ASL

# ARDENT STEEL LIMITED

Ref. No. ASL / MoEF & CC / 2017-18

Date: 27th June, 2018

To

The Director
Ministry of Environment & Forest, Govt. of India
Eastern Regional Office,
A/3, Chandrasekharpur,
Bhubaneswar – 751 023, Odisha.

Sub: Submission of half yearly Environmental Clearance Compliance Report for the Existing Iron Ore Pellet Plant (0.6 Million TPA) of M/s. Ardent Steel Limited in village Phuljhar, Block – Bansapal, Dist. – Keonjhar, Odisha.

Ref: EC Letter No. J-11011/112/2013-IA.II(I), date 29th March, 2016

Dear Sir,

As per the conditions given in the Environmental Clearance accorded on 29th March, 2016 to our Existing Project (0.6 Million TPA Pellet Plant) in Phuljhar village of Keonjhar district, we are herewith submitting the Half Yearly Environmental Clearance Compliance Report for the period of October' 2017 – March' 2018.

Thanking you.

Yours Faithfully
**For Ardent Steel Limited**

DR. SUBHASISH DAS
DIRECTOR

Encl: As above.

Received
29/6/18

PS to APCCF (Central)
GOI, M/o Envt. & Forests
Eastern Regional Office
Bhubaneswar-751023

H.O. : RR-12, Mainwali Nagar, Near Peeragarhi Chowk, New Delhi - 110 041
Tel. : 011-25275025 Fax : 011 - 25254669 E-mail : asl@ardentsteel.com
B.O. : Plot No. 208, New Colony, Jamuhata, Keonjhar-758001, Orissa
Tel. : 06766-258257, 258198 Fax : 06766-258473
Fact. : Vill & P.O. - Phuljhar, Via - Suakati, Distt. - Keonjhar, Orissa

HALF YEARLY COMPLIANCE REPORT OF

*(October, 2017 to March, 2018)*

# ENVIRONMENTAL CLEARANCE

IRON ORE PELLETIZING PLANT OF

ASL | ARDENT STEEL LIMITED

Vill: Phuljhar, Tehsil: Telkoi, Dist.: Keonjhar, Odisha.

**SIX MONTHLY COMPLIANCES FOR ENVIRONMENTAL CLEARANCE OF THE IRON ORE PELLETIZING PLANT OF**

**M/S. ARDENT STEEL LTD.**

**Vill: Phuljhar, Tehsil: Telkoi, Dist.: Keonjhar, Odisha.**

## A. SPECIFIC CONDITION:

| Sl. No. | CONDITIONS | COMPLIANCE |
|---|---|---|
| i. | Periodical medical examination of the workers engaged in the project shall be carried and schedule of health examination of the workers should be drawn and followed accordingly. | Periodical medical examination of the workers engaged in our plant has been carried out by the qualified doctor and the records of the examination of workmen are attached herewith for reference and record enclosed at **ANNEXURE – 1**. |
| ii. | The project proponent shall ensure supply of safe drinking water to the nearby villages. | The nearby villages of plant viz. Phuljhar, Bhuyan Sahi is being supplied with the drinking water through pipeline and other villages such as Chachana, Balabhadrapur and Munda Sahi is being supplied through tankers. |
| iii. | The project proponent shall install 24X7 air monitoring devices to monitor air emissions, as provided by the CPCB and submit report to Ministry and its Regional Office. | Installation of 24 X 7 air monitoring device to monitor air emission is under progress. |
| iv. | Continuous stack monitoring facilities for all the stacks shall be provided and sufficient air pollution control devices viz. Electrostatic precipitator (ESP), bag house, bag filters etc. shall be provided to keep the emission levels below50 mg/$Nm^3$ and installing energy efficient technology. | Air pollution control devices such as ESP, Bag house, Bag filters etc. has been provided to keep the emission level below the standard norms i.e. 50mg/$Nm^3$. |
| v. | The National Ambient Air Quality Emission Standards issued by the Ministry vide G.S.R. No. 826(E) dated 16$^{th}$ November, 2009 shall be followed. | Yes, followed. (Sample monitoring data during the reporting period enclosed at **ANNEXURE – 2**). |

| Sl. No. | CONDITIONS | COMPLIANCE |
|---|---|---|
| vi. | Gaseous emission levels including secondary fugitive emissions from all the sources shall be controlled within the latest permissible limits issued by the Ministry vide G.S.R. 414(E) dated 30th May, 2008 and regularly monitored. Guidelines / Code of Practice issued by the CPCB shall be followed. | Yes, followed. (Sample monitoring data during the reporting period enclosed at **ANNEXURE – 2**). |
| vii. | Vehicular pollution due to transportation of raw material and finished product shall be controlled. Proper arrangements shall also be made to control dust emission during loading and unloading of the raw material and finished product. | Vehicles having valid PUC certificates are being engaged and the raw materials being transported are covered Sprinklers have been provided at road sides as well as loading and unloading points to control the dust emission during loading and unloading of the raw materials. |
| viii. | 'Zero' effluent discharge shall be strictly followed and no wastewater shall be discharged outside the premises. | Yes, followed. |
| ix. | Regular monitoring of influent and effluent surface, sub-surface and ground water shall be ensured and treated wastewater shall meet the norms prescribed by the State Pollution Control Board or described under the E(P) Act whichever are more stringent. | Yes, followed. (Sample monitoring data during the reporting period enclosed at **ANNEXURE – 2**). |
| x. | Proper handling, storage, utilization and disposal of all the solid/hazardous waste shall be ensured and regular report regarding toxic metal content in the waste material and its composition, end use of solid/hazardous waste shall be submitted to the Ministry's Regional Office, SPCB and CPCB. | Coal ash which is a solid waste has been analysed and found that it does not contain hazardous waste as per **ANNEXURE – 3**. The company did not have HW waste authorization for period from 1/04/2014 till 31/03/2017. Renewal of Hazardous Waste License is under process at OSPCB, Bhubaneswar. |

| Sl. No. | CONDITIONS | COMPLIANCE |
|---|---|---|
| | The proponent shall submit a copy of the agreement with the authorized vender to the regional office as a part of compliance. | Hazardous wastes generated are usd oil and oil sludge. These wastes are collected and stored in HW storage area marked as per Hazardous and other waste (Management and Transboundary Movement) Rule 2016. The company has asked for renewal of Authorization. Reports concerning HW Rules are being submitted in due time.<br>The company has made an agreement with the vendor M/s Shriya Metals and Chemicals, St-Khairabandh,PO-Ranto, Bikera, PS: Brahmanitaranga, Dist: Sundergarh, Odisha who is an authorized vendor of OSPCB. (Enclosed at **ANNEXURE – 4(A)**. The company has sold some quantity of Oil sludge to M/s. N. C. Oil Refinery Private Limited Authorization annexed at **ANNEXURE – 4(B).** |
| xi. | Occupational health surveillance of the workers shall be done on a regular basis and records maintained as per the Factories Act and analysis shall be submitted to the regional office of the Ministry. | The dust generated in our plant is being suppressed by spraying the water through sprinklers in dust generation points. Adequate nos of dust masks are being provided to the workmen working in the dust generated areas. It is being as per the Factories Act. |
| xii. | A time bound action plan shall be submitted to reduce solid waste generated due to the project related activities, its proper utilization and disposal. | In our process, a negligible amount of solid waste is being generated and it is being kept separately. At the time of repairing of roads, the same is being utilized. Ref: (Sample monitoring data during the reporting period enclosed at **ANNEXURE – 5**). |

| Sl. No. | CONDITIONS | COMPLIANCE |
|---|---|---|
| xiii. | Proper utilization of fly ash shall be ensured as per Fly Ash Notification, 1999 and subsequent amendment in 2003 and 2009. All the fly ash shall be provided to cement and brick manufacturers for further utilization and Memorandum of Understanding shall be submitted to the Ministry's Regional at Chennai. | The coal gasifiers do not generate fly ash. |
| xiv. | A Risk and Disaster Management Plan shall be prepared and a copy submitted to the Ministry's Regional Office, SPCB and CPCB within 3 months of issue of environment clearance letter. | An Updated Risk and Disaster Management Plan prepared and submitted at Directorate of Factories & Boilers, Odisha. Ref: **ANNEXURE – 6.** |
| xv. | The project proponent shall provide for solar light system for all common area, street lights, villages, parking around project area and maintain the same regularly. | Solar light system has not been provided. Lights have been provided at all common area, Street and parking area of the plant. |
| xvi. | The project proponent shall provide for LED lights in their offices and residential areas. | Yes, provided. |
| xvii. | Green belt shall be developed at least in 33% of the total project area with at least 10 meter wide green belt on all sides along the periphery of the project area and along road sides etc. by planting native and broad leaved species in consultation with local DFO, local community and as per the CPCB guidelines. | Out of total plant area of 46.581, 15.37 acres has been developed by planting various trees. The details are annexed as **ANNEXURE – 7.** |
| xviii. | At least 2.5% of the total cost of the project shall be earmarked towards the Enterprise Social Commitment based on Public Hearing issues, locals need and item-wise details along with time bound action plan shall be prepared and submitted to the Ministry's Regional Office. Implementation of such program-shall be ensured by constituting a | The project is in operation since 31/07/2010.The project cost at that time (2010) was Rs.133.96 which presently has increased to Rs.199.00 (Rupees One Hundred and ninety nine crores) due to inflation. The stand alone pellet plants were waived off for conducting public hearing vide MoEF Notification No SO |

| Sl. No. | CONDITIONS | COMPLIANCE |
|---|---|---|
| | Committee comprising of the proponent, representatives of village Panchayat and District Administration. Action taken report in this regard shall be submitted to the Ministry's Regional Office. | 2572bE dated 14th September 2015. As such no public hearing issue has been recorded. However, the company has already spent about Rs.5,98,62000 (Rupees five crore ninety eight lakh and sixty two thousand only)on Enterprise social commitment which is about 4.47% of project cost is more than 2.5% as stipulated. The break-up of this figure has been provided in the EIA and again annexed as **ANNEXURE – 8.** ***(Ref: Table No. C8 – 1 of EIA/EMP Report)*** |
| xix. | The proponent shall prepare a detailed CSR Plan for every year for the next 5 years for the existing-cum-expansion project, which includes village-wise, sector-wise, (Health, Education, Sanitation, Health, Skill Development and infrastructure requirements such as strengthening of village roads, avenue plantation, etc.) activities in consultation with the local communities and administration. The CSR Plan will include the amount of 2% retain annual profits as provided for in Clause 135 of the Companies Act, 2013 which provides for 2% of the average net profits of previous 3 years towards CSR activities for life of the project. A separate budget head shall be created and the annual capital and revenue expenditure on various activities of the Plan shall be submitted as part of the Compliance Report to RO. The details of the CSR Plan shall also be uploaded on the company website and shall also be provided in the Annual Report of the company. | The project was accorded Environmental clearance vide MoEF & CC Letter No. J-11011/112/2013 – IA II (I) Dated 29th March, 2016. As such the five year period under consideration for which CSR activities need to be planned include 2016-17,2017-18,2018-19,2019-20 and 2020-21. The plant was not in operation during 2015-16. It incurred a loss of Rs. 4.78 crores in 2016-17. Inspite of the facts as stated the plan for CSR activities have been made which is enclosed at **ANNEXURE – 9.** |

| Sl. No. | CONDITIONS | COMPLIANCE |
|---|---|---|
| xx. | The Company shall submit within three months their policy towards Corporate Environment Responsibility which shall inter-alia address (i) Standard operating process/procedure to being into focus any infringement/deviation /violation of environmental or forest norms/conditions, (ii) Hierarchical system or Administrative order of the Company to deal with environmental clearance conditions and (iii) System of reporting of non-compliance/violation environmental norms to the Board of Directors of the Company and/or stakeholders or shareholders. | Corporate Environmental Responsibility attached at **ANNEXURE – 10** Standard Operating Procedure has been prepared as annexed at **ANNEXURE – 11**, Hierarchical system or Administrative order of the Company to deal with environmental clearance conditions annexed at **ANNEXURE – 12**, system of reporting of non compliance annexed at **ANNEXURE – 13**. |
| xxi. | Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, Safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project. | The construction activities have been completed before obtaining the approval. As such no housing for construction labor needed. |

**B. GENERAL CONDITIONS:**

| Sl. No. | CONDITIONS | COMPLIANCES |
|---|---|---|
| i. | The project authorities must strictly adhere to the stipulations made by the Odisha Pollution Control Board and the State Government. | Yes followed strictly. |
| ii. | No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment, Forest and Climate Change (MoEFCC). | Yes, Agreed. |

| Sl. No. | CONDITIONS | COMPLIANCES |
|---|---|---|
| iii. | At least four ambient air quality monitoring stations should be established in the downward direction as well as where maximum ground level concentration of $PM_{10}$, $PM_{2.5}$, $SO_2$ and $NO_x$ are anticipated in consultation with the SPCB. Data on ambient air quality and stack emission shall be regularly submitted to this Ministry including its Regional Office at Bhubaneswar and SPCB/CPCB once in six months. | The monthly monitoring is being carried by a third party agency which is submitting report regularly. Ref**: ANNEXURE – 2** |
| iv. | Industrial wastewater shall be properly collected, treated so as to conform to the standards prescribed under GSR 422 (E) dated 19th May, 1993 and 31st December, 1993 or as amended from time to time. The treated wastewater shall be utilized for plantation purpose. | Agreed. |
| v. | The overall noise levels in and around the plant area shall be kept well within the standards (85 dBA) by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels should conform to the standards prescribed under EPA Rules, 1989 viz. 75 dBA (daytime) and 70 dBA (nighttime) | Agreed. |
| vi. | Occupational health surveillance of the workers shall be done on a regular basis and records maintained as per Factories Act. | Yes, it is being done. |
| vii. | The company shall develop rain water harvesting structures to harvest the rain water for utilization in the lean season besides recharging the ground water table. | We do not utilize any surface water till date. However, Rain Water Harvesting and Ground Water Recharge Plan for our plant has been prepared. Ref**: ANNEXURE – 14** |

| Sl. No. | CONDITIONS | COMPLIANCES |
|---|---|---|
| | | |
| viii. | The project proponent shall also comply with all the environmental protection measures and safeguards recommended in the EIA/EMP report. Further, the company must undertake socio-economic development activities in the surrounding villages like community development programmes, educational programmes, drinking water supply and health care etc. | Yes, it is being carried out as per the need of the local villagers. |
| ix. | Requisite funds shall be earmarked towards capital cost and recurring cost/annum for environment pollution control measures to implement the conditions stipulated by the Ministry of Environment, Forest and Climate Change (MoEFCC) as well as the State Government. An implementation schedule for implementing all the conditions stipulated herein shall be submitted to the Regional Office of the Ministry at Bhubaneswar. The funds so provided shall not be diverted for any other purpose. | The project has become operational before getting the EC.. As such pollution control systems for air water and noise control has been in place. Total expenditure on account of pollution control measures-capital cost-6.7 crores and recurring expenditure about 0.67 crores per annum have been appropriated. |
| x. | A copy of clearance letter shall be sent by the proponent to concerned Panchayat, Zila Parishad/Municipal Corporation, Urban Local Body and the local NGO, if any, from whom suggestions/representations, if any, were received while processing the proposal. The clearance letter shall also be put on the web site of the company by the proponent. | Yes, Circulated to Panchayat. A receipt from Gram Panchayat on this subject has also been obtained which is available in the website. |
| xi. | The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including | Yes, the compliance report, monitoring report, CSR Activities report are being uploaded periodically. |

| Sl. No. | CONDITIONS | COMPLIANCES |
|---|---|---|
| | results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of the MoEFCC at Bhubaneswar. The respective Zonal Office of CPCB and the SPCB. The criteria pollutant levels namely; $PM_{10}$, $SO_2$, $NO_x$ (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the projects shall be monitored and displayed at a convenient location near the main gate of the company in the public domain. | |
| xii. | The project proponent shall also submit six monthly reports on the status of the compliance of the stipulated environmental conditions including results of monitored data (both in hard copies as well as by e-mail) to the Regional Office of MoEFCC, the respective Zonal Office of CPCB and the SPCB. The Regional Office of this Ministry at Bhubaneswar / CPCB/SPCB shall monitor the stipulated conditions. | The compliance report for the 6 month period from 01/04/2017 to 30/09/2017 has been submitted earlier. This report for 01/10/2017 to 31/03/2018. Now, it is being submitted now. |
| xiii. | The environmental statement for each financial year ending 31st March in Form-V as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of environmental conditions and shall also be sent to the respective Regional Office of the MoEFCC at Bhubaneswar by e-mail. | The Form-V for the year ending 31/03/2018 is being submitted. The same was not submitted for previous year as the plant was closed. |

| Sl. No. | CONDITIONS | COMPLIANCES |
|---|---|---|
| xiv. | The Project Proponent shall inform the public that the project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the SPCB and may also be seen at Website of the Ministry of Environment, Forest and Climate Change (MoEFCC) at http:/envfor.nic.in. This shall be advertised within seven days from the date of issue of the clearance letter, at least in two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned and a copy of the same should be forwarded to the Regional office at Bhubaneswar. | Yes, it has already been intimated to public and also submitted a copy to the State Pollution Control Board. (Supporting document already submitted as in previous 6 monthly reports.) |
| xv. | Project authorities shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of commencing the land development work. | The project has been completed before obtaining the EC.<br>Financial Closure : 21 .10.2008<br>Financial approval : 21.10.2008<br>Purchase of 1't [and : 31.05.2008<br>Proof for the above already submitted earlier. |

ANNEXURE - 1

# ARDENT STEEL LIMITED

CIN - U27310CT2007PLC007671

Ref : ASL /F & B /2017-18

Dt.03.05.2017

**The Asst. Director of Factories & Boiler,**
Keonjhar Zone,
Keonjhar

Sub : Submission of annual Health Check up Form 31 ( A ) under section 41 C of the Factories Act.

Ref : a) Your letter No.172 ( 2 ) , dt.14.03.2017
b) Our earlier letter No. ASL/F & B /2017-18, dt.06.04.2017

Dear Sir,

With reference to above enclosed please find herewith the Annual Health check up in Form 31 (A ) of remaining 91 nos . of our permanent employees duly examined and signed by Dr. P.C. Swain with his signature and seal. The summary of the health check up forms are attached herewith for your ready reference and record.

This is for your kind information and necessary action.

Thanking you,

Yours faithfully,
**For ARDENT STEEL LIMITED**

DILLIP PANI
FACTORY MANAGER

Encl : As above

RECEIVED
For Asst. D.F. & B., Kr
05-4-17

258

[FORM No. 31-A]

# Health Record

**(Pre-employment / Periodical)**
**[Prescribed under rule 62 –I]**

1 Name of the factory : ACL

2 Name of the Employee : Brahmananda Behera

3 Employee Distinguishing Number : 862

4 Age of the employee : 36 year.

5 Identification mark : cut mark is present in left eye

6 Nature of the job : senior fitter mech Grinding

7 Date of Employment : 1-10-2016

8 Length of service in years : 7 month

9 General Survey :
- Health : Good / ~~Fair~~ / ~~Poor~~
- Height : Cms. 5ft 4"
- Weight : Kg. 88 Kg

10 Blood group : B+ve done before.

11 Eye Vision
- Normal / ~~Abnormal~~
- Use of glass : ~~Yes~~ / No

12 Hearing : Normal / ~~Abnormal~~

13 Respiratory system and chest Measurement
- Inspiration 50 cm
- Expiration 48 cm
- Respiration rate / min. 19 / min
- Remarks, if any Nil

14 Cardiovascular system
- Pulse rate 90 / min
- B.P. 135 / 88 mm/Hg
- Heart Sound S1 S2 heard
- Remarks, if any Nil

15 Abdomen Tenderness : ~~Yes~~ / No

16 Nervous System
- History of Fits : ~~Yes~~ / No
- Epilepsy : ~~Yes~~ / No
- Remarks on Mental Health ~~Not~~ found

17 Locomotor System : Normal / ~~Abnormal~~

18 Skin Condition : Normal / ~~Abnormal~~

Remarks on any skin disease noticed : Not

19 Hearnias : ~~Present~~/ Absent

20 Hydrocele : ~~Present~~/ ~~Absent~~

21 Present complain if any : Nil

22 Summary of Findings :

Heart Disease: Nil

Hypertension: Nil

Diabetes : Nil

T.B. : Nil

Epilepsy: Nil

Poisoning: Nil

Others : Nil

Occupational Disease, if any : Absent

23 Recommendation, if any for any further investigation

Not required

Brahmananda Behera

Signature of the employee

27/2/2017

Signature of Medical officer

Dr. P. C. Swain
MBBS (Utkal) AFIH (Mumba
I.L.O Radiography (Dhanbad
OH Physician & Consultant

[FORM No. 31-A]

# Health Record

259

**(Pre-employment / Periodical)**
**[Prescribed under rule 62 –I]**

1 Name of the factory : ~~ASL~~

2 Name of the Employee : Subhat Kisman Nanda

3 Employee Distinguishing Number : 816

4 Age of the employee : 33 Year.

5 Identification mark : cut mark is present on right leg.

6 Nature of the job : Fitter mechanical core

7 Date of Employment : 1-10-2016

8 Length of service in years : 7 month

9 General Survey :
Health : Good / ~~Fair~~ / ~~Poor~~
Height : Cms. 5ft 6"
Weight : Kg. 80 Kg

10 Blood group : O+ve done before.

11 Eye Vision
Normal / ~~Abnormal~~
Use of glass : ~~Yes~~ / No

12 Hearing : Normal / ~~Abnormal~~

13 Respiratory system and chest Measurement
Inspiration 38 cm
Expiration 36 cm.
Respiration rate / min. 22/min
Remarks, if any Nil

14 Cardiovascular system
Pulse rate 74/min
B.P. 124/78 mm/Hg
Heart Sound S1 S2 heard.
Remarks, if any Nil

15 Abdomen Tenderness : ~~Yes~~ / No

16 Nervous System
History of Fits : ~~Yes~~ / No
Epilepsy : ~~Yes~~ / No
Remarks on Mental Health Solend

17 Locomotor System : Normal / ~~Abnormal~~

18 Skin Condition : Normal / ~~Abnormal~~

Remarks on any skin disease noticed : Nil

19 Hearnias : ~~Present~~/ Absent

20 Hydrocele : ~~Present~~/ Absent

21 Present complain if any : NIL

22 Summary of Findings :

Heart Disease: NIL
Hypertension: NIL
Diabetes : NIL
T.B. : NIL
Epilepsy: NIL
Poisoning: NIL
Others : NIL

Occupational Disease, if any : absent

23 Recommendation, if any for any further investigation
not required

Signature of the employee

27/2/2017
Signature of Medical officer
Dr. P. C. Swain
MBBS (Utkal) AFIH (Mumba
I.L.O Radiography (Dhanba
OH Physician & Consultant

# CENTRE FOR ENVOTECH AND MANAGEMENT CONSULTANCY PVT. LTD.

An ISO 9001-2008 & OHSAS 18001:2007 Certified Company, Empanelled with OCCL, ORSAC and SPCB of Govt. of Odisha
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Enlisted in Construction Industry Development Council (CIDC) established by the Planning Commission (Govt. of India)
MoEF&CC, Govt. of India, Recognised Environment Laboratory under Environment (Protection) Act, 1986.


| | | |
|---|---|---|
| Reference No | : | **CEMC/ASL/March-A-01/18** |
| Name of Company | : | **Ardent Steel Ltd** |
| Sample Description | : | **Ambient Air** |
| Date of Monitoring | : | **13.03.2018** |
| Date of Receiving | : | **14.03.2018** |
| Date of Analysis | : | **15.03.2018** |
| Sample Collected by | : | **Sagar Singha** |

## AMBIENT AIR QUALITY TEST REPORT (24 HOURLY AVERAGE)

| Sl. No. | LOCATION | MONITORING REPORT | | | | | |
|---|---|---|---|---|---|---|---|
| | | $PM_{10}$ ($\mu g/m^3$) | $PM_{2.5}$ ($\mu g/m^3$) | $SO_2$ ($\mu g/m^3$) | $NO_x$ ($\mu g/m^3$) | CO ($mg/m^3$) | $NH_3$ ($\mu g/m^3$) |
| 1 | At the boundary near the water harvesting pond (East Direction) | 72.9 | 39.2 | 13.8 | 18.9 | 0.4 | <20 |
| 2 | At the Boundary near ESP (South Direction) | 71.6 | 38.7 | 14.3 | 18.6 | 0.5 | <20 |
| 3 | At the Boundary near Coal Fines Stock yard (North Direction) | 68.8 | 37.9 | 13.9 | 18.4 | 0.5 | <20 |
| **NAAQ Standard** | | **100 ($\mu g/m^3$)** | **60 ($\mu g/m^3$)** | **80 ($\mu g/m^3$)** | **80 ($\mu g/m^3$)** | **4.0 ($mg/m^3$)** | **400 ($\mu g/m^3$)** |

**Authorized Signatory** **Seal of Laboratory**

**Notes:**

- The results relate only to the sample tested.
- This Test Report shall not be reproduced wholly or in part without prior written consent of the laboratory.
- The samples received shall be destroyed after two weeks from the date of issue of the Test Report unless specified otherwise.
- This Test Report shall not be used in any advertising media or as evidence in the court of Law without prior written consent of the laboratory.

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| | | |
|---|---|---|
| Reference No | : | **CEMC/ASL/March-A-02/18** |
| Name of Company | : | **Ardent Steel Ltd** |
| Sample Description | : | **Fugitive Air** |
| Date of Monitoring | : | **13.03.2018** |
| Date of Receiving | : | **14.03.2018** |
| Date of Analysis | : | **15.03.2018** |
| Sample Collected by | : | **Sagar Singha** |

## FUGITIVE EMISSION TEST REPORT

| Sl. No. | LOCATION | RESULT | |
|---|---|---|---|
| | | RSPM ($\mu g/m^3$) | SPM ($\mu g/m^3$) |
| 1 | Proportioning System (Ash & Coke Fines Bunker) | 391 | 1117 |
| 2 | Raw Material Transfer point of Mixture (Mixture Building) | 322 | 1093 |
| 3 | Ball Mill (Cool Grinding) | 331 | 1147 |
| 4 | Ball Mill (Flux & Coke Grinding) | 293 | 1056 |
| 5 | Finished Product Transfer points and plant de-dusting system | 281 | 978 |
| 6 | Travelling Grate & Rotary Kiln | 302 | 994 |
| **MoEF Standard** | | -- | **2000*** |

** The standard is applicable at 10 m distance from the source*

**Authorized Signatory** **Seal of Laboratory**

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| | | |
|---|---|---|
| Reference No | : | **CEMC/ASL/March-N-01/18** |
| Name of Company | : | **Ardent Steel Ltd** |
| Sample Description | : | **Noise Monitoring Report** |
| Date of Monitoring | : | **13.03.2018** |
| Date of Analysis | : | **15.03.2018** |
| Sample Collected by | : | **Sagar Singha** |

## NOISE LEVEL STUDY REPORT

| Sl. No. | Location | Noise Level In Day Time dB(A) | Noise Level In Night Time dB(A) |
|---|---|---|---|
| 01 | Ball Mill (Cool Grinding) | 74.2 | 70.9 |
| 02 | Raw Material Transfer point of Mixture (Mixture Building) | 71.8 | 67.4 |

## NATIONAL STANDARD NOISE LEVEL

| Area Code | Category of Area/Zone | Permissible Limit in dB (A) | |
|---|---|---|---|
| | | Day Time | Night Time |
| **A** | **Industrial Area** | **75** | **70** |
| B | Commercial Area | 65 | 55 |
| C | Residential Area | 55 | 45 |
| D | Silence Zone | 50 | 40 |

**Authorized Signatory** **Seal of Laboratory**

**Notes:**

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- The samples received shall be destroyed after two weeks from the date of issue of the Test Report unless specified otherwise.
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Enlisted in Construction Industry Development Council (CIDC) established by the Planning Commission (Govt. of India)
MoEF&CC, Govt. of India, Recognised Environment Laboratory under Environment (Protection) Act, 1986.


| | | |
|---|---|---|
| Reference No | : | **CEMC/ASL/March-SE-01/18** |
| Name of Company | : | **Ardent Steel Ltd.** |
| Sample Description | : | **Stack Monitoring** |
| Date of Monitoring | : | **13.03.2018** |
| Date of Receiving | : | **14.03.2018** |
| Date of Analysis | : | **15.03.2018** |
| Sample Collected by | : | **Sagar Singha** |
| Stack Height | : | **30m** |

## STACK EMISSION REPORT

| Sl. No. | Location of Sampling | Flue Gas Temp. in K | Concentration of Particulate Matter (PM) in mg/Nm$^3$ |
|---|---|---|---|
| | | | Result |
| 01 | ESP | 412 | 67.8 |

**Authorized Signatory**

**Seal of Laboratory**

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| | | |
|---|---|---|
| Reference No | : | **CEMC/ASL/March GW-01/18** |
| Name of Company | : | **Ardent Steel Ltd.** |
| Sample Description | : | **Ground Water** |
| Date of Sampling | : | **13.03.2018** |
| Date of Receiving | : | **14.03.2018** |
| Date of Analysis | : | **15.03.2018** |
| Sample Collected by | : | **Sagar Singha** |
| Sample Location | : | **Office Site Bore Well** |

## GROUND WATER TEST REPORT

| Sl. No | Parameter | Unit | Desired Limit of drinking water (BIS:10500:2012) | Permissible Limit of drinking water (BIS:10500:2012) | Result |
|---|---|---|---|---|---|
| 1 | Colour | Hazen | 5 | 15 | <5 |
| 2 | Odour | - | Agreeable | Agreeable | AL |
| 3 | Taste | - | Agreeable | - | AL |
| 4 | Turbidity | NTU | 1 | 5 | <1 |
| 5 | pH Value @ 25°C | - | 6.5-8.5 | No Relaxation | 7.06 |
| 6 | Total Dissolved Solid | mg/l | 500 | 2000 | 332 |
| 7 | Alkalinity as $CaCO_3$ | mg/l | 200 | 600 | 72 |
| 8 | Total Hardness as $CaCO_3$ | mg/l | 200 | 600 | 140 |
| 9 | Iron as Fe | mg/l | 0.3 | No Relaxation | 0.25 |
| 10 | Nitrate as $NO_3^-$-N | mg/l | 45 | No Relaxation | 5.1 |
| 11 | Sulphate as $SO_4$ | mg/l | 200 | 400 | 15.8 |
| 12 | Fluoride as F | mg/l | 1.0 | 1.5 | 0.22 |
| 13 | Calcium as Ca | mg/l | 75 | 200 | 36.07 |
| 14 | Chloride as $Cl^-$ | mg/l | 250 | 1000 | 43.30 |

**N.B:** AL – Agreeable

**Authorized Signatory** **Seal of Laboratory**

**Notes:**

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| | | |
|---|---|---|
| Reference No | : | **CEMC/ASL/March- SW-01/18** |
| Name of Company | : | **Ardent Steel Ltd.** |
| Date of Sampling | : | **13.03.2018** |
| Sample Description | : | **Surface Water** |
| Date of Receiving | : | **14.03.2018** |
| Date of Analysis | : | 15**.03.2018** |
| Sample Collected by | : | **Sagar Singha** |
| Sample Location | : | **Reservoir** |

## SURFACE WATER TEST REPORT

| Sl. No | Parameter | Unit | GSR 422E Standards | Result |
|---|---|---|---|---|
| 1 | Colour | Hazen | -- | 11 |
| 2 | Odour | - | -- | U/O |
| 3 | pH Value @ 25°C | - | 5.5-9.0 | 7.22 |
| 4 | Total Dissolved Solid | mg/l | 2100 | 202 |
| 5 | Iron as Fe | mg/l | 3.0 | 2.16 |
| 6 | Sulphate as $SO_4$ | mg/l | 1000 | 62.40 |
| 7 | Nitrate as $NO_3^-$-N | mg/l | 50 | 17.2 |
| 8 | Boron as B | mg/l | 2.0 | 0.65 |
| 9 | BOD for 3 days @ $27^0$C | mg/l | 30 | 2.8 |
| 10 | COD | mg/l | 250 | 48 |

**N.B:** U/O- Un-objectionable

**Authorized Signatory** **Seal of Laboratory**

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**ANNEXURE - 6**

# REPORT

# ON

# RISK AND DISASTER MANAGEMENT PLAN

Of

## ARDENT STEEL LIMITED

## At/Po: Phuljhar, Via: Suakati,

## Dist.: Keonjhar, Odisha.


**CENTRE FOR ENVOTECH AND MANAGEMENT CONSULTANCY PVT. LTD.**

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**Recognised Environment Laboratory under Environment (Protection) Act, 1986.**
***Environmental Studies (EIA & EMP),Monitoring, Forest Diversion Planning, DPR, Wildlife Management Plan, Hazardous & Safety Studies, RS& GIS, Baseline Survey, Hydrological & Geological Studies, Socio-economic Studies, DGPS & ETS Survey.***
**Regd. Office: 1st Floor, N-5/305, IRC village, Nayapalli, Bhubaneswar-751015, Odisha, India,Mobile: 9861032826**
**E-mail- cemc_consultancy@yahoo.co.in, cemc122@gmail.com, website: www.cemc.in, Landline: 0674-2360344.**
Laboratory At: Plot No. 800/1274, Johal, Pahal, Bhubaneswar-752101,
E-mail: cemclab@yahoo.in, Mobile: 9937631956, 8895177314

## RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

# CONTENT

## 1.0 GENERAL INFORMATION ABOUT THE FACTORY:

M/s Ardent Steel Limited (ASL), is a sister concern of Godawari Power & Ispat Ltd (GPIL), a public Ltd. Co, belonging to Hira Group of Industries, Raipur having diverse interest in commissioning & running Cement Plant, Sponge Iron Plant etc. backed by a directed team of professionally qualified personnel. M/s. Ardent Steel Limited is a part of the GPIL has set up a 0.6MTPA pellet production with matching accessory facilities, utilities, equipment and plant buildings in order to convert Iron Ore fines into finished pellet product as raw material which is to be charged into DRI Plant/ B.F.

