# Draft Report

## (Environmental Impact Assessment)

| Client | Project |
|---|---|
| **Dacca Steel Works Ltd. (DSWL)** | Feasibility Study For Establishment of a Modern Steel Mill of Dacca Steel Works Ltd. (DSWL) in Bogura Land, Owned by BSEC |



**Revision History**

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| 1 | 08/01/2024 | Issue for Approval | M. Hasan | K. Mansur | M.D. Hossain |
| 0 | 31/10/2023 | Issue for Approval | M. Hasan | K. Mansur | M.D. Hossain |
| Rev | Date | Reason For Issue | Prepared | Checked | Approved |

Document Title:

**Environmental Impact Assessment – Feasibility Study for Establishment of a Modern Steel Mill of Dacca Steel Works Ltd. (DSWL) in Bogura Land, Owned by BSEC**

| Document Number: | No. of Pages: | Revision: |
|---|---|---|
| **I001-RN-U-AA-00-00-03** | 130 | 1 |

| RFQ No. | Project No. | Date |
|---|---|---|
| DSWL/Contract/2023/01 | I001 | 08/01/2024 |

# Contents

# List of Figures

# List of Tables

# EXECUTIVE SUMMARY

The EIA study for the Project has identified potential impacts that are likely to arise during the construction and operational phases of the project. Potential environmental impacts are associated with air quality, solid waste, noise, surface and groundwater quality, soil quality, terrestrial biodiversity, resource use, health and safety, landscape and visual intrusion, as well as socio-economic impacts. The project is expected to bring a positive change in the socioeconomic setup of the area through the creation of jobs.

Potential Project impacts have been identified related to the project construction and operation phases. Impact predictions are based on the consultants' previous experiences on similar projects; professional judgment; data collected in the field; and discussions with local communities, relevant government officials, and relevant technical specialists. Many of the mitigation measures are related to good design practices, others with good construction and housekeeping practices.

The implementation of the mitigation measures, including monitoring, will provide a basis for ensuring that the potential positive and negative impacts associated with the establishment of the development are enhanced and mitigated to a level that is deemed adequate for the development to proceed.

# 1. INTRODUCTION

Steel is an essential component of modern civilization, especially for countries where development is proliferating. Bangladesh is no exception to that and as such demand for steel is high and still rising. Local production of steel is an established line of industry with several large manufacturers. The Government of Bangladesh (GoB) also has some initiatives in this area, under the Ministry of Industries. The corresponding government department is Bangladesh Steel Engineering Corporation (BSEC) and their sub-ordinate production wing is Dacca Steel Works Limited.

A Feasibility study including an Environmental Impact Assessment (EIA) is ongoing to analyze the establishment of a modern steel mill in the Bogura district.

## 1.1. Background

### 1.1.1. Steel Making in Bangladesh

Steel is emerging as one of the major industrial sectors in Bangladesh. It consists of small to large-scale steel melting and re-rolling plants throughout the nation. These companies primarily produce deformed bar rods of various grades, angles, channels, sheets, and coils for the construction industry.

The journey of Bangladesh's steel industry began in the late nineteen sixties with Chittagong Steel Mills Limited. Using pig iron and steel scrap as raw materials, the facility made steel in an open-hearth furnace. The 1980s saw the closure of the mill.

Since then, a large portion of Bangladesh's overall steel needs, notably those for use as concrete reinforcement, are being met by melting steel scrap. Steel was initially produced by melting scrap steel in electric arc furnaces. However, due to poor electricity conditions in the 1980s, the Bangladeshi steel industry turned to melting steel scrap in electric induction furnaces to make steel.

Following 1990, as Bangladesh's building industry continued to expand quickly, so did the steel demand, leading to the establishment of numerous sizable steel mills in the nation.

### 1.1.2. Dacca Steel Works Limited (DSWL)

Dacca Steel Works Limited (DSWL) is a subsidiary of Bangladesh Steel & Engineering Corporation (BSEC) under the Ministry of Industries. It was well-known throughout Bangladesh for making MS rods, angles, aluminum utensils, and other cast iron products. After the nation's independence in 1971, this organization was nationalized and placed under BSEC by the order of PO 16/72.

Three units make up DSWL. The first is the DSWL facility, which produces MS rod and angle. It is located at 76-78, Tongi I/A, Tongi, Gazipur, on 17 bigha of land. The second one is Ms. Prantik Traders, which was well known for producing aluminum utensils and is located in Tejgaon I/A, Dhaka, on a property measuring 5 bighas. The third one is Ms. Quality Iron & Steel Co., which is located in Tejgaon I/A, Dhaka, on 3 bighas of land and was once known for producing cast iron items. Another 18 bigha of open land belong to DSWL in Gazipur.

## 1.2. Brief Project Description

Since 1993, all DSWL locations have been closed on government directives. The Ministry of Industries, Government of the People's Republic of Bangladesh, had initiated steps to resume commercial business in DSWL after conducting a market analysis. As a follow-up, the Honorable Minister of the Ministry of Industries officiated the re-launch on 5th June 2018.

In July 2018, DSWL (BSEC) decided to upgrade the steel mill at Tongi I/A, Gazipur to produce high-quality steel products. The current DSWL Tongi location will have a contemporary micro steel plant installation to produce steel goods. BRTC of BUET conducted a feasibility assessment for the establishment of the specified factory. However, the decision was made to build the factory on the BSEC site in Bogura due to the difficulties associated with the land case.

### 1.2.1. Steel Melt Shop Production Capacity

| SN | Event | Duration (Days) | Hours |
|---|---|---|---|
| 1 | Calendar Time | 365 | 8760 |
| 2 | Holidays | 12 | 288 |
| 3 | Annual Maintenance Days (2 x 4 days) | 8 | 192 |

| | | | |
|---|---|---|---|
| 4 | Preventive Maintenance (12 hours per week) | 25 | 600 |
| | **Net availability for Steel Melt Shop** | **320** | **7680** |

| | | |
|---|---|---|
| Considered Steel Melting Duration | 320 | Days |
| | 7680 | Hours |
| Mill Utilization Factor | 90% | |
| Mill on Load | 6912 | Hours |
| Rated IF Capacity (2 x 40 Tonnes) | 80 | Tonnes |
| Average Heat Weight (100% of Rated IF Capacity) | 80 | Tonnes |
| Number of Heats per Day | 14 | |
| Liquid Steel Production | 46.67 | Tonnes per Hour |
| Yealy Liquid Steel Production Capacity | 322 560 | Tonnes |
| Yield of CCM | 98% | |
| Solid Billet Production | 45.73 | Tonnes per Hour |
| Yearly Solid Billet Production Capacity | 316 109 | Tonnes |

