Pre-Feasibility Report

on

Copper Project

Products:
- 1,000,000 TPA Copper Cathode
- 500,000 TPA Copper Rod
- 3,000,000 TPA Sulphuric Acid
- 500,000 TPA Phosphoric Acid
- 30,000 TPA Aluminum Fluoride

Adani Enterprises Limited (AEL)
Mundra
Gujarat
April, 2016
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CHAPTER – 1
Executive Summary

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1.1. Introduction

About ADANI Group

The Adani Group is one of India’s leading business houses with revenue of about $9.4 billion for financial year 2014. Adani is a global integrated infrastructure player with businesses spanning coal trading, coal mining, oil & gas exploration, ports, multi-modal logistics, power generation & transmission and gas distribution. With success responsibility also comes, so we take care to reinvest in protecting and developing the communities within which we operate.

Since Adani was founded in 1988, its revenue, assets and market capitalization have increased exponentially. After creating its mark in India, Adani has expanded its operation in Indonesia and Australia by acquiring coal mines and ports.

The holding company of the Group is Adani Enterprises Ltd. It was ranked among the top 50 Asian companies by Forbes Asia in 2009. Adani Enterprises is quoted on the Indian stock exchange, together with its two subsidiary companies - Adani Ports & SEZ and Adani Power.

Adani Enterprises Limited (AEL), would implement the Copper Project at Mundra, Gujarat.

1.2. Brief Description:

The project cost estimated to be around US $ 1.5 billion (Rs. 10,000 crore) includes Copper Smelter, Sulphuric Acid Plant, Copper Refinery, Continuous Cast Copper Wire Rod Plant, Precious Metal Recovery Plant, Phosphoric Acid
Plant, Aluminum Fluoride Plant, etc. The project would be located in Mundra, Gujarat will produce 10 LTPA of Copper Cathode; 5 LTPA of Copper Rod; 30 LTPA of Sulphuric Acid; 5 LTPA of Phosphoric Acid; 30,000 TPA of Aluminum Fluoride, 288 TPA of Selenium, 50 TPA of Gold; 500 TPA of Silver; etc with state of art environment friendly technology.

The following were the principle objectives, kept in mind while working on the feasibility of this proposal,

- Adopting environment friendly technology & Equipment and working on reduction of pollution load in air, water & solid waste.
- Conserving natural resources like water, Thermal & electrical energy.
- Waste reduction and recycling options.
- Aiming at waste heat recovery to best possible extent by state of art proven technology
- Value added By- Products.

Plant Configuration:

a. Copper Smelter Plant – 9 LTPA
b. Copper Refinery Plant – 10 LTPA
c. Continuous Cast Copper Rod Plant - 5 LTPA
d. Copper Scrap Melting Facility - 1 LTPA
e. Sulphuric Acid Plant – 30 LTPA
f. Phosphoric Acid Plant - 5 LTPA
g. Aluminum Fluoride Plant - 30,000 TPA
h. Selenium Recovery Plant - 288 TPA
i. Precious Metal Recovery Plant
   i. Gold – 50 TPA
   ii. Silver – 500 TPA
j. Oxygen (Industrial) Plant – 90,000 TPM (95% Purity)
k. Waste Heat recovery boiler based power plant – 50 MW
The advanced cutting edge, state-of-the-art technology of the Copper products will give superior product quality, which will provide easy market penetration of the product in India as well as overseas.

Major equipment of Copper project would be transported through sea and would be unloaded in Mundra Port.

1.3. Market Outlook:

Copper is considered to be the third most important industrial metal next only to iron and aluminium. The superior properties of copper such as its benchmark in electrical and thermal conductivity, without sacrificing performance and energy efficiency, make it valuable across industries.

The average expected growth of the construction industry of approximately 7% to 9% will continue to drive the demand for copper building wires. Improvement in living standards on account of per capital income growth will increase the density of copper usage in building wires as well.

The government of India has targeted 100% electrification of all rural houses by 2019. Also government by allowing foreign direct investment in the sector of telecom has accelerated the tele-density. The tele-density and broadband connectivity of 10 million subscribers (targeted) will create a huge opportunity for copper in India.

To support the average GDP growth of about 7% during the last 3 years there has been a considerable increase in primary energy demand. The growth in secondary source such as electricity was more than 10%. Therefore, India's priority is to increase availability by adding additional 70% of generation capacity by 2019. The aim is also to improve supply side efficiency by strengthening the distribution system and reducing the system efficiency. All this will result in an increase in demand for copper in power generation, transmission and distribution.
For the last 3 years the industry production is growing at an average rate of 7% to 8%. The growth rate is expected to remain similar in the future. For improving efficiency in the core industry sector, India needs more reliable electricity at cheaper cost. This will create demand for more energy efficient wires, bus-bars and additional potential in heat exchange products. All this can be achieved with copper.

Government’s target of saving the equivalent of 23,700 MW in power generation capacity, by investing in energy conservation initiatives, will create additional demand for copper used in products, systems and appliances.

Wind power installed capacity has grown by 12 times in 10 years with an installed capacity of 4,200 MW till date. As per the new and renewable policy statement 2005, Ministry of Non-conventional energy sources is targeting wind, solar biomass, hydro and nuclear power sources in order to achieve the targets.

With increased focus on Climate change across the world enhancing Solar Power and Wind power sector is become priority for all the countries. India and China are the world leaders in taking up huge targets.

- Every GW of Solar Energy requires 6000 MT of Copper whereas
- Every GW of Wind Energy requires 3840 MT of Copper.

The automobile sector in India is growing at the rate of 16% pa and is expected to have similar growth in the future. The increase in sophistication and size of passenger vehicles will give rise to a higher density of auto wiring harnesses.

Conversion from oil fuel to electricity has created a niche for copper in railway sector. The railway electrification will continue in next 5 years. Additional copper demand will also be created in urban mass rapid transport to reduce the traffic problem in crowded cities.
The current growth rate in appliances market is about 20% pa and is expected to grow with same pace for the next 5 years. There is a large potential for improvement in the levels of energy efficiency, which would increase the density of copper usage in the sector.

The per capita consumption of copper in India is less than 1 kg as compared to 2.7 kg as the World average. There is, therefore, a great potential for development of copper - based industries in the country. In view of the above; the proposal of setting up Copper Smelting and Refining capacity by M/s Adani Enterprises Limited at Mundra is the most appropriate and a timely decision.

1.4. Process Description:

State of the art technology will be used to produce 10LTPA of Copper Cathode at proposed site. The principal raw material for the production of copper metal is copper concentrate containing about 22-35% Copper, 25-35% Iron, 28-35% Sulphur and 7-10% moisture. Approximately 2LTPA Copper scrap is also used as input to Proposed copper smelting plant and Copper Scrap Melting Facility.

The major steps in copper extraction include:

- Blending of different grades of concentrates.
- Smelting of concentrate in Smelting furnace to produce an intermediate copper rich product known as "matte" containing 58 - 63% copper.
- Converting of liquid matte to blister copper (98- 99% Cu) in Pierce - Smith converter.
- Fire refining of blister copper to produce anode copper (99.5% Cu) in anode furnace and casting of the anodes.
- Electrolytic refining of anodes to produce copper cathodes (99.99% Cu).

In the process of extraction of copper metal, Sulphuric acid is recovered as a by-product from the off-gases generating from the Smelting and converting furnaces.
Part of Sulphuric acid produced is utilized for phosphoric acid production and rest will be sold in the Market based on market requirement. Hydro fluro Silicic acid generated from Phosphoric acid plant will be partly sold to Fluoride based industries and rest will be converted in value added Aluminum Fluoride. Aluminum Fluoride produced will be sold to Aluminum manufacturing Companies.

Precious metal in the form of anode slime is collected during electrolytic refining of copper will be processed to produce Gold, Silver and PGM (Platinum Group of Metals) Concentrate.

Copper Cathode produced from Copper Refinery will be melted and drawn in the form of Copper wire rod on continuous basis from a continuous casting and rolling machine. Rod will be of various sizes as per market requirement such as 8 to 25 mm.

Composite Process Flow sheet for Copper Smelter Plant is in Annexure - IX

Waste water generated from Copper Smelter, Sulphuric Acid Plant and Copper Refinery will be treated in state of art effluent treatment facility. Treated effluent will be consumed within the plant operations to maximum extent. A secondary RO will be installed at the outlet of treated effluent to reuse water internally and reduce water consumption.

1.5 Site Analysis:

The Project site is located in Siracha and Navinal Villages at APSEZ, Mundra taluka, District Kutch in the state of Gujarat and about 9.0 km from Mundra West Port, Gujarat, (latitude 22°48'55.78"N and longitude 69°34'32.02"E project area center approx). The village is accessible by road from NH-8A with extension between Gandhidham and Mandvi towns. Plant is located next to State Highway.

The site is well connected by the National / State Highways, broad gauge rail link and is about 3.0 km away from the Navinal railway Station. The nearest airport is Bhuj Airport located at a distance of 65 kms from the project site. The nearest railway station is Adipur/Gandhidham, which is about 63 kms from...
project site and nearest town is Mundra which is about 15.0 kms from the project site. The national highway NH-8A is passing at about 10.0 kms away from the site. State Highway SH-6 is adjacent at north of proposed site. The site is well connected with Ahmedabad city located at about 460 kms.

The area earmarked for proposed Copper plant is owned by APSEZL and is free from any human activity. There is no issue of Rehabilitation & Resettlement need. Around 634 acre land would be required for entire Copper Smelter Complex including its Greenbelt (33% of total land). The identified land is not an agricultural land and has already been designated/ recorded as industrial land. Land for different corridors (Power/ Road/ Raw Material Conveyor) would be additional.

There is no significant vegetation or habitation in the project site. The nearest significant features from the project site are 4620 MW Adani Power Plant and Tata Power (Western side of project area), and West Port of APSEZL (South – west direction from project). The villages which are in close proximity to the project site are Siracha and Navinal.

From South West to North East majority of area is of APSEZL where west port is also located. The land is having undulations and minor grading will be required.

### 1.6 Raw Materials & Source:

The major raw material required for Copper smelter is Copper Concentrate and Rock Phosphate for Phosphoric Acid plant will be imported through Mundra Port. Rest of the raw material and process consumables will be sourced largely through domestic market.

### 1.7 Utilities Requirement:

Following utility items are considered.

a) Power – Incoming Substation

b) Required Fuel Oil supply system
c) LNG/LPG  
d) Process air compressor  
e) Oxygen Plant  
f) Required Electrical & Instrumentation  
g) Waste Heat Recovery Based Power Plant  
h) Required Raw water storage facility.  
i) DM Plant  
j) Secondary RO Plant, etc

1.7.1 Water:  

The Requirement Water for the plant has been estimated around 32,800 M3/Day. M/s. Adani Ports & Special Economic Zone Limited (APSEZL) will be supplying the total water requirement for the plant.

1.7.2. Power:  

The total estimated power requirement for Copper Smelter Plant is 300 MW out of which 40 MW would be generated from internal process steam and balance 260 MW power would be sourced from APSEZL through M/s. Mundra Utility Pvt Ltd.

1.7.3. Fuel Oil:  

Fuel oil storage facility will be built as per requirement in accordance with guidelines from CCOE. Capacity of the system will be based on the design requirement after finalization of the engineering.

1.7.4. LPG/ LNG:  

LPG/LNG storage facility will be built as per requirement in accordance with guidelines from CCOE. Capacity of the system will be based on the design requirement after finalization of the engineering.

1.7.5. Air Compressor:
A dedicated air compressor station will be installed to supply process air as well as moisture free air as Instrument air for operation of pneumatic based instruments. Capacity of the system will be based on the design requirement after finalization of the engineering.

1.7.6. Oxygen Plant:

2 Oxygen plants each of 1500 TPD Capacity delivering 95% purity Oxygen will be set up for Copper smelter requirement.

1.7.7. Waste Heat recovery based power Plant:

With focus on recovery of heat energy, waste heat recovery based power plant with ~50 MW capacity will be installed.

1.7.8. DM Plant

A dedicated DM plant will be set up to fulfill the requirement of Copper Refinery Tank House and Continuous Cast Copper Rod Plant.

1.7.9. Secondary RO Plant:

A dedicated secondary RO plant will be installed at the down stream of the proposed Effluent Treatment Plant. This will help to reuse and recycle the treated water effectively within the plant requirement.

1.8 Proposed Infrastructure:

The proposed Copper Plant of Adani Enterprises Limited would require a total land area of 634 Acres (~ 256 Hectares). This area is based on a plot plan of Copper Plant as Annexure VII which has been developed taking into account the Copper Plant facility process, the site infrastructure requirement and external interfaces. These areas will be firmed up with ongoing engineering studies to suit the facility's operating conditions, construction and maintenance philosophies and storage requirements.
Copper Plant area would comprise of facilities Copper Smelter, Copper Scrap Melting Facility, Copper Refinery, Copper Rod Plant, Precious Metal Recovery Plant, Sulphuric Acid Plant, Phosphoric Acid Plant, Aluminum Fluoride Plant, Waste water Treatment Facility, Waste Heat recovery based power plant, Oxygen (Industrial) Plant, etc.

The Copper Plant Infrastructure includes facilities like Raw material Storage area, Copper Slag (Iron Silicate/ Ferro Sand) & Phospho Gypsum Storage Area, Secured Land fill for storage of Hazardous Waste, Pipelines, Road/Drainage, Pipe Racks/Trenches & Cable Trays, Buffer Zone, Non Plant Buildings, Laboratories, Fabrication Yard, Dispatch Section, General stores/ Warehouse, Fire & Safety Department, Maintenance Workshop, Occupational Health Center etc.

Area for greenbelt development as per prevailing statutory guidelines from GSPCB/CPCB/ MOEF will also be provided.

1.9 Social Infrastructure:

AEL believes that an effective growth policy must also take into account the fulfillment of basic needs of the masses, especially of those living in rural areas.

AEL has one of the best social infrastructure proposals which are based on the implementation already done by Adani Group at Mundra, in the core area of Health, Education, Sustainable livelihood options & women empowerment, Community infrastructure, Youth sport & cultural activities, Calamity management. AEL is strictly committed and is going to implement the proposal to uplift the social infrastructure surroundings the Copper Smelter Plant area.

1.10 Industrial Waste Management:

State of Art facility will be installed with a focus on the following:
a. Usage of Advanced and Proven Technology
b. Reduced Solid waste Generation
c. Value from Waste
d. Recycling and Reuses
e. Storage of waste in line with CPCB/GSPCB/MoEF guidelines.

1.11 Rehabilitation and Resettlement (R&R) Plan:
Since the entire land is vacant, hence no displacement and rehabilitation of local population is envisaged.

1.12 Project Schedule & Cost Estimates:
Implementation schedule for Copper Plant post all the relevant approvals and consents will be 30 Months.

The total estimated project Cost of the Copper Smelter project is around 1.5 Billion USD (10,000 Cr.).

Around 2000 people would be directly employed during operation of the plant. Around 3000 people would be required during construction phase of the project.

Pre-Feasibility Report
CHAPTER – 2
Introduction of Project & Market Outlook

2.1 General

Metal industry forms an indispensable part of the economy and it is considered to be the backbone of the industrial development of any country. Metal is the crucial sector for any economy as it meets the requirements of various other sectors. Since it is a core sector, it tracks the overall growth of the economy in the long term. The metal industry can be divided into two main segments:

1. Ferrous Metals –
   a. They primarily consist of iron and different varieties of steel
   b. Demand of such metals mainly comes from automobile and construction sectors

2. Non Ferrous Metals –
   a. They consist of aluminum, copper, zinc, lead, nickel and tin
   b. Demand for these metals comes from sectors such as automobiles, agriculture, railways, telecommunication, construction and chemicals

2.2 Brief Description of Project:

The project cost estimated to be around US $ 1.5 billion (Rs. 10,000 crore) includes Copper Smelter, Sulphuric Acid Plant, Copper Refinery, Continuous Cast Copper Wire Rod Plant, Precious Metal Recovery Plant, Phosphoric Acid Plant, Aluminum Fluoride Plant, etc. The project would be located in Mundra,
Gujarat will produce 10LTPA of Copper Cathode; 5LTPA of Copper Rod; 30LTPA of Sulphuric Acid; 5LTPA of Phosphoric Acid; 30,000TPA of Aluminum Fluoride, 50TPA of Gold; 500TPA of Silver; etc with state of art environment friendly technology.

2.3 Need For Project:

![Advantage India](http://www.ibef.org/download/Metals-and-Mining-March-220313.pdf)
Copper is considered to be the third most important industrial metal next only to iron and aluminium. The superior properties of copper such as its...
benchmark in electrical and thermal conductivity, without sacrificing performance and energy efficiency, make it valuable across industries.

The average expected growth of the construction industry of approximately 7% to 9% will continue to drive the demand for copper building wires. Improvement in living standards on account of per capital income growth will increase the density of copper usage in building wires as well.

The government of India has targeted 100% electrification of all rural houses by 2019. Also government by allowing foreign direct investment in the sector of telecom has accelerated the tele-density. The tele-density and broadband connectivity of 10 million subscribers (targeted) will create a huge opportunity for copper in India.

To support the average GDP growth of about 7% during the last 3 years there has been a considerable increase in primary energy demand. The growth in secondary source such as electricity was more than 10%. Therefore, India’s priority is to increase availability by adding additional 70% of generation capacity by 2019. The aim is also to improve supply side efficiency by strengthening the distribution system and reducing the system efficiency. All this will result in an increase in demand for copper in power generation, transmission and distribution.

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The current growth rate in appliances market is about 20% pa and is expected to grow with same pace for the next 5 years. There is a large potential for improvement in the levels of energy efficiency, which would increase the density of copper usage in the sector.