The factory is situated at Vill-Phuljhar, Block-Banspal under Banspal Tehesil in the district of Keonjhar which of 45kms from Kendujhargarh Railway Station and 20Km away from N.H.6. There are other two companies viz : Shree Metaliks Ltd. And Rungta Mines Ltd are also setting up their pellet plant within a radius of 4km. The plant has been set up in approx. 20 acres of area.

| | | |
|---|---|---|
| **Name & address of the Factory** | **:** | **M/S ARDENT STEEL LTD**<br>AT-PHULJHAR, P.O- PHULJHAR,<br>PANCHAYAT- PHULJHAR, BLOCK- BANSPAL<br>TEHESIL- BANSPAL,<br>DIST- KEONJHAR (ODISHA)-758001<br>PHONE: 06766-250173, FAX NO-06766-250182<br>Email- nsahoo@ardentsteel.com |
| **City Office address** | **:** | AT- Plot No-208, New Colony, Jamuhata<br>Dist- Keonjhar<br>PHONE: 06766-250173, FAX NO-06766-250182 |
| **Head Office address** | **:** | **F-9, Hira Arcade,**<br>**Near New Bus Stand**<br>**Pandri, Raipur**<br>**Chhatisgarh**<br>**Phone: 0771 - 4082745**<br>**Fax : 0771 – 4057601** |
| **Name & address of Occupier** | **:** | **DR. SUBHASISH DAS**<br>Flat No.404, Kalpataru Niwas, Apruri Road, Behind Idea Office<br>Bhubaneswar 751029<br>Phone: 09937043572/08800499454 |
| **Name & address of Manager** | **:** | **MR. DILLIP KUMAR PANY**<br>GA -382, Sailashree Vihar,<br>Bhubaneswar - 751021<br>Mobile-9437076534 / 8280826835 |

## 1.1 MAJOR PLANT AND MACHINERY:

| Plant | | Capacity /Size |
|---|---|---|
| Ball Mill (Iron Ore Grinding System) | : | 2X50 TPH |
| Filter Press | : | 2X 40 TPH<br>2x75 TPH |
| Flux Grinding System<br>Flux Pulverizing Unit<br>PGP unit | : | 1 X 5 TPH<br>2 X 1 TPH<br>4 x 9000 kwth |
| Mixer Machine | : | 1 X 120TPH |
| Balling Disc | : | 3 X 60 TPH |
| Travel Grate | : | 1 X 91 TPH |
| Kiln | : | 1 X 80 TPH |
| Annular Cooler | : | 1 X 80 TPH |

## 1.2 BRIEF MANUFACTURING PROCESS:

Preliminary Iron Ore wet grinding is carried out in closed circuit ball mill size of 3600mm x 7500mm and Derrick Screen. Underflow of Derrick screen product sizes is such that not less than 80% passing through 325 mesh with concentration of Iron Ore solid particle being 60%, which would directly be fed into filter press machine where the Iron Ore is filtered and discharged into iron ore filter cake bunkers/buffer shed. Iron ore grinding workshop is provided with a set of ball grinding machine, a set of Derrick screen, thickener, agitator and 4 set of press filters and other auxiliary equipments.

Filter cake is transferred by belt conveyor from buffer shed to filter cake bunkers.

**The bentonite is transferred by cars into** the storehouse in bags. Then Bentonite is lifted into the proportioning bunkers by electric hoist after manually dismantling bags

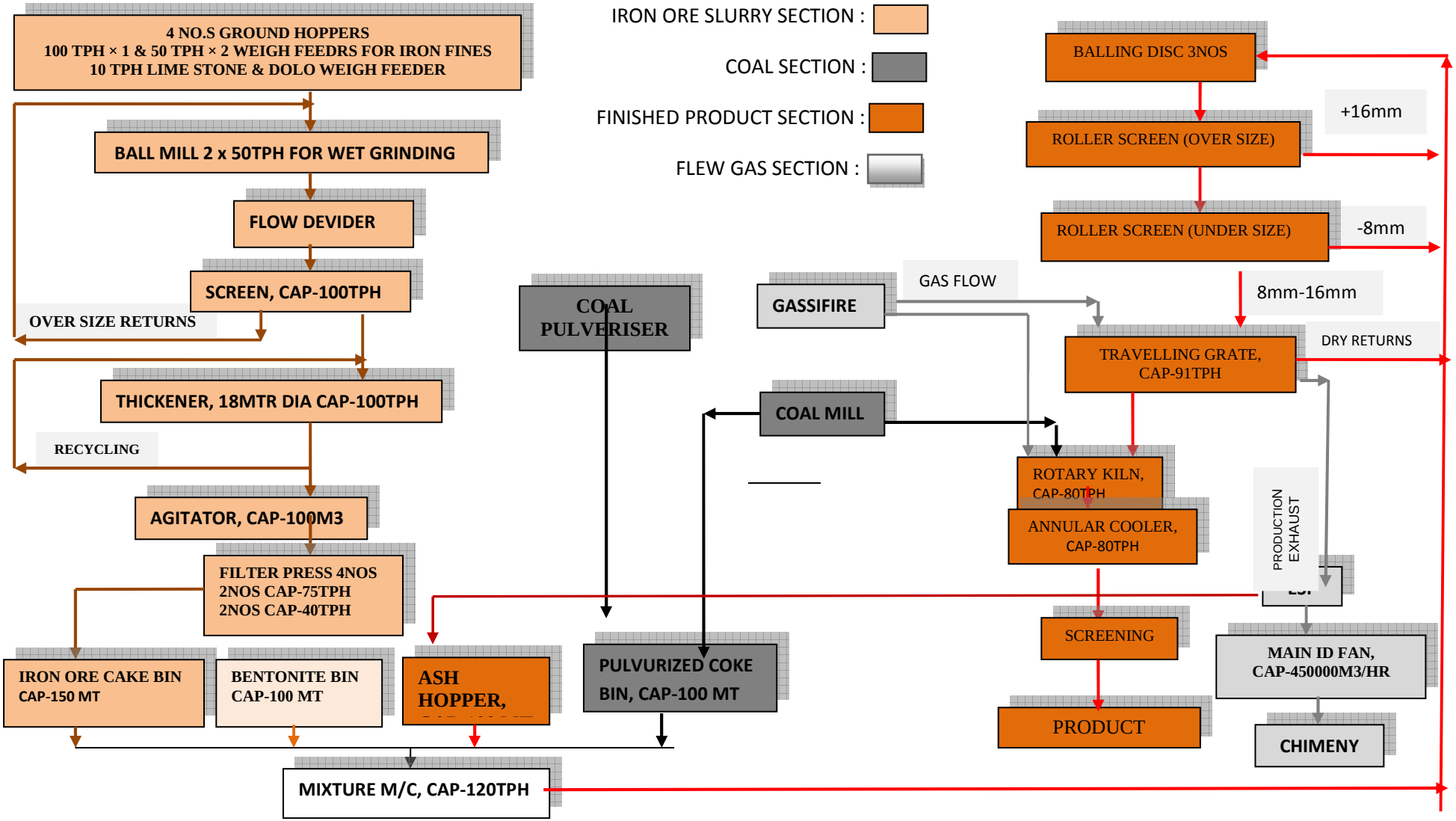
Iron ore filter cake is transferred from grinding unit through belt conveyor into the high level of proportioning room, where the filter cake fed into 2 filter cake bunkers.

Filter cake, Bentonite, Flux, Coke and dust are all mixed proportionately in a R-19 mixer. As per water content of material, some certain quantities of water is added so as to maintain water content before balling process ranged from 8 – 8.5%. Otherwise, it is not beneficial for subsequent procedures.

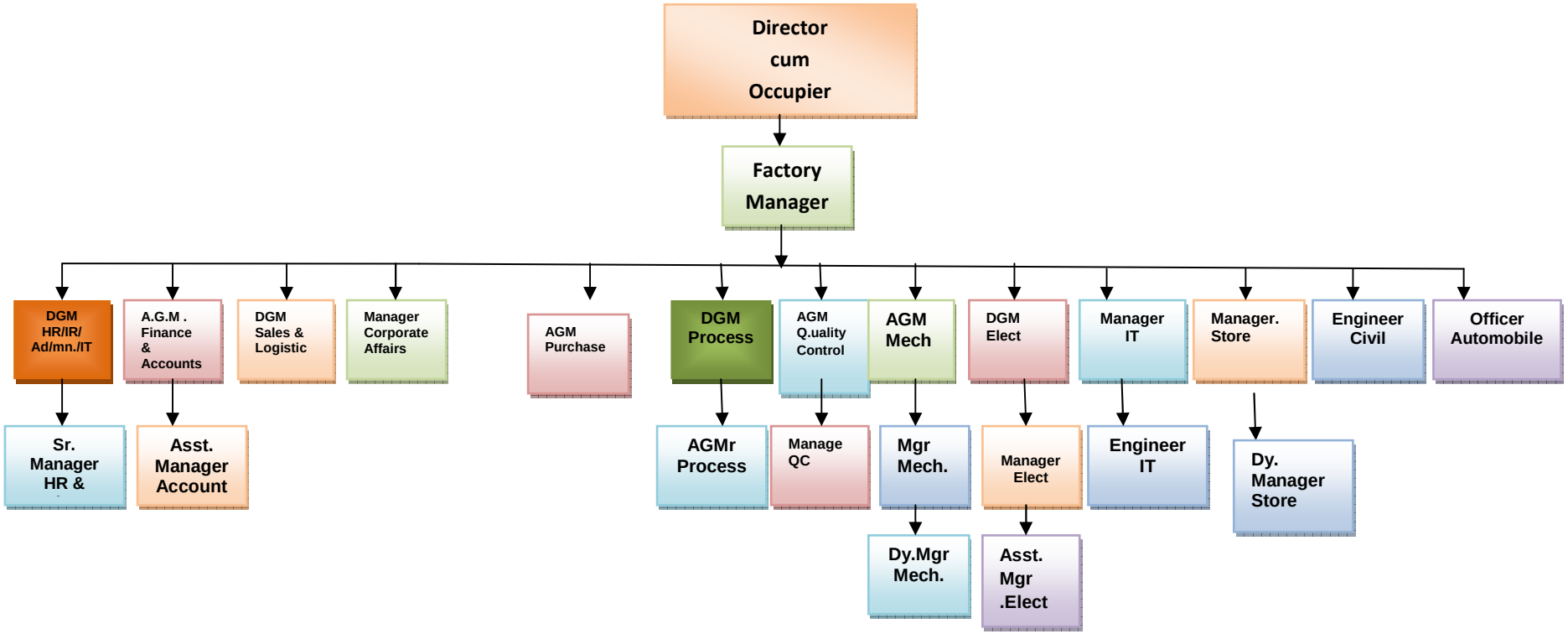
Mixed material is transferred through belt conveyor into the high level of balling room, where the material mix is discharged through plough-type dumper above belt conveyor separately into 3 mixed material bunkers.

Green ball produced from balling disc is transferred by collective belt conveyor into the green ball distribution system in the travel grate machine. Green ball are dried and preheated in the travel grate machine and baked, fired in the rotary kiln, cooled in the annular coole.

## MATERIAL FLOW CHART



## 2.0 ORGANISATION CHART:



### 3.0 MANPOWER:

Manpower as per license is- 800. However the all shifts manpower engaged in the factory is 778

| SHIFT | TIMING | No. of persons engaged | | Total |
|---|---|---|---|---|
| | | Regular | Contract | |
| **"A"SHIFT** | 0600 – 1400 hrs. | 131 | 100 | 231 |
| **"B"SHIFT** | 1400 – 2200 hrs | 67 | 101 | 168 |
| **"C"SHIFT** | 2200 – 0600 hrs. | 80 | 84 | 164 |
| **"G"SHIFT** | 0900 – 1800 hrs. | 95 | 120 | 215 |
| | **TOTAL** | **373** | **405** | **778** |

### 4.0 PRODUCT:

| SL.NO. | NAME OF PRODUCT | ONE TIME STORAGE QUANTITY | STORAGE TYPE | STORAGE CAPACITY & SIZE |
|---|---|---|---|---|
| 1 | Iron Ore Pellet | 54840 MT | Open Yard | 9600 $M^2$ |

### 4.1 INTERMEDIATE PRODUCT:

| SL.NO. | NAME | ONE TIME STORAGE QUANTITY | STORAGE TYPE | STORAGE CAPACITY & SIZE |
|---|---|---|---|---|
| 1 | Ash | 10000 MT | Open yard | Length-100 M<br>Breadth-100 M |

## 5.0 INVENTORY OF RAW MATERIALS:

| SL. NO. | NAME | ONE TIME STORAGE QUANTITY | TYPES OF STORAGE | STORAGE CAPACITY & SIZE |
|---|---|---|---|---|
| 01 | Iron Ore Fines | 54840 MT | Open Yard | 11000 $M^2$ |
| 02 | Coal | 707 MT | Open Yard/shed | 141.81 $M^2$ |
| 03 | Bentonite | 750 MT | Shed | 150.43 $M^2$ |

## 6.0 INVENTORY OF HAZARDOUS SUBSTANCE:

| SL. NO. | NAME | ONE TIME STORAGE QUANTITY | TYPES OF STORAGE | STORAGE CAPACITY & SIZE |
|---|---|---|---|---|
| 1 | HSD | 20KL | Underground storage tank | Length-5.5 Mtrs Diameter-2.438 Mtrs |
| 2 | Transformer oil | 4625 L | In the transformer | Inside the 7.5 MVA Transformer |
| | | 2 X 3482 L | In the transformer | Inside the 5.8 MVA x 2 nos Transformer |
| | | 1676 L | In the transformer | Inside the 2.8 MVA Transformer |
| 3 | Process Oil (LDO ) | 264560 L | Main tank-1 (ABOVE GROUND ) | Diameter-6.2 mtr height -8.8 mtr |
| | | 264970 L | Main tank-2 (Above the Ground ) | Diameter-6.2 mtr height -8.9 mtr |
| | | 35 KL | Kiln Day tank (Above the Ground) | Diameter-2.936 mtr height -5 mtr |
| | | 15 KL | TG Day Tank (Above the Ground) | Diameter-1.776 mtr height -6 mtr |

## 7.0 INVENTORY OF HAZARDOUS GASES / SUBSTANCES PRODUCED / GENERATED:

| SL.NO. | NAME | QUANTITY OF ONE TIME STORAGE | TYPE OF STORAGE |
|---|---|---|---|
| No hazardous substances/gases are produced/generated during the process | | | |

## 8.0 IDENTIFICATION OF HAZARDS:

Due to handling/storing of coal, diesel and transformer oil, the fire hazards may occur in the following area within the factory premises:

| Sl. | Area / Hazard Zone | Hazard | Impact |
|---|---|---|---|
| 1 | Coal yard | Fire may occur due to mild oxidation by weathering during storage of coal in the coal yard &spontaneous ignition of coal. | Significant heat level of 4.5 KW/$M^2$ will experience at distance of 15.2 meters. from the coal yard. |
| 2 | Diesel oil storage tank | Fire may occur due to expose to heat and naked lights | Significant heat level of 4.5 KW/$M^2$ experience at distance 6 metrs. from the storage tank. |
| 3 | 7.5 MVA Transformer | Fire may occur due to rupture of the container if container is not properly cooled. | Significant heat level of 4.5 KW/$M^2$ will experience at distance of 17.9 metrs. from the Transformer. |
| 5 | 5.8 MVA Transformer | Fire may occur due to rupture of the container if container is not properly cooled. | significant heat level of 4.5 KW/$M^2$ will experience at distance of 17.2 metrs. from the Transformer. |
| 6 | 2.8 MVA Transformer | Fire may occur due to rupture of the container if container is not properly cooled. | significant heat level of 4.5 KW/$M^2$ will experience at distance of 15.5 metrs. from the Transformer.. |

## 9.0 IDENTIFICATION OF MOST CREDIBLE HAZARD SCENARIO:

### 9.1 Fire on Coal Yard:

During storage of coal in the coal yard, weathering of coal takes place due to mild oxidation, which is an exothermic process. If the heat liberated is not completely dissipated, the temperature of coal rises as coal is a bad conductor of heat. The rate of oxidation is doubled with 10 $^0$C rising temperature. The bulk of coal may reach critical temperature i.e. its ignition point 50-80$^o$C and may burst into flame.

**Significant heat radiation experienced at distance in case of fire on coal yard (using ALOHA Software )**

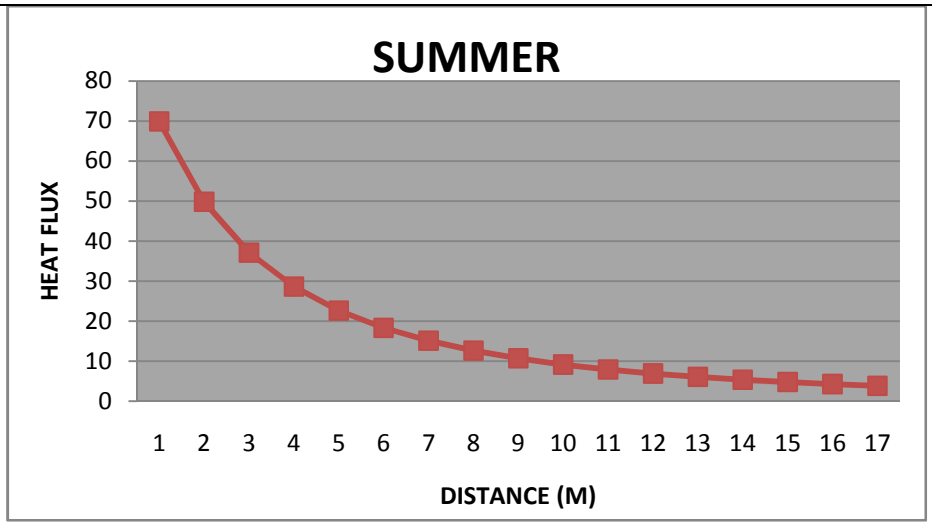
| Mass of coal | Significant heat level Kw/m$^2$ | Experience at distance in Mtrs. | | | Indication |
|---|---|---|---|---|---|
| | | Summer | Rainy | Winter | |
| Coal yard 707MT | 4.5 | 15 | 15.2 | 15.2 | Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality. |
| | 12.5 | 6.9 | 8.3 | 8.3 | Minimum energy required for melting of plastic |
| | 37.5 | 2.9 | 3.0 | 3.0 | Sufficient to cause damage to the equipment. |

### 9.1.1 FIRE MODELING FOR COAL IN COAL YARD:

| Storage detail | | Input data for Summer Season | |
|---|---|---|---|
| Storage type | Coal yard | | |
| Capacity | 707MT | | |
| Size | 141.81 M$^2$ | | |
| Meteorological data | (Google Net) | Season | |
| Parameter | Summer | Rainy | Winter |
| Average wind speed m/sec | 8 | 6 | 4 |
| Average wind direction | SW | NW | N |
| Humidity (%) | 70 | 81 | 50 |
| Average ambient air temperature ($^0$C) | 43 | 28 | 12 |

**HEAT FLUX DATA FOR SUMMER SEASON:**

| Distance (M) | Heat Flux ($KW/m^2$) | Heat propagation Curve |
|---|---|---|
| 1 | 68.64 | Coal yard- Summer season |
| 2 | 48.8 | |
| 3 | 36.27 | |
| 4 | 27.89 | |
| 5 | 22.03 | |
| 6 | 17.78 | |
| 7 | 14.61 | |
| 8 | 12.19 | |
| 9 | 10.31 | |
| 10 | 8.81 | |
| 11 | 7.6 | |
| 12 | 6.62 | |
| 13 | 4.8 | |
| 14 | 5.12 | |
| 15 | 4.55 | |
| 16 | 4.07 | |
| 17 | 3.65 | |



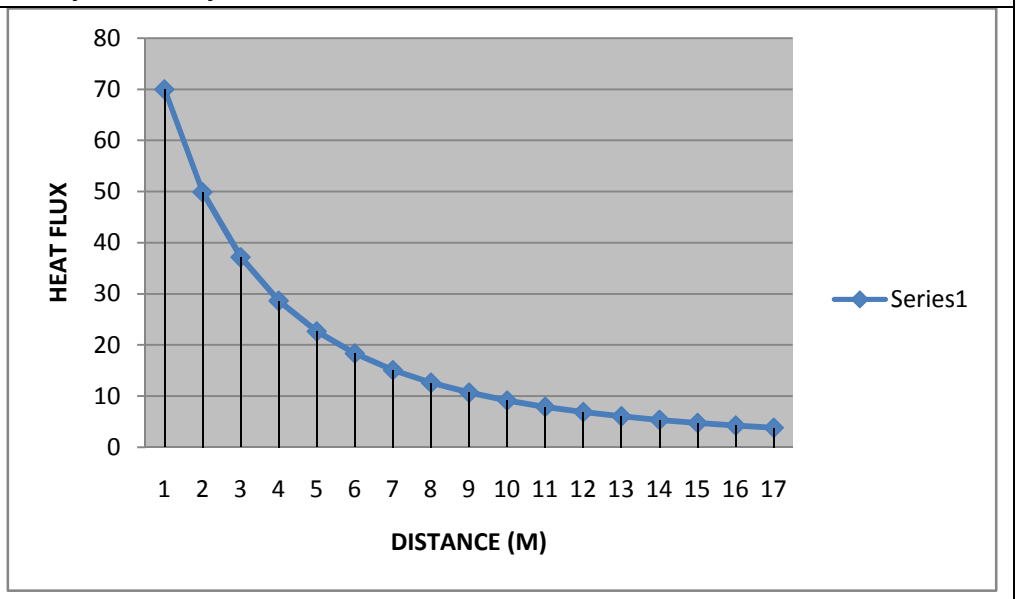

**SIGNIFICANT "HEAT LEVEL" EXPERIENCED AT DISTANCE DUE TO FIRE ON COAL YARD IN SUMMER SEASON**

| Significant Heat Level Value ($KW/M^2$) | Distance (M) | Indication |
|---|---|---|
| 37.5 | 2.9 | Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality. |
| 12.5 | 6.9 | Minimum energy required for melting of plastic |
| 4.5 | 15 | Sufficient to cause damage to the equipment. |

| Storage detail | | Input data for Rainy Season | |
|---|---|---|---|
| Storage type | Coal yard | | |
| Capacity | 707MT | | |
| Size | 141.81 $M^2$ | | |
| Meteorological data | Source Google Net | Season | |
| Parameter | Summer | Rainy | Winter |
| Average wind speed m/sec | 8 | 6 | 4 |
| Average wind direction | SW | NW | N |
| Humidity (%) | 70 | 81 | 50 |
| Average ambient air temperature ($^0C$) | 43 | 28 | 12 |

## HEAT FLUX DATA FOR RAINY SEASON:

| Distance (M) | Heat Flux ($KW/m^2$) | Heat propagation Curve |
|---|---|---|
| 1 | 69.93 | Coal yard- Rainy season |
| 2 | 49.85 | |
| 3 | 37.15 | |
| 4 | 28.63 | |
| 5 | 22.66 | |
| 6 | 18.33 | |
| 7 | 15.1 | |
| 8 | 12.62 | |
| 9 | 10.69 | |
| 10 | 9.15 | |
| 11 | 7.91 | |
| 12 | 6.9 | |
| 13 | 6.06 | |
| 14 | 5.36 | |
| 15 | 4.77 | |
| 16 | 4.27 | |
| 17 | 3.84 | |



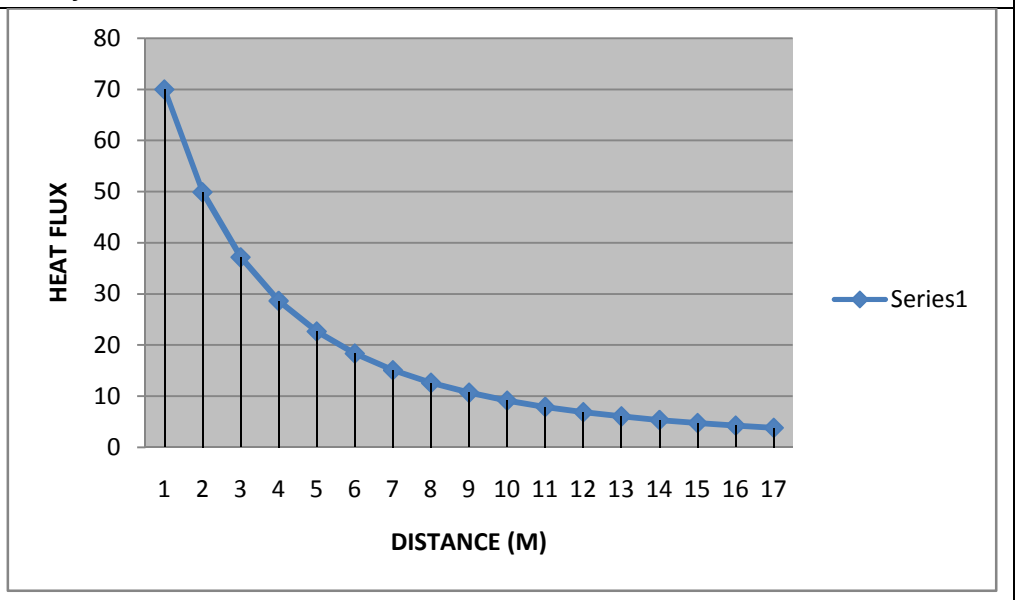

**SIGNIFICANT "HEAT LEVEL" EXPERIENCED AT DISTANCE DUE TO FIRE ON COAL YARD IN RAINY SEASON**

| Significant Heat Level Value ($KW/M^2$) | Distance (M) | Indication |
|---|---|---|
| 4.5 | 15.2 | Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality. |
| 12.5 | 8.3 | Minimum energy required for melting of plastic |
| 37.5 | 3.0 | Sufficient to cause damage to the equipment. |

| Storage detail | | Input data for Winter Season | |
|---|---|---|---|
| Storage type | Coal yard | | |
| Capacity | 707MT | | |
| Size | 141.81 $M^2$ | | |
| Meteorological data | Source : Google Net | Season | |
| Parameter | Summer | Rainy | Winter |
| Average wind speed m/sec | 8 | 6 | 4 |
| Average wind direction | SW | NW | N |
| Humidity (%) | 70 | 81 | 50 |
| Average ambient air temperature ($^0C$) | 43 | 28 | 12 |

## HEAT FLUX DATA FOR WINTER SEASON:

| Distance (M) | Heat Flux ($KW/m^2$) | Heat propagation Curve |
|---|---|---|
| 1 | 69.93 | Coal yard- Winter season |
| 2 | 49.85 | |
| 3 | 37.15 | |
| 4 | 28.63 | |
| 5 | 22.66 | |
| 6 | 18.33 | |
| 7 | 15.1 | |
| 8 | 12.62 | |
| 9 | 10.69 | |
| 10 | 9.15 | |
| 11 | 7.91 | |
| 12 | 6.9 | |
| 13 | 6.06 | |
| 14 | 5.36 | |
| 15 | 4.77 | |
| 16 | 4.27 | |
| 17 | 3.84 | |




**SIGNIFICANT "HEAT LEVEL" EXPERIENCED AT DISTANCE DUE TO FIRE ON COAL YARD IN WINTER SEASON**

| Significant Heat Level Value ($KW/M^2$) | Distance (M) | Indication |
|---|---|---|
| 4.5 | 15.2 | Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality. |
| 12.5 | 8.3 | Minimum energy required for melting of plastic |
| 37.5 | 3.0 | Sufficient to cause damage to the equipment. |

## 9.1.2 PRECAUTIONS FOR PREVENTION OF SPONTANEOUS IGNITION OF COAL:

The following precautions are taken for prevention of spontaneous ignition of coal.

- The exposed surface area of the raw coal heap is restricted to 20000 $m^2$ & maximum height of 3 mtrs. so as to avoid the contact of oxygen with coal.
- The exposed surface area of the raw coal heap is restricted to 15000 $m^2$ & maximum height of 3 mtrs. so as to avoid the contact of oxygen with coal.
- The exposed surface area is reduced by avoiding segregation and by packing the coal tightly and uniformly.
- The ventilation at the coal heap is suppressed so that weathering is avoided due to cut-off of oxygen.
- Coals of different sizes stored in a pile so that air voids are reduced to a great extent.
- The coal is consumed before the critical temperature (50-80$^oC$ ) is reached.
- Water Sprinkling is done to reduce the temperature.
- Coal is stored under shed so as to avoid direct contact with the sunlight. Besides it is kept away from the heat source.

