and wet quenching method. As depicted in Table 2 CDQ requires about four times more electrical power with respect to wet quenching process for per ton of coke Breakdown hours per annum of CDQ is 15 times higher than that of wet quenching for by product plant and the same is only 10 hours per annum for non-recovery coke ovens at HMC, Haldia. Considering the breakdown hours of CDQ any coke plant whether it is non-recovery type or by product type a wet quenching setup is essential to prevent carbon loss during breakdown hours.

Necessary raw material for wet quenching of coke is water only and only about 0.45 cubic meter of makeup water is required for per ton of coke where as raw material for CDQ is an inert gas (mostly Nitrogen) generated through a Nitrogen gas plant. Nitrogen gas may be readily available in an integrated steel plant like TATA STEEL, because there are many other uses of nitrogen in an integrated steel plant but for a merchant coke plant like HMC, Haldia a Nitrogen gas plant has to be installed for CDQ uses, which incurs huge investment. As reported in Table 8 wet quenching process at HMC, Haldia requires 3 persons in operation and 6 persons at coke discharge wharf as attendant whereas CDQ process, which is needs intense attention during operation need 12 CDQ operators, 10 boiler operators and other 25 persons at various points of CDQ plant, which is reported in Table 2 for CDQ with By Product type oven at TATA STEEL, Jamshedpur.

Table 8: Operating parameters of Wet Quenching unit being used with Non Recovery type coke plant at HMC

Parameters	Operating Range
Coal charge/oven (db), T	46-48
Bulk density of coal cake (wet), kg/m3	1060-1080
Coking Temperature, °C	1300-1320
Coking Cycle, hrs	64-66
Coke discharge temp., °C	1050
Coke temperature after quenching, °C	<120
Coke Yield, %	73
Coke production/day (DMT)/day/row	1100
Coke production capacity (Gross for all four rows), MTPA	1.6
Quenching water requirement, m3 / pushing	85
Quenching Power consumption, kW h/t	1.4
Makeup water requirement, m3/day/row	500
Break down hours at quenching tower /Annum /row	10 hrs
Man Power Requirement/day/quenching tower	Operation (3)+ Wharf attender (6)
Tentative cost of wet quenching setup, Crs.	4.5
Coke rate to BF, kg/t HM	380-400

Quality of water which is being recycled for wet quenching process at HMC, Haldia is presented in Table 9. All the data are within acceptable limits as per environmental norms. However, this water is not allowed to flow outside the plant boundary and is being recycled. Therefore, there is no hazard to environment as well as to the plant personals, whereas, CDQ tower where actual quenching operations are being carried out is quite prone to explosion due to presence of hydrogen in the circulating gases.

Table 9: Water quality after wet quenching at HMC

Parameters	Range/operating values
pH	6.6
TSS	46
COD	83.4
BOD	16
Chloride	700-900 mg/lit

Coke produced at HMC using Non Recovery Coke oven and wet quenching process is showing less VM (0.79%), FC (83.96%) with respect to coke produced at TATA Steel, Jamshedpur using By-product Coke Ovens and dry quenching process. Coke characterization data for HMC, coke is presented in Table 10. Comparison of hot and cold strength of coke produced shows that wet quenched coke carbonized in Non-recovery Ovens has CRS value of 66 where as dry quenched coke carbonized in By-product ovens has CSR value of 64.96. Similarly, improvement of 3 points in CRI value and 5 points in M40 was observed while using wet quenching process in Non-recovery ovens at HMC. Table 11 presents Hot and cold strength properties of HMC coke.

Table 10: Test results of Tata Steel Coke sample as produced in Non recovery type coke oven at HMC

Proximate Analysis		**Ultimate Analysis**		**Chemical Analysis**	
IM (db), %	0.56	C (adb), %	85.5	Fe(T) (db), %	0.77
Ash (db), %	14.69	H (adb), %	0.2	CaO (db), %	0.49
VM (db), %	0.79	N (adb), %	0.68	SiO_2 (db), %	7.39
FC (db), %	83.96	S (adb), %	0.97	Al_2O_3(db), %	3.77
		O (adb), %	-	MgO (db), %	0.072
Alkalis				MnO (db), %	0.001
Na_2O(db), %	0.267	**GCV of Coke**		TiO_2 (db), %	0.12
K_2O (db), %	0.258	GCV, kcal/kg	6995	P (db), %	0.075