The per capita consumption of copper in India is less than 1 kg as compared to 2.7 kg as the World average. There is, therefore, a great potential for development of copper - based industries in the country. In view of the
above; the proposal of setting up Copper Smelting and Refining capacity by M/s Adani Enterprises Limited at Mundra is the most appropriate and a timely decision.

**2.4 Price volatility:**

The volatility of the Copper price will not have any major impact on the project, as project is developed on Custom based smelter basis. Hence LME Price of the copper will be neutral as we will be securing ourselves with back to back hedge.

**2.5 Market Outlook: Copper Demand & Supply**

Use of copper has increased significantly and is found in a vast range of applications ranging from brass musical instruments to electrical wiring, electric dynamos, and solar cells.

Copper concentrate is typically further refined and formed into cathodes, which are typically up to 99.99% pure copper. These cathodes are then shipped to mills or foundries to be formed into one of the following forms: (1) wire rod, (2) billet, (3) cake, or (4) ingot. Copper is also combined with other metals to form copper alloys, which include bronze (copper and tin), brass (copper and zinc), and copper/nickel alloys.

As ‘Black Gold’ is the term frequently referring to Crude Oil, while ‘Red Gold’ is occasionally used to refer to Copper. Copper has been in use at least 10,000 years, but more than 95% of all copper ever mined and smelted has been extracted since 1900.

**Copper As A Precious Metal...Indeed Copper Is The ‘Dark Horse’ Among Precious Metals.** The astounding chart below shows that during the past 12 years, COPPER’s performance (appreciation) was greater than Palladium (224%), Platinum (109%). Furthermore, COPPER’s remarkable performance (256%) was only a tiny fraction below the appreciation of GOLD (268%) and
SILVER (259%). Indubitably, this remarkable feat qualifies COPPER AS A PRECIOUS METAL in the global world of commodities.

For centuries Copper has always been considered an Industrial Metal.

The following chart shows the appreciation of Copper, Gold, Silver and the DOW Stock Index during the past 12 years (as of January 26, 2015).

The southernmost country in South America is Chile, which produces as much copper as the next 5 largest copper producing countries...COMBINED (i.e. China, Peru, USA, Australia and Zambia.)
Fig 4: Production trends in the top five copper-producing nations

As mentioned Chile accounts for over one third of world’s copper production followed by China, Peru, United States, Australia, Indonesia, Zambia, Canada and Poland. Major exporters of copper ores and concentrates are Chile,
Peru, Indonesia, Australia, Canada, Brazil, Kazakhstan, United States, Argentina and Mongolia. The biggest importers of copper are China, Japan, India, South Korea and Germany.

2.5.1 World Copper Demand & Supply

![Fig 5: World Copper Demand – Source CRU](source)

*World copper demand is expected to grow at CAGR is 3.0% (2007-2032)*

**Exhibit 5: Global copper supply and demand balance ('000t')**

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Source: Goldman Sachs Global Investment Research, Wood Mackenzie, ICSG.

**Table 1: Global Copper Supply & Demand Balance- Wood Mackenzie, ICSG**

*Pre-Feasibility Report*
Morgan Stanley

Morgan Stanley recently published a “Commodity Manual”, breaking down the firm’s views on the state of various commodities. In their discussion of copper, they included a chart showing which countries have the highest demand for the metal. These countries could benefit from lower copper prices.

![Copper Demand by Region](source: WMBH, Morgan Stanley Commodity Research estimates)

**Fig 6: Global Refined Copper Demand by Region – Morgan Stanley**

China, with its huge manufacturing sector, is by far the biggest consumer of copper, and Morgan Stanley notes that 30% of copper used in China is imported. Manufacturing industries in Europe and the US also account for a large part of copper consumption:
2.5.2 Copper Consumption

Per capita consumption of copper in the United States was 10 kilograms per person in 1965, the same in 1995. In Japan per capita consumption increased from 6 kilograms per person to 11 kilograms per person over the same time period. Copper consumption in Korea in 1965 was less than 1000 tons. By 1995, Korea's consumption of copper had reached 637,000 tons, or more than 14 kilograms per person.

In China, even after years of economic growth, per capita copper usage is about 5.4 kg. As China's populace urbanizes, builds up its infrastructure and becomes more of a consuming society, there's no reason to suspect Chinese copper consumption won't approach or even surpass U.S., Japanese and South Korean levels. There's 1.3 billion people in China, even a slight
An increase in Chinese consumption will translate into enormous demand growth.

Per capita consumption of copper in India is much lower at 0.4 kg than 3.3 kg in Russia, 5.4 kg in China, and about 9-10 kg in developed countries. World Average of per capita Copper consumption is ~ 2.7 kg.

**Fig 8: Per Capita Copper Consumption in Kg**

India, with its 1.2 billion people, is presently using 0.4 kg of copper per person. The country is modernizing and needs to invest heavily in electrical power infrastructure. According to the International Energy Agency (IEA), India’s power production will need to rise by up to 20 percent annually to keep pace with its economic and population growth. Just meeting the required power target would double India’s annual copper consumption.
Energy Consumption per capita vs GDP per capita
These graphs suggest as the developing Asian economies such as China and India continue to move towards 1st world living standards, and hence increase their GDP per capita their energy consumption will increase, leading to increased demand for Copper.

Fig 9: Per Capita Electricity Consumption in KWHr
These graphs suggest as the developing Asian economies such as China and India continue to move towards 1st world living standards, and hence increase their GDP per capita their energy consumption will increase, leading to increased demand for Copper.

India’s economy grew by 5.7% in the three months to June, its fastest pace in two-and-a-half years. The new government of Narendra Modi is focusing on Asian partners China and Japan for enhancing investments in infrastructure and manufacturing. The growth model pursued by China and Japan - export oriented manufacturing, heavy infrastructure building and urbanization - has become India’s blueprint for pushing growth up to and beyond the 7 percent mark. The annual world average per-capita consumption of copper is 2.7 kg.
2.5.3 China’s economic development, industrialisation and urbanisation

Rapid economic development has spurred rising per capita incomes for Chinese citizens. At the start of the reform period, China’s GDP per capita (on a PPP basis) stood at around 2 per cent of that of the United States (US) (less than India, Vietnam, Laos and many other emerging Asian economies). More than 30 years later, in 2011, that share has grown to around 17 per cent. In another five years, the International Monetary Fund (IMF) projects that China’s GDP per capita will be close to one-quarter of that of the US and around a similar level to where Korea was in the early 1990s (Chart 1).

Chart 1: China’s economic development in a global perspective

Source: IMF World Economic Outlook, April 2012.
Notes: GDP is in PPP dollars.

Rising incomes have in turn led to changing consumer tastes, such as increased demand for durable goods (such as cars and whitegoods) and a shift towards more expensive protein and nutrient-rich foods. This trend is set to accelerate with Kharas and Gertz (2010) estimating, based on present trends, that by 2021 there could be over 670 million middle class consumers in China, compared to only 150 million in 2010.4

China’s economic development has coincided with rapid urbanisation, consistent with the experience of other earlier industrialising economies (Liu and McDonald, 2010. The urbanisation rate increased rapidly from 19 per cent in 1980 to 50 per cent in 2011, and the United Nations (2012) projects that it will continue to rise steadily to 73 per cent by 2050. While China’s urbanisation is rising rapidly, the share of the population residing in urban areas still remains below that of major advanced economies, and below the levels of other industrialising economies — such as South Korea and Malaysia — for the same level of per capita income (Chart 2).5

Chart 2: China’s urbanising population

Urban share of population

Urbanisation and GDP per capita 1960-2010

Pre-Feasibility Report
The newly emerging middle class are a major contributing factor to the fundamental demand shift in global commodity markets and per capita consumption of commodities in developing countries is still only a fraction of the level it is in developed countries.

Infrastructure spending and increased discretionary spending by consumers are the key factors driving this rising demand - as more and more people in emerging markets move from rural areas to the cities, consumption will increase putting massive upward pressure on commodities.

The World Bank estimates that the global middle class is likely to grow from 430 million in 2000 to 1.15 billion in 2030. The bank defines the middle class as earners making between $10 and $20 a day - adjusted for local prices.
Most of the world’s middle class has, until recently, been located in Europe, North America and Japan.

In the 1970s and 1980s South Korea, Brazil, Mexico and Argentina built sizeable middle-class populations. Today its China, India, Asia and Africa adding to the world’s middle class. In 2000, developing countries were home to 56 percent of the global middle class, by 2030 that figure is expected to reach 93 percent.

### 2.5.5 Uses Of Copper

Copper is used in water pipelines, intelligent houses and buildings, electrical motors, power lines, electrical appliances, health care, environment related industries, computers, communication devices, in general, in the industries that are shaping the future. Copper is also used in artillery shell casings, small arms ammunition, water pipes, and jewellery. (Source: Wikipedia)

**Construction (includes electrical):** Copper is used in a wide variety of construction applications, including plumbing, kitchen and bathroom fixtures such as taps, tubes, and fittings, heating fixtures, electrical wiring and outlets, air conditioning, and roofing. Copper’s high conductivity has made it the primary choice for use in power cables, transformers, building wire, and motors.

*Pre-Feasibility Report*
**Electronics and communication:** Copper is a significant raw material in electronics and telecommunications, including computers in the form of computer chips, electron tubes, data cables, and telephone wire.

**Transportation:** Copper is found in automobiles, usually as a copper/nickel alloy in applications such as radiators and hydraulic brakes, in addition to electrical wiring. In marine applications, copper is frequently combined with nickel to create copper/nickel alloys used for ship hulls, offshore units, desalination plants, etc., primarily owing to its resistance to seawater corrosion.

**Industrial machinery and equipment:** Copper is used heavily in industrial applications as an alloy, most commonly combined with tin to form bronze. Some uses include motors and wiring, heat exchangers, turbine blades, and natural gas pipes.

**Consumer goods:** Copper is found in a variety of consumer products as well, including microwave ovens, TV cathode rays, brass furniture and musical instruments, silverware, and coins. (Pennies are only 2.5% copper, 97.5% zinc. Nickels are actually 75% copper, while the dime, quarter, and half dollar coins contain 91.67% copper.)

Globally, the major end markets for copper have been construction and electronics, accounting for more than 60% of the global copper demand. However, regional variations in the end use of copper continue to exist. For instance, in India, 49% of copper consumption is by the construction sector, whereas in China the dominant use for copper is in the electronics and communication sector, which takes 42% of total copper consumption.
Deutsche Bank estimates Chinese copper demand is comprised of the following broad categories: building and construction (21%), electrical infrastructure (27%), industrial machinery and equipment (11%), transportation (11%), white goods (15%), electronics (7%) and miscellaneous (8%).
Pre-Feasibility Report

Fig 13: Copper Consumption in India - Industry Segment wise – Source IBM 2011

Major industrial sectors using copper in India are electrical & telecom with 56% share followed by transport with 8%, construction with 7%, consumer durables with 7% and engineering goods with 6% share in the total use.

While Chile still refines a substantial portion of the world’s copper (given its predominance as the world’s largest copper miner), refined copper production is sourced closer to the end markets, with China now the largest producer of refined copper globally. This is primarily driven by the economics; i.e., it is feasible to transport copper concentrates from distant mine locations to the smelters, while adding only a small amount to the landed cost. This makes it possible for the smelters and refiners to be located closer to the end consumers.

The advanced cutting edge, state-of-the-art technology of the Copper products will give superior product quality, which will provide easy market penetration of the product in India as well as overseas.
China is the leading copper-consuming nation in the world, accounting for approximately 37.7% of global demand, higher than the India (3.2%).

2.5.6 Conclusion:

Based on the above facts and figures, it can be concluded that marketing and sales of 1,000,000 TPA of Copper can be achieved.
2.6 Market Outlook: (Source Argusmedia Report)

2.6.1 Global Sulphuric Acid Demand & Supply

Supply:

- In 2014, around 243 mn t of Sulphuric Acid were produced on global basis.
- By 2020, global production forecasts to reach around 269 mn t of Sulphuric Acid.
- By 2025, global production forecasts to reach around 281 mn t of Sulphuric Acid.

Demand:

- In 2014, around 245 mn t of Sulphuric Acid were consumed on global basis.
- By 2020, global consumption is forecast to reach 270 mn t of Sulphuric Acid. Growth in consumption is expected in Latin America, Middle East, South Asia and East Asia.
- By 2025, global sulphuric acid consumption is forecast at around 281 mn t.

2.6.2 India Sulphuric Acid Demand & Supply

Supply:

- In 2014, around 10 mn t of Sulphuric Acid were produced in India. 6.16mn t of Sulphuric Acid is produced from Elemental Sulphur route which is imported and 3.79 mn t of Sulphuric Acid is produced from Smelting route (Copper and Zinc Smelting)
- By 2020, India production forecasts to reach around 10.6 mn t of Sulphuric Acid. 6.8 mn t of Sulphuric Acid is produced from Elemental Sulphur route which will be imported and 3.79 mn t of Sulphuric Acid is produced from Smelting route (Copper and Zinc Smelting)
- By 2025, India production forecasts to reach around 10.6 mn t of Sulphuric Acid. 6.8 mn t of Sulphuric Acid is produced from Elemental Sulphur route which will be imported and 3.79 mn t of Sulphuric Acid is produced from Smelting route (Copper and Zinc Smelting)

**Demand:**

- In 2014, around 10.6 mn t of Sulphuric Acid were consumed in South Asia, of which 97% is consumed in India and rest was consumed in Pakistan and Bangladesh. Of the Volume consumed in India, 55% is for Fertilizer use and balance in the industrial applications.
- By 2020, consumption in India is forecast to reach 11 mn t of Sulphuric Acid. Growth in consumption in India is expected in Fertiliser application to 6.5mn t from 5.8 mn t Sulphuric Acid in 2014.
- By 2025, sulphuric acid consumption in India is forecast at around 11 mn t.

**2.6.3 Conclusion:**

- India is agriculture based country and consume huge amount of Fertiliser and has huge consumption in industrial application. Currently 65% of the Sulphuric Acid is produced through elemental sulphur route and rest from base metal smelting route.
- There is a good opportunity available to replace the imported elemental sulphur with Sulphuric Acid Produced from smelting route and reducing the dependence on the same.
- By 2020, Global Sulphuric Acid balance is expected to shortfall of around 1mn t of Sulphuric Acid and by 2025 it will be around 400 kt.
CHAPTER – 3
Process Description
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3. **Process Description:**

3.1. **Raw Material Handling:**

To have the raw materials handling as the most environment friendly process, the following are planned:

1. Concentrate transportation from Port to Plant concentrate warehouse by Pipe Conveyor
2. Covered Concentrate warehouse
3. Internal transportation of the concentrate by pipe conveyor to the furnace.
4. Covered Bin building for intermediate storage of concentrate
5. Covered Storage for other Raw Material during rainy season.

3.1.1 **Concentrate Warehouse:**

Concentrate will be imported from across the world. Concentrate will be unloaded from the ship at Port and will be conveyed to plant warehouse in pipe conveyor. The concentrate will be stored separately in different heaps based on the quality of the material. Warehouse will be built to store at least 25 days consumption quantity. This will help to take care of the shipping schedule as well as blending requirement as per furnace feed design.

3.1.2 **Flux Storage Area:**

Silica Sand, Lime stone and Coal will be required for addition in the concentrate for effective smelting. They will be stored in open space. However a covered storage will be provided for minimum of 15 days storage, which will be required during rainy season continuous operations.

3.1.3 **Bin Building:**

*Pre-Feasibility Report*
Bin building will have intermediate storage bins to store different quality of the Copper Concentrate, Flux material along with Coal and Process Reverts. These bins will be equipped with weighing system for effective blending and maintaining the metallurgy of the furnace.

3.1.4 Paddle Mixer

Paddle mixer is a online mixing system to mix effectively different ratio of Concentrate with flux material and will have provision to add moisture to get required mix material, suitable for furnace feed.
3.2 Smelting Furnace:

It is proposed to have smelting furnace for production of 9,00,000 TPA of copper anode production. Copper Concentrate blend mixed with flux material is fed to the smelting furnace, where enriched air added with oxygen is fed to furnace. The smelting reaction takes place at furnace temperature around 1200°C. Furnace produces Copper Matte (~60% Cu); Copper Slag (~1% Cu) and Sulphur Di-Oxide Gas (SO₂). Both Copper Matte (~60% Cu) and Copper Slag (~1% Cu) is tapped to Settling furnace and Sulphur Di-Oxide Gas (SO₂) is transferred to Sulphuric acid plant through a closed pipeline. The smelting furnace will be provided with a waste heat recovery boiler to recover the heat from the off gas of the process.

\[
\text{CuFeS}_2 + O_2 + \text{SiO}_2 \rightarrow \text{Cu-Fe-S} + \text{FeO.SiO}_2 + \text{SO}_2
\]

Matte Slag Gas

Pre-Feasibility Report
The purpose is to utilise heat of the gases within the process and also conservation of water. The furnace will be attached with a state of the art, electrostatic precipitator and a high capacity induced draft fan to transfer the gases to Sulphuric Acid Plant. The secondary off gas will be taken to a high capacity secondary gas scrubbing system to scrub the traces of SO₂ before it is discharged to atmosphere.

3.3. Settling Furnace(s):

Settling Furnace will be provided for Matte and Ferrosand (Copper Slag also called as Iron Silicate) separation.

The Copper matte & ferro sand from smelting furnace will be periodically tapped from the tap hole which will be provided with water cooled copper block in the smelting furnace. The tap hole will be opened with a tap gunning machine. The ferro sand/ matte together will flow by gravity to the settling Furnace for ferro sand and matte settling and separation. Separation of will take place on the basis of the density difference. The temperature around 1250°C will be maintained. The off-gases from the furnace operation will be taken smelting furnace scrubbing system.
Ferro sand settled in the settling Furnace will be granulated and will be collected in the collection pond. Ferro sand granulation clear water will overflow into a clear water pond and it is pumped to spray pond for cooling and then recycled back.