### 1.2.2. Steel Rerolling Mill Production Capacity

| SN | Event | Duration (Days) | Hours |
|---|---|---|---|
| 1 | Calendar Time | 365 | 8760 |
| 2 | Holidays | 12 | 288 |
| 3 | Annual Maintenance Days | 12 | 288 |
| 4 | Preventive Maintenance | 15 | 360 |
| | **Net availability for Rerolling Mill** | **326** | **7824** |

| | | |
|---|---|---|
| Considered Steel Rerolling Duration | 326 | Days |
| | 7824 | Hours |
| Mill Utilization Factor | 85% | |

| | | |
|---|---|---|
| Mill on Load | 6650.4 | Hours |
| Rerolling Yield | 95% | |
| **Yearly TMT Rebar Production Capacity** | **300 303** | **Tonnes** |
| TMT Rebar Production | 45 | Tonnes per Hour |

### 1.2.3. Proposed Steel Melting Technology

In Bangladesh, Induction Furnace is considered the most popular type of steel melting technology. Except for Abul Khair Steel and GPH Ispat, all other steel mills here use this Induction Furnace technology.

In an induction furnace, the metal charge material is melted or heated by current generated by an electromagnetic field. When the metal becomes molten, this field also causes the bath to move. This is called inductive stirring. This constant motion naturally mixes the bath producing a more homogeneous mix and assisting with alloying. The amount of stirring is determined by the size of the furnace, the power put into the metal, the frequency of the electromagnetic field, and the type/amount of metal in the furnace. The amount of inductive stirring in any given furnace can be manipulated for special applications if required.

An induction furnace has the following economic/ technical benefits:

- Low requirements on the electricity grid; also suitable for power supplied by generators driven by diesel or gas.
- Little expenditure for environmental compatibility and clean workplaces
- High yield from the metallic feed materials, above all the alloying agents
- No electrode costs
- Relatively low investment costs and small space requirement
- Largely automatic operation in a simple manner.

One disadvantage is the sensitivity of the refractory lining in an induction furnace, which is characterized by a thin wall thickness and the potential for cracks to form and cause operational halts. In addition, the quality of the scrap metal must meet higher standards for induction furnaces than for electric arc furnaces.

## 1.3. Scope of Study

This study aims to identify the baseline condition of all the identifiable parameters in the site area, followed by an analysis of anticipated impacts, which will then be used to determine mitigation measures to manage any adverse impacts.

The scope of works of the EIA includes the following major steps:

- Screening
- Baseline survey
- Stakeholder Consultations
- Analysis of Impacts (for pre-construction, during construction, and operational phase of the industry)
- Determination of Mitigation Measures
- Preparation of Environmental Management Plan

## 1.4. Methodology

The EIA will assess the impact on all the parameters identified in the Baseline.

## 1.5. Limitations

The following are the limitations of the study:

- Utilization of secondary data
- Carrying out study in 3 months, skipping primary observation of weather and climate

## 1.6. EIA Team

The EIA team is comprised of the following professionals:

- Environmental Expert

- Social Expert
- Geologist
- Metal and Metallurgical Engineer
- Civil Engineer

## 1.7. References

1. Sayem, H. M., Rizvi, A., & Khatun, M. (2020, December 31). Assessment of the compressibility behaviors of some Barind Clay samples collected from Narhatta area, Bogura. ResearchGate. https://www.researchgate.net/publication/362373654_Assessment_of_the_compressibility_behaviors_of_some_Barind_Clay_samples_collected_from_Narhatta_area_Bogura

2. Bangladesh Bureau of Statistics (BBS) Agriculture Census 2019 District Report Bogura

3. Jamal, A., Ahmed, S., Akter, S., Nahar, A., Sultana, R., Uddin, M. R., Jahan, T., Sultana, S., & Hasan, M. (2020, May 16). Spatial Variation of Rainwater Quality Parameters at Khulna City of Bangladesh. Journal of Environment Pollution and Human Health. https://doi.org/10.12691/jephh-8-2-2

4. Publications of 2011 2nd International Conference on Environmental Science and Technology IPCBEE vol.6 (2011) © (2011) IACSIT Press, Singapore

5. Bangladesh Bureau of Statistics Economic Census 2013 District Report Bogura

6. Bangladesh Bureau of Statistics Estimate of Major Crops 2021-2022

7. Yearbook of Fisheries Statistics of Bangladesh 2021-22

8. Dillon, P., W. Alley, Y. Zheng, and J. Vanderzalm (editors), 2022, Managed Aquifer Recharge: Overview and Governance. IAH Special Publication. https://recharge.iah.org/ ISBN 978-1-3999-2814-4

9. Hossain, M. F., Bari, M. N., Miah, S. U., Kafy, A. A., & Nasher, N. R. (2021, August 1). Application of modified managed aquifer recharge model for groundwater management in drought-prone water-stressed Barind Tract, Bangladesh. Environmental Challenges; Elsevier BV. https://doi.org/10.1016/j.envc.2021.100173

10. Bangladesh Air Pollution Control Rules 2022

11. Bangladesh Air Pollution Studies (BAPS): Task 5 (Industrial Emission Estimate), Department of Chemical Engineering, Bangladesh University of Engineering and Technology (ChE-BUET) and Norwegian Institute for Air Research (NILU)

12. Bangladesh Noise Pollution Control Rules 2006

13. Industrial Noise Levels in Bangladesh; Is Worker Health at Risk? (n.d.). http://www.pjoes.com/Industrial-Noise-Levels-in-Bangladesh-r-nis-Worker-Health-at-Risk-,89365,0,2.html

14. Sarkar, S. K., Ansar, S. B., Ekram, K. M. M., Khan, M. H., Talukdar, S., Naikoo, M. W., Islam, A. R. M. T., Rahman, A., & Mosavi, A. (2022, March 28). Developing Robust Flood Susceptibility Model with Small Numbers of Parameters in Highly Fertile Regions of Northwest Bangladesh for Sustainable Flood and Agriculture Management. Sustainability; Multidisciplinary Digital Publishing Institute. https://doi.org/10.3390/su14073982

# 2. LEGISLATIVE, REGULATION AND POLICY CONSIDERATION

Applicable Laws, Rules, and Regulations of the Government of Bangladesh are as follows:

## 2.1. National Environmental Policy

The National Environment Policy envisaged environment conservation, pollution control, biodiversity conservation, and mitigation of the adverse effects of climate change to ensure sustainable development.