Table 11: Hot and Cold Strength of Coke as produced in Non recovery type coke oven at HMC

Properties	**Wet Quenching**
Coke CSR	66
Coke CRI	23
Coke M40	89
Coke M10	5.5

Coke size distribution for coke produced in by product plant using wet as well as dry quenching and coke produced in non-recovery coke oven is presented in Table 12. From the data presented in the tables it is evident that coke size distribution achieved from non-recovery coke plant, even with wet quenching is comparable or even better than the coke size distribution achieved from by product coke plant, either using wet or dry quenching. Coke average mean size in case of non-recovery coke oven with coke wet quenching at HMC, Haldia, is 53 mm which is most favorable for blast furnace uses. Coke wharf sizes for coke produced from by product coke plant and from non-recovery coke plant is presented in Table 13 and Table 14 respectively. From the wharf size distribution tables it is observed that 20.40% of coke mass is above 80 mm for by product type coke ovens whereas the same is 31.27% in case of non-recovery type coke oven. The 20.40% of +80 mm coke size in case of by product oven is before quenching when the hot coke mass is received form a height of 13 - 15 meters form carbonization chamber to quenching car and the 31.27% of +80 mm coke size is at the stage, when coke mass is getting transferred to coke belt conveyor after falling on the coke wharf from tilting of quenching car and after wet quenching.

Table 12: Size distribution of coke as Produced in By Product Coke Plant and in Non Recovery Type Coke Plant

Properties	**By-product Coke plant at TATA STEEL, Jamshedpur**		**Non recovery type coke oven at HMC**
Coke Size	**Wet Quenching**	**Dry Quenching**	**Wet Quenching**
+80 mm fraction, %	3.6	3.1	8.5
BF grade Coke (30-80 mm), %	79.7	81.6	83.4
Nut Coke (10-30 mm), %	17.1	15.3	5.3
Coke fines (mm), %	-	-	2.8
Coke AMS	47.91	47.54	53

Table 13: Size Analysis of Wharf Coke as produced in by product type coke oven

+100 mm	4.8
-100+80 mm	15.6
-80+50 mm	45.3
-50+40 mm	20.6
-40+30 mm	7.5
-30 mm	6.2
Total	100
Avg. Mean Size	61.35
Mean size range (-80+50 mm)	(-80+50 mm)

Table 14: Size Analysis of Wharf Coke as produced in Non recovery type coke oven at HMC

+100 mm, %	9.32
+90 mm, %	11.46
+80 mm, %	10.49
+70 mm, %	22.7
+60 mm, %	18.13
+50 mm, %	16.89
+40 mm, %	7.6
+30 mm, %	1.48
+20 mm, %	0.73
+10 mm, %	0.4
-10 mm, %	0.79
Mean Size	71.92

In case of non-recovery coke ovens in which stamped coke is charged for carbonization, the hot coke which is pushed to the quenching car is a lump of size as big as the ovens horizontal cross section and about 1 meter in height. If this hot coke lump is dropped from quenching car to a hopper by gravity only, it may have coke sizes as large as 500 mm.

Figure 4 shows one batch of quenched coke which was dropped on the coke wharf at HMC, Haldia. The sizes of the coke lump even after quenching and falling on the wharf is clearly visible.

As described above the hot coke mass received from carbonization chamber of a by-product coke oven plant is lifted by a winch lift to the charging hopper of a CDQ tower. Till date CDQ system is being practiced with by product type coke plant only, and is suitable for hot coke size received from charging car of a by-product type coke plant's carbonization chamber. In a by-product type coke plant, the elevation difference of carbonization chamber and coke quenching car is maintained as 13- 15 meters for its other functional requirements. Therefore, when the hot coke is pushed from carbonization chamber, it falls on the quenching car from a height of 13- 15 meter and break into the size as mentioned depicted in Table 13. The size of the opening for feeding hot coke and size of the CDQ chamber is designed for the hot coke particle size received in the quenching car of a by-product coke plant.

To retrofit a CDQ system in a non recovery coke plant, other than many constraints, the particle size of hot coke received on the quenching car may be a major constraints. There may be two solutions to overcome this constraint, first, to reduce the hot coke particle size so as to accommodate in the existing design of CDQ which proven and secondly, to design a CDQ system which can accommodate the hot coke size as received form carbonization chamber of non-recovery coke oven.