### 9.1.3 Fire Hazard in HSD Storage Tank:

HSD is a flammable liquid as per schedule-1, Part-II (b) (v) having flash point of $66^0$C and auto ignition temperature of $256^0$C and explosive limit of 5-7% volume in air. So, it is susceptible to fire hazard. Whenever HSD catches fire it shall manifest in the form of pool fire. The significant heat flux that spread from the source in case of pool fire in HSD tank is mentioned below.

***Significant heat flux experienced at distance due to pool fire on HSD in different season. ( By using ALOHA Software )***

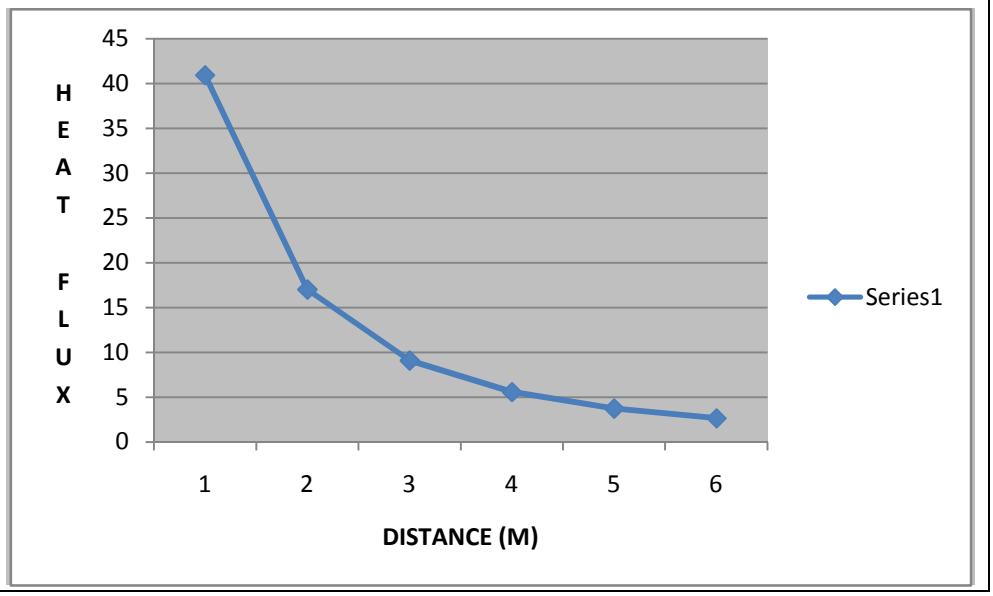
| Storage details | Significant heat level $Kw/m^2$ | Experience at distance in Mtrs. | | | Indication |
|---|---|---|---|---|---|
| | | Summer | Rainy | Winter | |
| HSD 20 KL | 4.5 | 6 | 4.5 | 5 | Causes pain if unable cove the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality. |
| | 12.5 | 2.5 | 1.9 | 3.3 | Minimum energy required for melting of plastic |
| | 37.5 | 1.4 | 0.8 | 0.6 | Sufficient to cause damage to the equipment. |

## FIRE MODELLING FOR HSD IN STORAGE TANK

| | | | |
|---|---|---|---|
| Storage detail | | | Input data for Summer Season |
| Storage type | Under Ground Storage Tank | | |
| Capacity | 20KL | | |
| Size | Dia-2.438 M, L-5.5 M | | |
| Meteorological data | Source : Google Net | Season | |
| Parameter | Summer | Rainy | Winter |
| Average wind speed m/sec | 8 | 6 | 4 |
| Average wind direction | SW | NW | N |
| Humidity (%) | 70 | 81 | 50 |
| Average ambient air temperature ($^0$C) | 43 | 28 | 12 |

**HEAT FLUX DATA FOR SUMMER SEASON:**

| Distance (M) | Heat Flux (KW/m$^2$) | Heat propagation Curve |
|---|---|---|
| 1 | 40.91 | HSD Storage Tank- Summer season: |
| 2 | 17.01 | |
| 3 | 9.09 | |
| 4 | 5.57 | |
| 5 | 3.73 | |
| 6 | 2.65 | |




SIGNIFICANT "HEAT LEVEL" EXPERIENCED AT DISTANCE

| Significant Heat Level Value (KW/M$^2$) | Distance (M) | Indication |
|---|---|---|
| 4.5 | 6 | Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2$^{nd}$ degree burn) is likely caused with no lethality. |
| 12.5 | 2.5 | Minimum energy required for melting of plastic |
| 37.5 | 1.4 | Sufficient to cause damage to the equipment. |

## FIRE MODELLING FOR HSD IN STORAGE TANK

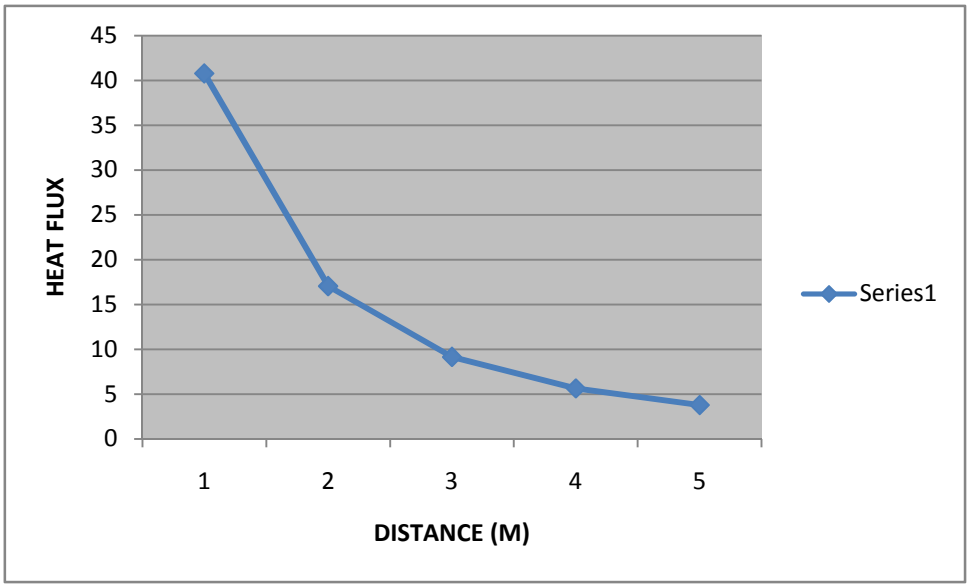
| Storage detail | | | Input data for Rainy Season |
|---|---|---|---|
| Storage type | Under Ground Storage Tank | | |
| Capacity | 20 KL | | |
| Size | Dia-2.438 M, L-5.5 M | | |
| Meteorological data | Source : Google Net | Season | |
| Parameter | Summer | Rainy | Winter |
| Average wind speed m/sec | 8 | 6 | 4 |
| Average wind direction | SW | NW | N |
| Humidity (%) | 70 | 81 | 50 |
| Average ambient air temperature ($^0$C) | 43 | 28 | 12 |

**HEAT FLUX DATA FOR RAINY SEASON:**

| Distance (M) | Heat Flux (KW/m$^2$) |
|---|---|
| 1 | 40.75 |
| 2 | 17.03 |
| 3 | 9.13 |
| 4 | 5.62 |
| 5 | 3.77 |

Heat propagation Curve

HSD Storage Tank- Rainy season:




SIGNIFICANT "HEAT LEVEL" EXPERIENCED AT DISTANCE

| Significant Heat Level Value (KW/M$^2$) | Distance (M) | Indication |
|---|---|---|
| 4.5 | 4.5 | Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2$^{nd}$ degree burn) is likely caused with no lethality. |
| 12.5 | 1.9 | Minimum energy required for melting of plastic |
| 37.5 | 0.8 | Sufficient to cause damage to the equipment. |

## FIRE MODELLING FOR HSD IN STORAGE TANK

| Storage detail | | | Input data for Winter Season |
|---|---|---|---|
| Storage type | Under Ground Storage Tank | | |
| Capacity | 20 KL | | |
| Size | Dia-2.438 M, L-5.5 M | | |
| Meteorological data | Source : Google Net | | Season |
| Parameter | Summer | Rainy | Winter |
| Average wind speed m/sec | 8 | 6 | 4 |
| Average wind direction | SW | NW | N |
| Humidity (%) | 70 | 81 | 50 |
| Average ambient air temperature ($^0$C) | 43 | 28 | 12 |

**HEAT FLUX DATA FOR WINTER SEASON:**

| Distance (M) | Heat Flux (KW/m$^2$) | Heat propagation Curve |
|---|---|---|
| 1 | 43.1 | HSD Storage Tank- Winter season: |
| 2 | 18.3 | |
| 3 | 9.94 | |
| 4 | 6.18 | |
| 5 | 4.18 | |
| 6 | 3.01 | |
| | | |
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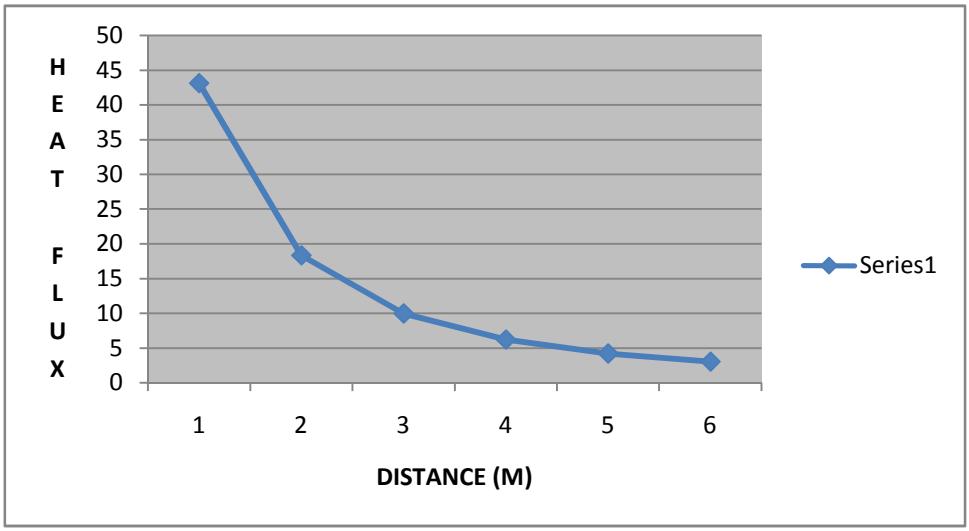



SIGNIFICANT "HEAT LEVEL" EXPERIENCED AT DISTANCE

| Significant Heat Level Value (KW/M$^2$) | Distance (M) | Indication |
|---|---|---|
| 4.5 | 5 | Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality. |
| 12.5 | 3.3 | Minimum energy required for melting of plastic |
| 37.5 | 0.6 | Sufficient to cause damage to the equipment. |

### 9.1.4 Fire Hazard in Transformer Oil in Transformer:

Transformer oil is a flammable liquid as per schedule-1, Part-II (b) (v) having flash point of 144$^0$C, auto ignition temperature of >270$^0$C and explosive limit of 0.7% volume in air. So, it is susceptible to fire hazard. Whenever Transformer oil catches fire it shall manifest in the form of pool fire. The significant heat flux that spread from the source in case of pool fire in transformer is mentioned below.

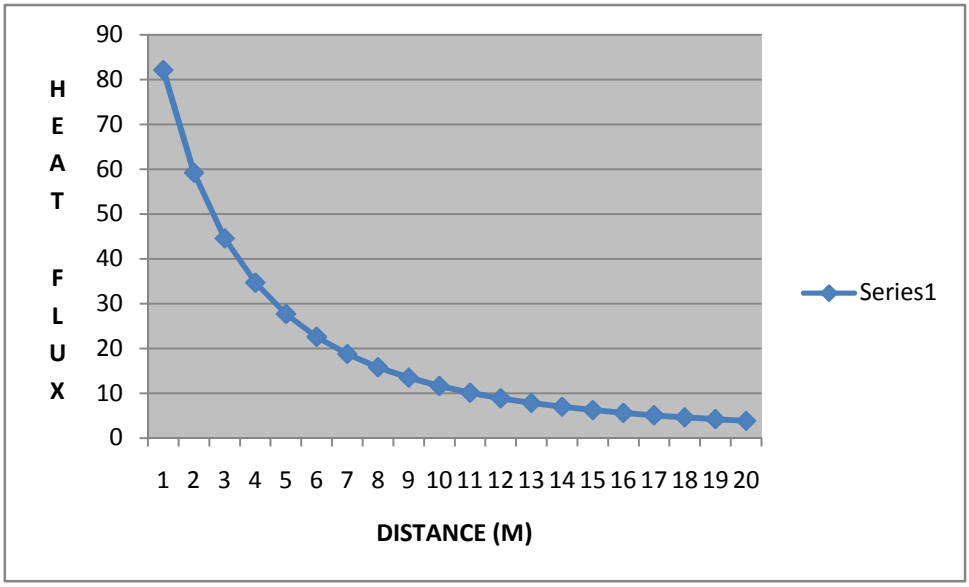
***Significant heat flux experienced at distance due to fire on transformer containing transformer oil in different season. ( By Using ALOHA Software )***

| Storage details | Significant heat level Kw/m$^2$ | Experience at distance in Mtrs. | Indication |
|---|---|---|---|
| Transformer oil 4625 Lin 7.5 MVA Transformer | 4.5 | 17.9 | Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2$^{nd}$ degree burn) is likely caused with no lethality. |
| | 12.5 | 9.8 | Minimum energy required for melting of plastic |
| | 37.5 | 3 | Sufficient to cause damage to the equipment. |
| Transformer oil 3482 L in 5.8 MVA Transformer | 4.5 | 17.2 | Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2$^{nd}$ degree burn) is likely caused with no lethality. |
| | 12.5 | 9.5 | Minimum energy required for melting of plastic |
| | 37.5 | 3.8 | Sufficient to cause damage to the equipment. |
| Transformer oil 1676 L in 2.8 MVA Transformer | 4.5 | 15.5 | Causes pain if unable cover the body within 20 seconds. However blistering of the skin (2$^{nd}$ degree burn) is likely caused with no lethality. |
| | 12.5 | 8.3 | Minimum energy required for melting of plastic |
| | 37.5 | 2.9 | Sufficient to cause damage to the equipment. |

**FIRE MODELING FOR TRANSFORMER OIL**

| Storage detail | | | Input data for 7.5MVA Transformer |
|---|---|---|---|
| Storage type | Transformer | | |
| Capacity | 4625 L | | |
| Meteorological data | Source : Google Net | Season | |
| Parameter | Summer | Rainy | Winter |
| Average wind speed m/sec | 8 | 6 | 4 |
| Average wind direction | SW | NW | N |
| Humidity (%) | 70 | 81 | 50 |
| Average ambient air temperature ($^0$C) | 43 | 28 | 12 |

| Distance (M) | Heat Flux (KW/m$^2$) | Heat propagation Curve |
|---|---|---|
| 1 | 82.11 | 7.5 MVA Transformer: |
| 2 | 59.2 | |
| 3 | 44.57 | |
| 4 | 34.68 | |
| 5 | 27.7 | |
| 6 | 22.6 | |
| 7 | 18.76 | |
| 8 | 15.81 | |
| 9 | 13.48 | |
| 10 | 11.63 | |
| 11 | 10.12 | |
| 12 | 8.88 | |
| 13 | 7.85 | |
| 14 | 6.99 | |
| 15 | 6.26 | |
| 16 | 5.63 | |
| 17 | 5.09 | |
| 18 | 4.62 | |
| 19 | 4.22 | |
| 20 | 3.86 | |



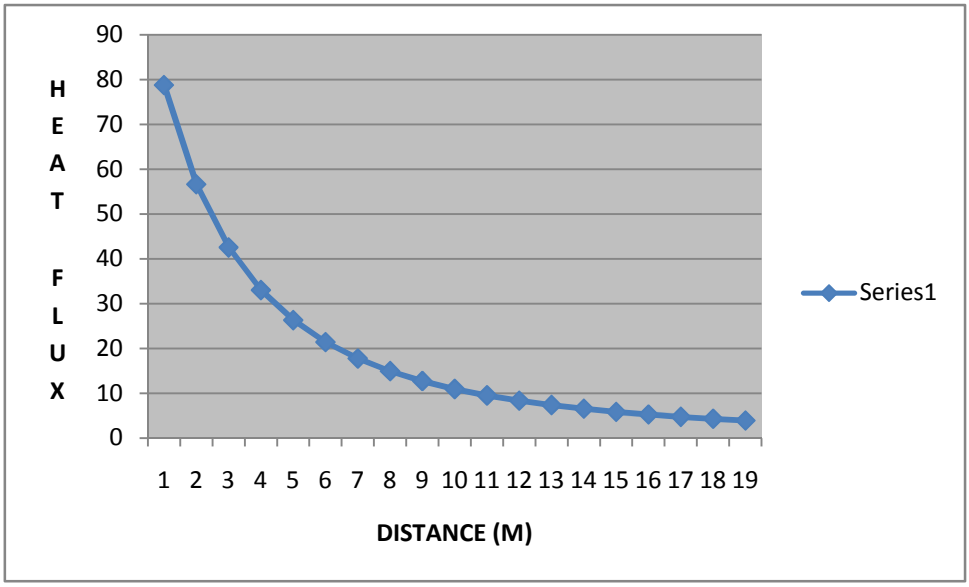

SIGNIFICANT "HEAT LEVEL" EXPERIENCED AT DISTANCE

| Significant Heat Level Value (KW/M$^2$) | Distance (M) | Indication |
|---|---|---|
| 4.5 | 17.9 | Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2$^{nd}$ degree burn) is likely caused with no lethality. |
| 12.5 | 9.8 | Minimum energy required for melting of plastic |
| 37.5 | 3 | Sufficient to cause damage to the equipment. |

**FIRE MODELING FOR TRANSFORMER OIL**

| Storage detail | | | Input data for 5.8 MVA Transformer |
|---|---|---|---|
| Storage type | Transformer | | |
| Capacity | 3482 L | | |
| Meteorological data | Source : Google Net | | Season |
| Parameter | Summer | Rainy | Winter |
| Average wind speed m/sec | 8 | 6 | 4 |
| Average wind direction | SW | NW | N |
| Humidity (%) | 70 | 81 | 50 |
| Average ambient air temperature ($^0$C) | 43 | 28 | 12 |

| Distance (M) | Heat Flux (KW/m$^2$) | Heat propagation Curve |
|---|---|---|
| 1 | 78.76 | 5.8 MVA Transformer: |
| 2 | 56.63 | |
| 3 | 42.53 | |
| 4 | 33.01 | |
| 5 | 26.31 | |
| 6 | 21.42 | |
| 7 | 17.75 | |
| 8 | 14.93 | |
| 9 | 12.71 | |
| 10 | 10.94 | |
| 11 | 9.51 | |
| 12 | 8.33 | |
| 13 | 7.36 | |
| 14 | 6.54 | |
| 15 | 5.84 | |
| 16 | 5.25 | |
| 17 | 4.74 | |
| 18 | 4.3 | |
| 19 | 3.92 | |



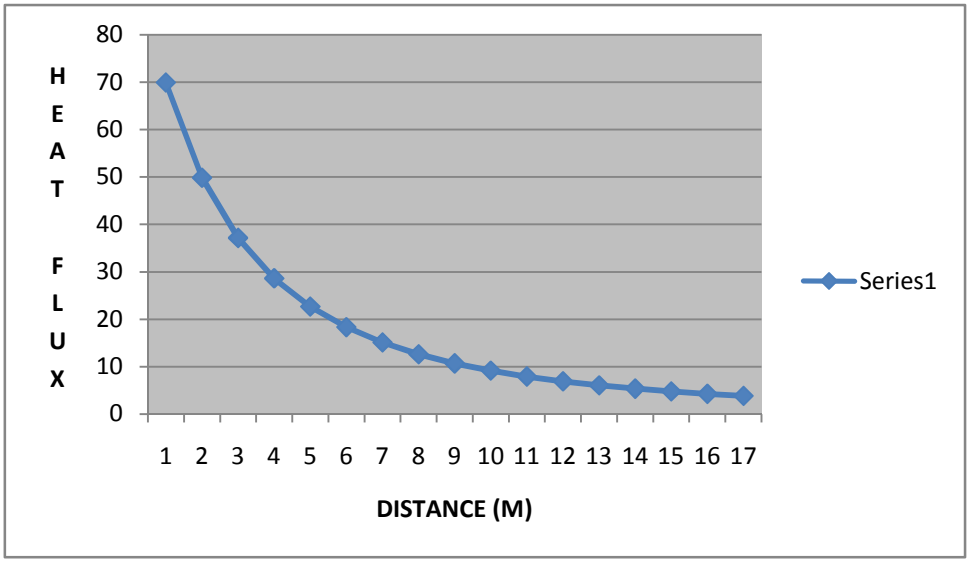

SIGNIFICANT "HEAT LEVEL" EXPERIENCED AT DISTANCE

| Significant Heat Level Value (KW/M$^2$) | Distance (M) | Indication |
|---|---|---|
| 4.5 | 17.2 | Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2$^{nd}$ degree burn) is likely caused with no lethality. |
| 12.5 | 9.5 | Minimum energy required for melting of plastic |
| 37.5 | 3.8 | Sufficient to cause damage to the equipment. |

**FIRE MODELING FOR TRANSFORMER OIL**

| Storage detail | | | Input data for 2.8 MVA Transformer |
|---|---|---|---|
| Storage type | Transformer | | |
| Capacity | 1676 L | | |
| Meteorological data | Source : Google Net | | Season |
| Parameter | Summer | Rainy | Winter |
| Average wind speed m/sec | 8 | 6 | 4 |
| Average wind direction | SW | NW | N |
| Humidity (%) | 70 | 81 | 50 |
| Average ambient air temperature ($^0$C) | 43 | 28 | 12 |

| Distance (M) | Heat Flux (KW/m$^2$) | Heat propagation Curve |
|---|---|---|
| 1 | 69.93 | 2.8 MVA Transformer: |
| 2 | 49.85 | |
| 3 | 37.15 | |
| 4 | 28.63 | |
| 5 | 22.66 | |
| 6 | 18.33 | |
| 7 | 15.1 | |
| 8 | 12.62 | |
| 9 | 10.69 | |
| 10 | 9.15 | |
| 11 | 7.91 | |
| 12 | 6.9 | |
| 13 | 6.06 | |
| 14 | 5.36 | |
| 15 | 4.77 | |
| 16 | 4.27 | |
| 17 | 3.84 | |




SIGNIFICANT "HEAT LEVEL" EXPERIENCED AT DISTANCE

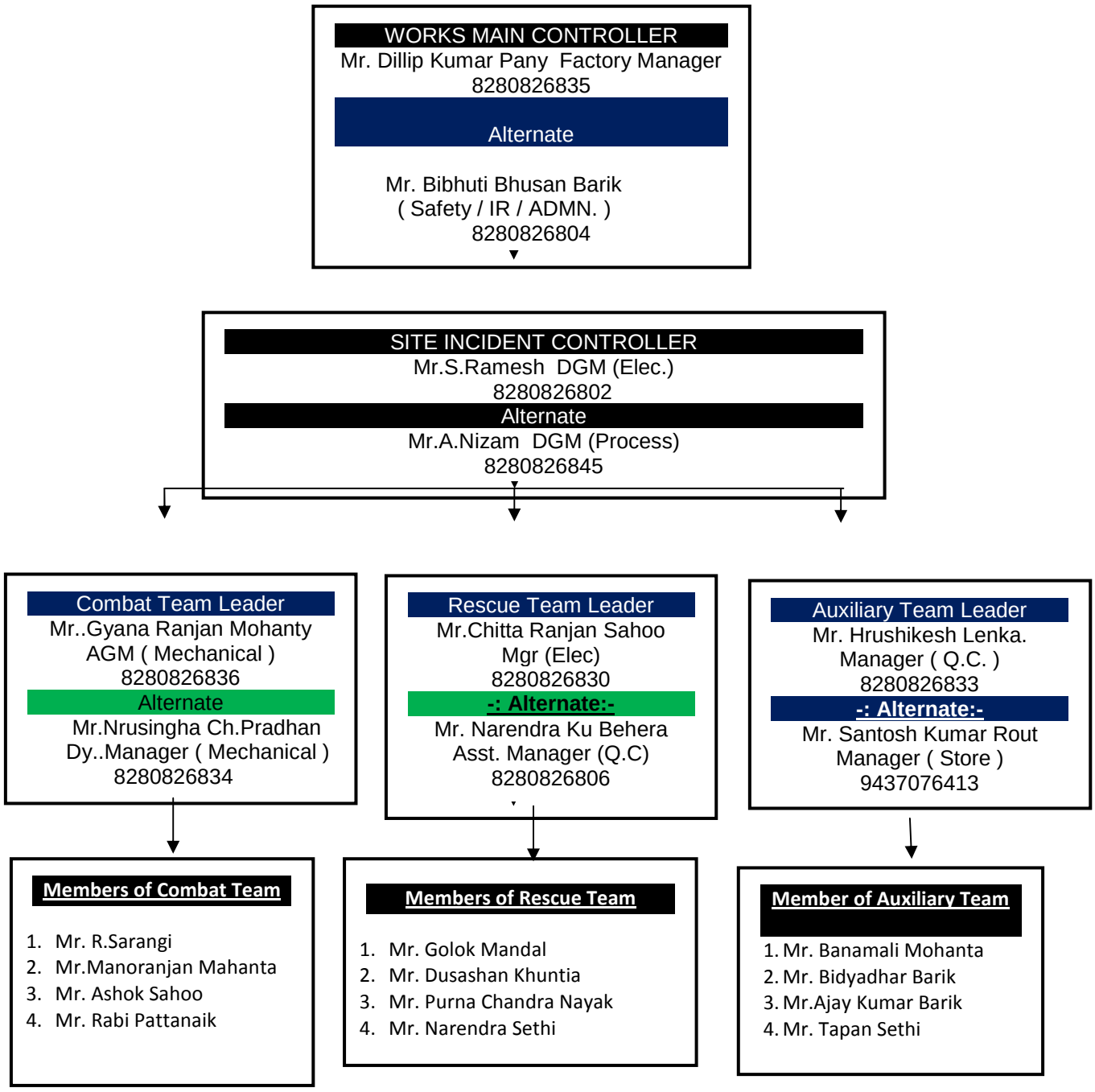
| Significant Heat Level Value (KW/M$^2$) | Distance (M) | Indication |
|---|---|---|
| 4.5 | 15.5 | Causes pain if unable to cover the body within 20 seconds. However blistering of the skin (2nd degree burn) is likely caused with no lethality. |
| 12.5 | 8.3 | Minimum energy required for melting of plastic |
| 37.5 | 2.9 | Sufficient to cause damage to the equipment. |

## 10.0 PLOT PLAN:

The plot plan showing the followings is given in **Annexure**.

(i) Hazard Zone (HZ)
(ii) Iso-risk Contour around Hazard Zone
(iii) Emergency Control Room (ECR)
(iv) Assembly Point (AP)
(v) Emergency Exit (EE)
(vi) Fire Hydrant line

## 11.0 EMERGENCY COMMAND STRUCTURE:



## 12.0 ROLE OF KEY PERSONS OF EMERGENCY COMMAND STRUCTURE:

### 12.1 WORKS MAIN CONTROLLER (WMC):

- On being informed, rush to the scene and take overall charges of the situation.
- Make quick assessment of the situation and decide declaration of emergency by blowing the siren in appropriate code [**intermittent three times with five seconds interval**].
- Make continuous review and assess the possible developments to determine the extent of damage to plant and human beings.
- Shut-down the plant, if necessary.
- Ensure that casualties are receiving adequate attention.
- Liaise with the fire services, police services and other statutory authorities.
- Declare closure of the emergency by blowing the siren [only once long siren for 30 seconds].
- Issue the authorized statements to the media services.
- Report all statutory authorities in the prescribed manner.
- Communicate to employees about the mishap, measures taken and giving confidence to employees for avoiding recurrence of the incident by investigation and ordering preventive measures to be implemented.

### 12.2 SITE INCIDENT CONTROLLER:

- On hearing Emergency siren, rush to the scene and report to the Works Main Controller.
- Make quick assess about the gravity of the situation and appraises Works Main Controller.
- Extend all sorts of help through different agencies to minimize the damage to human beings, plant, property and environment.
- Shutdown of Plant & Machinery.
- Undertake continuous review of the situation time to time and appraise to Works Main Controller.
- Provide the required information to the fire brigade team for fire fighting.
- Preserve the evidences for the subsequent inquiries.
- He will liaison between the various working teams.
- He will extend all possible help needed during the Emergency.
- Organize various teams by calling the team leader

### 12.3 COMBAT TEAM LEADER:

- On hearing the emergency siren, rush to the scene with fire fighting team with sufficient equipment in the minimum possible time.
- Ensure the team members resume their position with appropriate equipment
- Monitor the fire fighting operation to control the situation
- Ensure that the situation is controlled by arresting, spillage, fighting fire, shutting of the valve and equipment by the team in consultation with Site Incident Controller

- Alert the entire employees through PA System
- Command fire fighting activities. Also review and decide fire-fighting strategies

**12.4 COMBAT TEAM MEMBERS:**

The team members will assist the team Leader to ensure.

- Shutdown the Plant and Machinery & Isolate the affected area.
- Arrange of Isolation of Electrical Power Supplier all around the affected area.
- Alert the entire employees through PA System
- Operating the fire fighting equipments and materials and also to shift to effected site

**12.5 RESCUE TEAM LEADER:**

- On hearing the emergency siren, rush to the scene
- Ensure the arrival of his team members
- Keep necessary equipments of first-aid for preliminary treatment
- Keep the ambulance ready to carry the injure persons to the hospital
- Ensure the proper personal protective equipments lead the team for rescue operation
- Guide the mutual aid partners for their course of action at the site
- Guide the non-essential persons to reach assembly point
- Search the missing person on the roll call basis
- Rescue all the effected persons.
- Search for casualties and evacuate non-essential person from spot.

**12.6 RESCUE TEAM MEMBERS:**

- On hearing the emergency siren, rush to the scene with appropriate personal protective equipments
- Rescue all the effected persons.
- Search for casualties and evacuate non-essential person from spot.
- Arrange to send emergency case to hospitals.