The granulated ferro sand from settling pond will be collected and discharges the same in a steel bunker. From the steel bunkers ferro sand will be transported to the designed ferro sand dump area and further sale/disposal.

3.4. Pierce Smith Converter:

Pierce-Smith Converters will be used to Convert Copper matte to Blister Copper (~98% Cu). Converting is oxidation of molten Cu-Fe-S matte to form molten 'blister' copper (~98 % Cu). It entails oxidizing Fe and S from the matte with oxygen-enriched air or air 'blast'. It is mostly done in the Peirce-Smith converter, which blows the blast into molten matte through submerged tuyeres.

The main raw material for converting is molten Cu-Fe-S matte from smelting. Other raw materials include silica flux, air and industrial oxygen. Several Cu bearing materials are recycled to the converter - mainly solidified Cu-bearing reverters and copper scrap.

The products of converting are:

(a) molten blister copper which is sent to fire- and electrorefining

(b) molten iron-silicate slag which is sent to Cu recovery, then discard

(c) SO₂-bearing offgas which is sent to cooling, dust removal and & H₂SO₄ manufacture.

The heat for converting is supplied entirely by Fe and S oxidation; i.e. the process is autothermal.

The overall converting process may be described by the schematic reaction:

\[
\text{Cu-Fe-S} + \text{O}_2 + \text{SiO}_2 \rightarrow \text{Cu}_\text{blister}^\text{+} + \{ 2\text{FeO:SiO}_2 :\text{Fe}_3\text{O}_4 \} + \text{SO}_2
\]

Molten in air and in flux molten slag with Gas

matte oxygen some solid Fe₃O₄
Primary Gases from these furnace will be routed to Sulphuric Acid Plant. The furnace will be attached with a state of the art, electrostatic precipitator and a high capacity induced draft fan to transfer the gases to Sulphuric Acid Plant. Proper water cooled double hood arrangement and gas cooling system, etc will be installed to collect the secondary fugitive emission. The secondary off gases will be taken to a high capacity secondary gas scrubbing system to scrub the traces of $\text{SO}_2$. This will enable continuous operation of three converters with one converter on periodical maintenance.

3.5. Ferro sand Cleaning Furnace (FSCF):

The ferrosand (Copper Slag) from converter will be processed in the ferro sand cleaning furnace. Slag-cleaning furnaces process smelting furnace slag as well as slag from Pierce Smith Converters. A reducing agent is often required to reduce Cu oxide in the slag to Cu metal or Cu sulfide. Coal or Metallurgical coke is often added for this reduction.

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Carbon additions also reduce solid magnetite in the slag to liquid FeO:

\[ C + Fe_3O_4(s) \rightarrow CO + 3FeO \]

This decreases slag viscosity and improves settling rates.

Copper Slag is also called as Iron Silicate as well as Ferro sand. Ferro Sand from Cleaning Furnace will be granulated and will be collected in the collection pond. Ferro sand granulation clear water will overflow into a clear water pond and it is pumped to spray pond for cooling and then recycled back. The granulated ferro sand from settling pond will be collected and discharges the same in a steel bunker. From the steel bunkers ferro sand will be transported to the designed ferro sand dump area and further sale/disposal.

3.6. Copper Scrap Melting system

Considering the availability of the Copper scrap getting generated within the country as well as in house; a dedicated Copper scrap melting system will be
designed to have a sustainable solution for the country. This will help the various copper scrap producer a sustainable outlet to treat the copper scrap and produce LME Grade A Copper cathode. System is also designed to handle utilization of the imported copper scrap as feed stock as well. A state of art technology will be used for the same. Such facilities are available in various developed countries.

3.7. Anode furnace & Anode Casting Wheel:

Anode furnaces will be used to make anode copper (~99.5% Cu) from blister received from Pierce Smith Converters. The molten blister copper from Peirce-Smith converting contains -0.01% S and -0.5% O₂. At these levels, the
dissolved Sulfur and oxygen would combine during solidification to form bubbles (‘blisters’) of SO\(_2\) in newly cast anodes – making them weak and bumpy. In stoichiometric terms, 0.01 mass% dissolved Sulfur and 0.01 mass% dissolved Oxygen would combine to produce about 2 cm\(^3\) of SO\(_2\) (1083\(^\circ\)C) per cm\(^3\) of copper.

Fire refining removes Sulfur and Oxygen from liquid blister copper by:

(a) air-oxidation removal of Sulfur as SO\(_2\) to -0.002% S then:

(b) hydrocarbon-reduction removal of oxygen as CO and H\(_2\)O(g) to -0.15%

Liquefied Petroleum Gas or Natural Gas is used for doing fire refining.

The secondary off gases will be taken to a high capacity secondary gas scrubbing system to scrub the traces of SO\(_2\). The final product of fire refining is molten copper, -0.002% S, 0.15% O, 1180- 1200\(^\circ\)C, ready for casting as anodes. Most copper anodes are cast in open anode-shaped impressions on the top of flat copper moulds. Newly developed latest designed double casting wheel system will be installed with Casting rate of ~100 TPH. The newly poured anodes are cooled by spraying water on the tops and bottoms of the moulds while the wheel rotates. They are stripped from their moulds (usually by an automatic raising pin and lifting machine) after a half rotation. The empty moulds are then sprayed with a barite-water wash to prevent sticking of the next anode. The most important aspect of anode casting, besides flat surfaces, is uniformity of thickness. This uniformity ensures that all the anodes in an electro refining cell reach the end of their useful life at the same time. Automatic control of the mass of each pour of copper (i.e. the mass and thickness of each anode) will be used. Anode mass is normally 375-425 kg. Anode-to-anode mass variation in a smelter or refinery is +2 to 5 kg with automatic weight control.

Recent anode designs have incorporated

(i) knife-edged lugs which make the anode hang vertically in the electrolytic cell and

(ii) thin tops where the anode is not submerged (i.e. where it isn’t dissolved during refining).
The latter feature decreases the amount of un-dissolved 'anode scrap' which must be recycled at the end of an anode's life.

Suitable capacity Twin caster wheel arrangement will be provided to produce Copper anode. The Copper anode will be transferred to Copper Refinery for further processing.

3.8. Off gas handling:

a. We propose to install a Waste Heat Recovery Boiler (WHRB) to recover the entire off gas heat from the smelting furnace before reaching to Sulphuric Acid Plant for production of Sulphuric Acid through suitable ESP, ID fan, ducting and a gas-mixing chamber.

b. A suitable dust conveying system for WHRB & ESP will be installed and will be consumed within the process.

c. The secondary collection system with Scrubbing System will be ensured to have sufficient capacity to handle all the secondary gas.

d. Gases will be charged through required size stack to atmosphere after scrubbing and meeting standards prescribed authorities.

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3.9. Sulphuric acid plant:

Sulphuric acid plant having capacity of 30 LTPA will be provided to handle the gases from Copper smelter with required capacity of Gas cleaning plant to treat the incoming gases. State of art environment friendly technology of Double Contact Double Absorption will be used for Sulfuric acid plant. Effluent generated from Sulphuric Acid plant will be treated in state of art Effluent Treatment Facility.

The sulphurous gases generated during the sulphidic copper concentrate smelting and matte converting operation in a Copper Smelter plant are treated in Sulphuric acid plant for the production of Monohydrate sulphuric acid as a byproduct.

The process of production of sulphuric acid consists of three principal steps, namely:

i. Cleaning of the sulphur dioxide gas from the ISASMELT furnace and PS converters.

ii. Catalytic conversion of the sulphur dioxide (SO$_2$) gas to sulphur trioxide (SO$_3$) gas according to the chemical reaction:

$$\text{SO}_2 + \frac{1}{2} \text{O}_2 = \text{SO}_3$$

iii. Absorption of the sulphur trioxide (SO$_3$) gas by combining with water (H$_2$O) to form a solution of sulphuric acid (H$_2$SO$_4$) according to the chemical reaction:

$$\text{SO}_3 + \text{H}_2\text{O} = \text{H}_2\text{SO}_4$$

The conversion of SO$_2$ to SO$_3$ is an exothermic, reversible and adiabatic reaction and with increase in temperature the equilibrium constants become more unfavorable with respect to SO$_3$ formations. The other factors, which favour equilibrium conversions, are increase in oxygen concentration in the gases or high pressures but the relative gains are rather small. In contrast to the unfavorable effect of high temperature on equilibrium it is found that the rate of reaction increases rapidly with rising temperature. Consequently
optimum performance requires a balance between the opposing effects of reaction rate and equilibrium. Thus the gases entering the V2O5 catalyst normally are maintained between 400 - 450°C. Therefore, in order to achieve over-all high conversion efficiencies between 99.6% - 99.7%, it is imperative that the converter gases need to be cooled between stages to the above temperature range and also removing the partially converted sulphur trioxide formed normally after 2nd/3rd beds, before returning them to subsequent stages. This process is commonly known as Double Conversion and Double Absorption (DCDA).

3.9.1. Gas Cleaning Systems

Waste gases from the metallurgical process must be treated to reduce the sulphur dioxide emissions to the atmosphere. To achieve this the sulphur dioxide in the gas is converted to sulphur trioxide for the production of sulphuric acid in the sulphuric acid plant. The metallurgical off-gases must be cleaned prior to entering the contact section of the acid plant to enable the plant to produce a product acid of acceptable quality for use and sale.

As well, clean gas is required to prevent plugging of catalyst beds and other detrimental effects on equipment such as corrosion and erosion.

Gas Cleaning Systems

There are four main duties to be performed by the gas cleaning system of a metallurgical sulphuric acid plant:

1. **SATURATION** of the gases and **ELIMINATION** of the coarse and fine particulate matter,

2. **COOLING** of the gases, **CONDENSATION** of the metallic fumes and **REDUCTION** of the moisture content,

3. Removal of the very fine particulate matter as well as the bulk of the acid mist by **ELECTROSTATIC PRECIPITATION** to produce an optically clear gas which is fed to the acid plant downstream.
4. Specialty processes for removal of specific impurities in the gas (i.e. mercury removal, halogens)

**Saturation** – Adiabatic cooling and saturation of the gas is done in an open spray tower, low or high pressure drop venturi. Some removal of course particulate is achieved.

**Elimination** – The nature (type, concentration, size) of the impurity/dust determines the type of cleaning device required. Typically, high pressure drop venturi (fixed or variable throat), reverse jet scrubber (DynaWave), radial flow scrubber, etc. is required if dust loadings are high or particle size is small.
Cooling and Condensation – Removal of water from the gas is required to achieve the plant water balance. Direct contact devices (packed towers, tray
scrubbers) or indirect cooling (star coolers, shell and tube condensers) are used to cool the gas and provide some removal of gaseous impurities.

**Electrostatic Precipitation** – Usually the last stage of gas cleaning before the drying tower. Removes the finest dust particles and acid mist.

**Special Process** – These include mercury removal (Boliden-Norzink), fluoride scrubbers, sodium silicate systems, etc.

a. **Mercury Removal**

Three primary Outotec technologies which have since been further developed over the years:

- Outotec Mercury Removal Process – utilizes a chloride scrubber
- Outotec Mercury Removal Process – utilizes a selenium filter
- Outotec Mercury Removal Process – utilizes sodium thiosulfate

Outotec's chloride scrubber process has essentially become industry standard process providing these benefits:

- Insensitivity to high incoming values of mercury
- Cost-effectiveness; moderate investment costs and low operating costs, which are practically independent of the mercury level
- Applicability to almost any gases including ones containing SO2
- Proven technology: approx. 40 reference plants
- Option for an additional step involving a specially designed electro-winning cell, in which the calomel produced can be converted to high purity metallic mercury

**Process equipment**

- Reactor tower and other special vessels

Pre-Feasibility Report
- Chlorination system
- Electrowinning cell for metallic mercury production from calomel
- Process control

b. Fluoride Removal Process
Hydrogen fluoride in the SO$_2$ gas can cause damage to the sulfuric acid plant and therefore requires removal from the gas. This can be achieved by adding sodium silicate solution to the packed gas cooling tower. The hydrogen fluoride is absorbed in the gas cooling tower, reacts with the sodium silicate forming a reaction product with low vapor pressure and is finally bled to the waste water treatment plant.

c. Arsenic Removal Process
To avoid contamination to the sulfuric acid, it is necessary to remove as much arsenic in the SO$_2$ gas as possible. Particulate arsenic has already been removed during the hot gas cleaning process. High-efficiency scrubbers with a variable throat for efficient continuous scrubbing for removing most of the arsenic content to wet electrostatic precipitators for the final cleaning of the gas will be used. Gaseous arsenic condenses in the quench section where the SO$_2$ gas is cooled down to the saturation temperature. Solid arsenic forms here and is ready to be scrubbed out of the gas in the wet gas cleaning plant. The solved arsenic is then transferred to the waste water treatment plant with the weak acid bleed, where the arsenic has to be separated from the bleed.

Alternatively, some of the arsenic can be precipitated out of the weak acid as early as in the wet gas cleaning plant assuming the acid concentration in the quench liquid is high enough. This will allow for the solid arsenic to be separated from the weak acid before it is transferred to the waste water treatment plant.
3.9.2. Conversion of SO$_2$ to SO$_3$

**Double Absorption**

- Also known as Double Contact/Double Absorption
- Characterized by two SO$_3$ absorption towers

**Double Absorption Plant Arrangements**

- **2/1 Arrangement** - 2 catalyst beds before intermediate absorber followed by 1 catalyst bed. Will not meet current emission regulations.
- **2/2 Arrangement** - 2 catalyst beds before intermediate absorber followed by 2 catalyst beds. Used by Lurgi in many plants around the world.
- **3/1 Arrangement** - 3 catalyst beds before intermediate absorber followed by 1 catalyst bed. Standard arrangement for the modern contact sulphuric acid plant for obtaining SO$_2$ emissions of 4 lb/ST (2 kg/MT) or 99.7% conversion.
- **3/2 Arrangement** - 3 catalyst beds before intermediate absorber followed by 2 catalyst beds. Used when high overall conversions (>99.9%)/low SO$_2$ emissions are required.

Plants with 3/2 arrangements are required to ensure low SO$_2$ emissions and are considered Best Available Technology (BAT).

The optically cleaned SO$_2$ rich gases along with dilution air to the extent required for maintaining the requisite O$_2$ / SO$_2$ ratio are dried in a drying tower with 96% concentrated sulphuric acid in counter current circulation. The dried gases after heating to 400 - 450 ºC passed through converter with cesium promoted vanadium pent oxide catalyst. The converted SO$_3$ gases are absorbed in two absorption towers where 98% concentrated sulphuric acid is circulated to produce 98.5% strength Sulphuric acid product. During the start up and other abnormal operations such as when SO$_2$ content is less than auto thermal point, gases are heated before conversion in converter which helps in low SO$_2$ content in vent gases.
3.9.3 Acid Section

Acid produced is at during the absorption process is given bleed at > 98%. This acid is at a high temperature and need to be brought to the room temperature level say ~< 40 Deg C. Acid coolers are used for the same. Acid coolers are either plate heat exchangers or shell & tube heat changer with anodic protection to protect the cooler. Cooling of the acid is down either by using water or air or combination of the both depending upon the application. Cooled product acid is stored in the storage tanks and supplied for further use in the market as well as in house consumption to produce phosphoric acid.
3.10. Oxygen plant:

Oxygen plant with capacity of 90,000 TPM with 95% purity will be provided for Copper smelter plant requirement. To have flexibility in operations 2 Plants of 1500 TPD capacity each with 95% Purity Oxygen plant will be set up.

3.11. Refinery Unit:

The anodes produced from the smelter will be refined through electrolysis process to remove the impurities present. A refinery unit capable of handling the smelter capacity will be built. State of art electro refining technology will
be used to produce Copper Cathode of LME Grade A from Copper anodes produced in the Copper Smelter. Refinery will have state of art technology to produce value added products from the impurities include Bi, Te, Ni, etc.. Copper Anode slime generated during copper electro refining process will have precious metals such as Au, Ag, Pt, Pd, etc. Effluent generated from Copper refinery will be treated in state of art effluent treatment facility.

Electrorefining entails:

a. Electrochemically dissolving copper from impure copper anodes into
   \[ \text{CuSO}_4 + \text{H}_2\text{SO}_4 + \text{H}_2\text{O} \]
   Electrolyte

b. Selectively electroplating pure copper from this electrolyte
   \textit{without the anode impurities}.

It serves two purposes:

a. It produces copper essentially free of harmful impurities
b. It separates valuable impurities (e.g. gold and silver) from copper for recovery as by-products.
Application of an electrical potential between a Copper Anode and a metal cathode in CuSO$_4$ –H$_2$SO$_4$ – H$_2$O Electrolyte causes the following:

a. Copper is electrochemically dissolved from the anode into the electrolyte
   - producing copper cations plus electrons:
     \[ \text{Cu}^0_{\text{anode}} \rightarrow \text{Cu}^{++} + 2e^- \]

b. The electrons produced by above Reaction are conducted towards the cathode through the external circuit and power supply.

c. The Cu$^{++}$ cations in the electrolyte migrate to the cathode by convection and diffusion.

d. The electrons and Cu$^{++}$ ions recombine at the cathode surface to form copper metal (without the anode impurities), i.e.:
   \[ \text{Cu}^{++} + 2e^- \rightarrow \text{Cu}^0_{\text{cathode}} \]

Overall copper electrorefining is the sum of Reactions
\[ \text{Cu}^0_{\text{impure}} \rightarrow \text{Cu}^0_{\text{pure}} \]

Copper Anode slime generated in Copper Electro Refining process undergo roasting process to recover Selenium. Selenium is of a commercial grade with purity of 99.5%.