Figure 4: Quenched coke on Coke Wharf at HMC, Haldia

Reducing the size of hot coke which being received from the carbonization chamber need either similar height of fall to the quenching car as in the case of by product coke ovens or using a crushing system which can crush hot coke to sizes as required for available CDQ system. For maintaining 13 - 15 meter of falling height of coke will completely change the layout of a non-recovery coke plant as well as will be quite capital intensive and non-recovery coke oven plant will lose its charm of simplicity and low cost coke production. Whereas, handling such a lump of hot coke for size reduction in a crushing unit may not be recommended for safety concerns.

A CDQ system may be designed to accommodate the size of hot coke being pushed from carbonization chamber of existing non recovery coke ovens. For that the feed opening of the CDQ chamber has to be bigger so as to avoid jamming problem due to larger coke size and the diameter of the CDQ chamber, where exact quenching is taking place has to be increased so as to accommodate voids created due larger coke sizes. Due to larger coke sizes the effective surface area of coke, which will come in contact with inert gas to cool the incandescent coke will be reduced and therefore the residence time of incandescent coke inside the CDQ chamber has to be increased from the existing time required for cooling incandescent coke sizes being received from by product coke oven. This increased residence time of coke inside the chamber will increase the solution (carbon) loss, which already reported to be 1.7 ton/hour in case of CDQ system being used with by product coke oven plant. The coke inside the CDQ chamber progresses downwards by gravity only, therefore to increase the residence time of incandescent coke to get it quenched completely height of the CDQ chamber has to increased form the existing height for the same capacity of CDQ system which being used for by product coke oven plants. With increased diameter and height of the CDQ chamber flow of circulating gasses has to be increased, which subsequently increases the dimensions of other required accessories of CDQ system.

Apart from above mentioned problems associated with retrofitting of CDQ system with non-recovery coke oven, it requires considerable space, which may be equivalent to the space requirement of installing a non-recovery coke oven battery of similar capacity as that of available with HMC, Haldia.

Therefore, in technical terms for quenching the incandescent coke, being pushed from carbonization chamber of a non-recovery coke plant, and wet quenching is the better option.

7. Economics of CDQ in Non Recovery Type Coke Oven

Technical aspects of retrofitting CDQ system has been discussed in detail in last section. Operation data of CDQ and wet quenching and their analysis reveals that installation of same capacity of CDQ system for non-recovery coke ovens will cost much higher than that for a by-product coke oven plant, installed in an integrated steel plant like TATA STEEL.

To study the economics of a CDQ system installation, data has been taken from a 1972 American Waagner - Brio Company, Inc, which was published in Journal of the Air Pollution Control Association under the publication heading as "Dry Coke Quenching, Air Pollution and Energy: A Status Report". For the sake of matching the cost of 1972 from current cost, the 1972 costs have been multiplied by 5.7 (***Consumer Price Index (CPI-U)*** data as provided by the ***U. S. Department of Labor Bureau of labor Statistic*** of the April 1972 was 41.5 and for April 2015 is 236.599).

Table 15 represents the cost analysis of CDQ system and wet quenching system. The initial cost of CDQ system taken in Table .15 is the cost of available design of CDQ, which is suitable for by product type coke ovens. For making CDQ system suitable for non-recovery type coke oven size of CDQ chamber and other auxiliaries has to be increased, as discussed in previous section and this will cost about 1.5 times the existing design. Moreover, cost of installation of inert gas facility (mostly nitrogen) has not been included in Table 15, which is already available with an integrated steel plant.

As per technical discussions in previous section and the data provided by TATA STEEL for its by product coke plant with CDQ and non-recovery coke plant with wet quenching at HMC, Haldia, any remarkable enhancement in coke quality not observed. Therefore, any saving due to enhancement in coke quality has not been considered in cost analysis. Reduction of about 10 kg of coke per ton of hot metal production has been reported, but solution (carbon) loss of 1.7 ton/hour has

also been reported in case of CDQ system, whereas, solution losses is negligible for wet quenching process.

CDQ system produces good quality steam, which can be used for power production or for other process uses. But a non-recovery coke plant has got no use of steam for coke production, neither HMC, Haldia has got its own captive power unit to use this steam. So, as per present scenario for HMC, Haldia steam, which can be generated from CDQ system is of no use. Even after considering the cost of steam produced through CDQ system Table 15 indicates that CDQ system does not seems to be economically feasible for non-recovery type coke ovens as of HMC, Haldia.