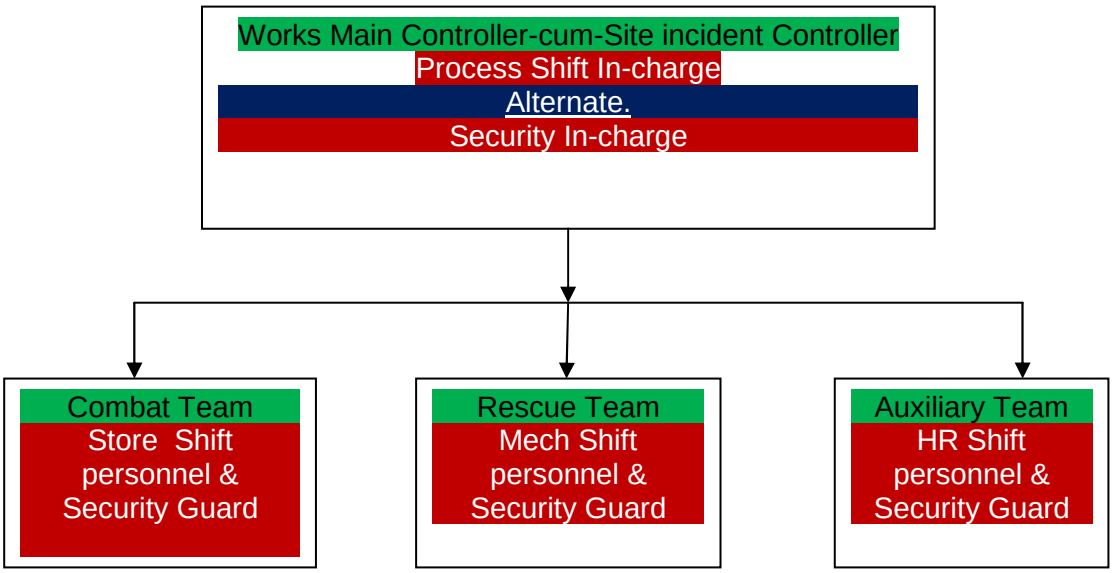
**12.7 AUXILIARY TEAM LEADER:**

- On hearing the emergency siren rush to the scene
- Ensure the arrival of his team members
- Intimate mutual-aider over phone
- Keeps the first-aid and primary health center staff, equipment ready to take care of immediate medical needs
- Takes care of victims' family
- Make all arrangement like transport, other needs, arrange finance
- Ensure all casualties are shifted to hospital for medical treatment
- Keep records of casualties and provide information of the matter to Works Main Controller

## 12.8 AUXILIARY TEAM MEMBERS:

- On hearing emergency siren, rush to the scene
- Carry out the orders of the team leader
- Provide immediate first-aid treatment to the victims
- Ensure ambulance vehicle ready
- Coordinate with combat team, rescue team, statutory authorities and mutual-aid partners
- Takes care of victims' family.

## 13.0 SILENT HOUR COMMAND STRUCTURE:




## 13.1 ROLE OF KEY PERSONS IN SILENT HOUR COMMAND STRUCTURE:

- Silent Hour is the time when General Shift people are not available
- The command structure for the silent hour shall be same as during normal hour, however, **during the silent hour the Shift In-charge / Security In-charge shall act as Works Main Controller-cum Site Incidence Controller , till the arrival of the Works Main Controller**
- **Works Main Controller-cum Site Incidence Controller (Silent Hour) shall inform** Works Main Controller, Site Incident Controller, Combat Team Leader, Rescue Team Leader and the Auxiliary Team Leader by telephone or by sending special messenger to their residences
- On receiving the information the Works Main Controller, Site Incident Controller, Combat Team Leader, Rescue Team Leader and Auxiliary Team Leader shall reach the site at the earliest and simultaneously Combat Team Leader, Rescue Team Leader and Auxiliary Team Leader shall ensure the presence of their respective team members
- Thereafter the action plan as well as the role of key persons shall be same as the normal hour execution of Command Structure

## 14.0 ACTION PLAN FOR ON-SITE EMERGENCY:

| STEP NO. | INITIATOR | ACTION TO TAKE |
|---|---|---|
| 1. | The person noticing the emergency | ➢ Inform the Security Gate and the concerned Shift-in-charge who in turn will inform Works Main Controller immediately regarding the fire hazard. |
| 2 | Works Main Controller (WMC) | ➢ On being informed, rush to the Emergency Control Room.<br>➢ Declare of emergency by blowing the siren in appropriate code **[intermittent three times with five seconds interval**]<br>➢ Make continuous review and assess the possible developments to determine the extent of damage to plant and human beings<br>➢ Shut-down the plant, if necessary<br>➢ Ensure that casualties are receiving adequate attention<br>➢ Liaise with the fire services, police services and other statutory authorities<br>➢ Declare closure of the emergency by blowing the siren [only once long siren for 30 seconds]<br>➢ Issue the authorized statements to the media services<br>➢ Report all statutory authorities in the prescribed manner<br>➢ Communicate to employees about the mishap, measures taken and giving confidence to employees for avoiding recurrence of the incident by investigation and ordering preventive measures to be implemented |
| 3. | Site Incident Controller (sic) | ➢ On hearing Emergency siren, rush to the scene and report to the Works Main Controller<br>➢ Make quick assess about the gravity of the situation and appraises Works Main Controller<br>➢ Extend all sorts of help through different agencies to minimize the damage to human beings, plant, property and environment<br>➢ Shutdown of Plant & Machinery<br>➢ Undertake continuous review of the situation time to time and appraise to Works Main Controller<br>➢ Provide the required information to the fire brigade team for fire fighting<br>➢ Preserve the evidences for the subsequent inquiries<br>➢ Make liaison between the various working teams.<br>➢ Extend all possible help needed during the Emergency. |
| 4 | Combat Team | ➢ On hearing Emergency siren, rush to the scene<br>➢ Shutdown the Plant and Machinery & Isolate the affected area.<br>➢ Arrange of Isolation of Electrical Power Supplier all around the affected area.<br>➢ Alert the entire employees through PA System<br>➢ Operating the fire fighting equipments and materials and also to shift to effected site |

| | | |
|---|---|---|
| 5. | Rescue Team | ➢ On hearing Emergency siren, rush to the scene<br>➢ Guide the non-essential persons to reach assembly point<br>➢ Search the missing person on the roll call basis<br>➢ Rescue all the effected persons.<br>➢ Search for casualties and evacuate non-essential person from spot. |
| 6. | Auxiliary Team | ➢ On hearing Emergency siren, rush to the scene<br>➢ Inform about the emergency to Statutory Authorities depending upon the situation.<br>➢ Shift the injured persons to hospital by ambulance after providing necessary first aid.<br>➢ Seek help of Mutual Aid Partners and Coordinate with Mutual Aid Partners to render their service if required.<br>➢ Arrange to inform the relatives of Casualties.<br>➢ Take care of visit of the authorities to the Emergency Site. |

## 15.0 ACTIVATION AND CLOSING PROCEDURE

⇒ **Anybody** notices FIRE, shout "FIRE, FIRE", "FIRE" and informs to Shift-in-charge [or Smoke detector indicates fire alarm installed in the emergency control room]

⇒ Being informed about fire, the **Shift-in-charge** informs **Works Main Controller** and **Site Incident Controller**

⇒ On hearing about the fire, Works Main Controller and Site Incident Controller rush to the scene and make quick assessment of the situation

⇒ On quick assessment of the situation, the Works Main Controller rush to the emergency control room and declare emergency by blowing appropriate siren code [**intermittent three times with five seconds interval**]

⇒ On hearing of Emergency siren the key personnel of Emergency Combat structure perform their duties and responsibilities as per the worksheet

⇒ During the emergency operation, the Works Main Controller keeps records of activities carried on, supervises overall, maintain liaison with mutual aiders, statutory authorities

⇒ After being controlled the situation, the Works Main Controller declares normalcy by blowing appropriate siren [30 seconds continuously]

**ANNEXURE-I**

**DETAILS OF FACILITIES AVAILABLE:**

**A. EMERGENCY CONTROL ROOM:**

- P&T phone - 01
- Wind direction and speed indicator- Top of the administrative building
- Windsock - Top of the administrative building
- Wallboard for fixing up drawings and drawing pins. Flip charts, drawing sheets and sketch pens
- Switch for actuating the siren, drinking water arrangement, tables, chairs, etc.
- Details of address and telephone numbers of key personnel of emergency command structure, statutory authorities and mutual aiders
- Worksheet of key personnel of emergency command structure
- Applicable siren code
- Safety manual
- List of emergency telephone numbers (external and internal)
- Local P & T telephone directories
- List of people working in the installation, location wise
- List of residential addresses of employees / contract workers and casual workers
- Red / Green flag – 6 nos. each

**B. ASSEMBLY POINTS:**

In an emergency, it will be necessary to evacuate people from the affected zones or the zones likely to be affected, to safe areas. The safe areas are identified and designated as Assembly Points (AP). The location of the assembly point is the vacant space shown in the Plot Plan. Arrangements for taking head count of persons, reconciling the head count with the attendance rolls, temporary shelter and further evacuation if necessary to safer place outside factory campus can be made.

**C. WIND SOCKS:**

During emergencies, the knowledge of exact wind direction helps the factory personnel to decide on the escape route to be taken for safe evacuation of personnel and also the safe assembly point and Emergency Control Centre. Therefore, the windsock is provided at the top of the administrative building for easy identification of the wind direction.

**D. COMMUNICATING THE EMERGENCY AND MEDICAL AID:**

For communicating the declaration of emergency and evacuation decision to the plant personnel, it is envisaged that the siren would be utilized.

| | | |
|---|---|---|
| Declaration of emergency | : - | Intermittent three times with 5 seconds interval |
| Normal factory siren | : - | Continuous for 20 secs. |
| All-clear signal | : - | Continuous for 30 seconds. |

## E. EMERGENCY MEDICAL ARRANGEMENT:-

⇒ The first-aid box is available in each department ; viz. main store, mechanical office , electrical office, control room, admin. office, PGP control room, grinding control room, automobile office, time office ,

⇒ First-aid boxes are maintained in each department

⇒ Adequate stock of essential medicines, bandages and other appliances are being maintained

## F. FIRE HYDRANT SYSTEM:

Fire Hydrant points are provided inside the plant as shown in plot plan. Fire hydrant hoses are 63mm. dia in size. Two motors of 55 kw having capacity of discharging water 180 $m^3$/hr are provided to main header to maintain a pressure of 7kg/$cm^2$. In case of temporary power failure, the fire pumps are run by DG. One water reservoir of capacity 3000 KL is supplying water to the fire main line .

## G. First Aid Centre:

One first aid room with facilities of oxygen fittings, stretchers, thermometer, first aid kits, blankets, kidney tray and a team of first aiders are available

## H. FIRE EXTINGUISHERS:

Required types of fire extinguishers have been provided at different locations of the plant as given below

| **Location of Equipment** | $CO_2$ Type | DCP Type | Foam Type | Fire bucket | **Remarks** |
|---|---|---|---|---|---|
| Ball Mill | 1 | 2 | 1 | 7 | At the time of Emergency any nos. of equipments can be used collecting from any place point as per requirement |
| Travelling Grate | 1 | 2 | 1 | 7 | |
| Filter Press | 1 | 2 | 1 | 7 | |
| DG room | 2 | 3 | 1 | 7 | |
| Diesel Tank area | 2 | 3 | 1 | 7 | |
| Control room | 2 | 2 | 1 | 8 | |
| Flux grinding | 2 | 2 | 1 | 7 | |
| Pump House | 1 | 2 | 1 | 7 | |
| Gasifier Control Room | 1 | 2 | 1 | 7 | |
| TOTAL | 13 | 20 | 09 | 64 | |

## J. SIREN:

Company has Siren/ hooter arrangement, which can be activated manually during fire related emergency.

## K. COMMUNICATION:

Public address system and EPABX telephone is available for effective communication inside the plant. Telephone directory is available in the entire department.

Hording

1. Wear only cotton/approved work clothes while on duty in the plant.
2. Don't resort to short cuts.
3. Don't attempt to operate any equipment to which you are not specifically assigned.
4. Don't use the defective equipments of any kind.
5. Use the PPE to work safely.
6. Insist your fellow workers to observe the safety rules.
7. Take instruction from your superior before starting any new works.
8. Report all injuries/dangerous occurrence to your superior.
9. Curing emergency be strictly guided by the emergency action plan.

ANNEXURE-II

**MUTUAL AID :**

| LIST OF MUTUAL AIDER DURING EMERGENCY | | | | |
|---|---|---|---|---|
| **Sl. No.** | **Name & Address of the mutual address** | **Distance from the factory** | **Contact Person with Tel. No.** | **Facilities available** |
| 1 | M/s. Shree Metaliks Ltd At-Anra, P.O- Suakati Dist-Keonjhar | 6 Km. | Mr. P.K.Palai, DGM 9437000640/07894 037640 | • Vehicle<br>• Fire extinguisher<br>• Trained first aider |

## MUTUAL AGREEMENT

Between M/ Ardent Steel Limited and M/s Sree Metaliks Limited

| | | | |
|---|---|---|---|
| 1 | Name of the Factory which will receive mutual Aid<br><br>M/s Ardent SteeL Limited<br>At/Po : Phuljhar, Via : Suakati<br>Dist : Keonjhar | 1 | Name of the Factory which will provide mutual Aid :<br><br>M/s Sree Metaliks Ltd.,<br>At /Po : Anra, Via : Suakati<br>Dist : Keonjhar |
| 2 | Hazards associated with the factory<br><br>Fire due to storage/handling of HSD, LDO ( Process oil ) & Transformer Oil | 2 | Hazards associated with the factory<br><br>Fire due to storage/handling of HSD, LDO ( Process oil ) & Transformer Oil |
| 3 | Facilities Available<br><br>Different type of Fire Extinguishers, Ambulance vehicle. | 3 | Facilities Available<br><br>Different type of Fire Extinguishers, Ambulance vehicle. |
| 4 | Facilities to be provided during emergency.<br><br>Fire Extinguisher, Ambulance, vehicle, trained First Aider. | 4 | Facilities to be provided during emergency.<br><br>Fire Extinguisher, Ambulance, vehicle, trained First Aider. |
| 5 | Contact person with designation and Mobile No.<br><br>Sri Balabhadra Prasad Yadav<br>Factory Manager<br>Mob : 9437076930 | 5 | Contact person with designation and Mobile No.<br><br>Sri Pradeep Kumar Palai<br>Factory Manager<br>Mob : 9437000640 |

For Ardent Steel Limited

Factory Manager

Signature of Occupier / Manager
With Seal

For SREE METALIKS LTD.

Factory Manager

Signature of Occupier / Manager
With Seal

**ANNEXURE-III**

## (A) DETAILS OF TELEPHONE NUMBERS OF KEY PERSONNEL

| TELEPHONE NUMBERS OF KEY PERSONS OF EMERGENCY COMMAND STRUCTURE | | | | |
|---|---|---|---|---|
| **Sl. No.** | **Name & Designation** | **Designation** | **Designation as per emergency command structure** | **Telephone Numbers** |
| 1. | Mr. Dillip Kumar Pany | Factory Manager | Works Main Controller | 8280826835 |
| 2. | Mr. Bibhuti Bhusan Bariki | Safety/IR/ADMN.) | Alternate Works Main Controller | 8282826804 |
| 3. | Mr.S,Ramesh | DGM (Elec) | Site Incident Controller | 8280826802 |
| 4. | Mr. Gyana Ranjan Mohanty | A.G.M Mechanical | Combat Team Leader | 8280826836 |
| 5. | Mr.Nrusingha Ch. Pradhan | Dy. Manager Mech. | Alternate Combat Team Leader | 8280826834 |
| 6. | Mr .Chitta Ranjan Sahoo | Manager Electrical | Alternate Rescue Team Leader | 8280826830 |
| 7. | Mr.Hrushikesh Lenka | Manager ( Q.C. ) | Auxiliary Team Leader | 8280826833 |
| 8. | Mr. Santosh Kumar Rout | Manager Store | Alternate Auxiliary Team Leader | 9437076413 |
| 9. | Mr. Narendra Kumar Behera | Asst. Manager (Q.C) | Alternate Rescue Team Leader | 8280826806 |

## (B) DETAILS OF TELEPHONE NUMBERS OF STATUTORY AUTHORITY

| Sl.No. | AUTHORITY | ADDRESS | TELEPHONE NUMBER |
|---|---|---|---|
| 1 | District Collector, | Keonjhar | 06766 - 255482 |
| 2 | Addl. District Magistrate, | Keonjhar | 06766 –255401 |
| 3 | District Fire Officer, | Keonjhar | 9437350983 |
| 4 | Chief District Medical Officer, | Keonjhar | 06766-255525 |
| 6 | Police Station, | Keonjhar | 9437369955 / 100 |
| 7 | Nearest Hospital | Keonjhar | 06766-255525 |
| 8 | Nearest Fire Station | Keonjhar | 9437350983 |
| 9 | Director of Factories & Boilers, Odisha | Bhubaneswar | 0674-2396070 |
| 10 | Asst. Director of Factories & Boilers, | Keonjhar | 9437290384 |

## ANNEXURE-IV

### MATERIAL SAFETY DATA SHEET FOR HIGH SPEED DIESEL

| | | |
|---|---|---|
| 1. | Physical State | Liquid |
| 2. | Colour | Straw red |
| 3. | Specific Gravity | 0.86 |
| 4. | Flash Point ℃ | 66 |
| 5. | Boiling Point ℃ | 149 |
| 6. | Auto ignition Temperature ℃ | 256 |
| 7. | Vapour Pressure | < 1 mm |
| 8. | Solubility | NO |
| 9. | Explosive Limit (% Volume in air) | 5 – 7 |

### A. POTENTIAL HEALTH EFFECTS

- **Inhalation:** - Irritation of the upper respiratory tract and eyes, with possible euphoria, dizziness, headache, dis co-ordination, ringing in the ears, convulsions, coma, and respiratory arrest.
- **Ingestion: -** Irritation of the mucous membranes of throat, esophagus and stomach which may result in nausea and vomiting; central nervous system depression may occur, if absorbed (see inhalation symptoms above). If aspirated, chemical pneumonitis may occur with potentially fatal results. Possible kidney and liver damage may be delayed.
- **Skin Contact:** - Defeating of the skin may occur with continued and prolonged contact. Irritation and burning sensation may occur on exposure to the liquid or mists.
- **Eye Contact:** - Severe burning sensation with temporary irritation and swelling of lids.

## B. FIRSTAID MEASURES

- **Inhalation:** Get person out of contaminated area to fresh air. !f breathing has stopped resuscitate and administer oxygen if readily available. **SEEK MEDICAL ATTENTION IMMEDIATELY.**
- **Ingestion:** Never give anything by mouth to an unconscious person. If swallowed, do not induce vomiting. If vomiting occurs spontaneously, keep airway clear. SEEK MEDICAL ATTENTION IMMEDIATELY.
- **Skin Contact:** - Wash contaminated areas with plenty of soap and water. A soothing ointment may be applied to irritated skin after thoroughly cleansing. Remove contaminated clothing and footwear.
- **Eye Contact:** - Immediately flush eyes with large amount of water for at least 15 minutes holding lids apart to ensure flushing of the entire eye surface. **SEEK IMMEDIATE MEDICAL ATTENTION.**
- **Note to Physician:** Do not induce vomiting, use gastric lavage only. Aspiration of liquid into the lungs could result in Chemical pneumonitis. Use of adrenaline is not advised. Treat symptomatically.

## C. FIRE FIGHTING MEASURES

- Fire Fighting Instructions:- Use water fog, C02, foam, dry chemical or Halon to extinguish. Keep personnel removed from and up-wind of fire. Cool adjacent structures and storage drums with water spray. Evacuate area. Prevent runoff from fire control dilution from entering streams or drinking supply.

## D. HANDLING AND STORAGE

- Store only in approved containers. Protect containers against physical damage. Outside or detached storage is preferred. Separate from oxidizing materials. Store in cool, well ventilated area of non-combustible construction away from possible sources of ignition. Keep away, from incompatible materials.
- **Product Use:** This product is intended for use as a fuel in engines and heaters designed for kerosene or diesel fuels, and for use in engineered processes. Use in other applications may result in higher exposure; and require additional controls, such as local exhaust ventilation and personal protective equipment.

## E. PERSONAL PROTECTION

- **Airborne Exposure Limits:** None established.
- **Ventilation System:** Not expected to require any special ventilation.
- **Personal Respirators:** Respiratory protection is not required unless product is sprayed or heated. Use approved respiratory protection following manufacture's recommendations where spray, mists, or vapors may be generated. Supplied air respiratory protection is required for IDLH (immediately dangerous to life and health) areas.
- **Skin protection:** Wear protective glove and clean body-covering clothing.
- **Eye protection:** Face shield and goggles or chemical goggles should be worn where mist or spray may be generated, and where splashing occurs. Shower and eyewash facilities should be accessible.

## F. ACCIDENTAL RELEASE MEASURES

- If material is spilled, steps should be taken to contain liquid and prevent discharges to streams or sewer systems and control or stop the loss of volatile materials to the atmosphere. Spills or releases should be reported, if required to the appropriate local, state and federal regulatory agencies.
- **Small Spills:** Remove ignition sources. Absorb spilled material with non-combustible materials such as cat litter, dirt, sand, or petroleum as sorbent pads/pillows. Do not use combustible materials like rags, wood chips, or saw dust. Remove contaminated materials to an appropriate disposal container.
- **Large Spills:** Remove ignition sources. Dike spill area with sand or dirt to contain material and cover sewers/drains. Remain upwind and keep unnecessary people away. Contact trained emergency response team for cleanup. Remove liquid using grounded suction pumps, isolate hazard area and deny entry.

## G. TRANSPORTATION

- It is transported as combustible liquid following the transport rules of hazardous chemicals.

## MATERIAL SAFETY DATA SHEET

## DURALIFE® TRANSFORMER OIL- ALL GRADES

MSDS Number : 12038

**1. PRODUCT AND COMPANY IDENTIFICATION Revision Date : 8/09/2010**

Product Name : DURALIFE® TRANSFORMER OIL- ALL GRADES

**2. HAZARDS IDENTIFICATION:**

IMMEDIATE HEALTH EFFECTS:

**EYE**: Not expected to cause prolonged or significant eye irritation.

**SKIN**: Contact with the skin is not expected to cause prolonged or significant irritation. Not expected to be harmful to internal organs if absorbed through the skin.

**INGESTION:** Not expected to be harmful if swallowed.

**INHALATION:** This product is not expected to pose an inhalation hazard under conditions of normal use. This product has a low vapor pressure and is not expected to present an inhalation hazard at ambient conditions. Caution should be taken to prevent aerosolization or misting of this product. Acute and chronic overexposures generated under unusual conditions may be irritating to the respiratory tract.

**3. FIRST AID INFORMATION:**

**EYE CONTACT:** Immediately flush eyes with large amounts of water and continue flushing until irritation subsides. If material is hot, treat for thermal burns and seek immediate medical attention.

**SKIN CONTACT:** No treatment is necessary under ordinary circumstances. Remove contaminated clothing. Wash contaminated area thoroughly with soap and water. If material is hot, submerge injured area in cold water. If victim is severely burned, move to a hospital immediately.

**INHALATION:** This material has a low vapor pressure and is not expected to present an inhalation exposure at ambient conditions. If vapor or mist is generated when the material is heated, and the victim experiences signs of respiratory tract irritation, remove to fresh air.

**INGESTION:** No treatment is necessary under ordinary circumstances. Do not induce vomiting. This material does not present any known ingestion hazard.

**4. FIRE AND EXPLOSION INFORMATION:**

**Flammable Properties:**

**Flash Point : > 293 $^{o}$F ( 145 $^{o}$C)** Test Method : ASTM D 92 (C.O.C.)

Flammable Limits in Air

Upper Percent: NA

Lower Percent: NA

**Auto-ignition Temperature: > 270 $^{o}$C**

Test Method: NA

NFPA Classification: Health: 0 Flammability: 1 Reactivity: 0

**Extinguishing Media:** Use dry chemical, foam, or carbon dioxide.

Fire Fighting Measures

**Special Fire Fighting Procedures and Equipment:** Water may be ineffective but can be used to cool containers exposed to heat or flame to prevent vapor pressure buildup and possible container rupture. Caution should be exercised when using water or foam as frothing may occur, especially if sprayed into containers of hot, burning liquid.

**Unusual Fire and Explosion Conditions:** Dense smoke may be generated while burning. Carbon monoxide, carbon dioxide, and other oxides may be generated as products of combustion.

**Hazardous Combustion By-Products:** None

**5. ACCIDENTAL RELEASE MEASURES:**

**Protective Measures:** Eliminate all sources of ignition in vicinity of spilled material.

**Accidental Release Measures:** Stop the source of the leak or release. Clean up releases as soon as possible, observing precautions in Exposure Controls/Personal Protection. Contain liquid to prevent further contamination of soil, surface water or ground-water. Clean up small spills using appropriate techniques such as sorbent materials or pumping. Where feasible and appropriate, remove contaminated soil.

**6. HANDLING AND STORAGE INFORMATION:**

Handling : Fire extinguishers should be kept readily available.

**STORAGE :** Do not transfer to unmarked containers. Store in closed containers away from heat, sparks, open flame, or oxidizing materials. See also additional information section below.

**Empty Container Warnings**

**DRUMS:** Empty drums should be completely drained, properly bunged and promptly returned to a reconditioned drum, or properly disposed. Empty containers retain product residue and can be dangerous.

**PLASTIC:** Do not reuse this container. Empty container may retain product residues.

## 7. EXPOSURE CONTROLS/PERSONAL PROTECTION:

Exposure Limits and Guidelines: This product does not contain any components with OSHA or ACGIH exposure limits.

**Personal Protective Equipment**

**EYE/FACE PROTECTION:** No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields as good safety practice.

**SKIN PROTECTION:** No skin protection is required for single, short duration exposures. For prolonged or repeated exposures, use impervious clothing (boots, gloves, aprons, etc.) over parts of the body subject to exposure. If handling hot material, use insulated protective clothing (boots, gloves, aprons, etc.). Launder soiled clothes. Properly dispose of contaminated leather articles including shoes, which cannot be decontaminated.

**RESPIRATORY PROTECTION:** Respiratory protection is not required under conditions of normal use. If vapor or mist is generated when the material is heated or handle, use an organic vapor respirator with a dust and mist filter. All respirators must be NIOSH certified. Do not use compressed oxygen in hydrocarbon atmospheres.

**PERSONAL HYGIENE:** Always wash hands and face with soap and water before eating, drinking, or smoking. Consumption of food and beverage should be avoided in work areas where this product is present.

**ENGINEERING CONTROL/WORK PRACTICES:** Use in a well-ventilated area. If user operations generate an oil mist, use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below the recommended mineral oil mist exposure limits.

## 8. PHYSICAL AND CHEMICAL PROPERTIES:

**Appearance:** Bright Yellow Pour Point : < -40 oF (- 40 oC)

**Odor:** Petroleum – mild Solubility in Water: Negligible in water

**Physical State:** Liquid Vapor Pressure : < 0.1 mm Hg

**Boiling Point:** > 482 oF (250 oC) Vapor Density (air=1): NA

**Melting Point:** -59.8 oF(-51 oC) pH : NA

**Specific Gravity:** < 1 Viscosity @ 40 oC: 12 c St m

## 9. STABILITY AND REACTIVITY INFORMATION:

**Chemical Stability:** : Stable

**Condition to Avoid:** High heat and open flames

**Incompatible Materials to Avoid:** May react with strong oxidizing agents

**10. TOXICOLOGICAL INFORMATION:**

| | | |
|---|---|---|
| **Primary Eye Irritation** | : | NA |
| **Primary Skin Irritation** | : | NA |
| **Acute Dermal Toxicity** | : | NA |
| **Subacute Dermal Toxicity** | : | NA |
| **Dermal Sensitization** | : | NA |
| **Inhalation Toxicity** | : | NA |
| **Oral Toxicity** | : | NA |
| **Mulagenicity:** | : | NA |

**11. DISPOSAL INFORMATION:**

**Regulatory Information:** All disposals must comply with federal, state, and local regulations. The material, if spilled or discarded, may be a regulated waste. Refer to state and local regulations. Department of Transportation (DOT) regulations may apply for transporting this material when spilled

**Waste Disposal Methods:** Waste material may be land filled or incinerated at an approved facility. Materials should be recycled if possible.

**12. TRANSPORTATION INFORMATION:**

**Highway / Rail (Bulk):** Not Regulated

**Highway / Rail (Non-Bulk):** Not Regulated

The DOT description is provided to assist in the proper shipping classification of this product and may not be suitable for all shipping descriptions .Health and Environmental Label Language

**CAUTION:** Contains Petroleum Lubricant. Repeated skin contact can cause skin disorders.

**ATTENTION:** Used motor oil is a possible skin cancer hazard based on animal data. Repeated

Exposure to oil mist in excess of the OSHA limit (5mg/m3) can result in accumulation of oil

Droplets in pulmonary tissue.

**PRECAUTIONARY MEASURES:** Avoid excessive & prolonged skin contact. Wash thoroughly after handling. Avoid generation and inhalation of oil mists.

**INSTRUCTIONS IN CASE OF FIRE OR SPILL :** In case of fire, use water spray, foam, dry chemical or carbon dioxide. Water spray may be ineffective, but can be used to cool containers. In case of spill, do not use water, soak up with absorbent material.