3.12.1. Selenium roasting process

The roasting of copper anode slime with selenium is done in an electrically heated furnace where the temperature is around 500°C. Oxygen and SO\textsubscript{2} gas are used as reagents. Selenium compounds react at this temperature forming gaseous selenium dioxide. Selenium dioxide is then sucked from the furnace into an aqueous solution. Elementary selenium and sulphuric acid is generated in the solution at a temperature of 80°C. Selenium crystals are then filtered, washed and dried.
The elementary selenium is of a commercial grade (99.5%) selenium. The attained purity rate is very high and the selenium content of the roaster slime is normally about 0.5%.
3.12.2. Deselenised Anode Slime Smelting
The Outotec® TROF (Tilting Rotating Oxy-Fuel) Converter was originally designed for processing selenium-free copper anode slime, but today the converter can also be adapted for other solutions, such as processing precious metals containing dusts, scraps and bullions. The Outotec® TROF Converter offers smooth tilting and rotating functions thanks to its sophisticated hydraulic system.
The selenium-free slime containing precious metals is mixed with soda and borax. This mixture is smelted in the furnace. The smelting temperature is as high as 1300°C. The slag is poured off by tilting the furnace. The metal is further refined by blowing oxygen and the end product is cast into anodes using casting equipment and called as Dore Anode.

### 3.12.3. Outotec silver electrolysis tankhouse

Dore Anode is consisting of Ag, Au, Pt, Pd, etc. Dore anode further undergoes electrolysis process to recover the precious metals.

The heart of the Outotec Silver Refining Plant process is the silver electrolysis tankhouse, which consists of electro-refining cells, circulation tanks and pumps, sieve tanks, a cooling system, and a pH control and adjustment system. A sophisticated control system monitors and controls the process, making it both easy to operate and highly efficient. With Outotec HCD (High Current Density) silver electro-refining cells, current densities exceeding 1000 A/m² are possible, depending on the composition of the silver Dore anodes being processed.
The electro-refining process is continuous except when new silver Doré anodes are loaded in the cells and silver anode slime and anode scrap is discharged from the cells at the end of the electrolysis cycle. The anodes continuously dissolve, depositing refined silver on the cathodes. The cell is equipped with an automatic scraper system that removes the deposits – the silver crystals scraped off the cathodes are collected at the bottom of the cells. At the end of the electrolysis cycle, a slurry containing crystals of cathode silver and electrolyte is discharged into a sieve tank. The quality of the silver crystals produced in the electrolytic refining process is ensured by electrolyte circulation.

All this helps increase the efficiency of the process, decrease manual work, and increase the amount of silver recovered. The modular design makes it easy to scale the solution for your desired capacity. Silver anode slime containing valuable impurities such as gold and platinum-group metals (PGMs) is also formed during the electrolysis process. The slime is collected inside anode bags surrounding silver Doré anodes and can be further processed using the Outotec Gold Refining process for recovery of gold and PGMs.
The non-dissolved anodes remaining after electrolysis are recycled for smelting and casting of new silver Doré anodes. Spent electrolyte withdrawn from circulation is replaced with fresh silver nitrate electrolyte in order to keep the silver content at a constant level.

Outotec silver electrolyte preparation system Some of the silver crystals produced in the silver electrorefining cell are processed in the Outotec silver electrolyte preparation system, where they are dissolved to produce pure silver nitrate solution. The process and equipment design avoids the formation of toxic NOx gases, which improves the safety of the working environment. The system is also available as standalone equipment with its own control system.

**Drying of silver crystals**
The final product can be either silver bars or silver granules. In both cases the silver crystals are dried using the fully automated Outotec Silver Dryer, which consists of a fan, a heater, and a sieve tank for the silver crystals. The dried silver crystals are then melted using an induction furnace.

**Casting and bar processing**
Casting of silver bars is performed using an Outotec Silver Bar Casting Wheel for 1000 troy ounce (approximately 31 kg) ingots. The bars are then cooled in a water bath. Further operations, such as polishing, weighing, marking, and stacking can be performed by the Outotec Silver PWMS Robot. The equipment produces silver bars that meet the requirements of the London Bullion Market Association’s Good Delivery standards.

**Granulation and packing**
Outotec Silver Granulation Equipment consists of an induction furnace, granulation equipment and a receiving tank. Granules are dried in the Outotec Silver Dryer and packed using a material-handling system that produces ready-to-ship bags that are sealed and marked.
3.12.4. Gold Leaching & Recovery

Outotec has developed a new environmentally friendly chloride leaching process for gold ores and concentrates. The new process combines effective gold leaching with a new type of gold solvent extraction process.
Highly oxidizing power in gold leaching provides very fast leaching kinetics and excellent gold recovery. Gold can be extracted from pregnant leach solutions using an Outotec's patented solvent extractant. Pure gold product is precipitated directly from the stripping solution. Solvent extraction technology enables also direct silver recovery.

Effluent generated during the process is treated in state of art effluent treatment facility.

3.13. Continuous Cast Copper Wire Rod Plant (CCR):

Copper Cathode produced from Copper Refinery will be melted in a vertical shaft furnace with the help of gaseous fuel like LNG/LPG/ etc and drawn in the form of Copper wire rod on continuous basis from a continuous casting and rolling machine. Rod will be of various sizes as per market requirement such as 8 to 25 mm.

The copper rod is manufactured by the modern continuous casting and rolling technology CONTIROD/ South Wire/ Properzi using the machinery supplied by Asarco (USA) – shaft furnace, Hazelett (USA) – twin belt caster/ South wire/ Continuous Properzi Caster, SMS-MEER (Germany)/ Morgan (USA)/ Continuous Properzi (Italy) – rolling mill.

The process of copper rod manufacturing consists of the following main stages:

1. Charging copper cathodes into the shaft furnace by the skip hoist and melting of the metal with gaseous fuel.
2. Preparation of metal for casting in the holding furnace.
3. Continuous casting rectangular/ Trapezoidal shape copper bar on the caster.
4. Rolling of continuously cast in the rolling mill.
5. Cooling and brightening of copper rod.
6. Coating the copper rod with anti-corrosion wax layer.
7. Coiling of the copper rod into coils.
8. Weighing, packing, warehousing, and shipping of the finished product.

3.14. Phosphoric Acid Plant:
Phosphoric acid plant of 5LTPA capacity will be set up. This will be value addition to proposed copper smelter project as well as Indian Fertilizer
industries. This will be sold to fertilizer companies. Phosphogypsum produced during the process will be sold to cement industries as well as fertilizer and rest will be stock piled. Hydro Fluro Silicic acid generated as a byproduct will be converted as Aluminum Fluoride as well as sold in the market.

The rock phosphate received by conveying system from port and stored in Rock phosphate storage area. The rock phosphate will be taken to reactor (R1) by conveyor and hopper where it is mixed with recycled slurry, which contains mainly P₂O₅, CaO, SO₃ and H₂O received from Reactor (R2). Slurry prepared in the reactor (R1) series will be sent to Flash Column to cool the slurry and maintain the required temperature in the reactor compartment. The slurry separated out from flash column will be fed to Reactor (R2) to react with sulphuric acid and form the slurry which will be sent to filter. Phosphoric Acid of 26-27% To 42-43% (Weak Phosphoric Acid) will be recovered based on the

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*Pre-Feasibility Report*
process of phosphoric acid is selected. A series of washes has been introduced to recover the $P_2O_5$ from the filtered cake, before it is sent Gypsum Pond. Filtered acid is then sent to Clarification section to trap the solids passed through the filter cloth. Clarified acid is then fed through Evaporation section to enhance the concentration to 48-54% $P_2O_5$ (Strong Phosphoric Acid) suitable for fertilizer manufacturer.

During evaporation of the weak Phosphoric acid to strong phosphoric acid, Hydro fluro Silicic acid of 18 -20% concentration is generated. This acid is then partially consumed in house for Aluminum Fluoride manufacturing and rest is sold in the market.

3.15. Aluminum Fluoride Plant

Hydro fluro Silicic acid generated from Phosphoric acid plant will be converted in value added Aluminum Fluoride. Aluminum Fluoride plant of 30,000 MTPA capacity will be set up. Aluminum Fluoride produced will be sold to Aluminum manufacturing Companies.
Aluminum hydrate will be sourced from local market. Aluminum hydrate will be digested with hydro fluoro silicic acid to make Aluminum fluoride in liquid form and silica part will be separated by filtration. Liquid aluminum fluoride will then undergo crystallization process and then Aluminum Fluoride will be filtered and dried with gaseous fuel before sending it to packaging section.

Cyclonic separator and bag filters will be installed to recover the Aluminum fluoride, which may get escaped during the drying process.

**3.16. Effluent Treatment Plant (ETP):**

Waste water generated from Copper Smelter, Sulphuric Acid Plant and Copper Refinery will be treated in state of art effluent treatment facility.

The Ferric arsenate process is a solution for managing toxic arsenic in process and effluent streams. The process consists of a ferric arsenate precipitation stage followed by neutralization using lime milk. The process is based on easy, robust and understandable precipitation. The treatment of toxic arsenic requires a high level process reliability. This can be guaranteed using the cost-effective Ferric arsenate process.
After the ferric arsenate process the treated water has a low arsenic concentration, typically containing 1-3 mg/L arsenic. If an even lower arsenic concentration is required, a polishing step with enhanced arsenic removal can be included. The process comprises the neutralization of acidic streams and the advanced removal of metal impurities, including Ni, Cd, Cu, Sb and Zn. The final product of the ferric arsenate treatment process is treated water that can be safely discharged to the environment or recycled back for process use. The selection of the arsenic treatment process is governed by residual stability. The residue of the Ferric arsenate process is a stable solid precipitate.

Treated effluent will be consumed within the plant operations to maximum extent and rest will be discharged to Sea, ensuring it confirm the discharge standards.

3.17. Utilities Requirement:

Following utility items are considered.

a. Power – Incoming Substation
b. Required Fuel Oil supply system
c. LNG/LPG
d. Process air compressor
e. Oxygen Plant
f. Required Electrical & Instrumentation
g. Waste Heat Recovery Based Power Plant
h. Raw Water Storage and supply system
i. DM Plant
j. Secondary RO Plant, etc

3.17.1. Water:

The Requirement Water for the plant has been estimated around 32,800 M3/Day. M/s. Adani Ports & Special Economic Zone Ltd (APSEZL) will be supplying the total water requirement for the plant.
3.17.2. Power:

The total estimated power requirement for Copper Smelter Plant is 300 MW out of which 40 MW would be generated from internal process steam and balance 260 MW power would be sourced from Grid/ M/s. Adani Ports & Special Economic Zone Ltd (APSEZL)

3.17.3. Fuel Oil:

Fuel oil storage facility will be built as per requirement in accordance with guidelines from CCOE. Capacity of the system will be based on the design requirement after finalization of the engineering.

3.17.4. LPG/ LNG:

LPG/LNG storage facility will be built as per requirement in accordance with guidelines from CCOE. Capacity of the system will be based on the design requirement after finalization of the engineering.

3.17.5. Air Compressor:

A dedicated air compressor station will installed to supply process air as well as moisture free air as Instrument air for operation of pneumatic based instruments. Capacity of the system will be based on the design requirement after finalization of the engineering.

3.17.6. Oxygen Plant:

2 Oxygen plants each of 1500 TPD Capacity delivering 95% purity Oxygen will be set up for Copper smelter requirement.

3.17.7. Waste Heat recovery based power Plant:

With focus on recovery of heat energy, waste heat recovery based power plant with – 50 MW capacity will be installed.

3.17.8. DM Plant
A dedicated DM plant will be set up to fulfill the requirement of Copper Refinery Tank House and Continuous Cast Copper Rod Plant.

3.17.9. Secondary RO Plant:

A dedicated secondary RO plant will be installed at the down stream of the proposed Effluent Treatment Plant. This will help to reuse and recycle the treated water effectively within the plant requirement. Rejects from the secondary RO plant will be discharged to sea through existing APSEZ’s desalination plant outfall channel.
3.18 Process Flow sheet for Integrated Copper Smelter Project

Copper Smelter Complex Flow Sheet

Air → Oxygen Plant → Smelting Furnace → Gas Cleaning Plant → Sulfuric Acid Plant → Copper Refinery Tank House → CCR Plant

Energy → Turbine → Steam → Settler/Slag Cleaning Furnace → Converter Slag → Slag Cleaning Furnace

SO₂ Gas → Fugitive Gases Scrubber → Gas Stack → Copper Scrap Melting Furnace

Hg Sales → Gas Cleaning Plant → Dry SO₂ Gas → H₂SO₄ Sales → Rock Phosphate

H₂SO₄ → H₂PO₄ Sales → Gypsum → Aluminum Fluoride Plant

H₃SiF₆ Sales → CCR Sales

H₃SiF₆ → Cathodes Sales → Precious Metal Recovery → Selenium

Bi & Sb Salts → Tellurium → Nickel

Minor Metal Recovery → Silver

Precious Metal Recovery → Gold

PGM Concentrate

Flux Material

Cu Concentrate

Matte + Slag → Slag Cleaning Furnace

Blister Copper → Copper Anode

Copper Metal

Anode Slag → Copper Scrap (Internal + External)

Converter Slag → Slag for Granulation

Matte → Slag for Granulation

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CHAPTER – 4
Resource Consumption
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CHAPTER – 4
Resources Consumption

4.1 Raw Material Consumption & Source:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>UOM</th>
<th>Total Quantity</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Raw Material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Copper Concentrate</td>
<td>TPA</td>
<td>32,00,000</td>
<td>Local &amp; Import</td>
</tr>
<tr>
<td>2</td>
<td>Silica</td>
<td>TPA</td>
<td>3,20,000</td>
<td>Local</td>
</tr>
<tr>
<td>3</td>
<td>Lime Stone</td>
<td>TPA</td>
<td>80,000</td>
<td>Local</td>
</tr>
<tr>
<td>4</td>
<td>Quartz</td>
<td>TPA</td>
<td>1,44,000</td>
<td>Local</td>
</tr>
<tr>
<td>5</td>
<td>Quick Lime</td>
<td>TPA</td>
<td>60,000</td>
<td>Local &amp; Import</td>
</tr>
<tr>
<td>6</td>
<td>Copper Scrap</td>
<td>TPA</td>
<td>2,00,000</td>
<td>Local &amp; Import</td>
</tr>
<tr>
<td>7</td>
<td>Rock Phosphate</td>
<td>TPA</td>
<td>17,50,000</td>
<td>Local &amp; Import</td>
</tr>
<tr>
<td>8</td>
<td>Alumina Hydrate</td>
<td>TPA</td>
<td>37,500</td>
<td>Local</td>
</tr>
</tbody>
</table>

Table 2: Raw Material Consumption Quantity & Source

Details of other in process Raw material will be known during feasibility study and same will be included later in the report.

Raw Material Chemical Analysis
1. Copper Concentrate Composition:

<table>
<thead>
<tr>
<th>Concentrate Blend Composition</th>
<th>Tentative Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>8%</td>
</tr>
<tr>
<td>Copper</td>
<td>26%</td>
</tr>
<tr>
<td>Iron</td>
<td>29%</td>
</tr>
<tr>
<td>Sulphur</td>
<td>34%</td>
</tr>
<tr>
<td>SiO$_2$</td>
<td>6%</td>
</tr>
<tr>
<td>CaO</td>
<td>1%</td>
</tr>
<tr>
<td>Al$_2$O$_3$</td>
<td>2%</td>
</tr>
<tr>
<td>Fe$_3$O$_4$</td>
<td>1%</td>
</tr>
<tr>
<td>Acid Insoluble</td>
<td>14%</td>
</tr>
<tr>
<td>Arsenic</td>
<td>2500 ppm</td>
</tr>
<tr>
<td>Selenium</td>
<td>300 ppm</td>
</tr>
<tr>
<td>Bismuth</td>
<td>250 ppm</td>
</tr>
<tr>
<td>Chloride</td>
<td>300 ppm</td>
</tr>
<tr>
<td>Fluoride</td>
<td>1000 ppm</td>
</tr>
<tr>
<td>Mercury</td>
<td>50 ppm</td>
</tr>
<tr>
<td>Lead</td>
<td>1.50%</td>
</tr>
<tr>
<td>Zinc</td>
<td>2%</td>
</tr>
</tbody>
</table>

Table 3: Copper Concentrate Chemical Composition

2. Silica Sand

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO$_2$</td>
<td>&gt; 95%</td>
</tr>
<tr>
<td>Mineralogy</td>
<td>Quartz</td>
</tr>
<tr>
<td>Particle Size</td>
<td>&lt; 3 mm</td>
</tr>
</tbody>
</table>

Table 4: Silica Sand Chemical Composition

3. Lime Stone

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>&gt; 45%</td>
</tr>
<tr>
<td>Particle Size</td>
<td>&lt; 8 mm</td>
</tr>
<tr>
<td>Mineralogy</td>
<td>Crystalline</td>
</tr>
</tbody>
</table>

Table 5: Lime Stone Chemical Composition

4. Quartz Chips
5. Quick Lime

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CaO</td>
<td>&gt; 90%</td>
</tr>
<tr>
<td>Particle Size</td>
<td>~ 25 mm</td>
</tr>
</tbody>
</table>

Table 7: Quick Lime Chemical Composition

6. Alumina Hydrate

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al₂O₃</td>
<td>&gt; 64.5%</td>
</tr>
<tr>
<td>SiO₂</td>
<td>&lt;0.016%</td>
</tr>
<tr>
<td>Hydrate</td>
<td>&gt; 98.5%</td>
</tr>
<tr>
<td>Moisture</td>
<td>&lt;8%</td>
</tr>
<tr>
<td>LOI</td>
<td>&lt;36%</td>
</tr>
</tbody>
</table>

Table 8: Alumina Hydrate Chemical Composition

7. Rock Phosphate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>&lt; 3%</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>30% – 34%</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.25% – 2.0%</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>0.25% – 1.50%</td>
</tr>
<tr>
<td>Chloride</td>
<td>50 ppm – 600 ppm</td>
</tr>
<tr>
<td>Fluoride</td>
<td>3% - 4.5%</td>
</tr>
<tr>
<td>Silica</td>
<td>4% - 14%</td>
</tr>
<tr>
<td>Sulphate as SO₃⁻</td>
<td>0.8% - 1.2%</td>
</tr>
<tr>
<td>CaO</td>
<td>44% - 52%</td>
</tr>
</tbody>
</table>

Table 9: Rock Phosphate Chemical Composition
4.2 Fuel Consumption & Source:

Table 10: Fuel Consumption Quantity & Source

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>UOM</th>
<th>Total Quantity</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High Speed Diesel</td>
<td>KLPD</td>
<td>50</td>
<td>Local</td>
</tr>
<tr>
<td>2</td>
<td>Furnace Oil</td>
<td>TPD</td>
<td>300</td>
<td>Local</td>
</tr>
<tr>
<td>3</td>
<td>Liquefied Petroleum Gas</td>
<td>TPD</td>
<td>100</td>
<td>Local</td>
</tr>
<tr>
<td>4</td>
<td>Coal / Pet Coke</td>
<td>TPD</td>
<td>100</td>
<td>Local</td>
</tr>
<tr>
<td>5</td>
<td>Met Coke</td>
<td>TPD</td>
<td>100</td>
<td>Local</td>
</tr>
</tbody>
</table>

4.3 Water Consumption & Source:

The Requirement Water for the plant has been estimated as 32,800 M3/Day. M/s. MPSEZ Utility Pvt. Limited (MUPL) will be supplying the total water requirement for the plant. This water would be utilized to meet the DM water and Plant/Utility water requirement of Copper Smelter Complex. The water system, is highly integrated and is designed for Zero Liquid Discharge (ZLD).