Cost of installation and operation of a wet quenching set is quite cheaper, easily operable, and not hazardous and relatively environment friendly with respect to CDQ for non-recovery coke making.

Table 15: Cost analysis of CDQ System and Wet Quenching System

Sl. No.	Description	Operating Parameters	Cost in USD
1	Dry Coke Production	3000 tons/day (125 tons/hr.)	-
2	Dry coke production/ yr	1,050,000 tons/yr	-
3	Working Days	350/yr	-
4	Power consumption	4 kwhr/ton of coke	-
5	Annual Power consumption	4,200,000 kwhr	-
6	Total Steam production/yr	840 x 10^6 lbs/ yr	-
7	Electric power cost	-	0.057/kwhr
8	Selling price per ton of dry coke	-	228
9	Selling price of coke breeze per ton	-	75.01
10	Price of superheated steam	-	6.55/1000 lbs
11	Initial cost of CDQ plant	-	25,650,000.00
Expanses per annum			
12	Annual power cost	-	239,400.00
13	Maintenance cost (2 - 3%/year of installation cost)	-	513,000.00
14	Total annual operating cost	-	2,034,900.00
15	Depreciation over 20 years (5%/ year)	-	1,282,500.00
16	Interest repayment (6% per annum)	-	1,539,000.00
17	Capital repayment per year (repayment in 2 years)	-	712,500.00
18	Total recurring cost for CDQ system (total sl. no 12 to 17)	-	6,321,300.00
Annual saving			
19	Cost of steam produced from CDQ system	-	5,460,000.00
20	Cost incurred for CDQ operation (sl. no. 18 - sl. no.19)	-	-861,300.00
	Wet Quenching	-	
21	Cost of wet Quenching Setup	-	750,000.00

8. Summary and Conclusions

Present study demonstrates that technological inside of the coke dry quenching (CDQ) and coke wet quenching technology for recovery and non-recovery (heat recovery) stamp charged coke making technologies. The salient conclusions of the present study are as follows:

- Although conversion from wet quenching to coke dry quenching required significant capital investment, characteristics of the Coke Dry Quenching process is attractive, when it is used in a by-product coke plant available with integrated steel plant like TATA STEEL, Jamshedpur. However, coke dry quenching units may allow the toxic inert gases, which are used as the cooling medium, to leak in a manner similar to coke ovens themselves. But, for satisfactory operation and desired coke quality after quenching in a non-recovery coke plant with CDQ system, lot of design changes to be incorporated in existing design of CDQ system because the quantity and size of coke lump pushed from an oven or carbonization chamber.
- Analysis of coal and coke data of by-product coke plant, with wet and dry quenching and non-recovery coke plant with wet quenching reveals that CDQ system is technically not feasible for merchant non-recovery coke making units like HMC, Haldia, where inert gas is not readily available and no scope of utilizing steam, generated out of CDQ system.
- It has been reported that by-products coke making, CDQ technology accounts for carbon loss of about 1.7 ton/hr of coke, whereas, in case of wet quenching same is zero or negligible. More coke fines are generated in CDQ chamber during descent of coke lump by gravity.
- Detail cost analysis of CDQ technology with respect to wet quenching for non-recovery coke plant reveals that annual financial loss estimated by use of CDQ system is more than the cost of a wet quenching setup for coke quenching in non recovery coke ovens.

On the bases of present study, it is concluded that Coke Dry Quenching is not feasible because of its larger break down hours, excess man power requirement, greater power consumption etc. and detail cost analysis of CDQ with respect to wet quenching, it is recommended to use wet quenching only for HMC, Haldia's non-recovery coke making units.

ANNEXURE-XIII

QUERY–13 : A note on non-compliance of stipulated environmental safeguards earlier accorded to this project, if any, should be provided along with the reasons for non-compliance.