Link:
https://moef.portal.gov.bd/sites/default/files/files/moef.portal.gov.bd/page/6ee9d54b_b349_4e85_b0da_6df1225285cb/%E0%A6%AA%E0%A6%B0%E0%A6%BF%E0%A6%AC%E0%A7%87%E0%A6%B6%20%E0%A6%A8%E0%A7%80%E0%A6%A4%E0%A6%BF%20%E0%A7%A8%E0%A7%A6%E0%A7%A7%E0%A7%AE.pdf

## 2.2. Bangladesh Biodiversity Law 2017

The law aims to conserve biodiversity and its components in Bangladesh with sustainable utilization,

Link:
http://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/5a9d6a31_d858_4001_b844_817a27d079f5/2021-10-24-05-59-f7bfc29fae5524de4af2120dd7505f07.pdf

## 2.3. Environment Conservation Act 1995 (amended in 2000, 2002, & 2010)

The Bangladesh Environment Conservation Act is an Act to provide for the conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution.

Link: http://bdlaws.minlaw.gov.bd/act-details-791.html

## 2.4. Environmental Conservation Rules 1997 (amended in 2002, 2003, 2023)

Rules aim to ensure sustainable development and prevent environmental degradation in Bangladesh by regulating activities that may have adverse impacts on the environment and human health. It includes the procedure to obtain environmental clearance and location clearance certificates and the validity thereof. Criteria and guidelines for conducting EIA and preparing an environmental management plan are also included in this. Furthermore, environmental standards for water quality, liquid waste emission, etc. regarding construction, approval, and operation of liquid/sewage waste treatment plants of industrial establishments and projects are also within this.

Link:
http://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/ad7db23c_aa9d_439f_adca_eecb06c37bd0/2023-03-15-09-20-5841d41a75596e71a58505fba9e12166.pdf

## 2.5. Noise Pollution (Control) Rules 2006

Noise pollution control rules categorize areas with allowed noise levels:

- Silent areas: 50 decibels for daytime and 40 decibels for night. The usage of horns is strictly prohibited.
- Residential areas: 55 decibels for daytime and 45 decibels for the night.
- Mixed areas: 60 decibels for daytime and 50 decibels for night.
- Commercial areas: 70 decibels for daytime and 60 decibels for night.
- Industrial areas: 75 decibels for daytime and 70 decibels for night.

Link:
http://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/ad7db23c_aa9d_439f_adca_eecb06c37bd0/2022-07-26-06-33-d580e912aee8ed9d5a04744579c0d52d.pdf

## 2.6. Air Pollution (Control) Rules 2022

The Air Pollution Control Rules in Bangladesh are established under the "Bangladesh Environment Conservation Act 1995". The rules create the National Air Quality Control Plan and the Air Pollution Prevention Plan, identify air pollution activities, and establish standards for emissions from industry, automobiles, and specific projects such as power generation, textiles, cement, and fertilizers. The main objectives of this rule are to prevent, control, and reduce air pollution.

Link:
http://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/ad7db23c_aa9d_439f_adca_eecb06c37bd0/2022-08-25-10-09-4f32bbf9444da9ba1f57af2e2fb8295a.pdf

## 2.7. Solid Waste Management Regulations 2021

The Bangladesh Solid Waste Management Rules 2021 was formulated by the government of Bangladesh to ensure proper management of solid waste. The rules include specific sub-clauses for the management of solid waste and have included Extended Producer Responsibility (EPR) for the first time in Bangladesh. The government has also developed a system to handle medical waste properly and enacted Medical Waste Management Regulations.

Link:
http://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/ad7db23c_aa9d_439f_adca_eecb06c37bd0/2022-01-09-17-12-6b986215e4bd05fd71445637b4b848b7.pdf

## 2.8. EIA Guidelines for Industries

This is a comprehensive guideline from the Department of Environment (DoE) of the Government of Bangladesh on the preparation of EIA for industries in Bangladesh.

Link:
http://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/260b2fa3_d26a_46fa_a0ce_52735287b9b9/2021-10-24-07-22-7522499caa96d7fef5649b86b7782415.pdf

## 2.9. Guidelines for Prevention of Air Pollution

This guideline outlines the process and procedures for air pollution control in Bangladesh.

Link:

http://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/260b2fa3_d26a_46fa_a0ce_52735287b9b9/2021-11-10-03-58-16e8029b3cc23341c1e004b5893825f8.pdf