4.4 Electricity Consumption & Source:

Total Power Consumption for the Copper Smelter Complex will be ~300 MW

Power generated through Waste Heat Recovery Boiler will be ~40 MW

Balance Electrical power will be sourced from Grid/MPSEZ Utility Pvt. Limited (discom).
Copper Plant Integrated (Copper Smelter, Oxygen Plant, Copper Refinery, CCR Plant, PMR Plant, Sulphuric Acid Plant, Phosphoric Acid Plant, Aluminum Fluoride Plant, etc)

Material Flow Sheet (Tentative) - 1000 KTPA Copper Plant - Integrated

<table>
<thead>
<tr>
<th>Products</th>
<th>Raw Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper Cathode</td>
<td>TPA 10,00,000</td>
</tr>
<tr>
<td>Sulphuric Acid (&gt; 98%)</td>
<td>TPA 30,00,000</td>
</tr>
<tr>
<td>Continuous Copper Wire Rod</td>
<td>TPA 30,00,000</td>
</tr>
<tr>
<td>Oxygen (Technical)</td>
<td>TPA 90,000</td>
</tr>
<tr>
<td>Gold</td>
<td>TPA 50,000</td>
</tr>
<tr>
<td>Silica</td>
<td>TPA 90,000</td>
</tr>
<tr>
<td>Copper Concentrate</td>
<td>TPA 32,00,000</td>
</tr>
<tr>
<td>Copper Scrap</td>
<td>TPA 2,00,000</td>
</tr>
<tr>
<td>Sulphuric Acid (&gt; 98%)</td>
<td>TPA 30,00,000</td>
</tr>
<tr>
<td>Rock Phosphate</td>
<td>TPA 20,00,000</td>
</tr>
<tr>
<td>Fluoride</td>
<td>TPA 1,44,000</td>
</tr>
<tr>
<td>Ferric Sulphate</td>
<td>TPA 32,500</td>
</tr>
<tr>
<td>Phosphoric Acid (as 100% P2O5)</td>
<td>TPA 5,00,000</td>
</tr>
<tr>
<td>Copper Tails</td>
<td>TPA 5,00</td>
</tr>
<tr>
<td>Byproducts</td>
<td></td>
</tr>
<tr>
<td>Anode Slime</td>
<td>TPA 37,500</td>
</tr>
<tr>
<td>Selenium</td>
<td>TPA 37,500</td>
</tr>
<tr>
<td>Phosphogypsum</td>
<td>TPA 2,08,333</td>
</tr>
<tr>
<td>Copper Tails</td>
<td>TPA 5,00</td>
</tr>
<tr>
<td>Waste</td>
<td>TPA 10,00,000</td>
</tr>
<tr>
<td>ETP Waste Sludge &amp; Scrubber Waste</td>
<td>TPA 50,00</td>
</tr>
<tr>
<td>Nickel Sludge</td>
<td>TPA 529</td>
</tr>
<tr>
<td>Mercury</td>
<td>TPA 18</td>
</tr>
<tr>
<td>Copper Tails</td>
<td>TPA 5,00</td>
</tr>
<tr>
<td>Waste Heat Recovery Boiler based power</td>
<td>TPA 50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Raw Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica</td>
</tr>
<tr>
<td>Coke</td>
</tr>
<tr>
<td>Coke Dust</td>
</tr>
<tr>
<td>Copper Shell</td>
</tr>
<tr>
<td>Alumina Hydrate</td>
</tr>
<tr>
<td>High Speed Diesel</td>
</tr>
<tr>
<td>Fuel</td>
</tr>
<tr>
<td>Uranium Hydrate</td>
</tr>
<tr>
<td>Ferric Sulphate</td>
</tr>
<tr>
<td>Phosphoric Acid (as 100% P2O5)</td>
</tr>
<tr>
<td>Coke PFA Coke</td>
</tr>
<tr>
<td>Coke Lime Clink</td>
</tr>
<tr>
<td>Coke Lime Coke</td>
</tr>
<tr>
<td>Coke Lime Coke</td>
</tr>
</tbody>
</table>

Pre-Feasibility Report
Water Balance - 1000 KTPA Copper Plant - Integrated

MUPL 32766 → Raw Water Reservoir 324

Raw Water Reservoir 324 → Evaporation 1516

Evaporation 1516 → Copper Smelter + Scrap Melting Furnace 7200

Copper Smelter + Scrap Melting Furnace 7200 → Copper Refinery & PMR 13175

Copper Refinery & PMR 13175 → Phosphoric Acid Plant 8800

Phosphoric Acid Plant 8800 → Sulphuric Acid Plant 1944

Sulphuric Acid Plant 1944 → Effluent Treatment Plant 1320

Effluent Treatment Plant 1320 → Copper Smelter 1920

Copper Smelter 1920 → Effluent Treatment Plant 1200

Effluent Treatment Plant 1200 → Sea Discharge 431

Sea Discharge 431 → Gardening 1597

Copper Refinery & PMR 13175 → Copper Smelter 1944

Copper Refinery & PMR 13175 → CCR Plant 1200

CCR Plant 1200 → Domestic Use 1000

Domestic Use 1000 → Sewage Treatment Plant 1000

Sewage Treatment Plant 1000 → Gardening 1597

Pre-feasibility Report

Copper Smelter Project

Water Balance (Quantities in M³/Day) (Tentative)
CHAPTER – 5
Products, By-Products and Waste

Page 93 - 96
## Products, Byproducts & Waste

### 5.1 Products and Capacity:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Products</th>
<th>UOM</th>
<th>Total Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Copper Cathode</td>
<td>TPA</td>
<td>10,00,000</td>
</tr>
<tr>
<td>2</td>
<td>Sulphuric Acid (&gt; 98%)</td>
<td>TPA</td>
<td>30,00,000</td>
</tr>
<tr>
<td>3</td>
<td>Continuous Cast Copper Wire Rod</td>
<td>TPA</td>
<td>5,00,000</td>
</tr>
<tr>
<td>4</td>
<td>Oxygen (Technical)</td>
<td>TPA</td>
<td>90,000</td>
</tr>
<tr>
<td>5</td>
<td>Gold</td>
<td>TPA</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>Silver</td>
<td>TPA</td>
<td>500</td>
</tr>
<tr>
<td>7</td>
<td>Phosphoric Acid (as 100% P2O5)</td>
<td>TPA</td>
<td>5,00,000</td>
</tr>
<tr>
<td>8</td>
<td>Aluminium Fluoride</td>
<td>TPA</td>
<td>30,000</td>
</tr>
</tbody>
</table>

Table 11: Products and Quantity

### 5.2 By-Products and Quantity

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Byproducts</th>
<th>UOM</th>
<th>Total Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anode Slime</td>
<td>TPM</td>
<td>500</td>
</tr>
<tr>
<td>2</td>
<td>Selenium</td>
<td>TPM</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>PGM Concentrate</td>
<td>TPM</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Ferro Sand/ Iron Silicate - Copper Slag (Granulated)</td>
<td>TPM</td>
<td>1,85,000</td>
</tr>
<tr>
<td>5</td>
<td>Phosphogypsum</td>
<td>TPM</td>
<td>2,08,333</td>
</tr>
<tr>
<td>6</td>
<td>Hydro Fluro Silicic Acid (~20% as H2SiF6)</td>
<td>TPM</td>
<td>2,500</td>
</tr>
<tr>
<td>7</td>
<td>Copper Telluride</td>
<td>TPM</td>
<td>42</td>
</tr>
<tr>
<td>8</td>
<td>Tellurium</td>
<td>TPM</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Nickel</td>
<td>TPM</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Bismuth Bisulphate</td>
<td>TPM</td>
<td>120</td>
</tr>
<tr>
<td>---</td>
<td>---------------------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>11</td>
<td>Calomel (Mercury Chloride)</td>
<td>TPM</td>
<td>18</td>
</tr>
<tr>
<td>12</td>
<td>Mercury</td>
<td>TPM</td>
<td>16</td>
</tr>
<tr>
<td>13</td>
<td>CCR Mill Scale</td>
<td>TPM</td>
<td>50</td>
</tr>
<tr>
<td>14</td>
<td>Waste Heat Recovery Boiler based power</td>
<td>MW</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 12: By-Products and Quantity

5.3 Waste Generation and Quantity

<table>
<thead>
<tr>
<th>D</th>
<th>Waste</th>
<th>UOM</th>
<th>Total Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ETP Waste Sludge &amp; Scrubber Waste</td>
<td>TPM</td>
<td>18,000</td>
</tr>
<tr>
<td>2</td>
<td>Nickel Sludge</td>
<td>TPM</td>
<td>529</td>
</tr>
<tr>
<td>3</td>
<td>Arsenic bearing sludge. As-Cu precipate</td>
<td>TPM</td>
<td>223</td>
</tr>
<tr>
<td>4</td>
<td>Used Oil</td>
<td>KL/Yr</td>
<td>200</td>
</tr>
<tr>
<td>5</td>
<td>Oil Sludge</td>
<td>T/yr</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>Spent Catalyst</td>
<td>KL/Yr</td>
<td>400</td>
</tr>
<tr>
<td>7</td>
<td>Spent Resins from DM, RO &amp; Refinery Plant</td>
<td>KL/Yr</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>ETP Treated Water</td>
<td>KL/Day</td>
<td>500</td>
</tr>
<tr>
<td>9</td>
<td>Rejects from Secondary RO Plant</td>
<td>KL/Day</td>
<td>500</td>
</tr>
</tbody>
</table>

Table 13: Type of Waste Generation & Quantity

5.4 By Product Characteristics (Typical)

Granulated Ferro Sand/ Iron Silicate/ Copper Slag

<table>
<thead>
<tr>
<th>Parameter</th>
<th>UOM</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>%</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>Iron</td>
<td>%</td>
<td>40 - 45</td>
</tr>
<tr>
<td>Sulphur</td>
<td>%</td>
<td>0.5 – 1.5</td>
</tr>
</tbody>
</table>
Silica | % | 28 – 35
---|---|---
Lime - CaO | % | 3.0 – 5.0
Arsenic | ppm | 25 - 50

**Table 14: Chemical Analysis of Granulated Ferro Sand/ Iron Silicate/ Copper Slag**

**Phospho Gypsum**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>UOM</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total P$_2$O$_5$</td>
<td>%</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>Water Soluble P$_2$O$_5$</td>
<td>%</td>
<td>&lt;0.2</td>
</tr>
<tr>
<td>Sulphate as SO$_3$</td>
<td>%</td>
<td>&lt;42</td>
</tr>
<tr>
<td>CaO</td>
<td>%</td>
<td>&lt;34</td>
</tr>
<tr>
<td>Silica</td>
<td>%</td>
<td>&lt;8</td>
</tr>
<tr>
<td>pH of 1% solution</td>
<td>%</td>
<td>&gt; 4.5</td>
</tr>
</tbody>
</table>

**Table 15: Chemical Analysis of Phospho Gypsum**

5.5 **Waste Characteristics (Typical)**

**Scrubber Cake**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>UOM</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>%</td>
<td>0.05 – 0.07</td>
</tr>
<tr>
<td>Copper</td>
<td>ppm</td>
<td>10 - 20</td>
</tr>
<tr>
<td>Zinc</td>
<td>ppm</td>
<td>1.0 - 2.0</td>
</tr>
<tr>
<td>CaO</td>
<td>%</td>
<td>30 - 32</td>
</tr>
<tr>
<td>Sulphate</td>
<td>%</td>
<td>40 – 45</td>
</tr>
<tr>
<td>Silica</td>
<td>%</td>
<td>&lt; 0.5%</td>
</tr>
<tr>
<td>Moisture</td>
<td>%</td>
<td>45</td>
</tr>
</tbody>
</table>

**Table 16: Chemical Analysis of Scrubber Cake**

*Pre-Feasibility Report*
### ETP Cake

<table>
<thead>
<tr>
<th>Parameter</th>
<th>UOM</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>%</td>
<td>4.5 – 6.2</td>
</tr>
<tr>
<td>Arsenic</td>
<td>%</td>
<td>0.8 – 1.5</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/l</td>
<td>1300 – 2100</td>
</tr>
<tr>
<td>Bismuth</td>
<td>mg/l</td>
<td>65 – 185</td>
</tr>
<tr>
<td>Cadmium</td>
<td>mg/l</td>
<td>&lt; 15</td>
</tr>
<tr>
<td>Chromium</td>
<td>mg/l</td>
<td>&lt; 15</td>
</tr>
<tr>
<td>Cobalt</td>
<td>mg/l</td>
<td>&lt; 15</td>
</tr>
<tr>
<td>Nickel</td>
<td>mg/l</td>
<td>&lt; 15</td>
</tr>
<tr>
<td>Lead</td>
<td>mg/l</td>
<td>20 – 50</td>
</tr>
<tr>
<td>Antimony</td>
<td>mg/l</td>
<td>&lt; 20</td>
</tr>
<tr>
<td>Selenium</td>
<td>mg/l</td>
<td>20 – 40</td>
</tr>
<tr>
<td>Zinc</td>
<td>mg/l</td>
<td>1100 – 2500</td>
</tr>
<tr>
<td>CaO</td>
<td>%</td>
<td>28 – 30</td>
</tr>
<tr>
<td>Sulphate as SO$_3^-$</td>
<td>%</td>
<td>38 – 42</td>
</tr>
<tr>
<td>Silica</td>
<td>%</td>
<td>&lt; 0.5%</td>
</tr>
<tr>
<td>Moisture</td>
<td>%</td>
<td>35</td>
</tr>
</tbody>
</table>

Table 17: Chemical Analysis of ETP Cake
CHAPTER – 6
Site Selection and Analysis

Page 98 - 116
6.1 Nature of Project:

The project cost estimated to be around US $ 1.5 billion (Rs. 10,000 crore) includes Copper Smelter, Sulphuric Acid Plant, Copper Refinery, Continuous Cast Copper Wire Rod Plant, Precious Metal Recovery Plant, Phosphoric Acid Plant, Aluminum Fluoride Plant, etc. The project would be located in Mundra, Gujarat will produce 10LTPA of Copper Cathode; 5LTPA of Copper Rod; 30LTPA of Sulphuric Acid; 5LTPA of Phosphoric Acid; 30,000TPA of Aluminum Fluoride, 288 TPA of Selenium, 50TPA of Gold; 500TPA of Silver; etc with state of art environment friendly technology.

Plant Configuration:

1. Copper Smelter Plant – 9 LTPA
2. Copper Scrap Melting Facility - 1 LTPA
3. Copper Refinery Plant – 10 LTPA
4. Continuous Cast Copper Rod Plant - 5 LTPA
5. Sulphuric Acid Plant – 30 LTPA
6. Phosphoric Acid Plant - 5 LTPA
7. Aluminum Fluoride Plant - 30,000 TPA
8. Selenium Recovery Plant - 288 TPA
9. Precious Metal Recovery Plant
   I. Gold – 50 TPA
   II. Silver – 500 TPA
10. Oxygen (Industrial) Plant – 90,000 TPM (95% Purity)
11. Waste Heat recovery boiler based power plant – 50 MW
6.2 Project Location:

The Project site is located in Siracha and Navinal Villages at APSEZ Mundra taluka, District Kutch in the state of Gujarat and about 8.0 km from Mundra West Port, Gujarat, (latitude 22°48'55.78"N and longitude 69°34'32.02"E project area center approx).

Location map of the plant is shown in Annexure - 1
Composite Layout for Copper Smelter Project

- UMPP – TATA Power Plant
- Adani Power Plant
- Adani West Port for RM Handling
- Intake Channel for Power Plant
- Outfall Channel for CGPL
- Raw Material Conveyor from West Port to Copper
- Outfall Channel
- Site 1
- Site 2
- Site 3
6.2.1 Connectivity

The proposed project will be located near to existing Adani Power Plant, 20 km distance from Mundra town and around 10.5 km from West Port. Proposed Plant site is located in Siracha and Navinal villages in APSEZ Mundra, Mundra Taluka, Kutch district (latitude 22°48'55.78"N and longitude 69°34'32.02"E project area center approx). All existing villages outside the APSEZ area and are accessible by existing State Highway 9Sh-6 and National Highway (NH-8A ext) between Gandhidham and Mandvi towns. Proposed Plant area is accessible through existing APSEZ road which connected through existing State Highway and national Highway.