ANNEXURE - 7

**PLANTATION STATUS OF M/S ARDENT STEEL LIMITED UNDER JURISDICTION OF REGIONAL OFFICE, SPCB, KEONJHAR UPTO 2014-15**

| Sl.No | Name & Addressd of the Industry/Mines | Total Area acquired by the Industry ( Hecters) | Plantation till the year 2011-12 (nos) | Plantation till the year 2012-13 (nos) | Plantation till the year 2013-14 (nos) | Plantation till the year 2014-15 (nos) | Total Plantation ( Nos ) | Area covered under plantation during the year 2011-12 (Ha) | Area covered under plantation during the year 2012-13 (Ha) | Area covered under plantation during the year 2013-14 (Ha) | Area covered under plantation during the year 2014-15 (Ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (a) | (b) | ( c) | ( d) | (e) | (f) | (f) | (g) | (h) | (i) |
| 1 | ARDENT STEEL LIMITED PLOT NO.208, NEW COLONY, JAMUHATA, KEONJHAR | 18.63 | 950 | 1150 | 1800 | 2500 | 6400 | 1.5 Ac | 2.0 Ac | 3.0Ac | 4.0 Ac |

| Total Area covered under plantation Ha) | Name & Address of the Agency /Source of tree saplings | Plantation in other area, if any ( excluding plant premises /mine lease hold area) |
|---|---|---|
| (j) | (k) | (l) |
| 10.5 Ac or 4.2 Ha | Sankar Nursery, Keonjhar | NIL |

KEONJHAR

Signature

**ANNEXURE - 8**

## EXPENDITURE UNDER CSR IN LAST 5 YEARS

| Sl. No. | Description | Expense Approx. Rs. |
|---|---|---|
| 1. | Village Road Work | 4,30,31,641 |
| 2. | Electrification Works | 32,62,340 |
| 3. | Water Supply | 73,72,000 |
| 4. | Ambulance Facility | 19,40,681 |
| 5. | Health Services | 13,90,000 |
| 6. | Training & Education | 11,25,000 |
| 7. | Puja / Religious Festivals / Sports / Cultural Programme etc. | 17,40,382 |
| | **Total** | **5,98,62,044** |

**ANNEXURE – 9**

## PROJECTED PLAN OF CSR ACTIVITIES FRO 5 YEARS

| DURING THE YEAR 2016-17 | | | | |
|---|---|---|---|---|
| S/N | **Details of Projects/activities under taken** | **Present Status** | **Fund utilised during the year for periphery development & CSR activities** | **Field** |
| 1 | Free medicines for (Anti cholera, viral fever, acidity, & etc) are regularly being provided to the people of village Phuljhar & nearby villages, through our experienced pharmacist. | Completed | 312280.00 | Health |
| 2 | Water tankers are dedicated to villagers for providing drinking waters. | Completed | 1378000.00 | Sanitation |
| 3 | Puja/Religious Festivals / Cultural Programme etc: Ardent Steel co-ordinates with different peoples of area and tries to promote their various cultural programmes & futher cop up with them in similar activities to an extent. | Completed | 346821.00 | Religious |
| 4 | Ambulance Facility : Expenses of Ambulance vehicle for the villagers of this area as a means of conveyance from village Phuljhar to Keonjhar Hospital | Completed | 295800.00 | Health |
| 5 | Training & Education: Numbers of teachers have been sponsored to various schools of nearby villages by Ardent Steel Management. | Completed | 365400.00 | Education |
| 6 | Promotion of sports activities to the students of the nearby area | Completed | 37595.00 | Skill Development |

| DURING THE YEAR 2017-18 | | | | |
|---|---|---|---|---|
| S/N | **Details of Projects/activities under taken** | **Present Status** | **Fund utilised during the year for periphery development & CSR activities** | **Field** |
| 1 | Free medicines for (Anti cholera, viral fever, acidity, & etc) are regularly being provided to the people of village Phuljhar & nearby villages, through our experienced pharmacist. | Continuing | 3,20,000.00 | Health |
| 2 | Water tankers are dedicated to villagers for providing drinking waters. | Continuing | 1,38,0000.00 | Sanitation |
| 3 | Puja/Religious Festivals / Cultural Programme etc: Ardent Steel co-ordinates with different peoples of area and tries to promote their various cultural programmes & futher cop up with them in similar activities to an extent. | Continuing | 346821.00 | Religious |
| 4 | Ambulance Facility : Expenses of Ambulance vehicle for the villagers of this area as a means of conveyance from village Phuljhar to Keonjhar Hospital | Continuing | 285800.00 | Health |
| 5 | Training & Education: Numbers of teachers have been sponsored to various schools of nearby villages by Ardent Steel Management. Youth of the area are given training in various trades like welding, fitting and air conditioning | Continuing | 3,50,000.00 | Education |
| 6 | Promotion of sports activities to the students of the nearby area | Continuing | 40,595.00 | Skill Development |

| DURING THE YEAR 2018-19 | | | | |
|---|---|---|---|---|
| S/N | **Details of Projects/activities under taken** | **Present Status** | **Fund utilised during the year for periphery development & CSR activities** | **Field** |
| 1 | Free medicines for (Anti cholera, viral fever, acidity, & etc) are regularly being provided to the people of village Phuljhar & nearby villages, through our experienced pharmacist. | To be carried out | 3,20,000.00 | Health |
| 2 | Water tankers are dedicated to villagers for providing drinking waters. De-silting of ponds in nearby villages | To be carried out. | 15,80,000.00 | Sanitation |
| 3 | Puja/Religious Festivals / Cultural Programme etc: Ardent Steel co-ordinates with different peoples of area and tries to promote their various cultural programmes & futher cop up with them in similar activities to an extent. | To be carried out | 50,000.00 | Religious |
| 4 | Ambulance Facility : Expenses of Ambulance vehicle for the villagers of this area as a means of conveyance from village Phuljhar to Keonjhar Hospital | To be carried out. | 3,00,000.00 | Health |
| 5 | Training & Education: Numbers of teachers have been sponsored to various schools of nearby villages by Ardent Steel Management. Youth of the area are given training in various trades like welding, fitting and air conditioning | To be carried out. | 3,50,000.00 | Education and skill development |
| 6 | Repair of Village Roads of adjacent villages-Phuljhar, Rangamatia,Andhari Khamam | To be carried out | 4,50, 000 | Infrastructure development |
| 7 | Plantation by the side of roads and provision of lighting facility in the villages | To be carried out | 2,50,000 | Infrastructure development |
| 8 | Promotion of sports activities to the students of the nearby area | To be carried out. | 40,595.00 | Skill Development |

| DURING THE YEAR 2019-20 | | | | |
|---|---|---|---|---|
| S/N | **Details of Projects/activities under taken** | **Present Status** | **Fund utilised during the year for periphery development & CSR activities** | **Field** |
| 1 | Free medicines for (Anti cholera, viral fever, acidity, & etc) are regularly being provided to the people of village Phuljhar & nearby villages, through our experienced pharmacist. | To be carried out | 3,30,000.00 | Health |
| 2 | Water tankers are dedicated to villagers for providing drinking waters.<br>De-silting of ponds in nearby villages | To be carried out. | 15,90,000.00 | Sanitation |
| 3 | Puja/Religious Festivals / Cultural Programme etc: Ardent Steel co-ordinates with different peoples of area and tries to promote their various cultural programmes & futher cop up with them in similar activities to an extent. | To be carried out | 50,000.00 | Religious |
| 4 | Ambulance Facility : Expenses of Ambulance vehicle for the villagers of this area as a means of conveyance from village Phuljhar to Keonjhar Hospital | To be carried out. | 3,00,000.00 | Health |
| 5 | Training & Education: Numbers of teachers have been sponsored to various schools of nearby villages by Ardent Steel Management. Youth of the area are given training in various trades like welding, fitting and air conditioning | To be carried out. | 3,50,000.00 | Education and skill development |
| 6 | Repair of Village Roads of adjacent villages-Phuljhar, Rangamatia,Andhari Khamam | To be carried out | 4,50, 000 | Infrastructure development |
| 7 | Plantation by the side of roads and provision of lighting facility in the villages | To be carried out | 2,50,000 | Infrastructure development |
| 8 | Promotion of sports activities to the students of the nearby area | To be carried out. | 45,000.00 | Skill Development |

| DURING THE YEAR 2019-20 | | | | |
|---|---|---|---|---|
| S/N | **Details of Projects/activities under taken** | **Present Status** | **Fund utilised during the year for periphery development & CSR activities** | **Field** |
| 1 | Free medicines for (Anti cholera, viral fever, acidity, & etc) are regularly being provided to the people of village Phuljhar & nearby villages, through our experienced pharmacist. Health camps to be conducted by experienced doctors | To be carried out | 4,10,000.00 | Health |
| 2 | Water tankers are dedicated to villagers for providing drinking waters.<br>De-silting of ponds in nearby villages | To be carried out. | 15,90,000.00 | Sanitation |
| 3 | Puja/Religious Festivals / Cultural Programme etc: Ardent Steel co-ordinates with different peoples of area and tries to promote their various cultural programmes & futher cop up with them in similar activities to an extent. | To be carried out | 60,000.00 | Religious |
| 4 | Ambulance Facility : Expenses of Ambulance vehicle for the villagers of this area as a means of conveyance from village Phuljhar to Keonjhar Hospital | To be carried out. | 3,00,000.00 | Health |
| 5 | Training & Education: Numbers of teachers have been sponsored to various schools of nearby villages by Ardent Steel Management. Youth of the area are given training in various trades like welding, fitting and air conditioning | To be carried out. | 3,50,000.00 | Education and skill development |
| 6 | Repair of Village Roads of adjacent villages-Phuljhar, Rangamatia,Andhari Khamam | To be carried out | 4,50, 000 | Infrastructure development |
| 7 | Plantation by the side of roads and provision of lighting facility in the villages | To be carried out | 2,50,000 | Infrastructure development |
| 6 | Promotion of sports activities to the students of the nearby area | To be carried out. | 45,000.00 | Skill Development |

**ANNEXURE - 10**

## Environment Policy of the Company:

### ENVIRONMENTAL POLICY

At Ardent Steels Ltd, preservation and promotion of environment is of elemental concern in all its business activities. Ardent Steels Ltd, having a foremost roll in delivering unswerving and quality products and services to all consumers at competitive cost is cognizant of its accountability towards creating, conserving and ascertaining safe and clean environment for sustainable progress.

- The company is devoted to accomplish excellence in environmental performance and towards achieving these objectives, the company shall:
- Espouse appropriate operational practices and suitable technologies to monitor, control and diminish the impact of its activities on environment.
- Commitment to continual improvement in EMS & prevention of Pollution.
- Incessantly improve its environmental performance by setting objectives and targets to thwart or reduce pollution; waste and minimize of resources.
- Act in accordance with all relevant legislative, Regulatory and other environmental requirements.
- Expand and uphold a vastly goaded work force qualified for efficient administration of environment and emergency state of affairs.
- Afford pertinent information of environmental policy to the concern authorities and interested parties ensuring that the policy is implicitly executed and upheld by employees at all levels within the group.
- Assess and transform environmental management practices keeping in view regulatory and other requirements, community concerns and technological advancements.
- Safeguard natural resources by their responsible and competent use in all the operations.
- Plant trees, develop green belt and endorse lush green surroundings at our generating locations and establishments to work in synchronization with nature; and
- Formulate this policy accessible to the community.

**- Director -**

This policy shall be regularly reviewed and made available to all interested parties.

M/s Ardent Steels Ltd.
At: Village Phuljhar,Block-Bansapal, Dist: Keonjhar
Odisha.

# SAFE OPERATING PROCEDURE

**SUBMITTED BY**

M/s. Ardent Steel Limited.
At/PO: Phuljhar, Via: Suakati,
Dist.: Keonjhar, Odisha.

**1. General:**

i.) After appointment the plant operators are importance with orientation and intensive training for specific plants. Experienced technical personnel help the operating staff in giving on the job training in the beginning.

ii.) All operators are instructed to ensure before the start-up of the plant that safety guards of running equipments are in position.

iii.) The operating personnel are advised not to wear loosely fitting clothes.

iv.) The shift-in-charge before starting a machine needs to ensure that the machine is not under maintenance and that the safety work permit issued for the machine has been cancelled and safety tag removed.

v.) All operating personnel shall put on safety shoes / helmets and other safety appliances. Welders shall wear face shields /goggles while carrying welding jobs.

vi.) In order to ensure equipment safety all trips and alarm systems of the machine as well as indicators should be in working order.

vii.) All the operating personnel should follow the starting and stopping sequence as detailed in the plant operation manual.

viii.) On-site Emergency Plan (OSEP) of the Company has been prepared and mock-drills are conducted once in six months. Operating personnel shall go through the OSEP and be aware of the assembly points, escape routes, Emergency Control Room, All exit gates etc.

ix.) The operating personnel should study the material safety data sheet of the materials handled in their section and safe handling procedure of the materials.

x.) All operating personnel shall go through the operation manual of their respective sections and work accordingly.

## 2. Safe operating Procedure for Conveyors

i.) Ensure that all personnel are equipped with the correct Personal Protection Equipment (PPE) relevant to the task and work area. Using PPE shall be strictly monitored by the appropriate safety officer.

ii.) Ensure that all STOP/START and emergency controls are clearly marked and that maintenance staff are familiar with the location of these safety systems.

iii.) Keep the area around the belt clean and tidy and apply good housekeeping practices to minimize potential hazards.

iv.) Lock out, isolate and tag all areas before working on any part of the conveyor. Do not climb on, over or crawl under any conveyor

v.) The only action that can be undertaken with the belt in motion is tracking of the belt.

vi.) In case of any emergency the operators are trained to stop the unit by using pull cord switch and intimate the position to shift Supervisor/ Engineer by Public Address System.

vii.) Ensure that pre-start alarm is working correctly and if not, isolate the conveyor and request that it be repaired.

viii.) Activate pre-start warning before starting a conveyor system

ix.) Start the conveyors sequentially

x.) For emergency stopping use the pull cord or stop switch or stop from control station

xi.) A stop/start station is a control device and should not be considered a lock out of the conveyor power source.

xii.) Conveyors in a conveyor system are often interlocked. Verify that the inter lock is working before start up.

- *Basic Check List Prior to Re-starting a Conveyor*

  Ensure that:
  - ✓ nobody is working on the belt;
  - ✓ guards have been re-fitted and that all the safety interlocks are operational;
  - ✓ the area is clean and clear of equipment and /or debris or spillages;
  - ✓ all the fire fighting and fire suppression devices and equipment are in place and operational;
  - ✓ all clamps are removed or released;
  - ✓ the take-up system is operational.
  - ✓ Belt alignment systems are working properly

The safe operation of pellet plant and gasifiers will be carried out as per the operation manual provided to operating personnel.

**3. Starting the Plant Operation:**

i.) Shift supervisor and Engineer to check up and ensure that the operators are properly dressed with safety appliances like helmet, safety boot etc.

ii.) Shift Engineer and Supervisor to ensure that no maintenance work is going by checking the shut down register. He will also interact with the maintenance Engineer about the plant position.

iii.) On being assured that the plant is ready for operation, the Main Control Desk (MCD) operator will be instructed by the Shift Engineer / Supervisor to blow the starting siren.

iv.) The plant Control Desk (CD) operator will ensure by public address system about the positioning of the different floor operators. The Control Desk (CD) operator then will blow the plant siren indicating that the plant will be started soon. The Control Desk (CD) operator starts the plant sequence wise one by one till plant feed belt is started. He will then inform the Main Control Desk (MCD) operator that the plant operation is ON, hence CHP operation may be started.

v.) Main Control Desk (MCD) operator will below the CHP operation siren indicating that CHP is going to be put in operation. Afterwards Main Control Desk (MCD) operator will start CHP units sequence wise one by one till the last raw coal receiving belt conveyor / feeder is put to operation.

Supervisor at feeding point is instructed by Main Control Desk (MCD) operator by Public Address (PA) system to start feeding coal to receiving hoppers.

**4. Stopping the Plant Operation:**

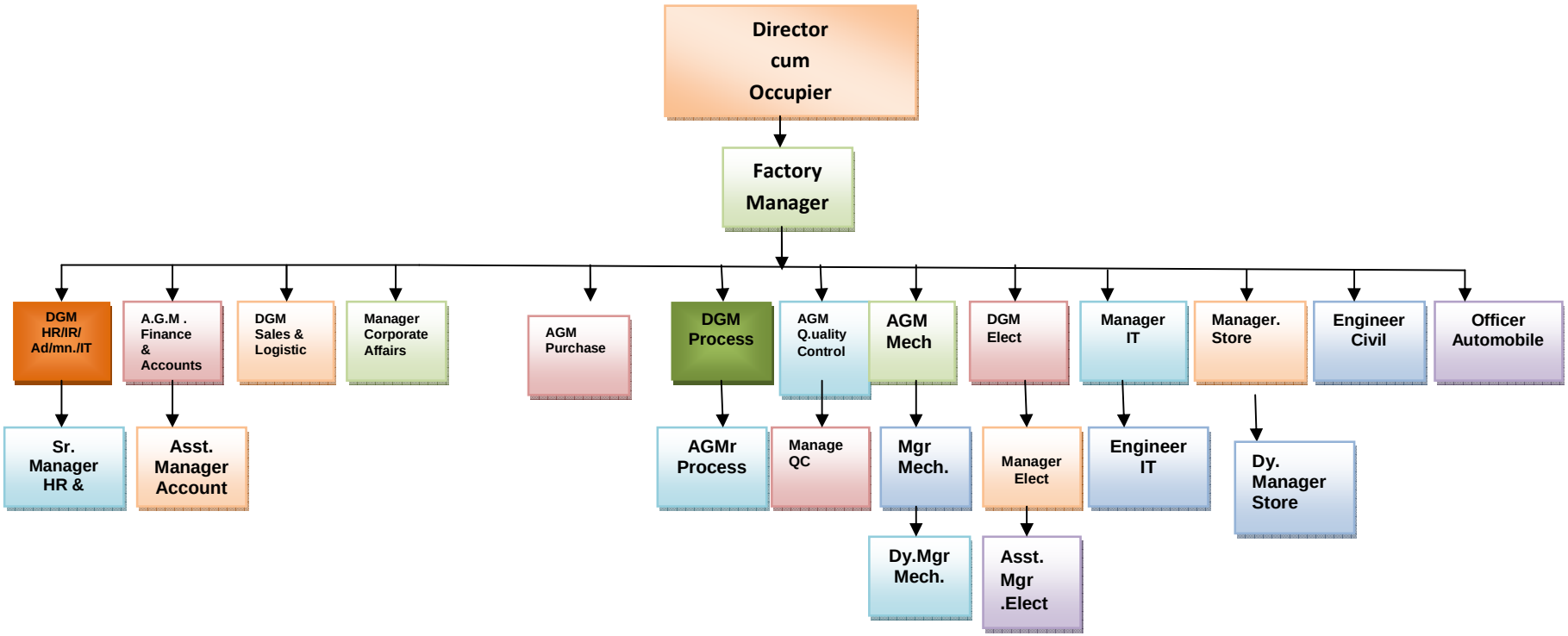
i.) At the end of the operation shift the plant/machineries are to be stopped sequence wise one by one the Main Control Desk (MCD) operator.

ii.) Before commencement of stopping procedure the Main Control Desk (MCD) operator will ensure that all the loaded tippers at the receiving pit is unloaded and the hoppers are emptied as well all belt conveyors are also emptied. Before the beginning of the stopping procedure it will announced in Public Address (PA) system. Afterwards plant units will be stopped one by one in reverse sequence by Main Control Desk (MCD) operator.

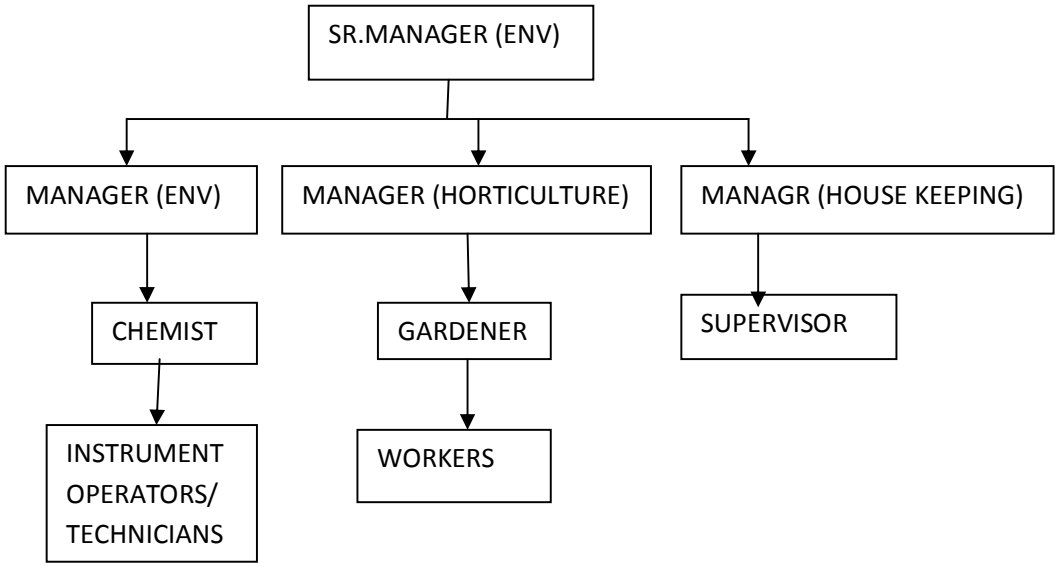
iii.) After total stoppage of plant operation the shift supervisor will announce in Public Address (PA) system came out of their duty places.

**ANNEXURE – 12**

## ORGANISATIONAL SET UP:



## ORGANISATIONAL SET UP OF ENVIRON MANAGEMENT CELL (EMC):




The environmental cell of the company is headed by a Sr. Manager. The responsibility of the cell would include the following:

1. Stack Emission monitoring and reporting of non-compliance to Factory Manager.
2. Ambient Air Quality monitoring and reporting of non-compliance to Factory Manager.
3. Monitoring of Waste water quality, Waste Water Management Practice, performance efficiency of ETP and reporting of non-compliance to the Factory manager.
4. Monitoring of noise level in the work place as well as the adjoining area and reporting of non-compliance to the Factory manager.
5. Monitoring of progress of various environmental programmes that may taken at times to ensure and preserve the environmental status of the area.
6. Arrange for Checking up the occupational health of the employees and health of people in the adjoining areas and maintaining records thereof. Pursue redressal action to ensure upkeep of health of affected people.
7. Monitor plantation activities for Green belt development and report to Factorymanager regarding the progress.

**ANNEXURE – 13**

## SYSTEM OF REPORTING OF NON-COMPLIANCE/VIOLATION ENVIRONMENTAL NORMS, TO THE BOARD OF DIRECTORS OF THE COMPANY AND/OR STAKEHOLDERS OR SHAREHOLDERS

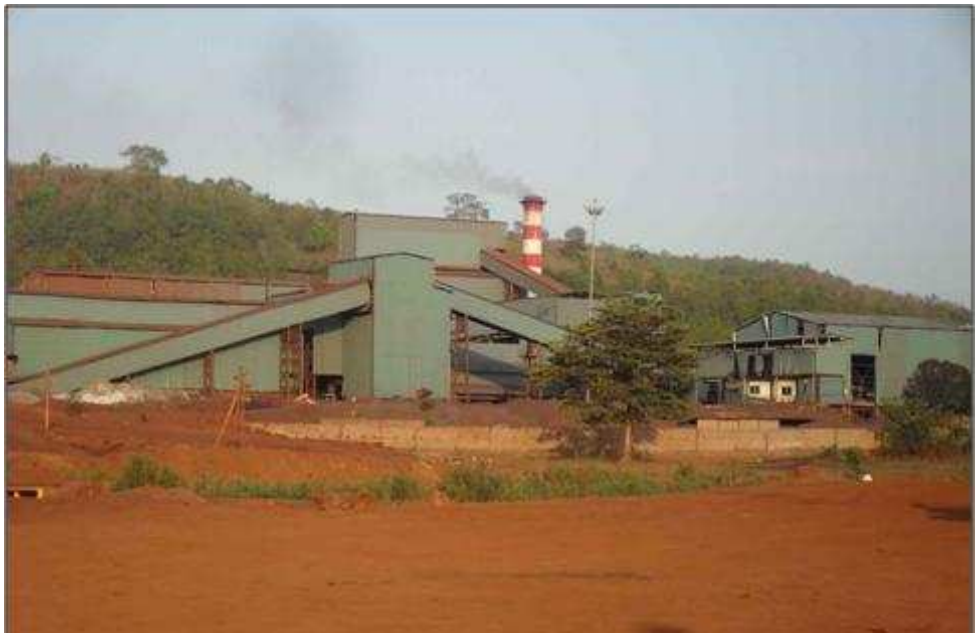
- For checks and balances, Factory Manager & Sr. Manager (Environment) of M/s ASL or their representatives will visit the sites for compliances of environmental norms on regular basis.
- In normal course, Laboratory in charge will report the Environment Manager about non-compliances/ violations of environmental norms who will in turn report to the Manger (EnV), Sr. Manager (ENV).Factory Manager will be finally informed if the bottle neck is not removed at lower level.
- Factory Manager will report such non-compliances/violations to the Executive Director of the project.
- Non-compliance will be discussed in the meeting of the HoD's and action to be taken for redressal will be communicated.
- Sr. Manager (Env) along with Environment Manager will make routine field visit to verify the efficacy of pollution control measures.
- Factory Manager will put up matters relating to non-compliance if such issues are not solved at his level to the Executive Director of the project. .The Executive Director may raise the issues in the Board of Directors' meeting depending on the merit ,if required,
- Half yearly compliance report of Environmental Clearance conditions of the project will be submitted to the Regional officer MoEFCC at Bhubaneswar.
- Due effort will be made to implement any point pertaining to environment raised by MoEF/ State Pollution control Board.

ANNEXURE - 14

# REPORT

ON

# GROUND WATER CONDITION AND PROPOSAL ON RAIN WATER HARVESTING & ARTIFICIAL RECHARGE



FOR

## *M/S ARDENT STEEL LIMITED*

**At: Village Phuljhar, Block: Bansapal, District: Keonjhar, Odisha.**

**JUNE 2018**


**Centre For Envotech and Management Consultancy Pvt. Ltd.**

AN ISO: 9001: 2008 and BS OSHAS 18001: 2007 certified company,
Empanelled with OCCL, Govt. Of Odisha, OSPCB as Category "A" Consultant Organization,

Accredited by NABET, Quality Council of India for EIA studies
As Category "A" Consultant Organization.

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# CHAPTER - 1
# INTRODUCTION

## 1.1 BACKGROUND

Water is amongst the basic necessities without which one cannot imagine of any human habitation. This is probably the root cause, why the development of past human civilizations has been associated with areas nearby water sources. In this 21st century, water can be attributed to be the root cause of most of the crises and conflicts. However, the problem of water does not only point towards the quantity of water available but also to the quality of water available and its conjunctive use.

The National Water Resources Council adopted the new National Water Policy (NWP) in its 5th meeting held on 01 April 2002. The policy provides the national perspective for the planning and management of water resources with a view to ensuring their optimal, economical and equitable use. It recognizes that "water is a scarce and precious national resource to be planned, developed, conserved and managed as such, and on an integrated and environmentally sound basis, keeping in view the socio-economic aspects and needs of the States". The focus of National Water Policy can be outlined as follows:

- The development and management of water resources has to be planned for hydrological units. "All individual development projects and proposals should be formulated and considered within the framework of such an overall plan …"
- River basin organisations should be established and "prepare comprehensive plans taking into account not only the needs of irrigation but also harmonising various other water uses … The scope and powers of the river basin organisations shall be decided by the basin states themselves."
- Planning, design, development and management of water resources schemes should involve "not only the various government agencies but also the users and other stakeholders. … Water Users' Associations and the local bodies such as municipalities and gram panchayats should particularly be involved in the operation, maintenance and management of water infrastructure." Wherever feasible, "private sector participation should be encouraged in planning, development and management of water resources projects for diverse uses."

With the growth of economy and subsequent upgradation of the very pattern of life, there is a corresponding increase in demand for water from different sectors. In a progressive society it is natural that demands of water remain on the rise. In this context the issues are varied and complex in our country, because in India there are remarkable variation in the availability of water on account of the regional rainfall and geography. Along with, the increasing population and urbanization are having telling effect on the availability and quality of water.

Ground water has emerged as an important source to meet the water requirements of various sectors including the major consumers of water like irrigation, domestic and industries. The sustainable development of ground water resource requires precise quantitative assessment based on reasonably valid scientific principles.

Water conservation can be defined as any beneficial reduction in water loss, use or waste as well as the preservation of water quality, a reduction in water use accomplished by implementation of water conservation or water efficiency measures; or, improved water management practices that reduce or enhance the beneficial use of water. A water conservation measure is an action, behavioral change, device, technology, or improved design or process implemented to reduce water loss, waste, or use. *Water efficiency* is a tool of water conservation. That results in more efficient water use and thus reduces water demand. The value and cost-effectiveness of a water efficiency measure must be evaluated in relation to its effects on the use and cost of other natural resources (e.g. energy or chemicals). The goals of water conservation efforts include as follows:

- Sustainability: To ensure availability for future generations, the withdrawal of fresh water from an ecosystem should not exceed its natural replacement rate.
- Energy conservation: Water pumping, delivery, and wastewater treatment facilities consume a significant amount of energy. In some regions of the world over 15% of total electricity consumption is devoted to water management.
- Habitat conservation: Minimizing human water use helps to preserve fresh water habitats for local wildlife and migrating waterfowl, as well as reducing the need to build new dams and other water diversion infrastructure.

## 1.2 OBJECTIVE OF STUDY

The major objectives of the study can be outlined as follows:

- To assess the hydrogeological setup of the project area.
- To assess the catchment characteristics, hydrometeorology and water harvesting potential of the project area.
- To study the nature of subsurface formation with help of geophysical survey and hydrogelogical investigation for designing suitable rain water harvesting structures.
- To study, identify and suggest suitable location and design of rain water harvesting and artificial recharge structures for the project area.

# CHAPTER – 2

# RAIN WATER HARVESTING AND ARTIFICIAL RECHARGE

## 2.1 RAIN WATER HARVESTING

With the ever-increasing population and rising demands, the pressure on the existing water resources has grown many folds. Rain water harvesting is the age old concept, which holds immense potential in the current times in controlling runoff and resultant water logging issues besides assuring an alternative source of water and supplement to existing natural resources in a wide variety of circumstances. It is the technique of collection and storage of rain water at surface or in sub-surface aquifers, before it is lost as surface run-off. The augmented resource can be harvested in the time of need.

There are two sources for rain water harvesting. They are Surface Runoff and Roof Top Rain water. The basic purpose of rain water harvesting are-

- To overcome the inadequacy of waters to meet our demands.
- To arrest decline in ground water levels.
- To enhance availability of ground water at specific place and time and utilize rain water for sustainable development.
- To increase infiltration of rain water in the subsoil, which has decreased drastically in urban areas due to paving of open area.
- To improve ground water quality by dilution.
- To increase agriculture production.
- To improve ecology of the area by increase in vegetation cover, etc.

## 2.2 CONCEPT OF ARTIFICIAL RECHARGE

The term artificial recharge has different connotations for various practitioners. Artificial recharge to ground water is defined as the recharge that occurs when the natural pattern of recharge is deliberately modified to increase recharge (ASCE 2001). The process of recharge itself is not artificial. The same physical laws govern recharge, whether it occurs under natural or artificial conditions. What is artificial is the availability of water supply at a

particular location and a particular time. In the broadest sense one can define artificial recharge as “any procedure, which introduces water in a previous stratum”.

The term artificial recharge refers to transfer of surface water to the aquifer by human interference. The natural process of recharging the aquifers is accelerated through percolation of stored or flowing surface water, which otherwise does not percolate into the aquifers. Artificial recharge is also defined as the process by which ground water is augmented at a rate exceeding that under natural condition of replenishment. Therefore, any man-made facility that adds water to an aquifer may be considered as artificial recharge (CGWB, 1994)

Artificial recharge aims at augmenting the natural replenishment of ground water storage by some method of construction, spreading of water, or by artificially changing natural conditions. It is useful for reducing overdraft, conserving surface run-off, and increasing available ground water supplies. Recharge may be incidental or deliberate, depending on whether or not it is a by-product of normal water utilization.

**2.3 NEED FOR ARTIFICIAL RECHARGE**

Natural replenishment of ground water reservoir is a slow process and is often unable to keep pace with the excessive and continued exploitation of ground water resources in various parts of the country. This has resulted in declining ground water levels and depletion of ground water resources in such areas. Artificial recharge efforts are basically aimed at augmentation of the natural movement of surface water into ground water reservoir through suitable civil construction techniques. Such techniques interrelate and integrate the source water to ground water reservoir and are dependent on the hydrogeological situation of the area concerned.

Occurrence of rainfall in India is mostly limited to about three months in a year. The natural recharge to ground water reservoir is restricted to this period only in a major part of the country. Artificial recharge techniques aim at extending the recharge period in the post-monsoon season for about three or more months, resulting in enhanced sustainability of ground water sources during the lean season. In arid regions of the country, rainfall varies between 150 and 600 mm/ year with less than 10 rainy days. A major part of the precipitation is received in 3 to 5 major storms lasting only a few hours. The rates of potential evapotranspiration (PET) are exceptionally high in these areas, often ranging from

300 to 1300 mm. In such cases, the average annual PET is much higher than the rainfall and the annual water resource planning has to be done by conserving the rainfall, by storing the available water either in surface or in sub-surface reservoirs. In areas where climatic conditions are not favorable for creating surface storage, artificial recharge techniques have to be adopted for diverting most of the surface storage to the ground water reservoirs within the shortest possible time.

In hilly areas, even though the rainfall is comparatively high, scarcity of water is often felt in the post-monsoon season, as most of the water available is lost as surface runoff. Springs, the major source of water in such terrains, are also depleted during the post monsoon period. In such areas, rainwater harnessing and small surface storages at strategic locations in the recharge areas of the springs can provide sustainable yields to the springs as well as enhance the recharge during and after rainy season. The basic advantages are-

- Cost of recharge to sub-surface reservoir is lower than surface reservoirs.
- The aquifer serves as distribution system also.
- No land is wasted for storage purpose and no population displacement is involved.
- Ground water is not directly exposed to evaporation and pollution.
- Storing water underground is environment friendly.
- It increases the productivity of aquifer.
- It reduces flood hazards.
- Effects rise in ground water levels.
- Mitigates the effects of drought.
- Reduces soil erosion.