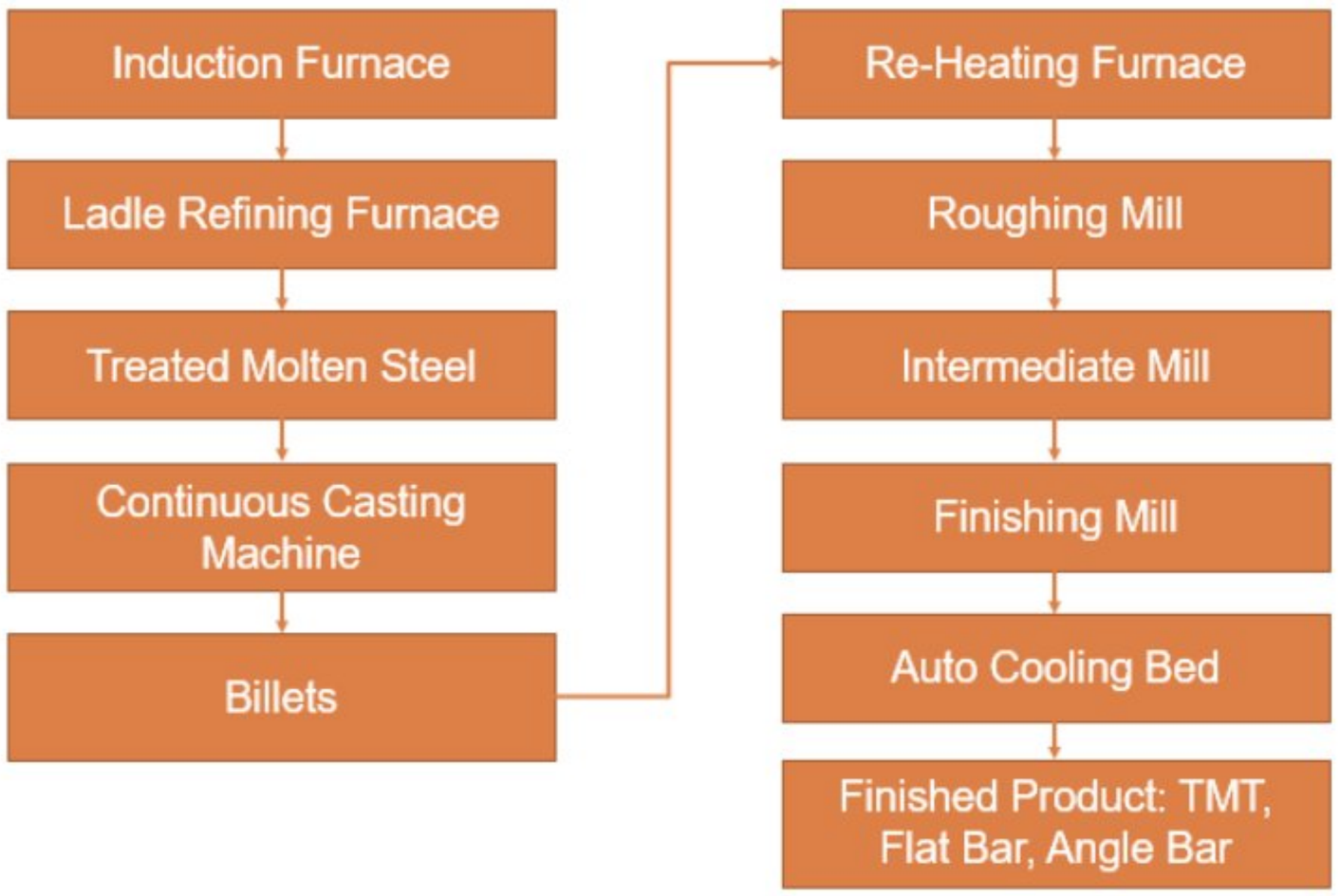
# 3. PROJECT ACTIVITIES

## 3.1. Project Need

The project will contribute to the increasing need for steel products in the country.

## 3.2. Project Description

The project will establish a steel mill to produce different types of steel products from raw materials. To realize the 300,000 TPA capacity, according to the site's actual situation, to make sure of realizing technical processes and smooth transportation on site, the equipment layout adopts the vertical crossing method and is optimized greatly, which can shorten the process and keep it running smoothly.




### 3.2.1. Manufacturing process of Steel Melting Shop with CCM

To achieve high energy efficiency, two numbers of 40 MT capacity Induction Furnaces with a higher power input capacity of 17~22 MW each will be set up with a completely automatic charging facility as well as a power-sharing panel. Electronic software will be installed to monitor the input power and maintain the power factor to almost unity level.

The melting process involves taking samples of HMS, Sponge Iron, and end cuttings from rolling mills or scraps and testing for their chemical composition. Before the preparation of the charge, necessary ingredients like Ferro Manganese, Ferro Silicon, etc. are added by weight, Flux is taken up in the crucible and then the charge is put into it.

Melting of steel along with other alloying elements is accomplished in the crucible of the coreless M.F. Induction Furnace. The high alternating current is passed through the copper oil wrapped around the outer periphery of the crucible. By transformer action, the alternating current induces a much higher secondary current at 1000 hertz in charge through the coil. Enormous heat is thus developed by resistance which causes the melting of the charge. As soon as the molten pool is formed, very pronounced stirring action in the molten metal takes place which helps in accelerating the melting. Deoxidizing agents and sometimes specific alloying elements are also added at suitable intervals during melting. Melting of homogenous mass occurs at 1600°C. If necessary, superheating up to 1650°C is done for a specific time. After the completion of the melting cycle of an hour, the homogeneous molten mass is poured hydraulically into the ladle.

### 3.2.2. LRF (Ladle Refining Furnace)

After the production of molten steel, the production of quality requires refining of the same for which one Ladle Refining Furnace will be set up with three electrodes arcing facility with complete provision to carry out de-sulphurization, and de-phosphorization if required. The liquid steel contained in the ladle will be brought to LRF and after due processing of the liquid steel, the ladle will be transferred to CCM. The slag generated during the melting as well as refining is removed manually through BELCHAS (Steel Spatulas).

### 3.2.3. CCM (Continuous Casting Machine)

The ladle containing liquid steel will be placed on the CCM platform and continuous casting of hot billet will be carried out in the same for which one R6m 4-strand CCM will be set up, the casting will be done through a highly automated controlled cooling software governed mechanism by which the casted billet will be so cooled that the temperature of billets does not fall below 1050°C. The case formation in the CCM mold starts with a drop in surface temperature below 1520°C, the liquid metal inside the case contains enough energy to maintain the overall temperature of the billet for hot online rolling. In the CCM section, hot

billet shearing machines will be installed with each casting strand, to facilitate the cutting of billets to the proper length for feeding into the rolling mill.

### 3.2.4. Manufacturing Process of Rerolled Steel through Rolling Mill

a) Raw Material i.e., Billet coming from CCM in red hot condition is cut either by Gas Cutting or automatic hot billet shearing machine. In the proposed plant automatic hot billet shear machines are going to be installed with each strand. The gas-cutting facility will be maintained as a backup to the hot billet shearing machine.

b) After the Billet is cut into the required length, then pushed out to rolling stands for re-rolling. Steel Pieces are rolled through all stands to get the required shape of finished goods i.e., TMT/Wire rod/ Bars. It is proposed to produce TMT bars at present; however, in the future, the Mills may be used to produce Wire rods or structures.

c) In case of production of TMT, the rolled bars will be passed through the TMT quenching machine and then after quenching of TMT, transferred to Cooling Bed for Cooling.

d) After Cooling, Wire rod Coils/TMT /Bars will be shifted to the De-coiling machine and after inspection, bundles will be ready for dispatch.

## 3.3. Project Site

The site is located in Bogura Sadar Upazila in Bogura District in the Division of Rajshahi. The site is located at Choypukuria, Godarpara Bazar, Bogura Sadar, Bogura. It is 1.2 kilometers west of Bogura Charmatha Central Bus Stand, towards Shantahar Road.

14.67 acres of land is available for the plant excluding the area for the Pragati Building.

A site map is provided below:

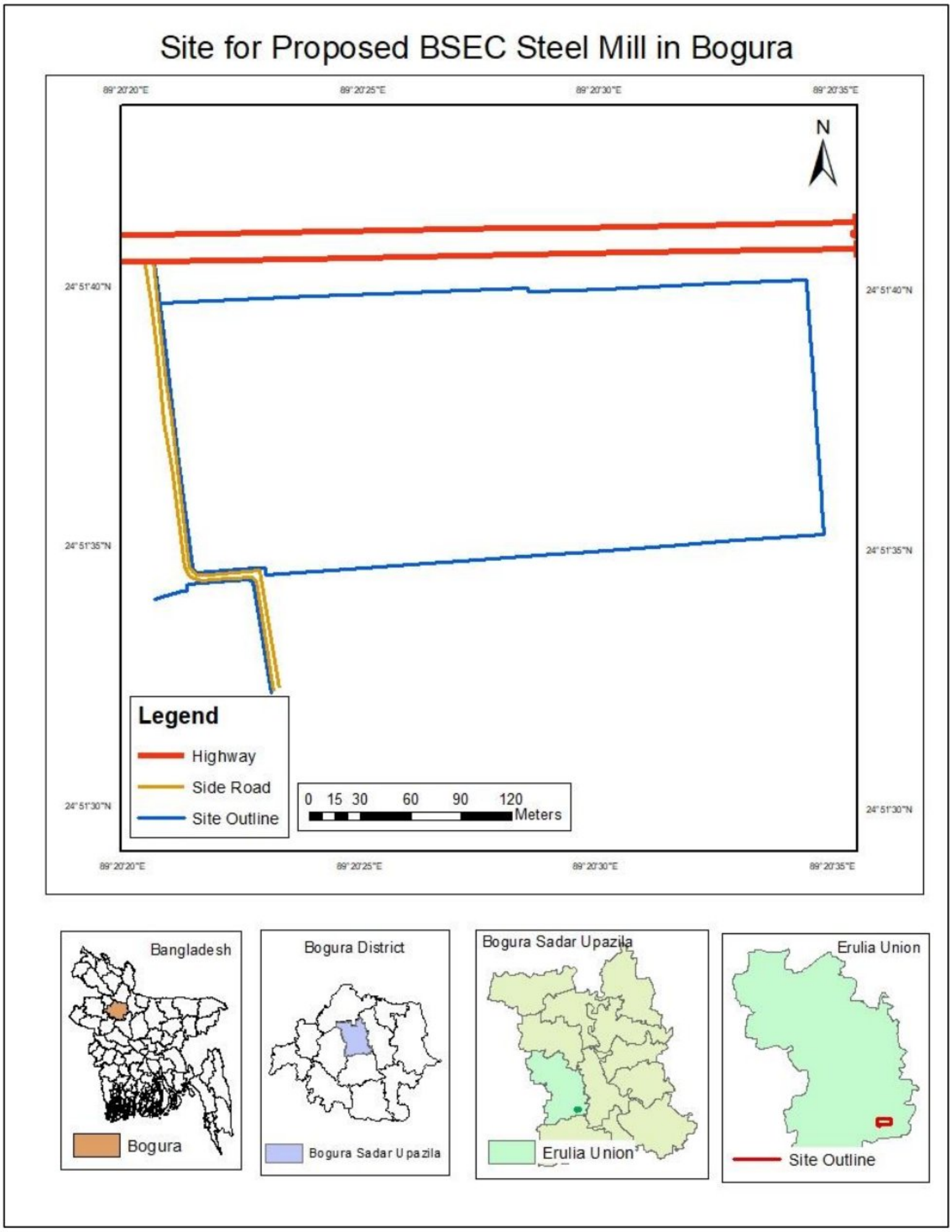



Figure 1: Site for the proposed steel mill in Bogura


Figure 2: Satellite image of the site location

# 4. PROJECT SCHEDULE

| SL. NO. | ACTIVITY DESCRIPTION | DURATION IN MONTHS |
|---|---|---|
| | | YEAR - 1 (1–12) · YEAR - 2 (13–24) · YEAR - 3 (25–36) |
| 1 | Preliminary Activities | |
| | Signing of Contract | |
| | Preparation and approval of TEFR | |
| | Preparation & issue of TS for core equipment | |
| | Receipt of offers and placement of order for core eqpt | |
| 2 | GO-AHEAD FOR THE PROJECT | |
| | Finalisation of General Layout | |
| 3 | STEELMELT SHOP | |
| | Receipt of basic data from Suppliers | |
| | Issue of TS for Auxiliary equipment | |
| | Placement of order for Auxiliary equipment | |
| | Delivery of core & auxiliary equipment at site | |
| | Civil Work | |
| | Structural Fabrication & ErectionWork | |
| | Equipment Erection Work | |
| | Trial Run | |
| | Commissioning of Steelmelt Shop | |
| 4 | ROLLING MILL | |
| | Receipt of basic data from Suppliers | |
| | Issue of TS for Auxiliary equipment | |
| | Placement of order for Auxiliary equipment | |
| | Delivery of core & auxiliary equipment at site | |
| | Civil Work | |
| | Structural Fabrication & ErectionWork | |
| | Equipment Erection Work | |
| | Trial Run | |
| | Commissioning of Rolling Mill | |
| | | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 |
| | | DURATION IN MONTHS |

# 5. RESOURCES AND UTILITIES DEMAND

The following are the key resources that will be required for the steel industry:

## 5.1. Construction

### 5.1.1. Site Development Soil

Site development by carted earth or dredged sand, sandy silt (free from any organic, foreign, environmentally hazardous substances) carried by head or truck or any other means including the cost of cutting or by dredging of sand, sandy silt, all; including local carrying, placing the earth/sand, sandy silt in the designated area, maintaining slopes, breaking lumps, leveling and dressing in layers up to finished level, etc. all complete as per direction and accepted by the Engineer-in-charge.

### 5.1.2. Cement

Based on the detailed design specifications, cement shall be Ordinary Portland Cement (conforming to the requirements of Bangladesh Standard BDS EN 197-1:2003 CEM-I 42.5 N and 52.5 N, European Standard EN 197 type CEM I, and American Standard ASTM C 150 Type-I mark) or Portland Composite Cement (BDS EN 197-1: 2003; CEM -II/A-M (V-S-L), 42.5 N)

a) Water for normal consistency: 26% to 33%

b) Fineness: Minimum 280m²/kg (by air permeability method)

c) Initial setting time, ASTM C191: Not less than 45 min

d) Final setting time, ASTM C191: Not more than 375 min

e) Minimum compressive strength: 3 days - 12.4 MPa (1800 psi), 7 days - 19.3 MPa (2800 psi), 28 days (optional): 27.6 MPa (4000 psi)

Cement shall be delivered in packages as packed by the Manufacturer with the brand name, type of cement, and weight of each bag marked on the bag. Sample tests of cement must be

done from the laboratory designated by the Engineer. Two bags from each brand or each consignment of supply of 25 metric tons of cement shall be selected for testing.

### 5.1.3. Reinforcement Bar

High tensile steel reinforcing bars shall be structural grade deformed bars specified as per ASTM A615M, and BDS 1313: 91. Bars having a minimum yield level of 500 MPa (72,500 psi designated as Grade 72.

### 5.1.4. Sand

Sand shall conform to BDS 243:1963, ASTM C33

Sand shall be either natural sand, composed of clean, hard, durable uncoated particles resulting from the disintegration of siliceous and/or calcareous rocks; or manufactured sand resulting from the crushing of boulders or shingle.

Sand shall be clean and free of injurious amounts of organic impurities; deleterious substances shall not exceed the following percentages by weight:

- Clay Lumps and friable particles – maximum: 3%
- Coal and Lignite: 0.25%
- Material passing the 0.075 mm (No. 200) sieve: 1 %
- Shale, coal, soft or flaky fragments: 1 %
- Sulfur compounds: 0.3%
- Organic material content: no organic material

Sand shall be well graded from course to fine and shall conform to the following Fineness Modulus:

- Concrete: 1.5 to 2.5
- Mortar: 1.5

- Filling sand: 0.8 to 1.0

Sand from different sources of supply shall not be mixed and stored in the same stockpile nor used alternately in the work without permission from the Engineer.