The proposed site is well connected by the existing National / State Highways, cargo rail link, which is about 2.0 km away from the Navinal Railway Station. The nearest airport is Bhuj Airport located at a distance of 65 kms from the proposed project site. The nearest railway station is Adipur/Gandhidham, which is about 80 kms from project site and nearest town is Mundra which is about 20.0 kms from the proposed project site.

The national highway NH-8A is passing at about 15.0 kms away from the site. State Highway SH-6 is about 3.0 km at north of proposed site. The site is well connected with Ahmedabad city located at about 460 kms.

6.2.2 Land Form/land Use Pattern, Use & Ownership:

The area earmarked for proposed Copper Smelter is approx 634 Acre. Details of the same are given below:

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Particulars</th>
<th>Approx. Area in Acres</th>
<th>Current Ownership</th>
<th>Khasra No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>APSEZ SEZ Notified Land (Part)</td>
<td>381</td>
<td>APSEZ</td>
<td>Siracha village</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>125/1, 125/2, 126, 129, 135, 137, 138/1, 140,</td>
</tr>
</tbody>
</table>
1. The required land for entire Copper Smelter Complex including its Greenbelt (33% of total land) will be accommodate as per the detailed project requirements in the identified land approx. 634 Acres. The Details of the identified land is mentioned above. Land for different corridors (Power/ Road/ Raw Material Conveyor) would be additional.

2. **6.2.3 Topography:**

The project site is located within the APSEZL land and already designated/recorded as industrial land. There is no significant vegetation or habitation in the project site. The nearest significant features from the project site are 4620 MW Adani Power Plant and Tata Power (Western side
of project area), and West Port of APSEZL (South – west direction from project). The existing Siracha and Navinal villages settlements are in proximity with the approx. distance of 2.5 km to the proposed project site.

From South West to North East majority of area is of APSEZL where west port is also located. The land is having undulations and minor grading will be required.

6.2.4 Existing Infrastructure:

- Distance from Mundra Town – 15KM
- Distance from Mundra West Port – 10.5 KM
- Distance from State Highway-SH6 – < 1 KM (Gandhidham-Mundra-Mandvi)
- Distance from NH8A – 10.0 KM
- Distance from Railway line – 3.0 KM (APL Gate no-4)
- Distance from Adani Airstrip – 25 KM
- Distance from Commercial Airport (Bhuj) – 65 KM
- Distance from Commercial Airport (Kandla) – 80 KM
- Water source (Sea) – Adjacent within 5.0km
- Adjacent to Adani Power Plant
- Distance from Adani Township – 30 KM

6.2.5 Soil Classification:

Detailed Soil Investigation has not been carried out in the area. However, based on available information from the nearby and adjacent power plant project, foundation system has been envisaged as follows:

The subsoil is expected to be generally of good quality. The sub soil is basically residual in nature with underlying rock layer. The soil in the adjacent area is medium dense silty fine to medium sand under the top layer followed by dense to very dense silty fine to medium sand in the lower layer. At some isolated places, stiff to hard silty clay or clayey silt may be found.
The underlying rock layer is highly weathered rock in the upper layer to moderately weathered rock in layers below.

With the above subsoil features, the subsoil is found to be of good quality and expected to provide good bearing capacity at a depth of about 3 to 4m. Heavy structures are expected to be on piles and the lighter structures will be on open foundations. The structures which require pile foundation shall be finalized based on the soil investigation data.

6.2.6 Climatic Data:

As per Indian Meteorological department, Govt. of India, Highest monthly mean of daily mean maximum temperature is 36°C and max. dry bulb temperature is 47.8°C, considering max Humidity 95%.

The wind is predominantly from the south- west as well as from west to some extent. The basic wind speed is 50 m/sec and maximum wind velocity is 65 kmph. The proposed site is located in Seismic Zone – V as per relevant IS: 1893-2002.

Meteorological Data enclosed as Annexure – VI.

6.3 Selection of Land for the Project site:

The following alternative locations/ sites were considered and analysed to select the most suitable location for development of proposed Copper Smelter facility on the basis of raw material, power & water availability, area requirement and accessibility via road or port.

Site - 1 (Area approx. 800 Acres) in APSEZ land located in Ratadiya. Gundala & Moka villages.
Site - 2 (Area approx. 634 Acres) in Village Siracha and Navinal (North East & East of existing Adani Power Plant)
Site - 3 (Area approx. 1200 Acres) in APSEZ notified SEZ land located in Mundra village.

Location of considered sites is shown below:-
Alternate Sites Evaluated for Copper Smelter Project

- UMPP – TATA Power Plant
- Adani Power Plant
- Adani West Port for RM Handling

Site 1

Site 2

Site 3
6.3.1. Requirements for Copper Smelter Plant Site

Following are the requirements which should be fulfilled by the selected site for the proposed Copper Smelter, Sulphuric Acid Plant, Copper Refinery, Continuous Cast Copper Wire Rod Plant, Precious Metal Recovery Plant, Phosphoric Acid Plant, Aluminum Fluoride Plant, etc.

a. Land

The total area within the plant boundary required for the installation of above facilities with necessary auxiliary and services units and considering a smooth operational flow will be Approx. 600 acres.

b. Water

A copper smelter plant in general consumes considerable quantity of water, bulk of which is required for cooling purposes and the rest is utilized for process needs, drinking, sanitary and fire fighting purpose. In order to reduce the requirement of fresh water, circulation system has been considered. In this system, the return water from various units of plant will be reused after necessary cooling/treatment. Fresh make up water will be added to compensate for losses in re-circulation system.

Total Water Requirement will be ~32,800 m$^3$/Day

c. Power

The plant and equipment of a copper plant are required to run round the clock and any un-planned interruption in the operation not only hampers the production but causes damage to equipment also.

Total Power Requirement will be ~ 300 MW. Part of the power ~40 MW will be generated from the various Waste Heat Recovery based power plant and rest will be sourced from Grid/MPSEZ Utility Pvt. Limited (discom).
Raw Material

About 50 LTPA of raw material will be required to produce of 10 LTPA of Copper Cathode as finished product and associated Phosphoric Acid. The annual major raw material requires for production of copper are given below:

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>UOM</th>
<th>Total Quantity</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Raw Material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Copper Concentrate</td>
<td>TPA</td>
<td>32,00,000</td>
<td>Local &amp; Import</td>
</tr>
<tr>
<td>2</td>
<td>Silica</td>
<td>TPA</td>
<td>3,20,000</td>
<td>Local</td>
</tr>
<tr>
<td>3</td>
<td>Lime Stone</td>
<td>TPA</td>
<td>80,000</td>
<td>Local</td>
</tr>
<tr>
<td>4</td>
<td>Quartz</td>
<td>TPA</td>
<td>1,44,000</td>
<td>Local</td>
</tr>
<tr>
<td>5</td>
<td>Quick Lime</td>
<td>TPA</td>
<td>60,000</td>
<td>Local &amp; Import</td>
</tr>
<tr>
<td>6</td>
<td>Copper Scrap</td>
<td>TPA</td>
<td>2,00,000</td>
<td>Local &amp; Import</td>
</tr>
<tr>
<td>7</td>
<td>Rock Phosphate</td>
<td>TPA</td>
<td>17,50,000</td>
<td>Local &amp; Import</td>
</tr>
<tr>
<td>8</td>
<td>Alumina Hydrate</td>
<td>TPA</td>
<td>37,500</td>
<td>Local</td>
</tr>
</tbody>
</table>

The indicative sources have been taken for the present analysis for comparison of various sites.

d. Road

For receipt of other raw materials at plant site and despatches of various products and byproducts from site, the region should be well connected by roads.

e. Port

Site should be well connected to the west port for receipt of Copper Concentrate & Rock Phosphate and for dispatch of finished products to overseas market. This will ensure lower transportation costs.
6.3.2 Criteria For Site Selection

Major factors, considered in selection of site for locating Copper Smelter, are stated below:

- Away from environmentally sensitive areas
- Availability of adequate land with favorable terrain and soil condition
- Availability of infrastructural facilities viz. power, water, road and port facilities.
- Proximity to the port for transportation of copper concentrate and as well as to export finished product.
- Site slope and drainage pattern

Keeping the above facilities in view, an attempt is made to select a suitable site which meets the above requirements and also results in optimization of not only the initial investment cost but also the operating costs.

6.3.3 Description of all the considered sites

Site – I (In Gundala & Mokha villages)

i. Location
The proposed site is located at a distance of 24 Km east of Mundra Port in Taluk Mundra. The sea is at a distance of approx 8.0 Km from site.

ii. Land & Terrain
Approx 800 acres of SEZ land is available for the proposed project. In the identified location approx. 20% of land are under process of acquisition rest land is available with APSEZ for the project development. The terrain is flat and average elevation of the site is 8.5 m as compared to high tide level of 6.5 m.

iii. Road
Existing National Highway no. 8A etx passing north of the identified site connecting Mundra /Mandvi is about 12 Km from the site. State Highway no. 6
Copper Smelter Project is running at southern side of the identified location which is at approx distance of 4 km from the site. The site is connected through existing NH-8A etx at north.

iv. Water
The Requirement of desalinated Water for the plant has been estimated as 32,800 M3/Day. M/s. APSEZL will be supplying the total water requirement for the plant.

v. Power
The requirement of power will be about 300 MW. To meet the above requirement the power will be made available through state govt power distribution agency i.e from PGVCL from existing mokha sub station located 5.0 km distance from the proposed site.

vi. Port
APSEZ Mundra port facilities are located at approx. 25 km distances and Receipt of copper concentrate will be at Mundra Port (West basin) and transfer through by road which is approx. 40 km.

Site – II (East Side of Adani Power Plant)

i. Location
The proposed site is located at a distance of 15 Km from Mundra Town between village Siracha and Navinal. The sea is at a distance of approx 9 Km from site.

ii. Land & Terrain
Approx 634 acres of SEZ land is available for the proposed project. The terrain is flat and elevation of the site varies from 6.5 m to 11 m above MSL. The site is full of bushes and jungle with small trees.

iii. Road

Pre-Feasibility Report
Existing National Highway no. 8A connecting Mundra to Mandvi is about 10 Km from the site. State Highway no. 6 is running close to the site.

iv. Water
The Requirement of desalinated Water for the plant has been estimated as 32,800 M3/Day. M/s. APSEZL will be supplying the total water requirement for the plant.

v. Power
The requirement of power will be about 300 MW. To meet the above requirement the power will be made available from 400 kV switch yard of Adani Power Plant. Development of bay and HT line of about 0.5 km from bay to site will be developed as infrastructure facilities.

vi. Port
Receipt of copper concentrate will be through pipe conveyor from west port at Mundra which is about 10.5 Km from Site.

Site III – (Near Mundra village)

i. Location
The proposed site is located at a distance of 7.5 Km from south of Mundra Town The sea is adjoining the proposed site via creek at south east of the proposed site

ii. Land & Terrain
The total identified land is notified SEZ land and available for the proposed project. The terrain is flat and average elevation of the site is +7.5 mt CD. Due to closeness of sea majority of area approx. 65% of land are fall under CRZ area.

iii. Road
The proposed site accessible through existing State Highway at west, which further connecting Mundra is about 7.5 Km from the site.
iv. **Water**

The Requirement of desalinated Water for the plant has been estimated as 32,800 M3/Day. M/s. APSEZL will be supplying the total water requirement for the plant.

v. **Power**

The requirement of power will be about 300 MW. To meet the above requirement the power will be made available from 400 kV switch yard of Adani Power Plant. Development of bay and HT line of about 20 km from bay to site will be developed as infrastructure facilities.

vi. **Port**

Receipt of copper concentrate will be through pipe conveyor from west port/South port at Mundra which further transfer by road is about 30 Km from Site.

6.4 Site Analysis

6.4.1 Salient Features of Sites Selected for Detailed Analysis

In order to select the best site out of the two sites considered for further analysis, it is necessary to carry out quantitative/qualitative comparison of all the relevant factors influencing the selection of one site over other. The salient features of two sites are depicted below:

<table>
<thead>
<tr>
<th>Sl.</th>
<th>Description</th>
<th>Site-1</th>
<th>Site-II</th>
<th>Site-III</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Location</td>
<td>24 kms east of Mundra, Gujarat</td>
<td>15 kms west of Mundra, Gujarat</td>
<td>7.5 kms south of Mundra, Gujarat</td>
</tr>
<tr>
<td>2.</td>
<td>Latitude – Longitude (Average Center of Plot)</td>
<td>22°54’53.63”N 69°47’46.81”E</td>
<td>22°48’55.78”N 69°34’32.02”E</td>
<td>22°46’43.82”N 69°42’56.42”E</td>
</tr>
<tr>
<td>3.</td>
<td>Terrain</td>
<td>Flat</td>
<td>Flat and sloping south east to</td>
<td>Flat</td>
</tr>
<tr>
<td></td>
<td>north west</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Average elevation from MSL</td>
<td>12-15 m above MSL</td>
<td>6.5-11 m above MSL</td>
<td>7.5-8.5 m above MSL</td>
</tr>
<tr>
<td>5.</td>
<td>Land Availability</td>
<td>800 acres</td>
<td>634 acres</td>
<td>1200 acres</td>
</tr>
<tr>
<td>6.</td>
<td>Land development requirement</td>
<td>Bushes/jungle clearance</td>
<td>Bushes/jungle clearance required</td>
<td>Flat vacant land No land development</td>
</tr>
<tr>
<td>7.</td>
<td>Distance from nearest National Highway no. 8A</td>
<td>adjoining at north</td>
<td>5 km</td>
<td>18 km</td>
</tr>
<tr>
<td>8.</td>
<td>Distance from nearest State Highway No. 6/ nearest APSEZ road</td>
<td>8 km</td>
<td>Close to site</td>
<td>Adjoining at west</td>
</tr>
<tr>
<td>9.</td>
<td>Approach Road requirement</td>
<td>Widening of existing road</td>
<td>Widening of existing road</td>
<td>Nil</td>
</tr>
<tr>
<td>10.</td>
<td>Distance from Power Source</td>
<td>Mokha Sun Station about 5 km</td>
<td>APL Switch Yard at about 0.5 km from site</td>
<td>APL Switch Yard at about 20 km from site</td>
</tr>
<tr>
<td>11.</td>
<td>Distance from Water Source</td>
<td>Water will be supplied by M/s. MUPL</td>
<td>Water will be supplied by M/s. MUPL</td>
<td>Water will be supplied by M/s. MUPL</td>
</tr>
<tr>
<td>12.</td>
<td>Distance from West Port</td>
<td>40 km</td>
<td>10 km</td>
<td>30 km</td>
</tr>
<tr>
<td>13.</td>
<td>River/ Streams/</td>
<td>Various Streams passing between the</td>
<td>Natural Steam passing through</td>
<td>Nil</td>
</tr>
</tbody>
</table>
Table 18: Site Evaluation for Copper Smelter Project

6.4.2 Merits & demerits

Site-I (Located in Gundala & Mokha village)

Site is close to existing NH-8A ext and SH-6 is close to site. Distance from water and power source is less compared to other identified site. Raw material transportation distance is more as compared to other identified site. Land is high and terrain is flat. Bushes/jungle clearance and tree cutting is involved for setting up the plant.

Site-II (East of APL)

Site is adjacent to existing APL and SH-6 is close to site. Distance of power and water sources is less as compared to Site -III and IV. Raw material transportation distance is more as compared to Site-III. Bushes/jungle
clearance and tree cutting is involved for setting up the plant. Land is high and terrain is flat. Site has weightage in respect of water, power source and approach road but disadvantage in raw material transportation from port.

**Site-III (Near Mundra Village)**

Site is approx. 30 km distance from the west port and land is flat. Distance of water and power sources are more as compared to other identified site.

### 6.4.3 Site Ranking

The ranking worked out for features for the proposed sites have been given in the Table below

<table>
<thead>
<tr>
<th>Item</th>
<th>Site-I</th>
<th>Site-II</th>
<th>Site-III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Approach</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Land terrain</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Land development</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Water Source</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Power Source</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Raw material transportation</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Rank</strong></td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

*Table 19: Copper Smelter Site Ranking*

### 6.5 Conclusion/Recommendation

The facts presented in preceding paragraphs mandate that Site-II in Siracha & Navinal Village adjacent to existing APL emerges as technically superior site such as availability & closeness of water and power source, land development, closeness to Road and Rail, etc. It is substantially advantageous in terms of environmental and technical criteria.

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CHAPTER – 7
Planning Brief

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CHAPTER – 7
Planning Brief

7.1 Planning Concept

The proposed Copper Plant Complex of Adani Enterprises Limited (AEL) would require a total land area of 634 Acres (~ 256 Hectares). The detail Break-up of land required for various facilities of Copper Smelter complex is enclosed as Annexure - VIII.

The Copper Smelter Complex will require above area for Copper Smelter plant & related facilities, Green Belt Area as well as common infrastructure requirement to support the World Class Copper Smelter complex.

Land required for corridors for Power/Road/Raw Material Conveyor from port is not included in the above area.

Annexure – VII, shows Plot Plan of the typical Copper Smelter Complex and associated facilities. This Area is based on a preliminary plot plan which has been developed taking into account the Copper Smelter facility process, the site infrastructure requirements and external interfaces. The unit block sizes and spacing on this Plot Plan are based on previously developed and engineered plant layouts.