## 2.4 FACTORS INFLUENCING PLANNING OF ARTIFICIAL RECHARGE SCHEME

Proper planning is essential for the successful outcome of any artificial recharge scheme. Planning of artificial recharge schemes involves the formulation of a suitable plan, under a given set of natural conditions, to augment the natural ground water recharge. The existing natural factors which influence the planning of artificial recharge scheme include:

- Depth to water level
- Subsurface storage capacity of the formation
- Source water available

- Topography
- Soil characteristics
- Landuse/land cover
- Hydrogeology

The scope for artificial recharge in an area is basically governed by the thickness of unsaturated material available above the water table in the unconfined aquifer. Depth to water level, therefore, provides the reference level to calculate the volume of unsaturated material available for recharge. Depth to water level recorded during post monsoon period is used for the purpose as areas where the natural recharge is not enough to compensate the ground water withdrawal, can be easily identified using the water level data. A realistic assessment and quantification of the source water help design the storage capacity of the structure. Otherwise, there is a possibility of arriving at an improper design of the recharge structure.

The topographic set-up of an area controls the retention period of surface and ground water within a topographic unit. The gradients are very steep (more than 1:10) in the runoff zones, with very little possibility of infiltration.

Soil and land use conditions are of vital importance if artificial recharge through surface spreading methods is contemplated in an area. Various factors such as the depth of soil profile, its texture, mineral composition and organic content control the infiltration capacity of soils. Areas having a thin soil cover are easily drained and permit more infiltration when compared to areas with thick soil cover in the valley zones. Soils having coarser texture due to higher sand-silt fractions have markedly higher infiltration capacity as compared to clay-rich soils, which are poorly permeable. Soils containing minerals, which swell on wetting like montmorillonite etc. and with higher organic matter, are good retainers of moisture necessary for crop growth but impede deeper percolation.

The land use and extent of vegetation also controls the infiltration capacity of soils. Barren valley slopes are poor retainers of water as compared to grass lands and forested tracts, which not only hold water on the surface longer, but also facilitate seepage during the rainy seasons through the root systems. Similarly, ploughed fields facilitate more infiltration as compared to barren fields.

Hydrogeological conditions of the area are also among important factors in planning

artificial recharge schemes. The recharged water moves below the soil zone in moisture fronts through the zone of aeration. The unsaturated flow is governed by the permeability of zone of aeration, which in turn varies with moisture content of the front. Usually, in case of consolidated and semi consolidated rock formations, the subsoil zone passes into weathered strata, which, in turn, passes into unweathered rock. The hydrogeologic properties of the weathered strata are generally much better as compared to the parent rock due to higher porosity and permeability imparted by weathering. The nature of soil, subsoil, weathered mantle, presence of hard pans or impermeable layers govern the process of recharge into the unconfined aquifer. The saturation and movement of ground water within unconfined and all deeper semiconfined and confined aquifers is governed by storativity and hydraulic conductivity of the aquifer material. Aquifers best suited for artificial recharge are those, which absorb large quantities of water and release them whenever required.

## 2.5 INVESTIGATIONS NEEDED FOR PLANNING OF ARTIFICIAL RECHARGE SCHEME

Various inputs are necessary for proper and scientific planning of artificial recharge schemes in any terrain. Scientific investigations leading to a better understanding of the characteristics of sub-surface formations are to be taken up for realistic determination of these inputs. The various field based investigation techniques adopted for an effective planning includes:

***Remote Sensing Studies:***

*Remote sensing, with its advantages of spatial, spectral and temporal availability of data has now become a very useful tool in assessing, monitoring and conserving ground water resources. Satellite data provides quick and useful baseline information on various parameters controlling the occurrence and movement of ground water such as geology, structural features, geomorphology, soils, land use, land cover, lineaments etc. All these parameters used to be studied earlier independently due to non-availability of data and lack of integrating tools and modeling techniques*

***Hydrological & Hydrometeorological Studies:***

*Rainfall and evaporation are two of the most important parameters, which are required for proper planning of artificial recharge schemes. Detailed information pertaining to the amount, duration and intensity of rainfall in a given area is a necessary pre-requisite*

*for planning recharge schemes. Long-term average rainfall is an important parameter for assessing the storage capacity of various artificial recharge structures. On the other hand, daily and hourly rainfall data is essential for planning water conservation schemes such as farm ponds, contour trenches, roof top rainwater harvesting schemes and also for designing filters for runoff recharge schemes. Evaporation data is useful for assessing the potential losses from the free surfaces of ponds and other surface water storage structures. Data related to daily/seasonal/monthly evaporation losses is helpful for identification of most effective recharge. The hydrological studies also include estimation of runoff.*

***Geophysical Studies:***

*Geophysical studies can provide useful information pertaining to the characteristics of sub-surface lithological formations, which influence the type of recharge mechanism suitable for a particular area. These studies are normally taken up to complement the data collected through hydrogeological investigations. The main purpose of applying geophysical methods for the selection of appropriate sites for artificial recharge studies is to assess the unknown sub-surface hydrogeological conditions economically, adequately and unambiguously. They are usually employed to narrow down the target zone and to pinpoint the probable sites for artificial recharge structures. The application of geophysical techniques is also useful for bringing out a comparative picture of the sub-surface litho-environment and to correlate them with the hydrogeological setting.*

**Hydrogeological Studies:**

*A detailed understanding of the hydrogeology of the area is of prime importance in ensuring successful implementation of any artificial recharge scheme. A desirable first step toward achieving this objective is to synthesize all available data on various hydrogeological parameters from different agencies. Regional geological maps indicate the location of different geological strata, their geological age sequence, boundaries/contacts of individual formations and structural expressions like strike, dip, faults, folds, fractures, intrusive bodies etc. These maps also indicate the correlation of topography and drainage to geological contacts. Maps providing information on regional hydrogeological units, their ground water potential and general pattern of ground water flow and chemical quality of ground water in different aquifers are also necessary. Satellite imagery provide useful data on geomorphic units and lineaments, which govern the occurrence and movement of ground water, especially in hard rock terrain. A detailed hydrogeological study, aimed at supplementing the*

*regional picture of hydrogeological set up available from previous studies, is imperative to have precise information about the promising hydrogeological units for recharge and to decide on the location and type of structures to be constructed. The purpose of detailed hydrogeological mapping is to prepare the following maps, which facilitate an understanding of the ground water regime and its suitability to artificial recharge schemes.*

**2.6 METHODS OF ARTIFICIAL RECHARGE**

As it has been discussed earlier, the selection of a suitable technique for artificial recharge of ground water depends on various factors, which include:

- Quantum of non-committed surface run-off available.
- Rainfall pattern
- Land use and vegetation
- Topography and terrain profile
- Soil type and soil depth
- Thickness of weathered / granular zones
- Hydrological and hydrogeological characteristics
- Environmental and ecological impacts of artificial recharge scheme proposed

The various Artificial Recharge Structures used for Rain Water Harvesting are-

- Recharge Pit
- Recharge Trench
- Recharge Well
- Gully Plug
- Contour Bund
- Gabion Structure
- Percolation tank/Recharge Pond
- Check Dam/ Cement Plug/ Nala Bund
- Recharge shaft
- Ground Water Dams/Subsurface Dyke

# CHAPTER - 3
# PROJECT PROFILE & ITS ENVIRONMENT

## 3.1 COMPANY BACKGROUND

Ardent Steel Limited is an associate company of the reputed Hira Group of Raipur. Hira Group of companies is pioneer in the field of Sponge Iron, Steel and Power having a successful track record and a name to be reckoned in the Iron and Steel Industry. Hira group of industries of Raipur are having interests in various segments of the core sector of the economy, viz Ferro-alloys, sponge iron, steel billets, wire rods, steel wires, power generation, coal beneficiation and mining (iron ore and coal). The group is one of the leading manufacturers of silico based Ferro-alloys in India. The group turnover is over Rs. 1000 crores. Hira Group is having 75% stake in Ardent Steel Ltd.

## 3.2 PROJECT DESCRIPTION

Having their existing manufacturing base at Raipur, Chhatishgarh, these group have presently set up a Green-field Iron Ore Pelletisation Plant of 0.6 MTPA capacity at Vill. Phuljhar, Tehsil; Telkoi, Dist.: Keonjhar, Odisha, by using High-grade Iron ore fines. The plant is located at Village Phuljhar, Tehsil; Telkoi, District Keonjhar, in the State of Odisha. Pelletisation offers the following advantages:

- Utilisation of iron ore fines
- Production of a more value added product
- Pellets have high tumbling index and lower abrasion index
- Pellets have higher porosity
- Charging of pellets increases productivity.

### Expansion Plans of Ardent Steel Limited

In view of expanding market and consistent market demand on iron and steel products in domestic as well as international market. It proposes now to set up an Iron ore beneficiation plant with a capacity of 3.0 million tons along with expansion of present unit from 0.6 MTPA to 1.8 MTPA so as to effectively utilize the ore fines generated at the mines.

The planning of acquiring additional land of about 325 acre is going on for the above up-coming project. The total project configuration is presented in Table 1.1 as given below:

**Table 3.1 Project Configurations**

| Unit | Product | Existing | Proposed | Total |
|---|---|---|---|---|
| Pelletisation Plant | Pellet | 0.6 MTPA | 1.2 MTPA | 1.80 MTPA |
| Beneficiation Plant | | - - | 3.0 Million Ton | 3.0 Million Ton |

**Market Prospects**

Steel has played a vital role in the development of a country's economy. Production of steel is an important index of measuring the country economic and industrial development. The demand for steel is correlated with development of country's Infrastructure like Roads, Railways, Ports, housing drinking water, growth of manufacturing and automobile industries , Indian construction sector is consuming about 10 million tonnes of steel annually with steel cement consumption ratio of 0.32:1 against international standard ratio of I:I. This sector is likely to increase the steel consumption for increasing quality construction and durability. Our per capita consumption of steel is only 29 Kg per annum against the international standard of 150Kg.

Steel Industries in India have made progressive growth since 2003 with growth of qualitative and quantitative crude steel production. India has targeted 120 Million tonnes of steel production by 2020 against the present production capacity of 44 million tonnes. Indian population is expected to grow to about 1400 million by 2020 and with an average per capita steel consumption of about 150Kg; the total demand will be around 210 million tonnes per annum. This shall lead to a short fall in production by about 90 million tonnes.

The present steel production in India is growing at a rate of 7.3 % with about 50 % of the total capacity in the secondary steel sector of DRI-Scrap-Electric Furnace route. Manufacture of secondary steel in India particularly in Odisha and Jharkhand is competitive with lower operating cost due to availability of Iron ore and non-coking coal. India is the largest manufacturer of DRI.

**Global Scenario**

The pellet plant capacity increased from a mere 7 MTPA in 1955 to about 290 MTPA in the year 2000. The capacity increased to about 345 MTPA in 2006. The growth of pelletization globally is at a rate of 13.5 % annually. USA is the leading producer of pellets followed by Brazil and China. At present the total installed capacity of pellet plants in India is about 18 MTPA which corresponds to a share of about 5 % of World Pellet Capacity. India is placed in the 7th position globally. Plants installed in India are mostly of higher capacity and are based on straight grate induration process which is more suitable for hematite ore available in India. The notable pellet producers are Kudremukh Iron Ore Company, Jindal South West, Essar Steel. Visakhapatanam Steel Plant in joint venture with NMDC is proposing to set up a 2 MTPA pellet plant. Similarly NMDC is planning 2 MTPA Pellet Plant at Bachelli, Chhatisgarh, and Donimalai, Karnataka. Ministry of Steel is examining the feasibility of setting up a pellet plant at Goa. Similarly Tamil Nadu Industrial Development Corporation is examining the feasibility for beneficiation and pelletization at Kanjamali and Tiruvannamalai Deposits. Janki Corporations Ltd and Tungabhadra Minerals are setting up pellet plants at Bellary of capacity 0.6 MTPA and 1.2 MTPA respectively. India Exports iron ore pellets to countries like Brazil, Canada, Mexico & Australia.

### 3.3 DETAILS OF COMPANY

| | | |
|---|---|---|
| 1 | Name of the Company | ARDENT STEEL LIMITED |
| 2 | Constitution | Limited Company |
| 3 | Date of Incorporation | 30 April, 2007 |
| 4 | Promoters / Directors | 1) Sri Sanjay Gupta<br>2) Sri Dinesh Kumar Gandhi<br>3) Sri Bhrigu Nath Ojha<br>4) Sri Sanjay Bothra<br>5) Sri Hari Om Haritash |
| 5 | Nature of Industry | Iron Ore Pelletisation |
| 6 | Product | PELLET |
| 7 | Installed capacity | 0.6 MTPA |
| 8 | Address of the Company | |
| | Regd. Office | F-9, Hira Arcad, Near Bus Stand, Pandri, Raipur, Chhattisgarh – 492004 |

| | | |
|---|---|---|
| | Factory | At – Phuljhar , Via – Suakati<br>P.O.-Phuljhar, P.S. - Nayakote<br>Dist. –Keonjhar |
| | City Office<br>(Address for Correspondence) | At – Plot No.208, New Colony, Mining Road, Jamuhata ,<br>Dist : Keonjhar<br>Pin : 751 018, Odisha<br>Tel : 06766-250173<br>Fax : 06766-258473<br>Email: asl@ardentsteel.com |

### 3.4 WATER BALANCE SYSTEM

Grinding of Iron Ore is wet process and green pellets are heat harden in the Grate-Kiln-cooler. Both the processes require a considerable quantity of circulating and cooling water for control of processes as well as for dissipation of heat. To minimize the consumption of water, it has been planned to recirculate the water by treating the waste water generated. In order to further economize on fresh water demand, closed circuit water re-circulation systems have been planned to effect extensive recycling and reuse of return water from plant processes. The water will be re-circulated in closed circuits. Evaporative cooling towers will be provided for cooling water recirculation. Process water losses will be compensated by adding make-up water of respective qualities.

**Table 3.2 Break-up of water requirement**

| Activity | Present Requirement ($M^3$/day) | Total Requirement ($M^3$/day) | No. of Operational days in a year | Annual Requirement ($M^3$/year) |
|---|---|---|---|---|
| Industrial Activity | 492 | 492 | 345 | 169740 |
| Residential & Domestic | 5 | 5 | 345 | 1725 |
| Green Belt Development/ Environment maintenance | 3 | 3 | 180 | 540 |
| Total | 500 | 500 | | 172005 |

### 3.5 LOCATION AND EXTENT OF THE STUDY AREA

The area under present study has been taken as buffer area of 10km. radius keeping iron Ore Pelletization plant of M/s. Ardent Steel Limited at the center. The study area falls under the Survey of India Topo sheets No. 73 G/5, G/6, G/09 and G/10. It lies within $21^0$ 38' 48.78" to $21^0$ 49' 36.21" North Latitudes and $85^0$ 20' 19.96" to $85^0$ 31' 56.87" East Longitudes. The total study area is 314 sq. km. The study area falls in Banspal, Keonjhar Sadar, Joda and Jhumpura blocks of Keonjhar district. The major reserved forests in the area are Nayagarh, Gandhamardan and Raigurha. The main rivers in the area are Baitarai River, Malda nadi, Bamni nadi, Kadal nala and Jagadhara nadi which all flow from south to north. The area can be approached from Raisuan on NH-215 which passes in east of the area joining Keonjhar and Rourkela. A well net work of PWD road and village road exist in the study area. The nearest railway station is Nayagarh. The study area is shown in the Fig. 3.1.

### 3.6 PHYSIOGRAPHY

The project site is situated in a hilly terrain and has been elevated upto a maximum height of 540 m above mean sea level (MSL). The area is characterized by hilly as well as flat ground having elevation from 802 m to 500 m above M.S.L. The hills & hill ranges are Satpuri, Rai, Boita, Nandijhara, Matkam, Nekeraghara, Handibhanga, Udaipini, Jankapani, Dhaurduma, Sangaithali and Sanda Paharah. The Relief map within 10km radius of the project site is given in Fig. 3.2.

### 3.7 GEOMORPHOLOGY

Information on landforms is an important input for identification of potential zones of ground water occurrence. Identification of various geomorphic units is primarily based on remote sensing techniques with the input of actual ground truth. Various factors like degree of ruggedness, nature of dissection, amount of elevation/depth, drainage density, texture and pattern, vegetation and land use pattern, reflectivity in terms of brightness grey value/colour, slope characters, relative relief, alignment of ridges/ valleys, crest configuration, origin, extent of denudation, etc. have been taken into consideration in classifying the geomorphic units. Major geomorphic units of the area have been discussed below. The Fig.3.3 depicts the geomorphic units in the study area.

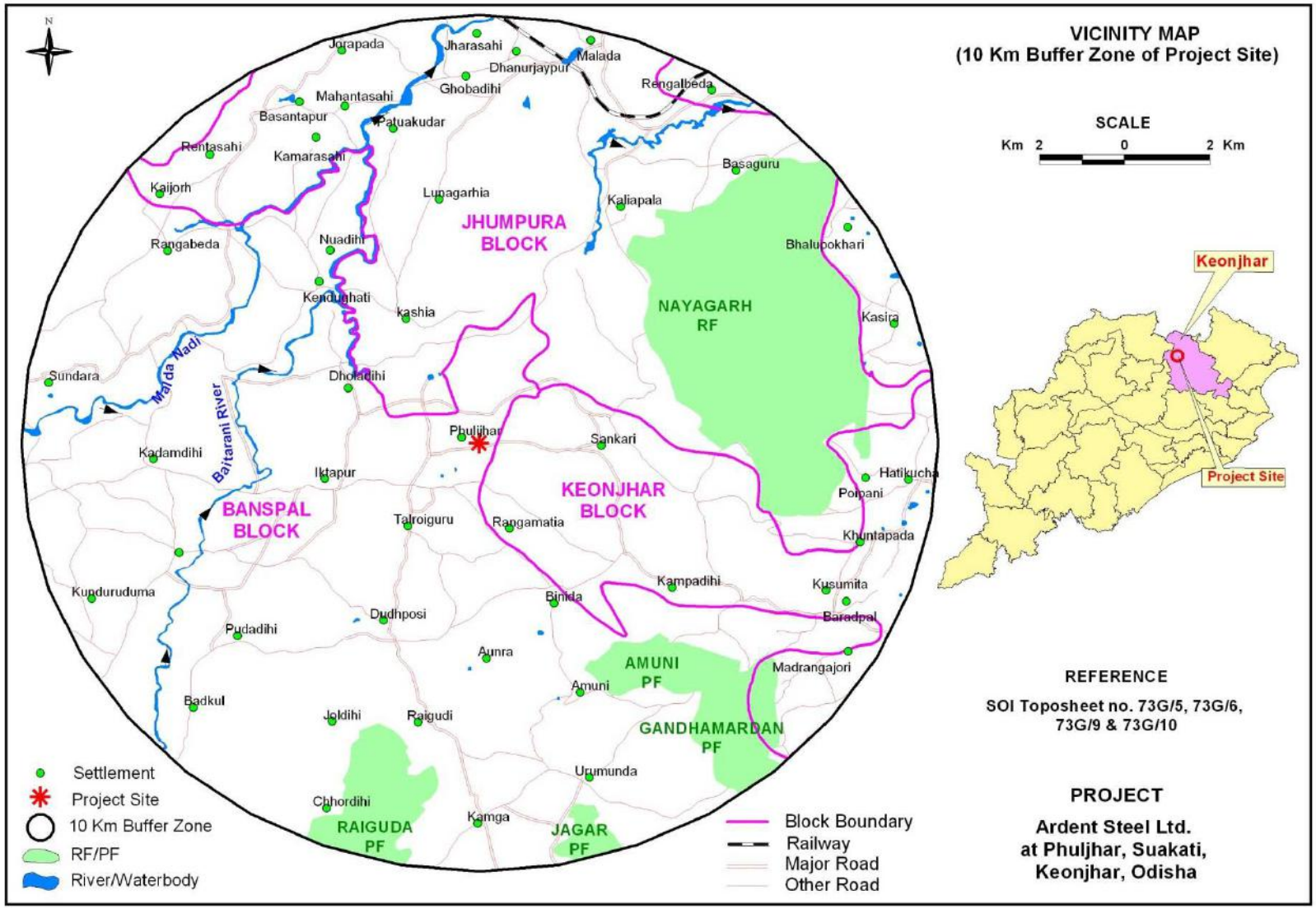

VICINITY MAP
(10 Km Buffer Zone of Project Site)
SCALE
Km 2 0 2 Km
Keonjhar
Project Site
JHUMPURA BLOCK
BANSPAL BLOCK
KEONJHAR BLOCK
NAYAGARH RF
AMUNI PF
GANDHAMARDAN PF
RAIGUDA PF
JAGAR PF
Malda Nadi
Baitarani River
Jorapada
Jharasahi
Malada
Dhanurjaypur
Ghobadihi
Rengalbeda
Mahantasahi
Basantapur
Paluakudar
Renlasahi
Kamarasahi
Basaguru
Kaijorh
Lunagarhia
Kaliapala
Rangabeda
Nuadihi
Bhalupokhari
Kendumahati
kashia
Kasira
Sundara
Dhoradihi
Phuljhar
Sankari
Kadamdihi
Iktapur
Hatikucha
Poipani
Talroiguru
Rangamatia
Khuntapada
Kundurduma
Kampadihi
Kusumita
Bimda
Baradpal
Dudhposi
Pudadihi
Aunra
Madrangajori
Amuni
Badkul
Joldihi
Raigudi
Urumunda
Chhordihi
Kamga
Settlement
Project Site
10 Km Buffer Zone
RF/PF
River/Waterbody
Block Boundary
Railway
Major Road
Other Road
REFERENCE
SOI Toposheet no. 73G/5, 73G/6, 73G/9 & 73G/10
PROJECT
Ardent Steel Ltd.
at Phuljhar, Suakati,
Keonjhar, Odisha

**Fig. 3.1**

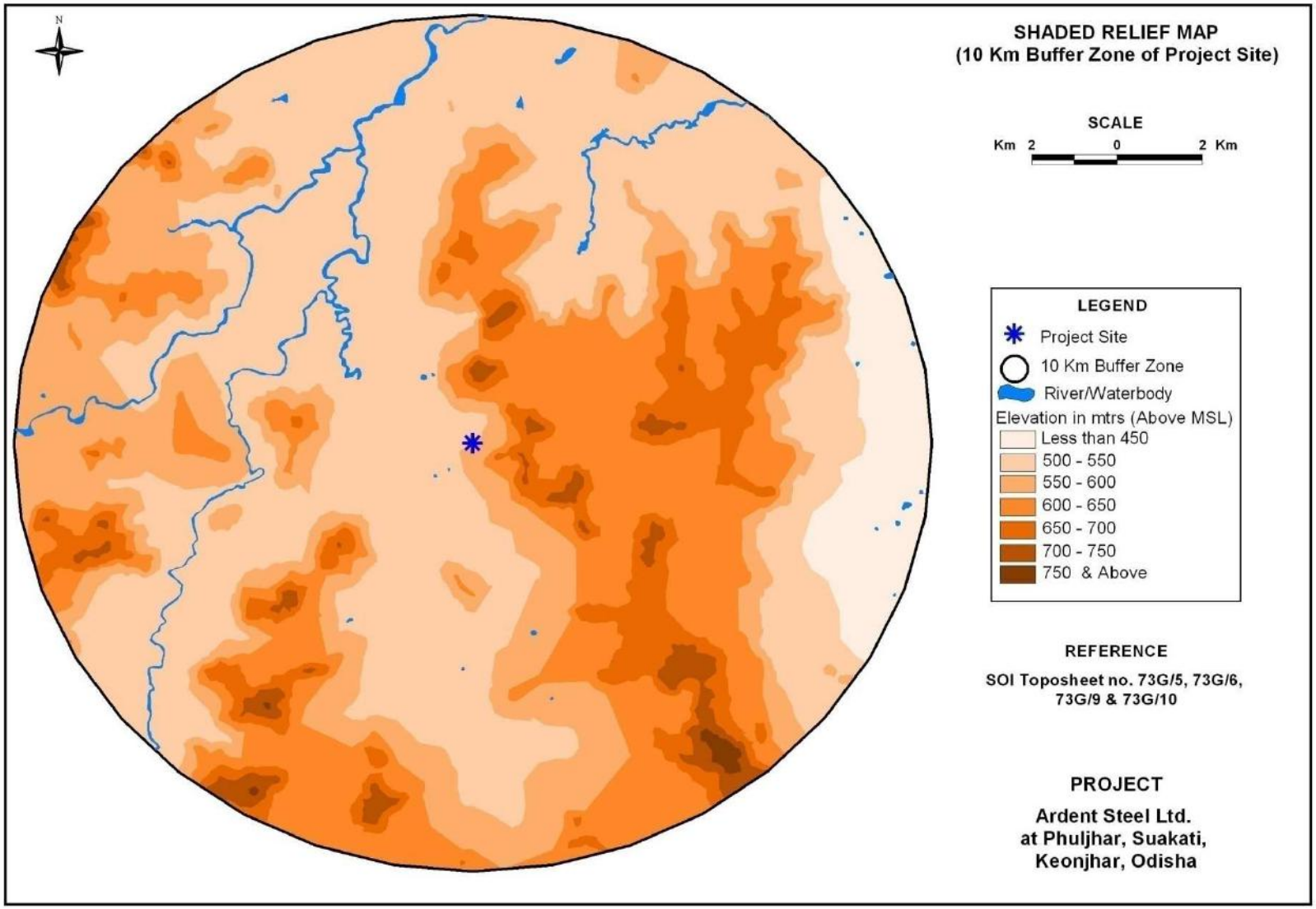

N
SHADED RELIEF MAP
(10 Km Buffer Zone of Project Site)
SCALE
Km 2 0 2 Km
LEGEND
Project Site
10 Km Buffer Zone
River/Waterbody
Elevation in mtrs (Above MSL)
Less than 450
500 - 550
550 - 600
600 - 650
650 - 700
700 - 750
750 & Above
REFERENCE
SOI Toposheet no. 73G/5, 73G/6, 73G/9 & 73G/10
PROJECT
Ardent Steel Ltd.
at Phuljhar, Suakati,
Keonjhar, Odisha

**Fig. 3.2**

***Structural Hills***

This hydrogeomorphic unit in the area comprises of Banded Hematite Jasper/ banded hematite quartzites of Iron Ore Supergroup and occupy a major part in the central part of the buffer zone area. These are structurally controlled hills and traversed by numerous joints and fractures facilitating ground water infiltration. Structural hills are the linear or arcuate hills exhibiting definite trend lines and BHQ/BHJ formations. These hills are structurally controlled with complex folding, faulting, criss-crossed by numerous joints/fractures which facilitate some infiltration and mostly act as run off zones. These are found almost throughout the study areas. The structural trend of the hills ranges in the southwest to northeastern direction with slight deviation towards the western part. The slope of the hills ranges from 12 degree to1 4 degree. In this unit groundwater prospects is very poor.

***Residual Hills***

These hills are formed due to differential erosion and weathering, so that a more resistant formation stand as mountain/hill. This unit in the area mainly comprises of BHQ/BHJ and occurs in the south-western part of the project site.

***Intermontane Valley***

Broad depression between mountains normally filled with colluvial deposits and sometimes controlled by fractures. Ground water potential in these areas is good to moderate and depends on thickness of the detritus fill. The yield range in this unit varies from 50-100 lpm.

***Valley Fill***

Unconsolidated sedimentary deposit which fills or partly fills a valley. These are narrow fluvial valleys with unconsolidated sediments deposited by streams/rivers. These are very good sites for ground water exploitation. Potential depends on the thickness of the fill. The yield potential in these areas varies from 120-170 lpm.

***Inselberg***

This hydromorphic unit occurs in isolated hillocks in several parts of the buffer zone. These are developed due to active weathering and erosion in humid tropical climatic condition. Inselbergs acts as runoff zones, thus ground water potential is very poor. This is a minor unit.

***Pediments***

This unit is developed as a result of continuous processes of pedimentation. The altitudinal variation is relatively high for rolling plain and is about 5 -10 m. In this horizon are exists irregular dissected portions with a number of gully are present. This formed due to intensive weathering under semi arid climatic conditions, representing final stage of the cyclic erosion. Pediplains are found in isolated patches dispersed throughout the study area. Devoid of any structural control these are characterized by isolated mounds of small hills with weathered residuum of up to 10 meters and poor to good ground water potential.

**3.8 DRAINAGE**

Baitarani, Bamni, Malda, Jagadhara and Kadal rivers are the major perennial streams in the study area. All these major streams flow in south-north direction. Besides these streams there are numerous seasonal nalas which join in these rivers. The drainage in the area is controlled by the topography of the area. The natural drainage pattern of the project area and its adjacency has been given in Fig.3.4.

**3.9 LANDUSE/LANDCOVER**

Landuse and landcover pattern is important in planning rainwater harvesting in an area. The landuse pattern for the study area has been given in Fig.3.5. & Land use/ cover area statistics has been given in Table No.3.9. However the landuse use pattern of the project area has been presented in Fig. 3.6. This reveals that the rooftop area of major structures is 14211 sq. m. The area of existing rain water harvesting reservoir is 10400 sq. m. Other open area, road area and open stack yards represent around 90 % of the total project area.