### 5.1.5. Coarse Aggregate

Coarse aggregate shall confom1 to BDS 243:1963 (Coarse and Fine Aggregates from Natural Sources for Concrete 1; ASTM C 33: Concrete Aggregates).

The nominal maximum size of coarse aggregate in concrete shall not be larger than:

a) One-fifth of the narrowest dimensions between sides of forms; or

b) One-third the depth of slabs; or

c) Three-fourths the minimum clear spacing between individual reinforcing bars or wires, bundles of bars, or pre-stressing tendons or ducts.

The boulders to be used for coarse aggregate in concrete shall be composed of limestone, sandstone, granite, trap rock, or rock of a similar nature and shall have the following properties:

- Compressive strength (minimum): 35 MPa (5000 psi)
- Specific gravity: 2.2-2.6
- Unit weights: 22-25.1 kg/cum
- Porosity: 2.10%
- Water absorption (maximum): 2.5% by wt

The boulder shall be of uniform light color as approved and shall be free of thin laminations, adherent coatings, and deleterious substances. The wear loss of coarse aggregate of all types shall not exceed 35% by weight when tested by the Los Angeles Abrasion Test

### 5.1.6. Bricks

First Class Bricks shall comply with the following requirements of BDS 208: 1980 (Common Building Clay Bricks-First Revision)

Picked Jhama Bricks shall be over-burnt First Class Bricks, uniformly vitrified throughout with good shape, hard, slightly black, and without cracks or spongy areas. Minimum compressive strength shall not be less than 28N/mm1 (4000 psi). All other requirements for First Class shall apply to Picked Jhama except for dimensions.

### 5.1.7. Water

The water used in mixing and curing concrete shall be tested for chlorides and sulfates in a standard material-testing laboratory as directed by the Engineer. The maximum acceptable limits shall be as follows:

- 100 mg/L as $SO_3$ for sulphates
- 500 mg/L as Cl ion for chloride

Water shall be clear and free from salt, oil or acid, vegetable, or other substances injurious to the finished product. Water used in construction work shall be potable.

### 5.1.8. Admixtures

Admixtures used to modify the normal plastic life of concrete mix or for influencing its rate of gaining hardness and strength or for the workability of concrete shall not be used except with the written approval of the Engineer.

Admixture if specified or permitted shall conform to the requirements of AASHTO Standard Specification M-194/ASTM, C-494, or ASTM C-l017.

It shall be kept in mind that a small change in the amount of Admixture may cause great change in their action and their adequacy of performance is difficult to measure at the construction site during the progress of work. Water-reducing admixture, accelerating admixture, water-reducing and retarding admixtures, water-reducing and accelerating admixtures shall conform to ASTM

C-494 (Chemical Admixtures for Concrete) or ASTM C-l017 (Chemical Admixtures for use in producing flowing concrete).

## 5.2. Operation

### 5.2.1. Water

Approximately 6900 m³ water will be utilized in the plant every hour for various actions. This water will go through various cooling and treatment processes to be reused in a closed loop.

Table 1: Water requirements in the proposed steel plant

| No | Consumer | Qty | Flow Rate (m³/h) | Inlet Pressure (MPa) | Outlet Pressure (MPa) | Inlet Temp. (°C) | Outlet Temp. (°C) | Water Type |
|---|---|---|---|---|---|---|---|---|
| 1 | 40T Induction Furnace Cooling | 2 | 600 | 0.20-0.25 | 0.15-0.20 | 35 | 47 | Soft Water 1 |
| 2 | Induction Furnace Power Supply Cooling | 2 | 120 | 0.15-0.20 | 0.10-0.15 | 35 | 43 | Soft Water 1 |
| 3 | Rectifier Transformer Cooling | 2 | 100 | 0.1 | | 35 | 43 | Soft Water 1 |
| 4 | Sintering Panel Cooling | 2 | 80 | 0.2 | | 35 | 50 | Soft Water 1 |
| 5 | Sintering Panel Transformer Cooling | 2 | 30 | 0.2 | | 35 | 50 | Soft Water 1 |
| 6 | CCM | 1 | 650 | 0.9-1.0 | 0.4 | 35 | 45 | Soft Water 2 |
| 7 | 40T Ladle Refining Furnace Cooling | 1 | 280 | 0.30-0.40 | | 35 | 55 | Soft Water 3 |
| 8 | Secondary water | 1 | 1300 | 0.5 | 0.2 | | | Soft |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | for evaporative cooler | | | | | | | Water 3 |
| 9 | Water for rolling mill | 1 | 405 | 0.4 | | 35 | 47 | Soft Water 3 |
| 10 | Water for hydraulic equipment | 1 | 180 | 0.4 | | 35 | 47 | Soft Water 3 |
| 11 | Water for reheating furnace | 1 | 100 | | | | | Soft Water 3 |
| 12 | Unpredicted Consumption | 1 | 150 | | | | | Soft Water 3 |
| 13 | Cooling water for the secondary cooling segment | 1 | 240 | 0.9-1.0 | | 35 | 60 | Soft Water 3 |
| 14 | Direct circulating cooling water of the rolling mill | 1 | 685 | 0.4 | | 35 | 45 | Soft Water 3 |
| 15 | Cooling equipment | 1 | 500 | 0.6 | | 35 | 45 | Soft Water 3 |
| 16 | Direct cooling water for CCM equipment | 1 | 200 | 0.3-0.4 | | 35 | 55 | Soft Water 4 |
| 17 | Scale flushing water of CCM | 1 | 200 | 0.3-0.4 | | 35 | 55 | Soft Water 4 |
| 18 | Scale flushing water of the rolling mill | 1 | 150 | 0.3 | | 35 | 45 | Soft Water 4 |

Table 2: Soft water quality requirements in the proposed steel plant

| Item | Unit | Soft Water 1 | Soft Water 2 | Soft Water 3 | Soft Water 4 |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Total Hardness | mg/L ($CaCO_3$) | < 2 | < 20 | ≤ 150 | ≤ 240 |
| M-Alkility | mg/L ($CaCO_3$) | | | ≤ 90 | ≤ 200 |
| Suspended Solids | mg/L | < 5 | < 20 | < 20 | < 30 |
| Total Salinity | mg/L | | | ≤ 500 | |
| Sulphates ($SO_4^{2-}$) | mg/L | | ≤ 50 | ≤ 100 | ≤ 200 |
| Chlorides ($Cl^-$) | mg/L | 2 | ≤ 50 | ≤ 100 | ≤ 200 |
| Soluble Silica ($SO_2$) | mg/L | | | < 40 | < 120 |
| Iron | mg/L | | ≤ 1.5 | 0.5~3 | ≤ 5 |
| Oil | mg/L | | | | ≤ 5 |
| Conductivity | µs/cm | < 15 | ≤ 500 | ≤ 600 | ≤ 1200 |

Approximately 60 MW of electric power shall be derived from the PGCB 132 kV line via the NESCO distribution system.