7.2 Land Justification of Copper Plant Complex:

Copper Plant Complex:

- Copper Plant Complex would comprise of Land for following Units:-
  - Raw Material Storage and Blending System

Pre-Feasibility Report
Copper Smelter Project

- Main Smelting Plant
- Oxygen (Industrial) Plant
- Pollution Control Equipment & Systems
- Sulphuric Acid Plant
- Effluent Treatment Plant
- Secondary RO plant
- Copper Refinery Tank House
- Minor Metal Recovery Plant
  - Precious Metal Recovery Plant
  - Continuous Cast Copper Rod Plant
  - Phosphoric Acid Plant
  - Aluminum Fluoride Plant

The above facilities would require land around 167 Acres.

**Copper Smelter Infrastructure:**

Based on preliminary estimates, the Copper Smelter Infrastructure would require an additional ~ 119 Acres of land which includes facilities like

- Fuel Oil and LPG Storage
- Pipelines/ Pipe Racks/ Trenches, Cable Trays
- Road/Drainage
- Logistical area requirements, e.g. Truck loading and unloading area, Dispatch Section and corridors for coal and product transportation.
- Non-Plant Building (Workshop, Laboratories, Admin Buildings, Training Block, Security Room, Site Offices, Canteens OHC etc.)
- General Stores/Warehouses
- Weigh Bridges
- Construction lay down Area
- Buffer Zone
- Fabrication Yards

*Pre-Feasibility Report*
- Gate House/ Time Office
- Fire & Safety Department etc.

**Copper Smelter Township:**

- No separate Township has been planned for Copper Smelter Complex. The house for O&M personnel would be provided at Adani’s existing township by augmenting the township, which is around 30 km away from the proposed Copper Smelter Complex.

**GREEN BELT:**

Out of the entire area of proposed Copper Smelter complex, 33% of total Copper Smelter complex area which is around 209 Acres of land is reserved for Green Belt development as per prevailing guidelines from GSPCB/CPCB/MOE & F.

**7.3 Land Use Plan:**

The Copper Smelter Complex will require plot areas for the Copper Smelter and related common facilities. The proposed Copper Smelter Complex of **Adani Enterprises Ltd.** would require a total land area of 634 Acres (~256 Hectares). Also, the detailed Land Break-up of entire Copper Smelter Complex is attached as **Annexure - VIII.**

**7.4 Copper Smelter Infrastructure Requirements:**

The analysis of infrastructure needs is an important step in any project. The Copper Smelter venture operates in a complex environment and needs reliable access to critical infrastructure resources like Power, Water as well as infrastructure linkages like Road, Rail, Port and Air connectivity. These
key infrastructure requirements are elaborated below based on various studies done by venture so far.

7.4.1 Physical Infrastructure needs:

7.4.1.1. Water:

The Requirement Water for the plant has been estimated as 32,800 M3/Day. M/s. Adani Ports & Special Economic Zone Ltd (APSEZL) will be supplying the total water requirement for the plant.

An integrated water system is proposed where effluent from the process units is treated and reused to reduce water demand. It is also proposed to install a secondary RO Plant to further treat water from the Effluent Plant Facility for effective use and water balance with the Copper Smelter Complex.

Water demand is made up of the following:

- Water for Product purpose like Sulphuric Acid and Phosphoric Acid
- Make-up losses for Copper Slag Granulation preparation
- Make up Losses in The Cooling Towers and Heat Exchangers/Circuits
- Steam losses from the steam and power systems
- Steam consumed directly in the process, etc

7.4.1.2. Power

Power requirement @300 MW would be sourced from M/s. Adani Ports & Special Economic Zone Ltd (APSEZL) through M/s. MUPL. Power is distributed within the plant at 3 phase, 11 kV and 50 Hz via a number of unit substations. The APL’s power plant is around 1 kms away from the
proposed Copper Smelter site. Steam Turbine of capacity 50 MW is envisaged which will partially meet power requirements of Copper Smelter facility.

The construction power need of around 20 MW would be sourced from the Grid/ M/s. Adani Ports & Special Economic Zone Ltd (APSEZL).

7.4.1.3. Road Linkage

The project site is located about 12 km from National Highway – 8A and 4 km from State Highway SH-6 and 63 km from the Adipur / Gandhidham railway station. Hence, transportation of materials to the project site will not be a major constraint.

Further studies are planned on these specific connections and access routes to determine the impact of increased traffic volumes.

7.4.1.4. Rail Linkage

The nearest railway stations to the proposed site are Adipur/Gandhidham which is 63 KM away from the Copper Smelter Complex.

The distance from existing railway line of APL’s Gate NO-4 to proposed Copper Smelter Complex is around 1 km.

7.4.1.5. Port Connectivity

The Port of Mundra is India's biggest private port. Located in the Kutch district of the state of Gujarat, Mundra lies on the north shores of the Gulf of Kutch about 50 kilometers south of Anjar and 44 kilometers east the Port of Mandvi.

The Port of Mundra is not only a private port, but it is also a special economic zone. Incorporated in 1998 as Gujarat Adani Port Limited (GAPL),
the company began operating in 2001. The Mundra Special Economic Zone was incorporated in 2003 and was merged with GAPL in 2006. The combined company was renamed “Mundra Port and Special Economic Zone Limited” and now is Adani Ports & Special Economic Zone Limited (APSEZL). It is India’s first multi-product port-based special economic zone (SEZ).

The Port of Mundra and SEZ hopes to be a global player and preferred partner that pursues innovation in business, technological, and commercial areas. It strives to add value to partners’ activities and efforts while also reducing its impact on the environment. The Port of Mundra and SEZ is responsible for acquiring, developing, and managing knowledge to become experts in the field and to apply that knowledge across their range of business interests. As a private port, the Port of Mundra also seeks to ensure tangible and intangible profits.

The Port of Mundra offers 21 closed dockside warehouses (go-downs) with capacity for 137 thousand square meters to store wheat, sugar, rice, fertilizer and fertilizer raw materials, and deoiled cakes. The port offers 880 thousand square meters of open storage for steel sheets, coils, plate, clinker, scrap, salt, coke, bentonite, and coal. An additional 26 thousand square meters of open storage is available alongside the railway. The port also offers a wheat-cleaning facility with capacity to handle 1200 metric tons per day and a rice-sorting and –grading facility that can handle 500 metric tons per day.

The Port of Mundra is planning several additions and improvements. A new terminal site is proposed to be located about ten nautical miles west of the current terminals at the Port of Mundra. The terminal will eventually contain three deep-water offshore berths and two sets of stackyards for coal, iron ore, and other dry bulk cargo.
The town’s showpiece is the Port of Mundra, which has transformed the local economy and atmosphere. The Port of Mundra was the place in addition to Abadasa and Lakhpat talukas in Kutch which were not seriously damaged in the 2001 Gujarat earthquake that devastated rest of the district.

The current capacity of port to handle 2.5 m TEU’s is to be expanded to 5 m TEU by 2015, making it India’s second largest container port.

The Copper Concentrate and Rock Phosphate would be imported through West Port which is around 10 km away from the proposed Copper Smelter site.

7.4.1.6. Air Connectivity

The proposed Mundra site is 60 km away from Bhuj Airport, 65 KM away from Kandla Airport and 460 km away from the nearest commercial airport, Ahmedabad. Adani Groups own Airstrip is around 25 km away from the proposed site.

7.4.2. Social Infrastructure needs:

Development of physical infrastructure cannot usher in overall development at the desired level if the social infrastructure is not simultaneously developed. Education, Health, Social security, public entertainment etc. has to be developed to ensure proper social infrastructure.

7.4.2.1. Educational Initiatives:

- Infrastructural Development in the form of school building, teaching & learning equipment and furniture & Fixtures etc.
- Quality Teacher support
- Scholarship for Education Excellence
- Promotion of Girl Child Education
- Incorporation of Extra Curricular activities

7.4.2.2. Health:

ASL would take care of all the medical requirements of the Copper Smelter complex by establishing a hospital with quality doctors. In addition different awareness programs would be conducted as furnished below.

- Addressing the Mother & Child Health
- Support to the Nutritional Program of Mother, Child & School goers.
- Support the District Health administration in the community health activities
- Improvement of town Sanitation through Solid- Liquid Waste Management.
- Knowledge Enhancement on Preventive Health Care.
CHAPTER – 8
Proposed Infrastructure

8.1 Industrial Area (Processing Area):

The proposed Copper Smelter Complex of Adani Enterprises Limited would require a total land area of 634 Acres (~256 Hectares). This area is based on a plot plan of Copper Smelter complex as Annexure - VII which has been developed taking into account the Copper Smelter facility process, the site infrastructure requirement and external interfaces. These areas will be firmed up with ongoing engineering studies to suit the facility’s operating conditions, construction and maintenance philosophies and storage requirements.

Copper Smelter Plant area of around 167 Acres of land would comprise of facilities for Copper Smelter Plant, Oxygen Plant, Sulphuric Acid Plant, Scrubber Units, Copper Refinery tank house, CCR Plant, Precious Metal recovery Plant, Phosphoric Acid Plant, Aluminum Fluoride plant, Effluent treatment Plant, Utilities storage of Water and Fuel, etc.

The Copper Smelter Plant Infrastructure would require around 118 Acres of land which includes facilities like Pipelines, Loading/Unloading, Road/Drainage, Pipe Racks/Trenches & Cable Trays, Non Plant Buildings, Laboratories, Fabrication Yard, Dispatch Section, General stores/Warehouse, Fire & Safety Department, Maintenance Workshop, Occupational Health Center etc.

Therefore, the land considered for the Copper Smelter Project Industrial Area (Processing Units) is around 286 Acres.
8.2 Green Belt:

Out of the entire area of proposed Copper smelter complex, 33% of total Copper smelter complex area which is around 208 Acres of land is reserved for Green Belt development as per prevailing statutory guidelines from GSPCB/CPCB/MOE & F.

The Land Break-up for Non Processing Area is tabulated in Below Table:

**Land Break up of Non Processing Units:**

<table>
<thead>
<tr>
<th>Non Processing Area</th>
<th>Area (Ac.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA Green Belt (33% of total Land)</td>
<td>209</td>
</tr>
<tr>
<td>Total</td>
<td>209</td>
</tr>
</tbody>
</table>

8.3 Social Infrastructure:

AEL believes that an effective growth policy must also take into account the fulfillment of basic needs of the masses, especially of those living in rural areas.

AEL has one of the best social infrastructure proposals which are based on the implementation already done by APSEZ and APL at Mundra, in the core area of Health, Education, Sustainable livelihood options & women empowerment, Community infrastructure, Youth sport & cultural activities, Calamity management. AEL is strictly committed and is going to implement the proposal to uplift the social infrastructure surroundings the CTP area.

The key highlights of some initiatives & activities to improve social infrastructure that AEL is going to undertake at Mundra are:
8.3.1. Sustainable livelihood options & Women Empowerment:

- Strengthening the Community Based Organizations like Self-Help Groups, Farmer Federation etc.
- Capacity Building of the underprivileged communities on various market driven skills
- Establishment of Forward & Backward Market Linkages through networking
- Facilitating the easy reach to the technical institutions for knowledge upgradation.
- Promotion of livestock health management

8.3.2. Education Initiatives:

- Skill upgradation through establishment of Technical Training Institution
- Infrastructural Development in the form of school building, teaching & learning equipment and furniture & Fixtures etc.
- Quality Teacher support
- Scholarship for Education Excellence
- Promotion of Girl Child Education
- Incorporation of Extra Curricular activities
- Holistic approach to the education through “Yoga & Art Of Living”
- Promotion of Functional Literacy

8.3.3. Health Initiatives:

- Addressing the Mother & Child Health
- Support to the Nutritional Program of Mother, Child & School goers.
- Control on Blindness, Malaria, T.B., HIV & AIDS, Diarrhea etc.
- Support the District Health administration in the community health activities
- Improvement of Village Sanitation through Solid-Liquid Waste Management.
- Knowledge Enhancement on Preventive Health Care

8.3.4. **Community Infrastructure & facilities:**

- Enhancement of Green Coverage
- Protection of Wildlife through awareness generation
- Promotion of Renewal Energy
- Waste Management through installation of recycling measures

8.3.5. **Natural Resource Management:**

- Enhancement of Green Coverage
- Ground Water Recharge through Water Harvesting
- Protection of Wildlife
- Solid & liquid Waste Management
- Promotion of use of Renewal Sources of Energy

8.3.6. **Youth, sports & culture:**

- Promotion of brotherhood & fraternity within the village youths
- Development of Sports Activities
- Nurturing the youth for participation at District, state and National level events.

8.4 **Connectivity:**

**Brief Profile of Kutch District:**

Kutch district (also spelled as Kachchh) is a [District](https://en.wikipedia.org/wiki/Kutch_district) of [Gujarat](https://en.wikipedia.org/wiki/Gujarat) state in western [India](https://en.wikipedia.org/wiki/India). Covering an area of 45,652 km, it is the largest district of India.
The administrative headquarters is in Bhuj which is geographically in the center of district. Other main towns are Gandhidham, Rapar, Nakhatrana, Anjar, Mandvi, Madhapar, Mundra and bhachau. Kutch has 969 villages. Kala Dungar (Black Hill) is the highest point in Kutch at 458 metres (1,503 ft).

Kutch is virtually an island, as it is surrounded by the Arabian Sea in the West; the Gulf of Kutch in South and South-East and Rann of Kutch in North and North-East. The border with Pakistan lies along the Northern edge of the Rann of Kutch, of the disputed Kori Creek. The Kutch peninsula is an example of active fold and thrust tectonism. In Central Kutch there are four major east-west hill ranges characterized by fault propagation folds with steeply dipping northern limbs and gently dipping southern limbs.

According to the 2011 census Kutch District has a population of 2,090,313, roughly equal to the nation of Macedonia or the US state of New Mexico. This gives it a ranking of 217th in India (out of a total of 640). The district has a population density of 46 inhabitants per square kilometre (120 /sq mi). Its population growth rate over the decade 2001-2011 was 32.03%. Kutch has a sex ratio of 907 females for every 1000 males, and a literacy rate of 71.58%.
The site is well connected by the National / State Highways, broad gauge rail link and is 5.5 km away from the Mundra West Port. The nearest airport is Bhuj Airport located at a distance of 60 kms from the project site. The nearest railway station is Adipur/Gandhidham, which is about 63 kms from project site and nearest town is Mundra which is about 20 kms from the project site. The national highway NH-8A is passing at about 12 kms away from the site. Distance from State Highway SH-6 is 4 kms. The site is well connected with Ahmedabad city located at about 460 kms.

8.5 Drinking Water Management:

Source of Water:

The Requirement Water for the plant has been estimated as 40,000 M3/Day. M/s. MPSEZ Utility Pvt. Limited (MUPL) will be supplying the total water requirement for the plant.

8.6 Sewage System:

The generated sewage water would be treated in Sewage Treatment Plant and the treated water would be utilized for Horticulture purposes.

8.7 Industrial Waste Management:

There will not be any significant gaseous emissions from the Gasification Island during normal operation. Overall, the plant design minimizes the emissions by process integration and waste heat management.

The Industrial Wastes that could be generated from Copper Smelter Plant are ETP Cake, Scrubber Cake, Phospho Gypsum, Process Waste Water, etc. The same is covered in Chapter 5 of this report. AEL adopts ZLD system for Process Waste Water. A secondary RO plant will be installed at the downstream of the ETP, to effectively reuse and recycle the water. RO
rejects from the secondary RO plant will be discharged into sea through the outfall channel of APSEZ’s desalination Plant. Besides, the gaseous emissions would be suitably treated with latest environment technologies before discharging in to the atmosphere.

8.7.1 Air Emissions:

The Copper Smelter facility would be well equipped to deal with air pollutant regulations. Fugitive emissions from Copper smelter plant will be effectively collected and scrubbed with the latest environmental technologies and will be released through stack, which will be well within the permissive levels of emission, as stipulated by Central/State Pollution Control Boards, Ministry of Environment & forest (MOE&F).

The following steps would be taken to reduce air emissions with examples of abatement technologies:

2. Fluorine (F): High Efficiency collection and scrubbing system with water to produce Hydro Fluro Silicic Acid, which will be input to Aluminum fluoride plant.
3. Particulate Matter: Wet Scrubbers, Cyclones, Electrostatic Precipitators, bag Filters, Vacuum Trucks, Road Vacuum Sweepers, etc.; based on the application.

The final gaseous emissions from the Copper Smelter Complex would be well within the Permissible Limits as prescribed by GSPCB/CPCB/MOE&F.

8.7.2 Waste Water Management:

The Copper Smelter waste water treatment system consists of:
- ETP/Process Waste Water Treatment Plant.
- Sewage Treatment Plant

The Process Waste Water generated from gas cleaning plant of Sulphuric acid plant will be treated in state of art Effluent treatment plant then recycled for reuse within Plant Battery Limit.

The site philosophy is to minimize the import of raw water by maximizing the re-use of treated wastewater within the Copper Smelter facility. The waste water system is highly integrated and is designed for Zero Liquid Discharge (ZLD).

The generated sewage waste water would be treated in Sewage Treatment Plant and the treated water would be used for Horticulture purposes.

### 8.7.3 Solid Waste Management:

The main solid waste from the
- Copper Smelter Plant will be Copper slag also called as Ferro Sand in Korea and Iron Silicate in Germany.
- Phosphogypsum from Phosphoric Acid plant and
- Hazardous Cake produced from Effluent treatment plant
- Scrubber Cake from Fugitive Gas Handling Scrubbers

Options would be explored to maximize the utilization of Copper Slag in the following areas:
- Road/ Embankment Making
- Sea Shore Embankment
- Land development
- Shot Blasting
Cement Manufacturing

Options would be explored to maximize the utilization of Phosphogypsum in the following areas:

- Cement Manufacturing
- Soil Rectification
- Land development

Hazardous Cake and Scrubber Cake will be stabilized and stored in secured land fill as per guidelines of MoEF/ CPCB/ GSPCB. An area of around 30 acre is identified.