**Table 3.3: Land use/ Land cover Area Statistics**

| **Land use Type** | **Area (in Sq. Km.)** |
|---|---|
| Settlement | 3.03 |
| Agricultural Land | 131.798 |
| Open Forest | 94.648 |
| Dense Forest | 36.978 |
| Scrub Forest | 22.986 |
| Land with/without Scrub | 18.321 |
| Waste Land | 2.414 |
| River/ Water body | 4.105 |
| **Total** | **314.28** |

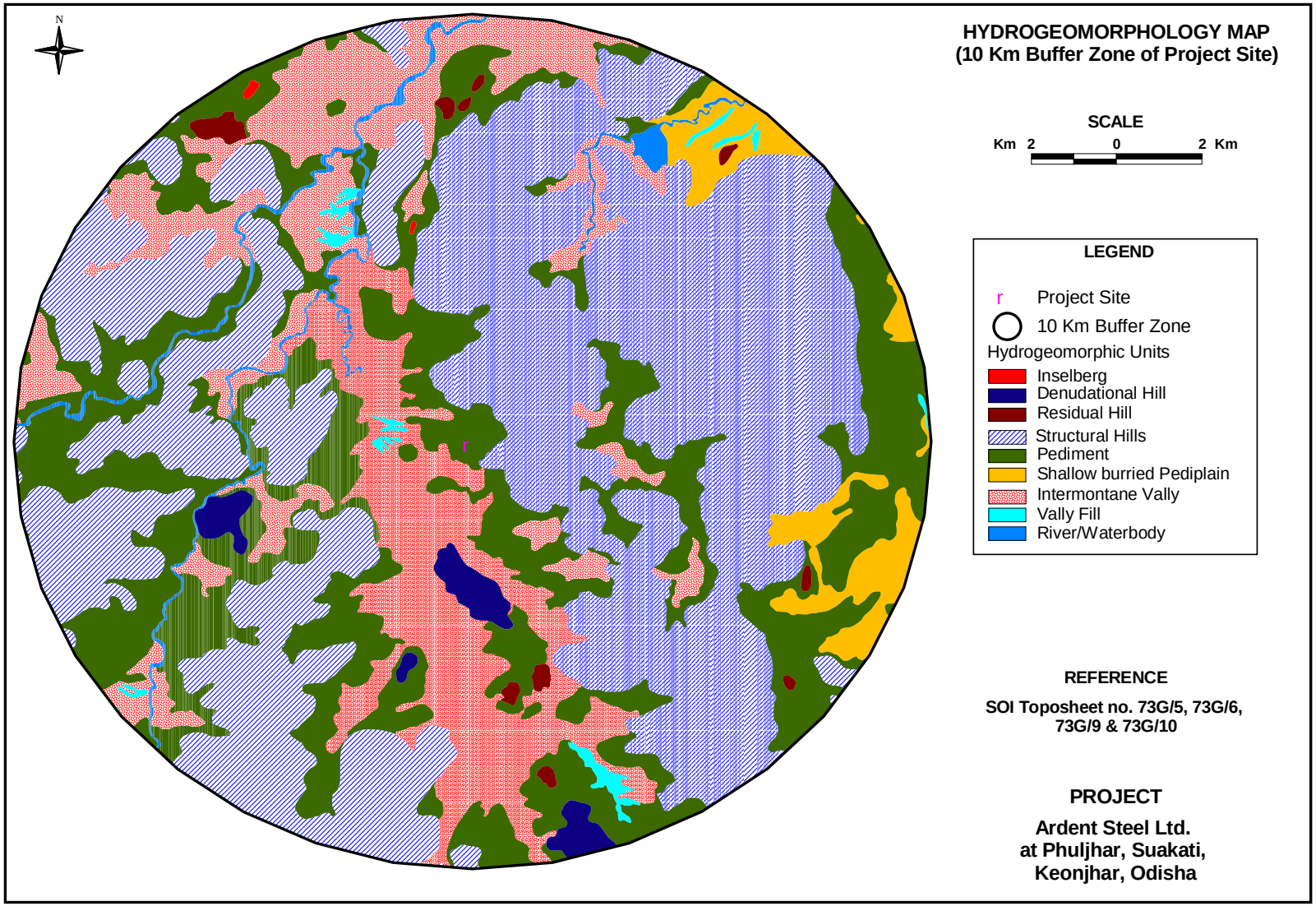

N
HYDROGEOMORPHOLOGY MAP
(10 Km Buffer Zone of Project Site)
SCALE
Km 2 0 2 Km
LEGEND
r Project Site
10 Km Buffer Zone
Hydrogeomorphic Units
Inselberg
Denudational Hill
Residual Hill
Structural Hills
Pediment
Shallow burried Pediplain
Intermontane Vally
Vally Fill
River/Waterbody
REFERENCE
SOI Toposheet no. 73G/5, 73G/6, 73G/9 & 73G/10
PROJECT
Ardent Steel Ltd.
at Phuljhar, Suakati,
Keonjhar, Odisha

**Fig. 3.3**

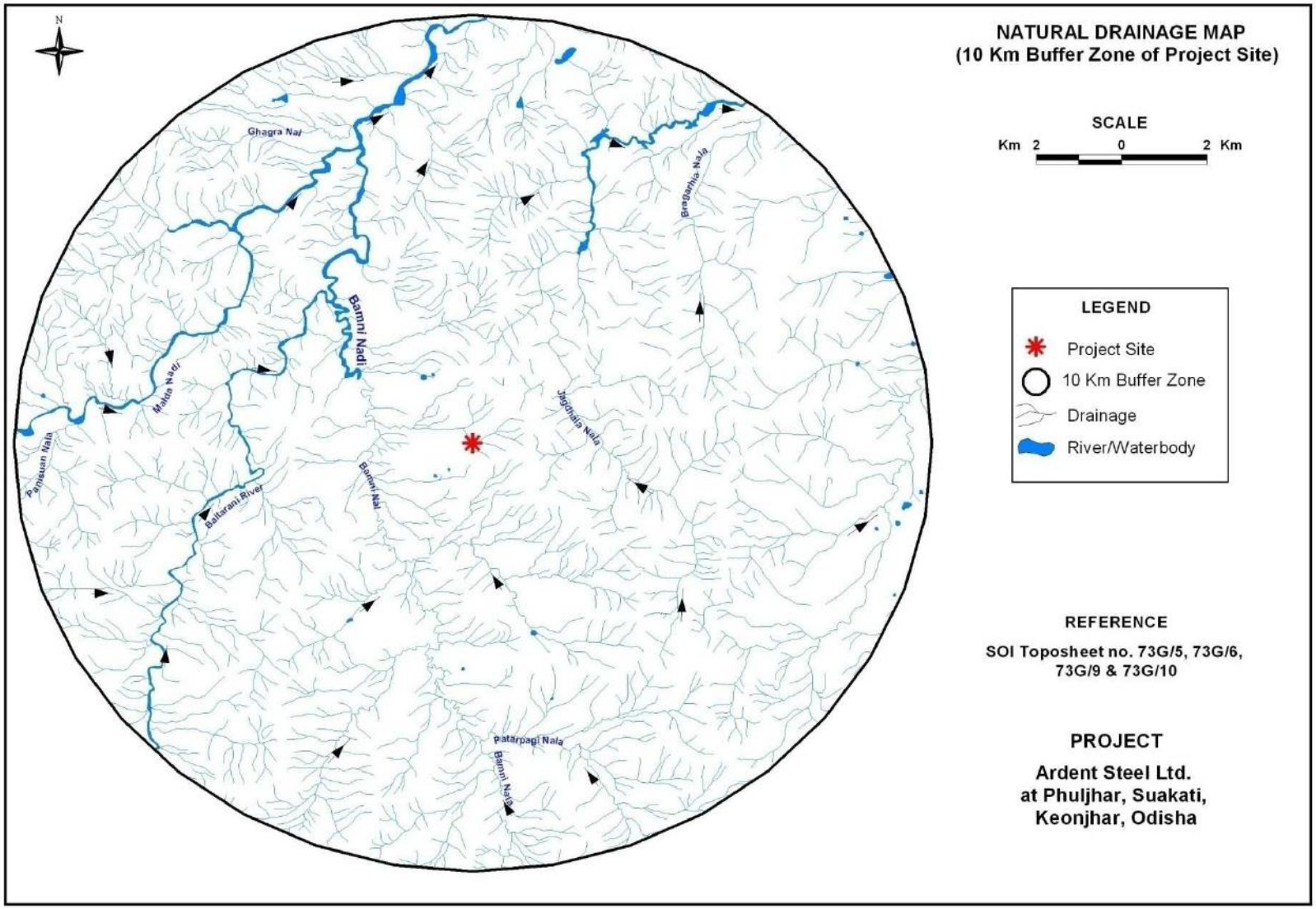

N
NATURAL DRAINAGE MAP
(10 Km Buffer Zone of Project Site)
SCALE
Km 2 0 2 Km
LEGEND
Project Site
10 Km Buffer Zone
Drainage
River/Waterbody
REFERENCE
SOI Toposheet no. 73G/5, 73G/6, 73G/9 & 73G/10
PROJECT
Ardent Steel Ltd.
at Phuljhar, Suakati,
Keonjhar, Odisha
Ghagra Nal
Bamni Nadi
Malda Nadi
Panisuan Nala
Baitarani River
Bamni Nal
Jagdhala Nala
Bragamia Nala
Patarpagi Nala
Bamni Nala

**Fig. 3.4**

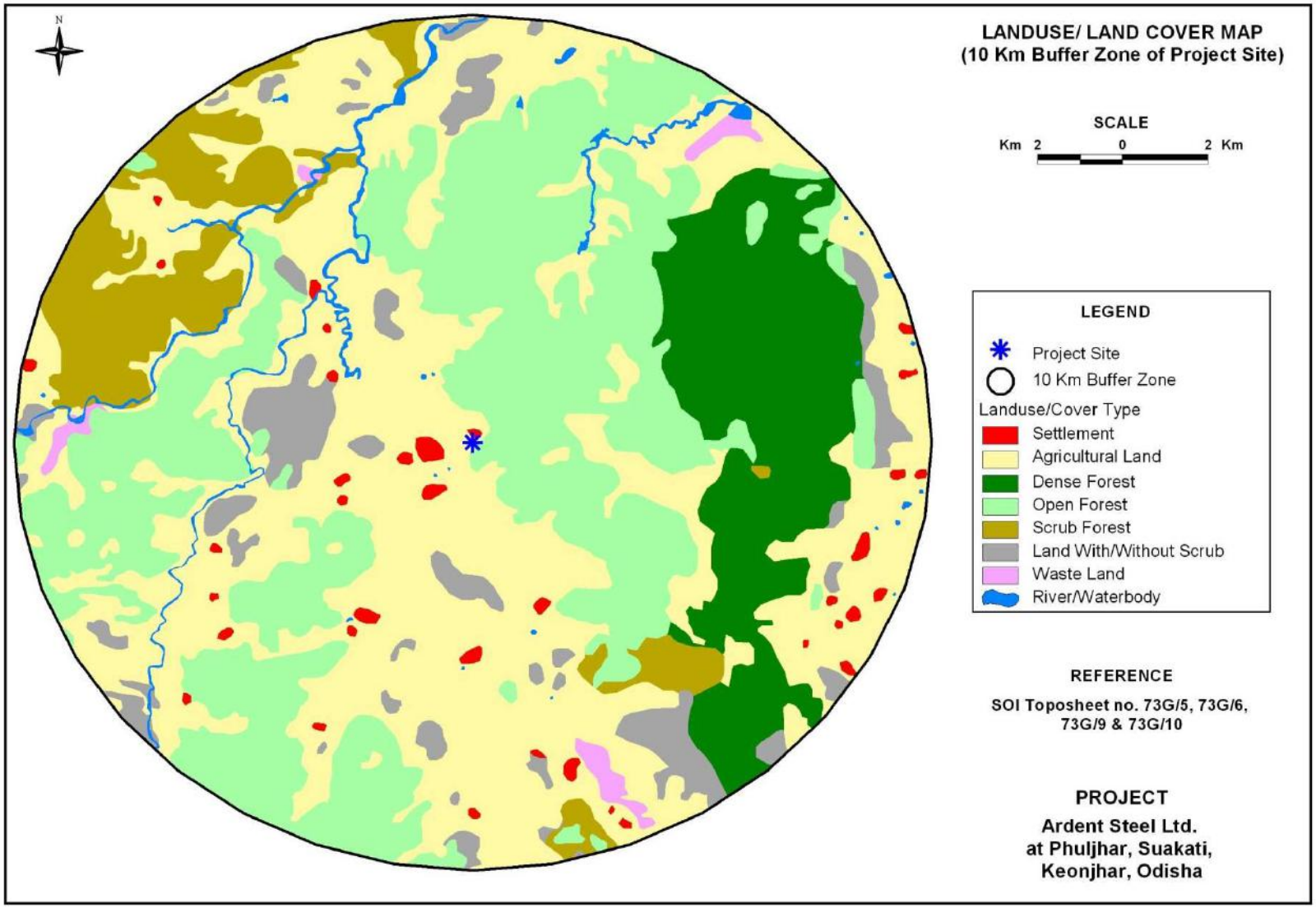

N
LANDUSE/ LAND COVER MAP
(10 Km Buffer Zone of Project Site)
SCALE
Km 2 0 2 Km
LEGEND
Project Site
10 Km Buffer Zone
Landuse/Cover Type
Settlement
Agricultural Land
Dense Forest
Open Forest
Scrub Forest
Land With/Without Scrub
Waste Land
River/Waterbody
REFERENCE
SOI Toposheet no. 73G/5, 73G/6, 73G/9 & 73G/10
PROJECT
Ardent Steel Ltd.
at Phuljhar, Suakati,
Keonjhar, Odisha

**Fig. 3.5**

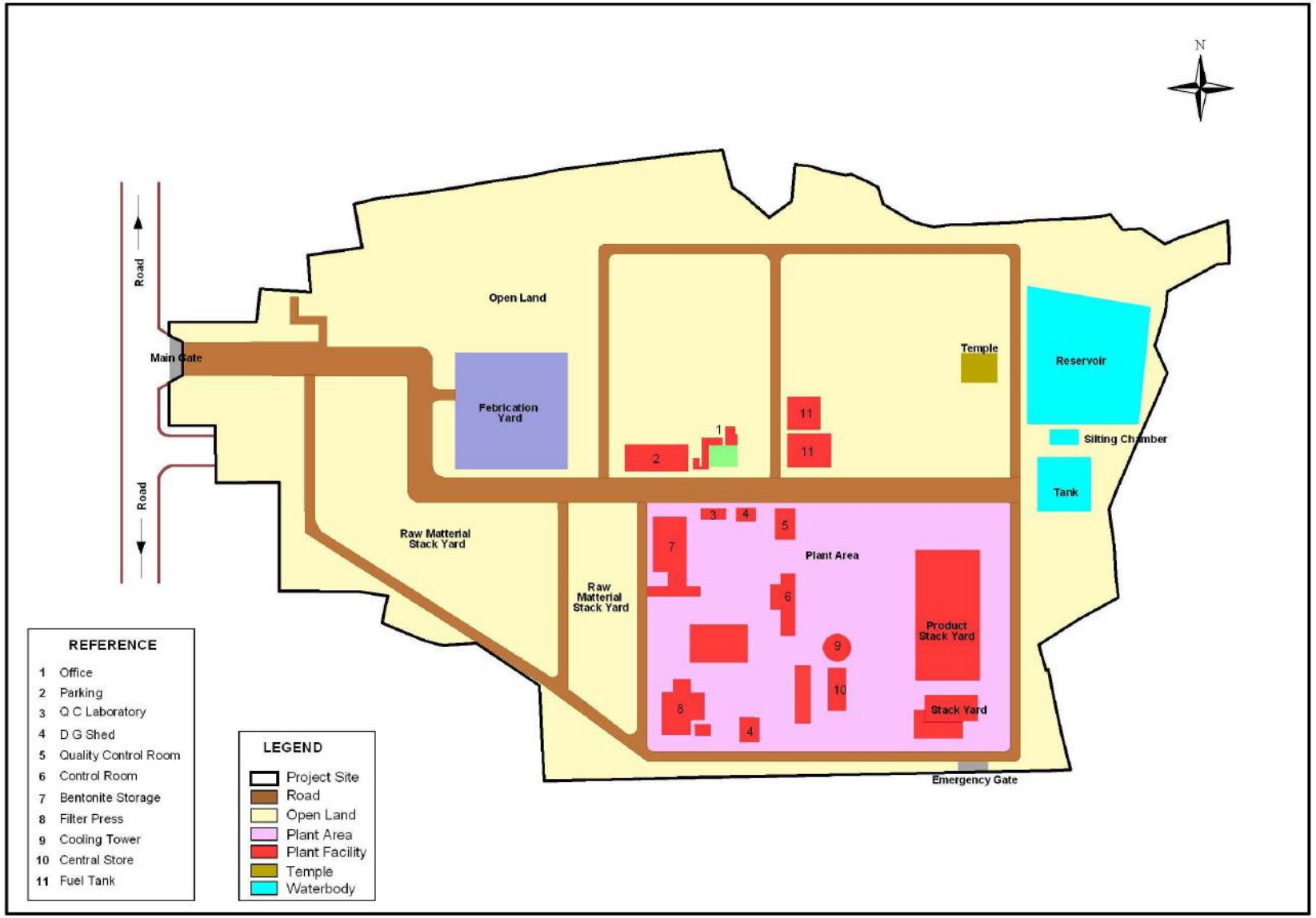



**Fig. 3.6: landuse use pattern of the project area**

## 3.10 PEDOLOGY

There are two major soil types in the buffer zone - Alfisols and Ultisols.

***Alfisols***

These soils include Red sandy and Red gravelly soil .These soils are deficient in nitrogen and $P_2O_3$. Both total and available $K_2O$ are fairly adequate and pH varies from 6.5 to 7.3. The reddish colour is due to oxidation of original ferruginous materials. These soils occur in area in patches in the east, east-central, north-west and south-western part of the study area.

***Ultisols***

It consists of mainly lateritic soils which covers most of the study area. These types of soils are characterized by vesicles and compactness. These are composed of mainly hydrated oxides of aluminum and iron.

## 3.11 CLIMATE

The area is characterized by extreme climate with very hot ($42^0$ C) summer and very cold winter ($4^0$ C). It experiences tropical and humid climate which shows three distinct seasons viz. summer, rainy and winter. The summer is very hot and dry starting from March and continues till end of May or early June. The rainy season lasts from early June to end of September. October and November are the post monsoon months followed by a cold winter which lasts till end of February.

# CHAPTER – 4
# GEOLOGY AND HYDROGEOLOGY

## 4.1 GEOLOGY

The area is underlain by rocks belonging to the Iron Ore Group (IOG), Singhbhum Granite, Older Metamorphics and alluvium ranging in age from Archaean to Holocene. The regional stratigraphic succession has been established and is as follows:

| Group/Formation | Lithology | Age |
|---|---|---|
| **Alluvium** | Sand, silt, clay | Holocene |
| **Lower Bonai Group** (Iron Ore Group) | Basalt, tuff, meta gabbro<br>Granite<br>Shale, tuff and manganese<br>BHQ, BHJ, ferruginous shale and quartzite<br>Gritty sandstone, orthoquartzite, conglomarate | Archean to Palaeo-Proterozoic |
| **Gorumahisani Group** (Iron Ore Group) | Hornblende schist, chlorite schist, amphibolite and meta gabbro<br>Quartzite, quartz sericite schist, cherty quartzite, fushsite quartzite & black chert<br>Quartzite, chert<br>BHQ, BMQ, BCQ, BJQ<br>Ferruginous shale, carbonaceous shale, phyllites and mica schist<br>Pebbly quartzite, gritty quartzite and quartzite | Archean |
| **Singhbhum Granite** | Granite | |
| **Older Metamorphic Group** | Pellitic schist, quartzite, amphibolite | |

Pebbly quartzite, gritty quartzite and quartzite ; Ferruginous shale, carbonaceous shale, phyllites and mica schist; BHQ, BMQ, BCQ, BJQ; Quartzite, chert; Quartzite, quartz sericite schist, cherty quartzite, fushsite quartzite & black chert; Hornblende schist, chlorite schist, amphibolite and meta gabbro are the rock types in Gorumahisani Group. Similarly Gritty

sandstone, orthoquartzite, conglomarate; BHQ, BHJ, ferruginous shale and quartzite; Shale, tuff and manganese; Granite; Basalt, tuff, meta gabbro are the rock types in Lower Bonai Group. The major lithounits observed in the buffer zone have been presented in Fig. 4.1. The lithounits are as follows:

**Quartzite**

*This litho unit occurs in northwestern and southeast part of the buffer zone. These are resistant in nature and mostly occur as ridges. The ground water occurs within the fractures. The yield ranges from 3 to 5 lps.*

**Granite**

*Granite is the major rock type occurring in Bonaigarh and Sundergarh areas. The texture varies from coarse grained to fine grained aplitic types. These rocks are well foliated and joined and generally have a thick weathered zone. The weathered and fractured granites from the most productive aquifer in the terrain.*

**Banded Haematite Jasper**

*Banded Hematite Jasper/quartzite of Iron ore super group covers major part of the project area. BHJ is the parent rock of iron ore bodies. BHJ consist of alternate layers of dark, bluish grey hematite and red coloured jasper or chert. The thickness of iron and silica bands varies from less than 0.5 cm to more than 1 mt. Different structures like banding, penecontemporaneous and post depositional structures are found in these rocks. They are very resistant than the surrounding rocks, hence from hill ranges in the area.*

## 4.2 HYDROGEOLOGICAL SETUP

Hydrogeology of the study area is mainly controlled by geomorphological and geological set up and also by climatic conditions. Since major part of the study area are underlain by the hard rocks of diverse lithological composition and structure, the water bearing and transmitting properties of the formations vary widely. The area has undergone several phases of intense tectonic deformations, which has been responsible for the development of deep seated intersecting fracture system. Hydrogeological surveys in the study area brings out the bearing of lithology and tectonic deformation on the occurrence and distribution of groundwater reservoirs and their water bearing and water yielding properties in different lithological units.

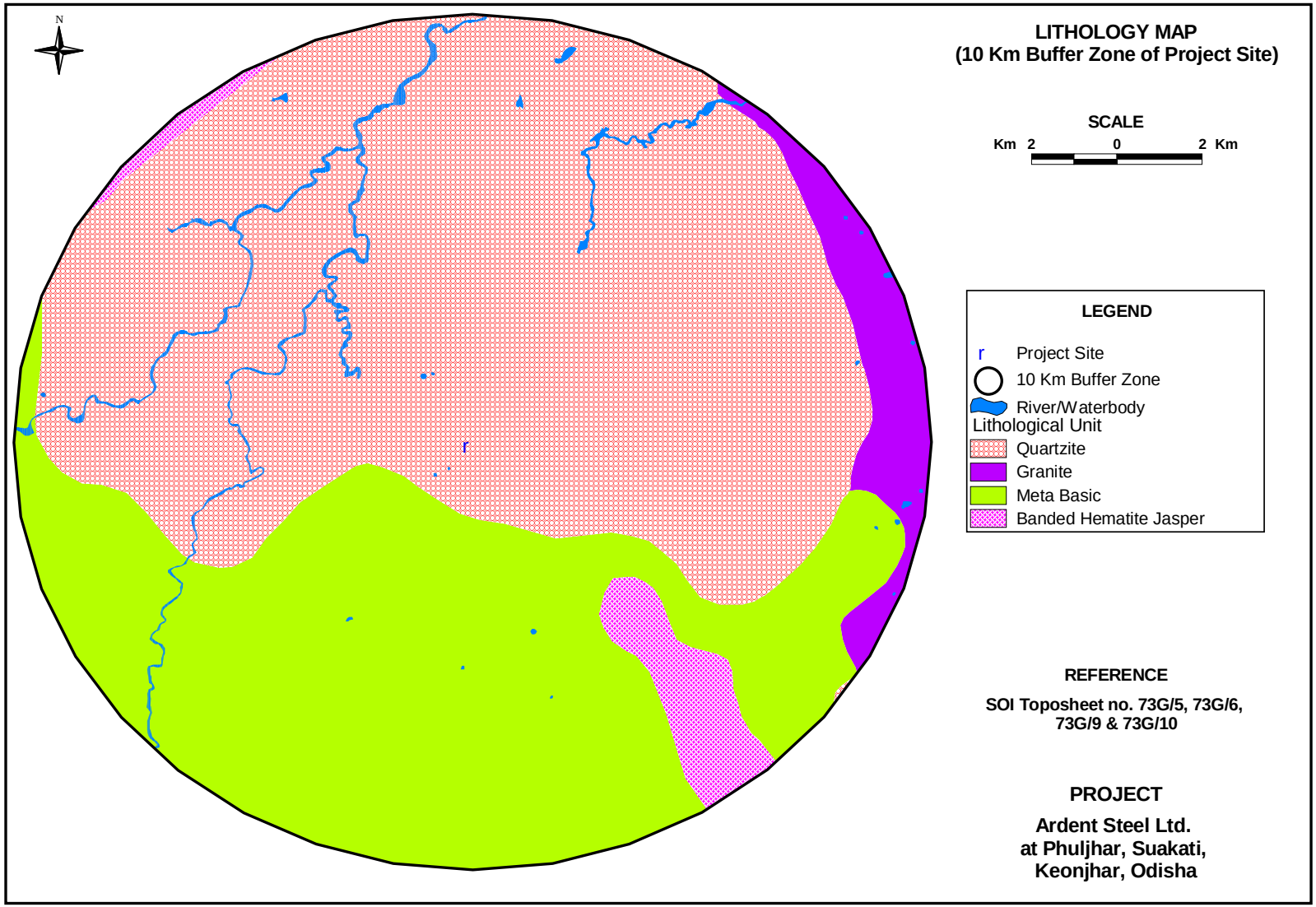

N
LITHOLOGY MAP
(10 Km Buffer Zone of Project Site)
SCALE
Km 2 0 2 Km
LEGEND
r Project Site
10 Km Buffer Zone
River/Waterbody
Lithological Unit
Quartzite
Granite
Meta Basic
Banded Hematite Jasper
REFERENCE
SOI Toposheet no. 73G/5, 73G/6, 73G/9 & 73G/10
PROJECT
Ardent Steel Ltd.
at Phuljhar, Suakati,
Keonjhar, Odisha

**Fig. 4.1**

The Consolidated Formation (hard rocks) forms the main hydrogeological unit occurring in the study area. It includes Older Metamorphic, Gorumahisani Group (iron ore group); Lower Bonai Group (iron ore group). These rocks lack primary porosity and are rendered porous and permeable by weathering and fracturing. The water yielding capability of these rocks depends entirely on the intensity of fracturing and weathering. In plateau areas lateritic capping is developed on the weathered residuum. In theses area dug wells and dug cum bore wells are suitable ground water structures.

Thin weathered zone on hilly and hill slope areas acts as temporary water bearing zone just after monsoon season and in post-monsoon season, ground water from this saturated zone is drained out as base flow and water level starts depleting very fast. The wells in this area may go dry in January/February months. Fracture zones form the deeper aquifer systems and ground water occurs under semi-confined to confined conditions. Generally 2 to 3 potential fracture zones are encountered within the depth range of 100 m. Areas occupied by other hard rock formations are having water bearing fracture zones but are less promising as compared to granitic rocks. Granite suites of rocks are having more promising aquifers (may yield more than 3 liters per second with moderate drawdown). However, the successes of bore wells are site specific (under suitable topography and hydrogeologcal conditions).

Laterites and Alluvium of Sub-recent to Recent age constitutes the unconsolidated formations. Laterite which occurs as patches as capping over the hard rock formations are usually porous in nature and form very good shallow aquifers, developed through open wells. Alluvium occurs as small patches along the courses of the Baitarani River and their tributaries. Alluvium forms good shallow aquifers to be developed through dug wells and shallow tube wells. The coarse grained sands with pebbles form the main repository of ground water.

### 4.3 GROUND WATER REGIME/DEPTH TO WATER LEVEL

Depth to water level is an important parameter of hydrogeological investigation which is mainly influenced by topography, rainfall, lithology, drainage characteristics, depth and nature of weathering and soil conditions of the area. The occurrence and movement of ground water and seasonal water table fluctuation are studied through monitoring wells established in the study area.

The depth to water level data and map shows that the pre-monsoon (April –2011) depth to water level in the study area ranges between 3.8 to 12.3 m bgl. Maximum depth to water level of 12.3m bgl is observed at Phuljhar. The data shows that depth to water level during post monsoon (November–2011) varies from 0.79 to 5.6mbgl in the wells monitored. Maximum depth to water level of 5.6 m bgl is observed at Phuljhar. The perusal of data reveals that water level fluctuation between pre to post-monsoon period is of the order at 3.01 to 8.2m. The maximum and minimum rises in water level have been observed at Kusimita and Rengalbera.

# CHAPTER – 5

# RAIN WATER HARVESTING & GROUND WATER RECHARGE PLAN FOR THE PROJECT

## 5.1 CATCHMENT CHARACTERISTICS

The proposed project comes under the Baitarani Sub-basin of Brahmani Basin (as per CGWB sources) (Fig. 5.1). The Baitarani originates from the Gonasika hills of Keonjhar at an elevation of 900 m. After flowing North-Easterly direction in its upper reaches, for a distance it runs as the boundary between Odisha and Jharkhand and turns in South-Easterly direction to join the river Brahmani and flows in to Bay of Bengal as Dhamra. At Akhuapada, the river throws off the first branch Budha and about 10 Km. downstream Genguti takes off. Budha, after flowing for about 25 Km., falls into Kharsuan, a branch of Brahmani river. The total length of the river is 365 Km. and Akhuapada (the delta head) it drains an area of 10360 Sq. Km. Its major tributaries are Deo and Salandi on the left bank and Kanjhari, Musal and Kusei on the right bank. The average annual runoff of the Baitarani at Akhuapada is about 5450 M. cum. The peak discharge recorded is 11893 cumecs. The important towns in the sub-basin are Joda, Champua, Karanjia, Keonjhar, Anandpur and Jaipur. The basin is rich in mineral wealth. Iron ore, copper, chromite, asbestos, manganese, atomic minerals, china clay and soap stone are available in Cuttack, Keionjhar, Mayurbhanj districts of Orissa and in the Singhbhum district of Bihar.