### 5.2.2. Gas

Gas will be required in Melt Shop in units like ladle and tundish preheater, billet cutting, scrap cutting, metal cutting, tundish cleaning, etc. In addition, gas is also required in Rolling Mill units such as RHF, cobble cutting, etc.

208,000 and 910,000 $Nm^3$ of natural gas will be required every month in Melt Shop and Rolling Mill respectively. This 1,118,000 $Nm^3$ of natural gas shall be derived from the PGCL grid.

Besides 7,800 and 2,600 $Nm^3$ of oxygen gas will be required every month in the Melt Shop and Rolling Mill respectively. This 10,400 $Nm^3$ of oxygen gas shall be derived from the installed Oxygen Production Plant.

In addition, 3 and 3 bottles of argon gas will be required per month in Melt Shop and Rolling Mill respectively. These 6 bottles of argon gas shall be collected from the approved vendors.

### 5.2.3. Raw materials

Plant production capacities are listed below:

| | | | |
|---|---|---|---|
| Yealy Liquid Steel Production Capacity | : | 322 560 | Tonnes |
| Yield of CCM | : | 98% | |
| Yearly Solid Billet Production Capacity | : | 316 109 | Tonnes |
| Rerolling Yield | : | 95% | |
| Yearly TMT Rebar Production Capacity | : | 300 303 | Tonnes |

Considering the 95% yield of molten steel production, the raw material requirement would be 339 536 tonnes. A typical raw material percentage is considered as shown below:

Table 3: Raw material requirements in a year

| Raw Materials Category | % | Total Quantity (Tonne per Annum) |
|---|---|---|
| HMS-1 & PNS | 35 | 118 838 |
| HMS-2 & LMS | 15 | 50 930 |
| Shredded | 20 | 67 907 |
| NTP Bundles/ Tin Bundles/ Sponge Iron | 15 | 50 930 |
| CI/ Busheling/ Blue Steel & Others | 13.5 | 45 837 |
| Alloy (Fe-Si, Fe-Mn, Si-Mn) | 1.5 | 5 093 |
| **Total** | **100** | **339 536** |

Purchased and self-produced scrap will be used as raw materials. The quality requirements are as follows:

- The scrap for melting should be kept dry, and shouldn't carry ice and snow, closed containers, explosives, oily cuttings, nonferrous metal, radioactive substances, obvious refractories, slags, and other impurities.
- Large amounts of nonferrous metals in the motor should be cleaned in time.
- Unless melting special steel grade, the content of residual elements like Copper, Nickel, Chromium, Lead, etc. in scrap should be within the required range of steel grade., the Lead element that has great damage to the service life of the furnace body should be removed from scrap raw material.
- The requirement of scrap size is as follows:

- Density of scrap > 0.7 tonne/m³
- Maximum length ≤ 500 mm
- Maximum section <100 mm × 200 mm
- Maximum unit weight ≤ 100 kg

Table 4: Scrap material specifications

| Scrap Type | Unit Weight (kg) | Length (mm) | Breadth (mm) | Thickness (mm) |
|---|---|---|---|---|
| Heavy | < 70 | < 400 | ≤ 300 | ≥ 40 |
| Medium | < 50 | < 600 | ≤ 300 | ≥ 6 |
| Thin | < 30 | < 600 | ≤ 300 | ≥ 6 |

- No motor cylinder of the automobile in the scrap for melting
- When sorting scraps, wasted heating radiator, cast iron pipe, valves, and other iron casting and motor vehicle track should be sorted and stocked separately.

## 5.3. Waste management

The industrial melting course will generate a huge amount of fume and dust, fume which contain Carbon Monoxide, fluoride, and other harmful gases to become one of the main sources of pollution. Large amounts of dust will seriously pollute the working environment and affect the physical and psychological health of workers. To improve the working environment, protect the physical and psychological health of workers, and improve the air quality inside and outside the factory area, dedustor equipment is equipped to draft waste gas in the furnace effectively, during the production process.

Fume is collected with a fume collecting cover placed in the melting workshop. The original fume temperature is about 800~1150℃, the cooled and collected fume temperature is <130℃ and will be guided into the bag-type dedustor shared by the two IFs and one LRF, then discharged into air after being filtered.

A residual substance that is produced in liquid form during the steel-making process is called steel slag. The floating steel slag is detached from the molten steel surface towards the end of the steel-making process, and the molten steel then solidifies into a solid product.

The slag is subsequently crushed by dropping a huge steel ball or a solid steel cylinder on top of the solidified slag. Until the desired aggregate size is obtained, the crushing and grading procedure is repeated. Electromagnetic recovery of metallic iron particles is used.

The construction agencies are then given the slag in the form of construction aggregate. Since there is a shortage of high-performance aggregate, it must compete with natural aggregate. This highlights the value of substitute aggregates such as steel slag. These are therefore useful goods, not wastes, and they may help the environment. Steel slag utilization is a multi-step process that starts with steel slag production and ends with finished goods. It is not anticipated that successful utilization will occur in one step.

Table 5: Waste material generation and subsequent management in the proposed steel plant

| SN | Source | Item | Generation (Tonnes) | In-Plant Use | Outside Disposal | |
|---|---|---|---|---|---|---|
| 1 | Induction Furnace | Slag | 18,750 | 0 | 18,750 | Will be disposed of for landfilling or road construction or selling to authorized recycler |
| 2 | Ladle deslagging | Slag | 1,750 | 0 | 1,750 | |
| 3 | Dust | Slag | 2,650 | 0 | 2,650 | To be sold to authorized recycler |
| 4 | Continuous casting machine | Recovered Scrap | 2,500 | 2,500 | | |
| 5 | Rolling Mill | Recovered Scrap | 10,000 | 10,000 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | Mill Scale from Reheating Furnace + Rolling Process in Rolling Mill | | 4,750 | | | |
| 7 | Broken Refractories from Billet Reheating Furnace | | 3,250 | | 3,250 | Will be disposed of for landfilling or road construction. |
| 8 | Scrap | Sorted Cu and Al | 500 | | 500 | To be sold to authorized recycler |
| 9 | Scrap | Mud and Rubbish | 3,250 | | 3,250 | To be sold to authorized recycler |

### 5.4. Wastewater Treatment

The characteristics of wastewater from steel mills can be summarized as follows:

a) High concentration: Wastewater generated during steel production contains a large number of suspended solids and dissolved solids, such as iron, manganese, chromium, nickel, and other metal ions, as well as organic substances such as acids, alkalis, and oils.

b) High temperature: Certain processes in steel production, such as cooling water and sintering water, can generate high-temperature wastewater, which needs to be cooled before discharge or treatment.

c) Strong acidity or alkalinity: The use of chemical reagents, such as acids and alkalis, in the steel production process often results in wastewater with high acidity or alkalinity, requiring neutralization treatment.

d) Complex composition: The wastewater from steel mills contains a complex mixture of organic compounds, metal ions, minerals, salts, and other substances, which can have a certain environmental impact.

e) Presence of filler materials: Steel mill wastewater often contains a significant number of solid particles, such as carbon black and dust, which present challenges for treatment and filtration.