For the initial years of Copper Smelter plant operation till sustained Utilization/Management of Copper Slag and Phosphogypsum; in the above application areas are developed, as well as for emergency purpose, an Copper Slag Storage Area and Gypsum Pond of around 105 Acres would be identified and made available for intermediate/emergency storage of the same.

Provision would be made to reclaim the disposed Copper Slag and Phosphogypsum from Gypsum pond at a later stage for various utilization ventures.

8.8 Power Requirement & Supply:

The by-product HP & MP Steam which is produced from various process units of Copper Smelter plant would be used for the power generation

Estimated Power Consumption by Copper Smelter Project : - 300 MW
Power generation from process Steam : - 40 MW
Net Import : - 260 MW
The construction power (@20 MW) and Copper Smelter operating Power (@260 MW) would be sourced from the M/s. Adani Ports & Special Economic Zone Ltd (APSEZL) through M/s.MUPL.
CHAPTER – 9
Rehabilitation & Resettlement Plan
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CHAPTER – 9
Rehabilitation & Resettlement Plan

The proposed Copper Smelter Complex land is vacant, hence no displacement and rehabilitation of local population is envisaged.
10.1. General

Successful execution on the Copper Smelter Complex calls for well thought out project execution strategies and an elaborate Project Implementation plan for carrying out a whole range of critical activities such as:-

- Selection of Technology/ Process Licensor
- Financing (Financial Closure)
- Pre Project Activities
- Statutory Approval
- Project Execution Philosophy and Plan
- Project Coordination Procedures
- Project Management, Monitoring, Control & Feedback, System & Services
- Management of Technology Transfer
- Basic Engineering / Front End Engineering
- Detailed Engineering
- Procurement
- Monitoring and Expediting of Manufacturing & Fabrication activities
- Construction Management
- Inventory and Warehousing Control
- Quality Assurance and Quality Control
- Organizing and deployment of skilled labour and Skilled Contractors
- Training of plant personnel to take over operations on completion of construction activity
- Pre-commissioning, commissioning and performance testing of all systems and putting in operation
- Maintenance Management

All the above activities can be phased out in such a manner that the project is executed in the most efficient and optimized economic course with a defined time schedule governed by overall project schedule & the implementation Bar chart.

Pre-Feasibility Report
For execution of the contemplated Mega Project like Copper Smelter it essentially demands for a strong Project Execution Team with specialist in each of the above identified activities. Besides: the responsibility and reporting matrix needs to be well defined.

The Project Execution plan (PEP) can be further elaborated in the future when the Copper project achieves further maturity.
10.2. **PROJECT EXECUTION PHILOSOPHY**

The enclosed typical Block Matrix sets out to development of project implementation plan for the Copper project. This implementation model is prepared to achieve the optimum schedule and most effective project cost.

![Project Execution Strategy Diagram]

**Fig 15: Project Execution Strategy**

10.3 **PROJECT IMPLEMENTATION PLAN (PIM)**

*Pre-Feasibility Report*
Generally: The project can be executed in the following manner:

**Phase 1:** Detailed planning phase including licensor selection basic engineering, detailed engineering

**Phase 2:** Awarding of PMC (Project Management Consultant/LSTK procurement & construction) contract, ordering of long delivery items.

**Phase 3:** Completion of all contracts for realization of the project as elaborated earlier.

The various phases are further briefly elaborate herein is General but essential for execution of a contemplated mega project alike Copper Smelter

**Phase 1: Detailed Planning phase**

This phase of the project covers the following critical activities:

- Financial approval of the board following DFR and DPR stages
- Selection of Technology Supplier
- Study and planning of transportation of capital & construction equipment
- Site development planning & selection of contractor
- Authority approval (various Stages i.e. EIA, EMP etc)
- Cost optimization
- Completion of Basic Engineering Package & Review of DPR
- Completion of detail engineering
- Negotiation of PMC & Selection

**Phase 2:**

- Awarding of PMC
- Project Control: Engineering Phase
- Ordering of Long delivery item etc

**Phase 3:** Completion of all contracts for realization of project of projects

This phase covers the following activities:

- Project Management
- Project Control: Procurement phase
- Project Control: Construction phase
- Project Control: Commissioning phase

Implementation schedule for Copper Project post all relevant approvals and consents will be 30 Months.
10.3.1. Typical Project Phases for Integrated Copper Smelter Project Execution:

---

**Phase I**
- Conceptual CP/PFR
- Develop / Select Process Configuration
- Technology Input
- PIP to Client

**Phase II**
- Feasibility Report (DFR)
- Design Basis Finalisation
- Plant / Project Definition
- Process Flows Diagram
- Procession Description
- Equipment List
- Utility/Offsite Facility
- Effluent Summary
- Tech. inputs for Statutory clearances
- Project Cost Estimate
- Op. Cost Estimate
- Financial Analysis

**Phase III**
- Detail Project Report (DPR)
- Design Basis
- Facility Planning
- Develop & select best alternatives
- Select Technology
- Execution & Design philosophies
- Develop Business opportunity
- Accuracy > 30%

**Phase IV**
- Front End Engg Design (FEED)
- Provide assets according to Business Plan
- Implement w/ minimum changes
- Facility & business systems ready for start-up
- Owner quality assurance

**Phase V**
- EPC / Pre Commissioning Startup / GTR
- Safe start-up of the assets and business systems
- End-of-job documentation
- Business & Safety
- In specification product
- SBUs acceptance

---

Fig 16: Copper Smelter Project Phases – Concept to Commissioning

---

*Pre-Feasibility Report*
10.3.2 Project Schedule for Copper Smelter Project

Table 20: Project Implementation Schedule

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<thead>
<tr>
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<td>All Relevant Approvals and Consent</td>
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<td>Finalisation of Basic Engineering and Order Placement</td>
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<td>2</td>
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<tr>
<td>3</td>
<td>Plant Trial Production Start Up</td>
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</tbody>
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Pre-Feasibility Report
10.4 Project Cost Estimate

The total project cost is estimated: Rs. 10,000 crores.

Investment in Pollution prevention will be ~ 9%.

This investment will be majorly in the following areas:

- Hot Gas Electrostatic Precipitators in Copper Smelter
- Secondary Gas Scrubbing System in Copper Smelter
- Pierce- Smith Converter Double Hood Gas Collection System
- Wet Gas Electrostatic Precipitator Acid Plant
- Venturi Scrubbers in Sulphuric Acid Plant
- Tail Gas Scrubbing System in Sulphuric Acid Plant
- Effluent Treatment Plant for Copper Smelter, Sulphuric Acid Plant and Copper Refinery
- Secondary RO Plant
- Scrubbers in Phosphoric Acid Plant
- Secured Landfill for Storage of Hazardous Waste
- Lined pond for Gypsum storage
- Online Stack Analysers
- Air Quality Monitoring Stations, etc.

The project cost has been estimated on the basis of identified scope, engineering details for cost estimation, licensor’s information and cost data for Engineering, Procurement and Construction management (EPCM) mode of execution. A reasonable contingency factor has been applied to take care of the unforeseen items.

The total estimated project Cost of the Copper Smelter project is around 1.5 Billion USD (10,000 Cr.).
CHAPTER – 11

Final Recommendation

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CHAPTER – 11
Final Recommendations

The Proposed Copper Project of AEL is one of the important project. It is evident from the key findings of the Pre-Feasibility Report undertaken by AEL that the proposed Copper Smelter Project is Techno-Commercially Viable.

Based on the various studies, AEL believes that the Copper Smelter Project would add significant value to Indian economy. The project will not only help ensuring by becoming self sufficient in terms of Copper and Sulphuric Acid for India but also drive macroeconomic growth.

The series of benefits that the Project would reap, may it be Strategic or Socio-Economic are tabulated below:-

1. **Benefits to India and State of Gujarat:**

AEL has undertaken a cost benefit analysis to ascertain the benefits that would accrue to the India and Gujarat in particular from its proposed Copper Smelter Project. The study results show that the Copper Smelter Project would create substantial amount of tax revenue for India over 25 years of project life.

The Copper Project venture is expected to employ about 5,000 direct and indirect employees. Adani group have been pioneers in corporate social responsibility and made significant contributions to improve quality of people's life in all the regions they operate in. In Gujarat, APSEZL and AEL have started key initiatives in support of sustainable development. The CSR activity of APSEZL and AEL aims at bettering the socio-economic and cultural status of local people. The key highlights of some initiatives & activities that AEL is going to undertake at Mundra are:

*Pre-Feasibility Report*
1. **Sustainable livelihood options & Women Empowerment:**

   - Strengthening the Community Based Organizations like Self-Help Groups, Farmer Federation etc.
   - Capacity Building of the underprivileged communities on various market driven skills
   - Establishment of Forward & Backward Market Linkages through networking
   - Facilitating the easy reach to the technical institutions for knowledge up gradation.
   - Promotion of live stock Health Management

2. **Education Initiatives:**

   - Skill up-gradation through establishment of Technical Training Institution
   - Infrastructural Development in the form of school building, teaching & learning equipment and furniture & Fixtures etc.
   - Quality Teacher support.
   - Scholarship for Education Excellence.
   - Promotion of Girl Child Education.
   - Incorporation of Extra Curricular activities.
   - Holistic approach to the education through “Yoga & Art Of Living”.
   - Promotion of Functional Literacy.

3. **Health Initiatives:**

   - Addressing the Mother & Child Health
   - Support to the Nutritional Program of Mother, Child & School goers.
   - Control on Blindness, Malaria, T.B., HIV & AIDS, Diarrhea etc.
Support the District Health administration in the community health activities.

Improvement of Villages Sanitation through Solid- Liquid Waste Management.

Knowledge Enhancement on Preventive Health Care

4. **Community Infrastructure & facilities:**

   - Enhancement of Green Coverage.
   - Protection of Wildlife through awareness generation.
   - Promotion of Renewal Energy.
   - Waste Management through installation of recycling measures.

5. **Natural Resource Management:**

   - Enhancement of Green Coverage
   - Ground Water Recharge through Water Harvesting
   - Protection of Wildlife
   - Promotion of use of Renewal Sources of Energy

6. **Youth, sports & culture:**

   - Promotion of brotherhood & fraternity within the village’s youths.
   - Development of Sports Activities.
   - Nurturing the youth for participation at District, State and National level events.
   - Patronization of the local art & culture.
Annexure I – Copper Smelter Location Map
Annexure II – Satellite View of the Proposed Copper Smelter Plant Location

UMPP – TATA Power Plant

Adani Power Plant

Proposed Location of the Copper Smelter Project

Pre-Feasibility Report
Annexure III: Alternate Sites Evaluated for Copper Smelter Project

Site 1
UMPP – TATA Power Plant
Adani Power Plant
Site 2
Site 3
Arabian Sea
Adani West Port for RM Handling
Annexure IV: Raw Material Conveying from West Port to Copper Smelter Plant Site

Proposed Site for Copper Smelter

Conveyor System for Raw Material

Adani West Port for RM Handling
Annexure V : Composite Layout for Copper Smelter Project

- UMPP – TATA Power Plant
- Adani Power Plant
- Outfall Channel for CGPL
- Intake Channel for Power Plant
- Adani West Port for RM Handling
- Raw Material Conveyor from West Port to Copper
- Outfall Channel
- Site 1
- Site 2
- Site 3
Annexure- VI Site Meteorological Data

a. Maximum dry bulb temperature : 47.8 ºC
b. Highest monthly mean of daily Max. Temp : 36.0 ºC
c. Annual mean relative humidity : 60%
d. Maximum relative humidity : 95%
e. Minimum relative humidity : 20%
f. Average annual rainfall : 350 mm
g. Maximum twenty four(24) hr. rainfall : 470 mm
h. Seismic zone : Zone-V as per IS-1893
i. Maximum Wind speed experienced : 65 Km/hr
j. Basic Wind speed for design : 50 m/ Sec as per IS-875
k. Altitude : 6.5-11 M above MSL.
Annexure VII: Plot Plan for Copper Smelter Project
## Annexure VIII: Copper Smelter Project Land Break Up

<table>
<thead>
<tr>
<th>Description</th>
<th>Area in Acres</th>
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<tbody>
<tr>
<td>Smelter incl of Scrubbers</td>
<td>50</td>
</tr>
<tr>
<td>Refinery, CCR &amp; PMRP</td>
<td>37</td>
</tr>
<tr>
<td>SAP</td>
<td>14</td>
</tr>
<tr>
<td>PAP &amp; AIF3</td>
<td>50</td>
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<tr>
<td>ETP</td>
<td>16</td>
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<tr>
<td><strong>Plant Area (in acres)</strong></td>
<td><strong>167</strong></td>
</tr>
<tr>
<td>O2 Plant - Ancillary 1</td>
<td>6</td>
</tr>
<tr>
<td>Incoming SUB - Ancillary 2</td>
<td>8</td>
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<tr>
<td>Water Reservoir - Ancillary 3</td>
<td>8</td>
</tr>
<tr>
<td>Offices, Fire Station, Change Room - Ancillary 4</td>
<td>6</td>
</tr>
<tr>
<td>Material Stores &amp; Fabrication Yard</td>
<td>6</td>
</tr>
<tr>
<td>LPG &amp; Fuel Storage</td>
<td>4</td>
</tr>
<tr>
<td><strong>Utility Area (in acres)</strong></td>
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<tr>
<td>Slag</td>
<td>33</td>
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<tr>
<td>Gypsum</td>
<td>70</td>
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<tr>
<td>SLF</td>
<td>30</td>
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<tr>
<td>Value yard</td>
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<tr>
<td><strong>Waste Storage Area (in acres)</strong></td>
<td><strong>136</strong></td>
</tr>
<tr>
<td><strong>Total Area (in acres)</strong></td>
<td><strong>341</strong></td>
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<td>Roads and Support Infrastructure</td>
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<tr>
<td><strong>Green Belt</strong></td>
<td><strong>209</strong></td>
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<tr>
<td><strong>Total Area (in acres)</strong></td>
<td><strong>634</strong></td>
</tr>
</tbody>
</table>
Annexure IX – Composite Process Flow Sheet for Copper Smelter Plant
Annexure X – Material Flow Sheet for Integrated Copper Smelter Plant

<table>
<thead>
<tr>
<th>Products</th>
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<tbody>
<tr>
<td>Copper Cathode</td>
<td>10,00,000</td>
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<tr>
<td>Sulphuric Acid (&gt; 98%)</td>
<td>30,00,000</td>
</tr>
<tr>
<td>Copper Concentrate</td>
<td>3,00,000</td>
</tr>
<tr>
<td>Copper Scarp</td>
<td>2,00,000</td>
</tr>
<tr>
<td>Ferronickel</td>
<td>1,44,000</td>
</tr>
<tr>
<td>Ferronickel Oxide</td>
<td>3,20,000</td>
</tr>
<tr>
<td>Ferro Silicon</td>
<td>30,000</td>
</tr>
<tr>
<td>Phosphoric Acid (as 100% P2O5)</td>
<td>5,00,000</td>
</tr>
<tr>
<td>Copper Scrap</td>
<td>2,00,000</td>
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<tr>
<td>Aluminium fluoride</td>
<td>37,500</td>
</tr>
<tr>
<td>Oxygen (Technical)</td>
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<td>Lime Stone</td>
<td>80,000</td>
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<tr>
<td>Gold</td>
<td>50</td>
</tr>
<tr>
<td>Quartz</td>
<td>1,00,000</td>
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<tr>
<td>Silver</td>
<td>500</td>
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<tr>
<td>Quick Lime</td>
<td>60,000</td>
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<td>Phosphogypsum</td>
<td>100</td>
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<tr>
<td>Hydro Fluor Silicic Acid (~20% as H2SiF6)</td>
<td>2,500</td>
</tr>
<tr>
<td>Used Oil</td>
<td>200</td>
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<td>Coal / Pet Coke</td>
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<td>Met Coke</td>
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<td>ETP Treated Water</td>
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<td>ETP Waste Sludge Scourer Waste</td>
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<td>CCR Mill Scale</td>
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| CCR Plant Integrated (Copper Smelter, Oxygen Plant, Copper Refinery, CCR Plant, Phosphoric Acid Plant, Aluminium Fluoride Plant, etc) Material Flow Sheet (Tentative) - 1000 KTPA Copper Plant - Integrated

Pre-Feasibility Report
Annexure XI – Water Balance (Tentative) for Integrated Copper Smelter Plant (M3/Day)

Water Balance - 1000 KTPA Copper Plant - Integrated

- Phosphoric Acid Plant: 8800
- Sulphuric Acid Plant: 13176
- Copper Smelter: 1944
- Effluent Treatment Plant: 1872
- Copper Smelter + Scrap Melting Furnace: 7200
- Copper Refinery & PMR: 1516
- Sea Discharge: 431
- Effluent Treatment Plant: 1597
- Sewage Treatment Plant: 1000
- Domestic Use: 1000
- Gardening: 1597
- Evaporation: 324
- Raw Water Reservoir: 32766
- MUPL: 503
- CCR plant: 759

Pre-Feasibility Report
### List of Abbreviations:

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<td>Engineering Procurement and Construction Management</td>
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<tr>
<td>IRR</td>
<td>Internal Rate of Return</td>
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<td>In Side Battery Limit</td>
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<td>LTPA</td>
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<tr>
<td>MUPL</td>
<td>MPSEZ Utilities Pvt. Ltd.</td>
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<tr>
<td>ppm</td>
<td>parts per million</td>
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<td>TPA</td>
<td>Tons Per Annum</td>
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<tr>
<td>TPD</td>
<td>Tons Per Day</td>
</tr>
<tr>
<td>TPH</td>
<td>Tons Per Hour</td>
</tr>
<tr>
<td>USD/US $</td>
<td>United States Dollar</td>
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<tr>
<td>ZLD</td>
<td>Zero Liquid Discharge</td>
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