## 5.2 RAINFALL CHARACTERISTICS

Rainfall and runoff available constitute the major sources of water for artificial recharge of ground water. Rainfall is the primary source of recharge into the ground water reservoir. Rainfall in India is typically monsoonal in nature. ‘Monsoon’ literally means seasonal wind. It is basically a part of the trade wind system. The southeast trade winds and northeast trade winds converge at the Inter-Tropical Convergence Zone (ITCZ). Due to uneven distribution of land and water masses, it is crooked in shape and keeps shifting seasonally. During its northwards movement, it draws the southeast trades along with it. After crossing the equator, the winds change direction by 90 degrees (due to Coriolis force),

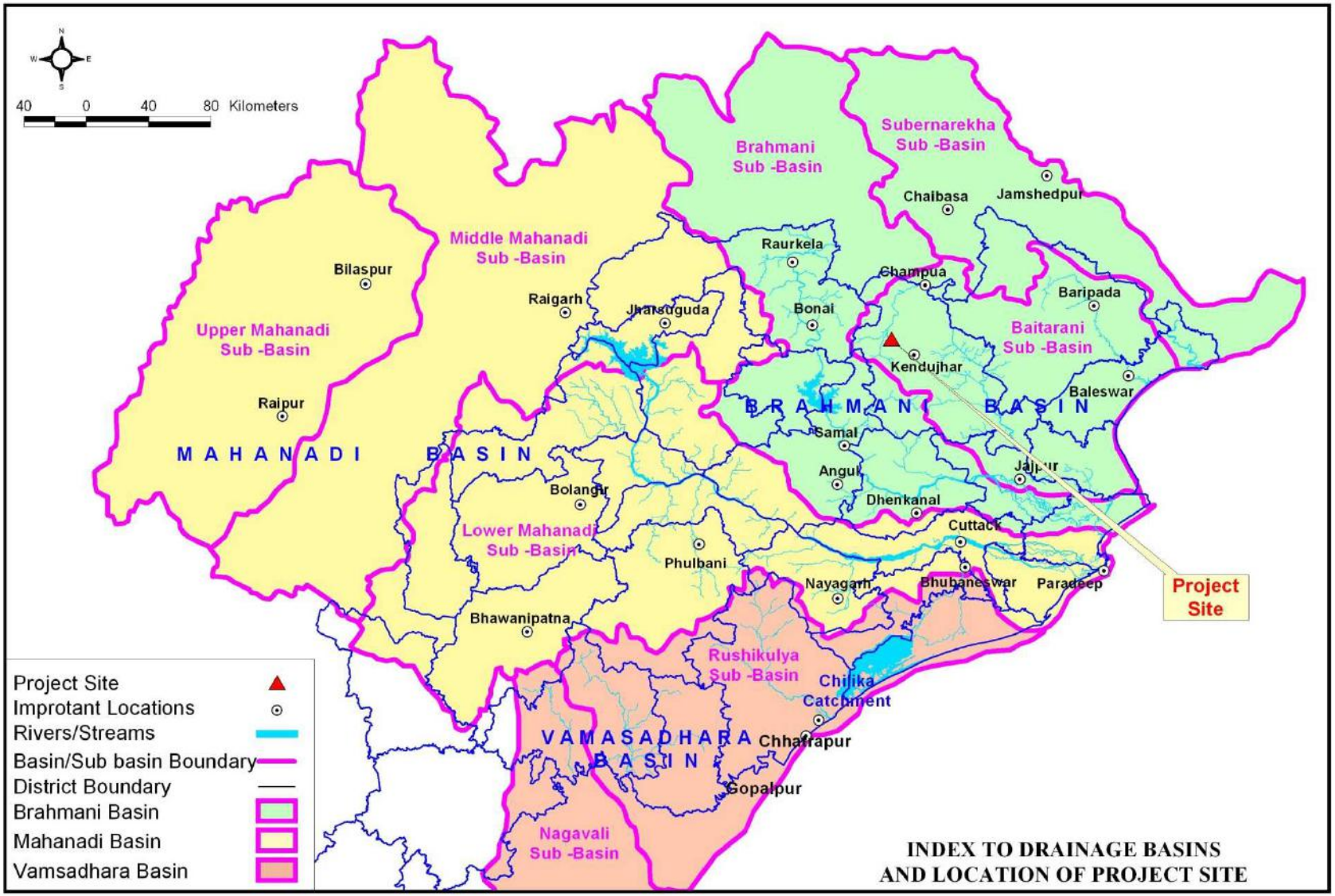

N
W
E
S
40 0 40 80 Kilometers
Brahmani Sub -Basin
Subernarekha Sub -Basin
Middle Mahanadi Sub -Basin
Upper Mahanadi Sub -Basin
Lower Mahanadi Sub -Basin
Baitarani Sub -Basin
Rushikulya Sub -Basin
Nagavali Sub -Basin
Chaibasa
Jamshedpur
Raurkela
Champua
Baripada
Bonai
Bilaspur
Raigarh
Jharsuguda
Kendujhar
Baleswar
Raipur
Samal
Angul
Jajpur
Dhenkanal
Cuttack
Bolangir
Phulbani
Nayagarh
Bhubaneswar
Paradeep
Project Site
Bhawanipatna
Chilika Catchment
Chhatrapur
Gopalpur
MAHANADI BASIN
BRAHMANI BASIN
VAMASADHARA BASIN
Project Site
Improtant Locations
Rivers/Streams
Basin/Sub basin Boundary
District Boundary
Brahmani Basin
Mahanadi Basin
Vamsadhara Basin
INDEX TO DRAINAGE BASINS
AND LOCATION OF PROJECT SITE

**Fig. 5.1**

taking a southwesterly direction. Hence, these seasonal winds are named Southwest monsoon. It lasts for four months, from June to September. While traversing the vast stretches of water, (Bay of Bengal and Arabian Sea), these winds pick up lot of moisture. On an average, annually, about 1120 mm of rainfall is received in the country. Bulk of this rainfall occurs during Southwest monsoon.

Length of rainfall data records to be considered is an important factor in the analysis of rainfall. If the frequency distribution of mean annual rainfall becomes stable after a certain period, the addition of further years of observations does not add significantly to the accuracy. The length or period of record needed to achieve stability varies between seasons and regions. As per IMD experience it is observed that rainfall data of 30 years is adequate under Indian conditions. This period encompasses dry as well as wet cycles and is called the normal period. Averages of normal periods are termed normals. These normals need updating to account for changes in environment and land use.

The long-term average annual rainfall of the State is 1482 mm. In the state, 78% of annual rainfall is received from June to September and the balance 22% is available in eight months. As the project site is located in Baitarani Sub-Basin, the nearest gauging station in Baitarani Sub-basin is Kendujhargarh. So the rainfall data of Kendujhargarh station has been taken for analysis. The available rainfall normal of Kendujhargarh is based on 60 years data (as per IMD, Govt. of India). The data has been presented in Table 5.1.

**Table 5.1: Average Rainfall and No of Rainy Days at Kendujhargarh as per IMD**

| Month | No of Rainy Days | Rainfall in mm | % of Annual Total |
|---|---|---|---|
| January | 1.4 | 21.1 | 1.47 |
| February | 2.4 | 39.0 | 2.71 |
| March | 1.9 | 23.1 | 1.61 |
| April | 3.1 | 47.4 | 3.30 |
| May | 5.9 | 95.8 | 6.66 |
| June | 10.5 | 198.0 | 13.77 |
| July | 16.8 | 356.7 | 24.81 |
| August | 15.7 | 306.2 | 21.30 |
| September | 12.7 | 221.6 | 15.41 |
| October | 5.7 | 95.8 | 6.66 |

| | | | |
|---|---|---|---|
| November | 1.5 | 29.2 | 2.03 |
| December | 0.4 | 4.0 | 0.28 |
| Annual Total | 78.0 | 1437.7 | 100.00 |
| Monsoon Total | 55.7 | 1082.5 | 75.29 |

Thus the annual average rainfall at Kendujhargarh is 1437.7 mm and the average monsoon rainfall is 1082.5 mm. The peak daily rainfall at Kendujhargarh is 273.1 mm (3rd July 1945). However, the rainfall data of recent years for Bansapal block has been given in Table 5.2 as well as Fig. 5.2 & 5.3.

**Table No.5.2: Monthly Rainfall (mm) in Banspal Block**

| Year/ Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2004 | 1 | 0 | 0 | 15 | 9 | 93 | 226 | 317.1 | 135.8 | 74 | 0 | 0 | 870.9 |
| 2005 | 3 | 2 | 0 | 0 | 24 | 196 | 357.9 | 251.5 | 187.3 | 4 | 0 | 0 | 1025.7 |
| 2006 | 0 | 0 | 0 | 32.4 | 180 | 268.7 | 324.9 | 398.1 | 228 | 17 | 34 | 0 | 1482.8 |
| 2007 | 1 | 150 | 0 | 46.2 | 30 | 132 | 520 | 452 | 446 | 3 | 33 | 0 | 1813.2 |
| 2008 | 18 | 0 | 2 | 2 | 19 | 615 | 256 | 241 | 333 | 32 | 0 | 0 | 1518 |
| 2009 | 0 | 0 | 0 | 0 | 59 | 62 | 313.5 | 104.1 | 139 | 33 | 18 | 0 | 728.6 |
| 2010 | 0 | 0 | 0 | 0 | 23 | 86 | 301.5 | 121 | 171 | 40 | 0 | 0 | 742.5 |
| 2011 | 0 | 15 | 0 | 61 | 40 | 189 | 136 | 275 | 564 | 4 | 0 | 0 | 1284 |
| **Av.** | **2.88** | **20.88** | **0.25** | **19.58** | **47.96** | **205.21** | **304.48** | **269.98** | **275.51** | **25.88** | **10.63** | **0.00** | **1183.21** |

**Fig.5.2: Monthly Rainfall in Banspal Block, Keonjhar District**

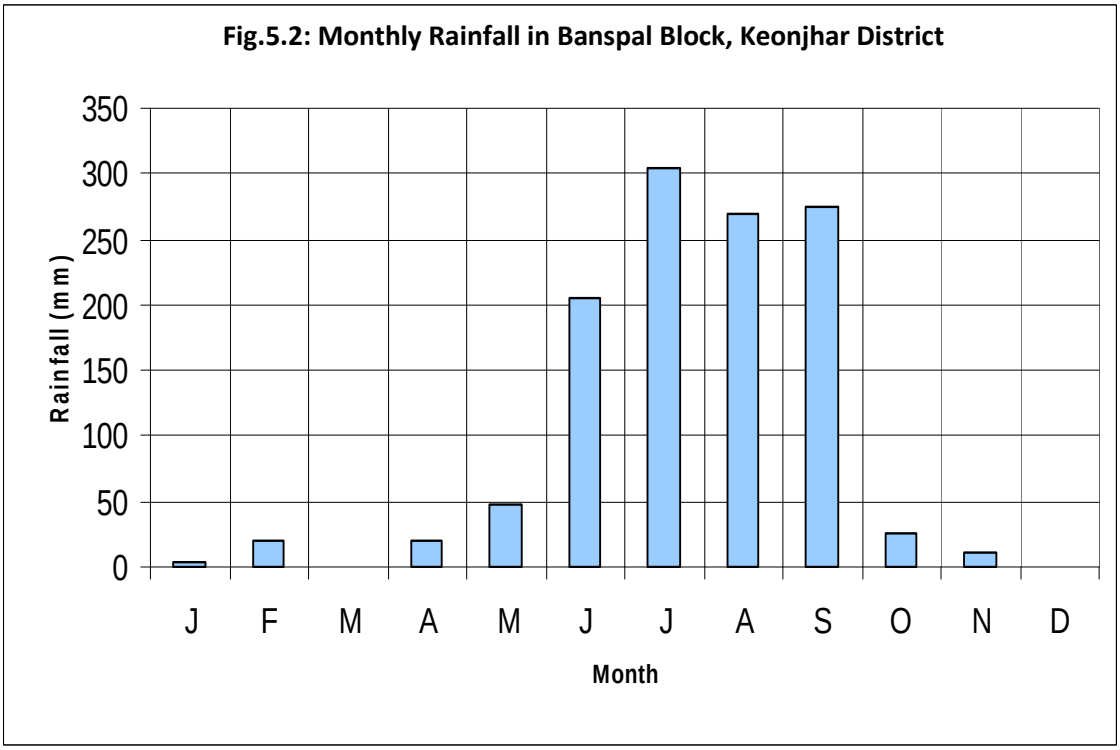
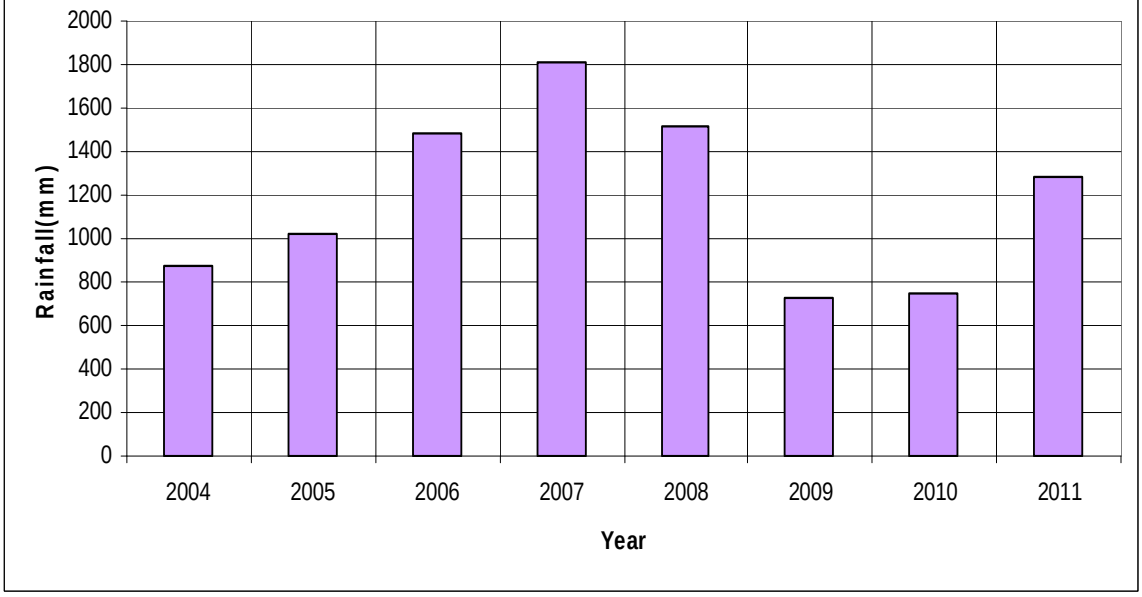



**Fig.5.3: Annual Rainfall in Banspal Block, Keonjhar District**




## 5.3 RAIN WATER HARVESTING POTENTIAL

Precise estimation of runoff is the basic and foremost input requirement for the design of recharge structures of optimum capacity. Unrealistic runoff estimates of catchments yield often leads to the construction of oversized or undersized structures,

which, in any case, must be avoided. Runoff is defined as the portion of the precipitation that makes its way towards rivers or oceans as surface or subsurface flow. After the occurrence of infiltration and other loses from the precipitation (rainfall), the excess rainfall flows out through the small natural channels on the land surface to the main drainage channels. Such types of flow are called *surface flows.* A part of the infiltrated rainwater moves parallel to the land surface as subsurface flow, and reappears on the surface at certain other points. Such flows are called *interflows*. Another part of the *infiltrated* water percolates downwards to ground water and moves laterally to emerge in depression and rivers and joins the surface flow. This type of flow is called the *subsurface flow* or *ground water flow*.

In order to harvest the rain water within the plant premises it is recommended to harvest roof top rain water from major buildings as well as surface runoff. For this purpose quantity of rain water that could be generated is calculated using the below given formula.

**Runoff = Rainfall X Catchment Area X Runoff Coefficient**

Existing Major Roof top area = 14,211 sq. m

Road, Open Stack yard and other open area = 2,41,600 sq.mt.

Coefficient of Run off for Rooftop = 0.85

Coefficient of Run off for Open area = 0.60

*(Ref. – Manual on Norms and Standards for Environment Clearance by MoEF, GOI).*

Average Annual Rainfall = 1.438 m

So, the quantity of average annual run-off from roof top is

1.438 X 14,211 X 0.85 = 17,370 $m^3$

And, the quantity of average annual run-off from open area/road is

1.438 X 241,600 X 0.6 = 2,08,453 $m^3$

Hence, quantity of average annual run-off for project area

= 17,370 $m^3$ + 2,08,453 $m^3$ = 2,25,823 $m^3$

So the total rain water that is generated and can be harvested within the bounded area of the project is 2,25,823 $m^3$.

**5.4 EXISTING/IMPLEMENTED STRUCTURES**

In respect to the existing guidelines of Central Ground Water Board as well as advice of the CGWA vide NOC obtained during 2008, the Plant has planned, developed and commissioned rain water harvesting and ground water recharge structures within the plant premises. The purpose of the structure is to harvest and store the surface run off generated inside the plant premises and surface runoff generated from the hills in the north of the plant. The harvested water is being used in the plant process. The existing structures are a combination of:

- Check dam
- Associated Rain Water Harvesting Reservoir
- Storm water drainage network connecting the reservoir

The Check Dam is a Concrete Dam constructed inside the plant area across a seasonal nala carrying the flow from the foot hills and from the plant premises. The dimension of the check dam is:

Length : 8.5m

Height : 5.5m

Width : 1.0m

The Check Dam is located at 540 m amsl and is surrounded by high land on the east, north and north-east. Maximum elevation of these lands is 724 m amsl.

The pondage area of the check dam has been further excavated to increase the volume of harvested rain water. Thus a rain water harvesting reservoir has been developed with dimension as follows:

Width = 95 m.

Length = 95 m.

Depth = 5 m.

Volume = 45,125 $m^3$

The catchment of the check dam feeds the reservoir. Moreover, the surface runoff from more than 70% of the plant areas is channelized to this reservoir. The plant has developed a well net work of storm water drainage system to drain out the rain water to this reservoir. Rainfall from all roof area, stack yard area, road and open area is being channelized to the reservoir through this drainage network. The holding capacity (volume) of the reservoir is 45125 $m^3$. The reservoir gets excess water than its capacity. The excess water overflows the

check dam through spill ways. The harvested water is being used in the plant process, dust suppression and green belt development, which in turn reduce dependency on ground water.


**Fig. 5.4: Photograph showing the Implemented Rain Water Harvesting Reservoir**

**Fig. 5.5: Existing Rain Water Harvesting Reservoir with Check Dam**

**Fig. 5.6: Implemented Check Dam**

**Fig. 5.7: Part of Implemented Drainage Network Connecting Reservoir**

## 5.5 PROPOSED STRUCTURES

However, based upon the estimation of water harvesting potential, few more structures have been proposed to add with the existing structures for effective management of water resources as well as ground water recharging. Detailed study was carried out in the plant premises of the Ardent Steel. Hydrogeological survey was carried out surrounding the area of the plant. Depth to water level was measured both during pre and Post-monsoon period. It was observed that the underlying aquifer is being fully recharged through nature process during monsoon. The aquifer has the potential to accept recharging by artificial means.

In this regard, it is noteworthy that, the plant establishment comprises of huge sheds having mostly sloping roof. In fact the total roof top area is 14211 sq. m. This roof top area generates good amount of rain water amounting to be 17,370 $m^3$ (in an average per annum as discussed in previous section). Presently all this rain water is being channelized to existing reservoir through storm water drainage network. This can be harvested and recharged to ground water system through suitable structures.

So it is proposed to group the major roof areas in to two pockets or clusters as shown in Fig. 5.8 and Fig 5.9. The small buildings may be ignored and the rain water from roof area of major sheds/buildings located in each cluster will be channelized to an artificial recharge structure located at a nearby suitable location. This channelization of roof top rain water may be done through a well designed collection gutter system of PVC pipes. Map showing the two clusters of roof top area proposed for artificial recharge and location of proposed recharge structures on plant layout has been given in Fig. 5.10.

### 5.5.1 Recharging Method

Rainwater will be recharged to ground water system through injection well at the centre of storage cum filtration chamber. Rainwater falling on the roofs of sheds will be channelized to the recharging structure. Gutter will be fitted at the end of the slanting roof for collection of rainwater. Rainfall from individual roof-sheds will be brought down through PVC Pipe and all the landing pipes will be connected to a single PVC Pipe which will be laid down underground and will be connected to the recharge structure.

An injection well up to the depth of 100 m. will be constructed or its depth will be decided during drilling of the borewell to tap probable productive fractures. 4” (102mm)

dia. PVC pipe will be lowered in a 5.5" dia. drilled borehole. The area around the pipe will be surrounded with gravel. Aquifer or fracture zones will be tapped by placing 4" dia. slotted pipe. After construction of the injection well, it will be developed with air compressor to clear the well of all suspended matter.

A storage/filtration chamber will be constructed around the injection well. The dimension of the trench will be 5.0 m x 5.0 m x 3.0 m. taking maximum rainfall intensity of 15 mm/hr. The wall of the trench is to be made of RBC structure as per the design shown in Fig. 5.11. The chamber is to be filled with filtering material i.e. gravel and medium to fine sand. The chamber is to be connected to the roof-tops through PVC Pipe. The approximate design of the recharge structure is shown in fig. 5.11.

**Fig. 5.8: Photograph showing Roof Top Clusters for Proposed Rain Water Harvesting & Artificial Recharge**


**Fig. 5.9: Photograph showing Roof Top Clusters for Proposed Rain Water Harvesting & Artificial Recharge**

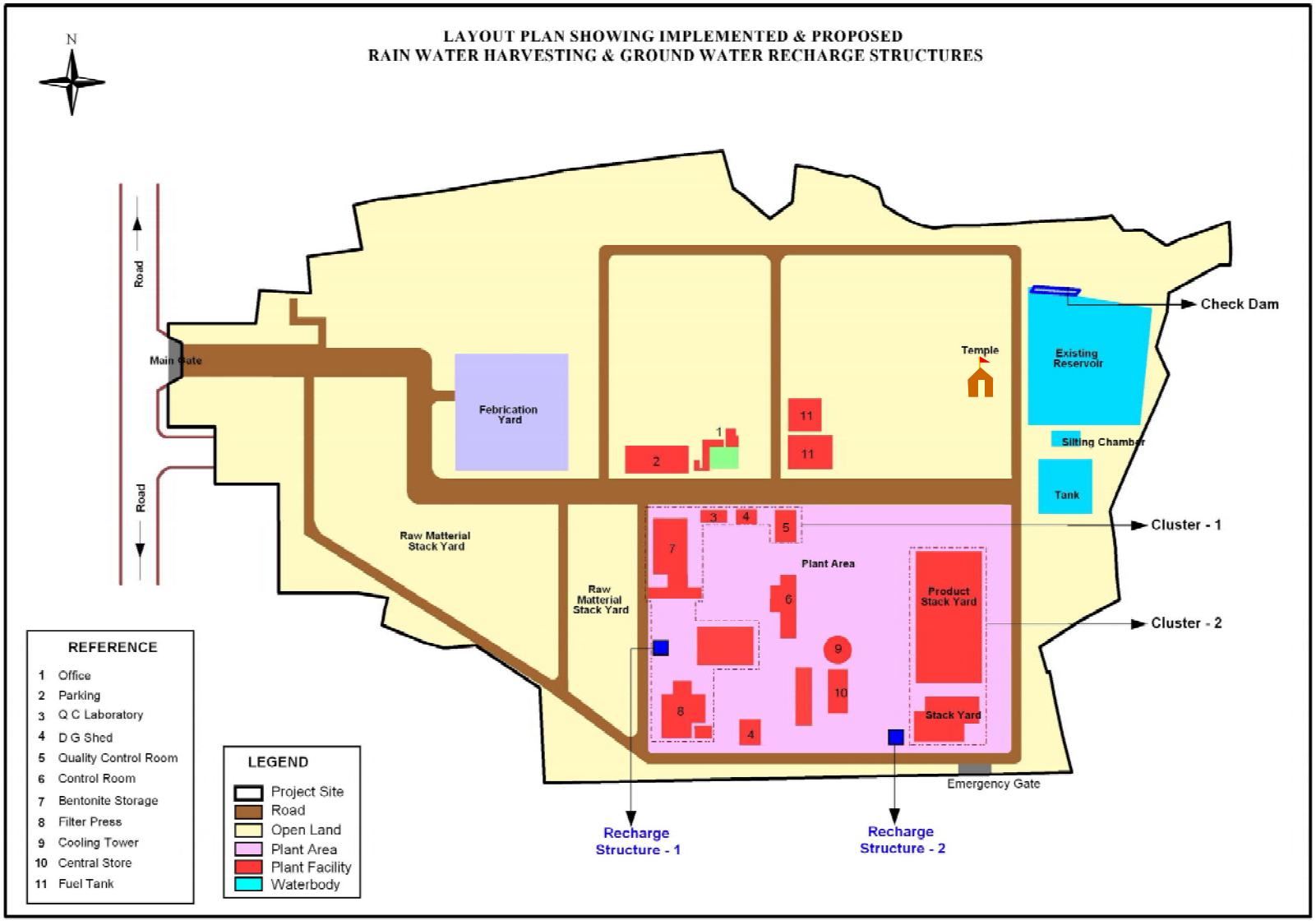

LAYOUT PLAN SHOWING IMPLEMENTED & PROPOSED
RAIN WATER HARVESTING & GROUND WATER RECHARGE STRUCTURES
N
Road
Main Gate
Road
Febrication Yard
Raw Matterial Stack Yard
Raw Matterial Stack Yard
Plant Area
Product Stack Yard
Stack Yard
Temple
Existing Reservoir
Silting Chamber
Tank
Check Dam
Cluster - 1
Cluster - 2
Emergency Gate
Recharge Structure - 1
Recharge Structure - 2
REFERENCE
1 Office
2 Parking
3 Q C Laboratory
4 D G Shed
5 Quality Control Room
6 Control Room
7 Bentonite Storage
8 Filter Press
9 Cooling Tower
10 Central Store
11 Fuel Tank
LEGEND
Project Site
Road
Open Land
Plant Area
Plant Facility
Waterbody

**Fig. 5.10**

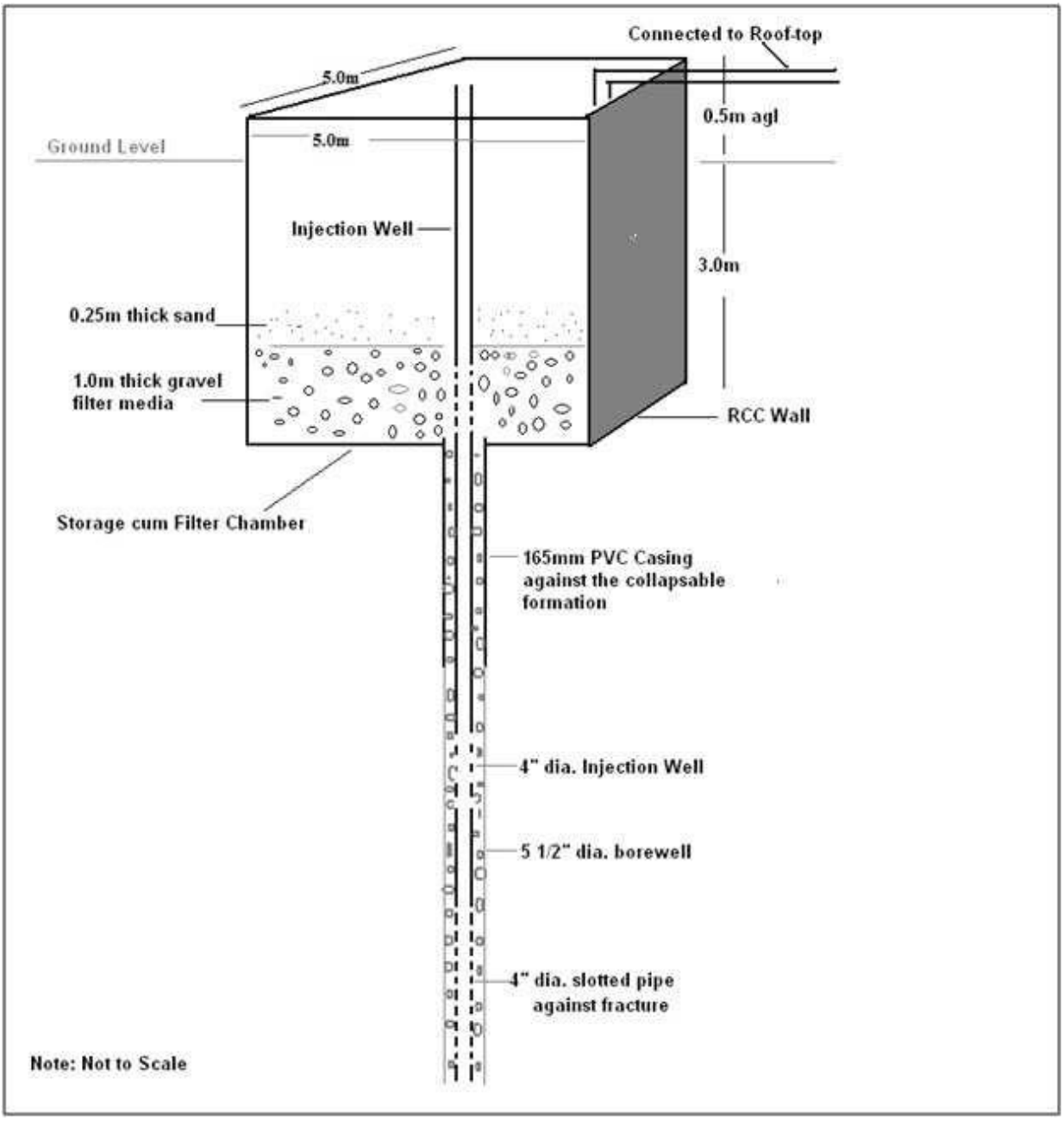



**Fig. 5.11 Design of Recharge structure**

# CHAPTER – 6

# CONCLUSION

The rain water harvesting and artificial recharge schemes will result in numerous direct and indirect beneficial impacts which include:

- Conservation and harvesting of surplus monsoon runoff in ground water reservoir which otherwise was going un-utilized outside the watershed/ basin and to sea.
- Rise in ground water levels due to additional recharge to ground water. In case where continuous decline of ground water level was taking place, a check to this and/or the intensity of decline subsequently reduces. The energy consumption for lifting the water also reduces.
- The ground water structures in the benefitted zone of artificial structures gains sustainability and the wells provides water in lean month when these were going dry. The domestic wells will become sustainable and many of the areas become tanker free.
- The cropping pattern in the benefitted zone will undergo marked change due to additionality of ground water and cash crops will start growing. Orchards which went dry earlier due to ground water scarcity may rehabilitated and new plantation be grown.
- Green vegetation cover may increase in the zone of benefit and also along the structures due to additional availability of soil moisture.
- The quality of ground water may improve due to dilution.
- Besides the direct measurable impacts, the artificial recharge schemes will generate indirect benefit in terms of decease in soil erosion, improvement in fauna and flora, influx of migratory birds, etc. Besides, the social and economic status of farmers of benefitted zone will also substantially improve due to increase in crop production.

Periodic maintenance of artificial recharge structures is essential because infiltration capacity reduces rapidly as a result of silting, chemical precipitation and accumulation of organic matter. In case of surface spreading structures, annual maintenance consists of scraping the infiltration surfaces to remove accumulated silt and organic matter. In the case

of injection wells, periodic maintenance of the system consists of pumping and /or flushing with a mildly acidic solution to remove encrusting chemical precipitates and bacterial growths on the well screens. The intervals between periodic cleanings can be extended by converting injection wells into dual purpose wells. However, in the case of spreading structures constructed with an overflow or outlet mechanism, annual desilting is a must.

Several issues are to be considered in the operation and maintenance of artificial recharge structures. These have been categorised as issues of high concern and moderate concern (ASCE, 2001). Safety, optimisation techniques and programs, value of wet-dry cycles, frequency of pond cleaning and condition of filters attached to the structures fall under issues of high concern, whereas security issues and rising ground water levels are among those of moderate concern in this regard. The following monitoring and surveillance activities are suggested to be carried out in periodic intervals:

- Measurement of Inflow and outflow rates, duration and quality of inflow and outflow into and out of each unit of the recharge system.
- Depth to water level and quality of ground water in the area being recharged and adjacent areas.
- Thickness and composition of surface clogging layer when the structure is dry (in case of surface structures).
- Precipitation and evaporation from surface ponds.

Preventive maintenance of artificial recharge structures implies a periodic action taken to forestall major repair or replacement of its components. It may be drying up and scarifying of recharge ponds, periodic pumping of recharge wells, or regular application of lubricants / protective substances to the mechanical parts or replacement of minor parts that are subject to deterioration or repeated failure. It also involves regular observation and recording of the behaviour of both static and dynamic components of the system to detect changes in their inherent condition that indicates the need for unscheduled maintenance. These include reduction in the recharge rates, temperature of mechanical parts or rate of settlement.

Maintenance of roof top rainwater harvesting system (RRHS) is simple and costs little. Cleanliness of surroundings as well as the system including its various components such as roof, gutters, filtration unit and the storage tank, will ensure supply of water of

potable quality throughout the water scarcity period for the drinking and cooking purposes of the household. The following few maintenance activities are suggested in this regard:

- Always keep the surroundings of the tank clean and hygienic
- Remove algae from the roof tiles and asbestos sheets before the monsoon
- Drain the tank completely and clean the inside of the tank thoroughly before the monsoon
- Clean the water channels (gutters) often during rainy season and definitely before the first monsoon rain
- Avoid first 15 or 20 minutes of rainfall depending on the intensity of rain. Use the first flush arrangement to drain off this first rainwater.
- Change the filter media every rainy season
- Cover all inlet and outlet pipes with closely knit nylon net or fine cloth or cap during non-rainy season to avoid entry of insects, worms and mosquitoes
- Leakage or cracks in the storage tank should be immediately attended to. This will obviate the need for major repairs caused by propagation of cracks.
- Heavy loads should not be applied on the lid.
- Water should not be allowed to stagnate in the collection pit
- The filter material should be washed thoroughly before replacing in the filter bucket