In summary, the characteristics of wastewater from steel mills include high concentration, high temperature, strong acidity or alkalinity, complex composition, and the presence of filler materials. These characteristics determine the need for specific treatment technologies and measures to ensure compliance with discharge standards and environmental protection.

Table 6: Wastewater properties[1]

| S.NO | Parameter | Units | Results | | |
|---|---|---|---|---|---|
| | | | Min | Max | Average |
| 1. | T ($C^0$) | $C^0$ | 35.00 | 48.00 | 39.43 |
| 2. | Odor | TON | 7.00 | 13.00 | 9.57 |
| 3. | pH | -- | 7.59 | 8.01 | 7.79 |
| 4. | E.C | µs/cm | 805 | 912 | 861.86 |
| 5. | TSS | mg/l | 75 | 95 | 84.57 |
| 6. | TDS | mg/l | 1333 | 1824 | 1722.14 |
| 7. | Turbidity | NTU | 25 | 55 | 36.43 |
| 8. | BOD5 | mg/l | 15.00 | 20.00 | 17.57 |
| 9 | COD | Mg/l | 45 | 95 | 76.25 |
| 10 | Iron | mg/l | 2.54 | 3.87 | 3.28 |
| 11 | Cupper | mg/l | 0.22 | 1.25 | 0.49 |

## 5.5. Sewage Disposal

Sewage treatment system is designed for the capacity of 20 $m^3$ per day, considering 200 people generating 100 liters of wastewater everyday.

[1] Mohammad, N., Ullah, Z., & Naz, R. (2014, February 19). Study of Steel Re-Rolling Mill for Mitigation Measures with Special Reference to Water Recycling. ResearchGate. https://www.researchgate.net/publication/260244184_Study_of_Steel_Re-Rolling_Mill_for_Mitigation_Measures_with_Special_Reference_to_Water_Recycling

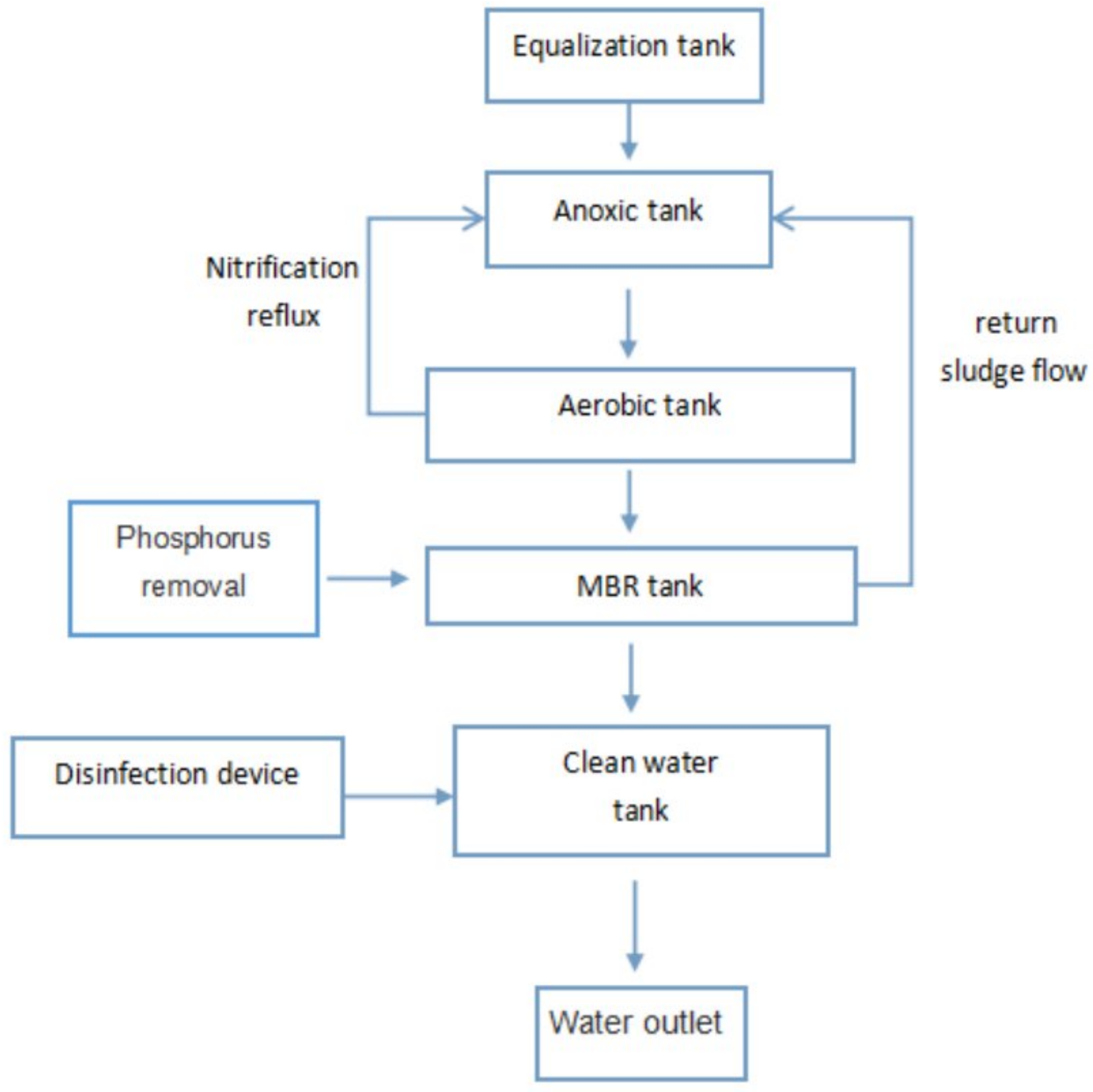



Figure 3: Sewage waste management schematics for the proposed steel plant