REPLY: **Point-1: PM_{10} level in ambient air has exhibited tendency of crossing the prescribed limit of annual average standards of 60 µg/m^3. The PM_{10} values range from 70 to 92 µg/m^3. The project needs to bring down annual average PM_{10} emission in ambient air significantly. In addition, constitutional analysis of the dust may also be carried out to ascertain the source of particulate matter i.e. process or natural.**

Ans.: Tata Steel has taken various initiatives to reduce the PM_{10} level in ambient air. In order to maintain PM at low level in the stack emissions, 100% combustion of gas evolving from coal that is being charged inside the oven is ensured. Two stage air supplies ensure complete combustion and the key indicator is O_2 level in waste gas. 6-8% O_2 level indicates around 20% excess air, which is ideal. This O_2 level in waste gas is being monitored regularly and it is very consistent.

Any oven draft variation impacting combustion is reflected in waste gas O_2 level. Consistent and uninterrupted boiler operation is the key to control this draft. Though it is under control, an interlock arrangement is being introduced with the tunnel damper. If any variation in the draft happens the tunnel damper will operate automatically to maintain the draft.

Apart from controlling the PM emission from the stacks, the company has taken the following actions:

(i) Regular road cleaning.
(ii) Reduced transportation of the material.
(iii) Charging emission is minimised through effective process control. Some new APCE like suppression fan on backboard of charger plate has been installed for controlling charging emission.
(iv) More number of sprinklers and Dry Fog system has been installed at wagon tippler and loader area.
(v) Interlocking arrangement for dry fog operation has been done.
(vi) Effective usage of IVC machine is ensured.
(vii) Wheel washing system is put in practice.

Besides industrial emission, the source of PM_{10} appears to be due to the dust blown on account of the vehicular movement in the southern side of the plant. However, water sprinkling around the road will be done.

Point 2: Some areas in the material and product handling zones have been affected by spillage. The areas below the conveyor belt and the drains passing parallel to conveyor belts which have been filled by fines need regular inspection. Efforts are needed to improve the environmental quality in these areas.

Ans.: The company has taken the initiative to address the problem of spillage. The following measures have been taken for the spillage reduction:

- **For Spillage Reduction at Quenching Track & Quenching Tower:**
  - **Liner Plate size has been modified by small size**
  - **Advance Pusher Ram by 400 mm on coke tray**
  - **Flap gate has been modified by Refractory Bricks**
  - **Flap gate height has been Modified from 800 mm to 1000 mm**

- **For Spillage Reduction at Wagon Tippler Deck, Belt pieces were connected by flat and bolts in order to cover the gap of cradle and beam.**

- **For Spillage Reduction at Charger Plate, Side wall and backboard bottom gap was covered by rubber pad.**

- **Some other actions taken in different areas for spillage reduction:**
  - **Weigh feeder and Wagon tippler vibro feeder feeding chute manual poking was eliminated by air blaster so the manual poking opening was covered and spillage from that point was eliminated.**
  - **CL#1 belt tensioning arrangement will be modified with screw take up arrangement as gravity take up was not effectively working at that point.**
  - **Wagon tippler hopper gratings were modified.**
  - **Stamping station side wall and front baffle bottom gap closed by 100 mm MS flat.**

Point 3: Project must install online ambient air quality monitoring system and the data along with the online stack data should be displayed in front the main gate of the industry for the stake holders to know about the performance of the industry in terms of environmental quality.

Ans.: The online ambient air quality monitoring system has already been installed and data are being displayed at the main gate. Online stack data display synchronization with this system in under progress.

Point 4: The refractory materials (Ceramic) being sent to TSDF may be converted to useful materials i.e. Paving the roads or Hollow Bricks which can be used in buildings or for road making inside the industry during proposed expansion.

Ans.: Shall be complied. For this, the feasibility study will be conducted with the help of Tata Steel R&D - Jamshedpur.

ANNEXURE-XIV

QUERY–14 : Details regarding treatment of waste water before using for the coke quenching process.

REPLY: In the present practice, for coke quenching process three interconnected settling ponds are there along with each quenching tower. The excess quenched water, after quenching process, is collected in first settling chamber. Water from this chamber overflows and settles in the consecutive chambers. The steam loss is compensated by the fresh make up water after quenching process. This mix water is pumped to the tank for next quenching.

Solid sediment part (coke sludge) is being lifted periodically and sold to the outside party through M/S “m-junction” for making the coke briquette, that are used as industrial fuel.

The water cycle at HMC is a closed cycle and no waste water flows out side the factory premises. The unit maintains “**Zero Discharge**” concept.

The quenching ponds, where the quenched water settles, are made of concrete. All drains inside the factory are concreted to avoid any ground water contamination.