HINDUSTAN ZINC SMELTER, DEBARI

Internship Report

Project - Steam line Linear Asset Management implementation of Leaching & Purification

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HINDUSTAN ZINC

Zinc & Silver of India

Submitted to:

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Acknowledgement

Gratitude is the hardest of emotions to express and often one does not find adequate words Firstly heartiest thanks to my mentor, Mr. Anurag Shrivastav, Deputy Manager, Leaching & Cell House, Hindustan Zinc Smelter, Debari, for guiding and giving me the opportunity to initiate this report. Then I want to thank Vedanta Ltd for giving me the opportunity to do my internship in the Hindustan Zinc Smelter, Debari.

My special thanks to Mr. Amit Kumar and Mr. Sharan Kumar, who assisted me in the project. These people invested time and energy to this project, I am so appreciative of their efforts.

I would also like to thank cordially Ms. Mahima Mishra, HR, Hindustan Zinc Smelter and SPOC during internship, who helped me in every step in the organization and also assisted me a lot for the preparation of this project. I am also very grateful to department for their cordial support without which the project would have been difficult for me to complete.

I would also like to thank CTAE, Udaipur, Mechanical Department for giving me opportunity of this Internship. Last but not the least I am indebted to my Parents who provided me their time, support and inspiration needed to prepare this report.

Preface

As per the requirement of B. Tech. Course, Hindustan Zinc Limited Debari Smelter has been kind enough to permit me to complete my Industrial Training. This report is prepared during the practical training which is student's first and greatest treasure as it is full of experience, observation and knowledge. Industrial training plays a vital role in the progress of future engineers. Not only does it provide insights about the future concerned, it also bridges the gap between theory and practical knowledge. The summer training was very interesting and gainful as it is close to real what have been studied all the years through, was seen implemented in a modified and practical form.

I was fortunate that I was provided with an opportunity of undergoing, industrial training at the Company. The experience gained during this period was fascinating to say the least. It was a tremendous feeling to observe the operation of different units and processes. It was overwhelming to notice how such a big plant is being monitored and operated with proper coordination to achieve desired results. This This report describes the knowledge gained by me during one month training at Hindustan Zinc Smelter, Debari. During this period, I have understood a lot of things related to the working of a company in its different divisions under the Mechanical Department. This has developed a sense of confidence in me. I perceive as this opportunity as a big milestone in my career development. This internship is proved to be a good practical experience and has also enhanced my technical knowledge. A lot credit goes to my instructors who helped me all the way from the very beginning . Thus, I hope that this training serves as a stepping stone for me in future and help me carve a niche for myself in this field.

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Introduction

Hindustan Zinc Limited (HZL) is an integrated mining and resources producer of zinc, lead, silver and cadmium. It is a subsidiary of Vedanta Resources PLC. HZL is the world's second largest zinc producer. Its FY2015 revenues were Rs. 147.9 billion.

- Hindustan Zinc Limited was incorporated from the erstwhile Metal Corporation of India on 10 January 1966 as a Public Sector Undertaking.
- Hindustan Zinc is now a direct subsidiary of Vedanta Limited.

Operations:

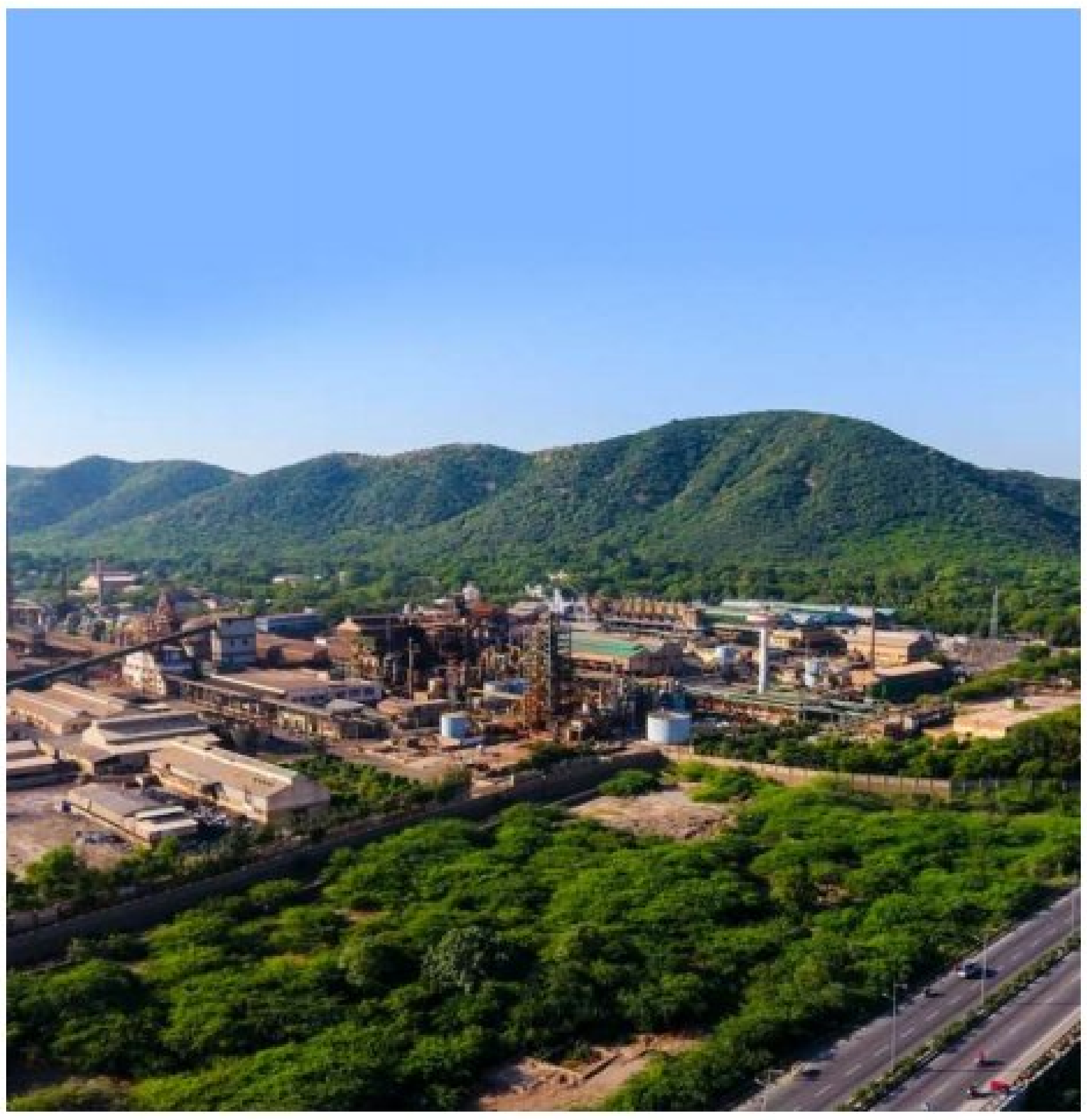
Mining

HZL operates the world's third largest open-pit mine, and World's largest Zinc Mine in Rampura Agucha, Rajasthan. Other mines with HZL are located in Sindesar Khurd, Rajpura Dariba, Kayar and Zawar, all in Rajasthan.

HZL is one of the lowest cost zinc producers in the World.

Smelting

HZL operates Zinc and Lead smelters and refineries at Chanderiya (Chittorgarh), Debari (Udaipur) & Dariba (Rajsamand) in Rajasthan with total zinc and lead production capacity of 1.0 million tonnes. A smelting facility was establishedat Pantnagar in Uttarakhand. It was initially intended to serve as a smelting facility for silver production, but later Zinc and Lead melting and casting plants were also established here. The total metal production was 880,000 tonnes for year 2014- 2015. It also has zinc smelter in Vizag, Andhra Pradesh, where operations have been suspended in February *2012.*



Background Information

Zinc Smelter Debari was commissioned in the year 1968 with an initial production capacity of 18,000 tonnes per annum of zinc. In the past several years the capacity of the smelter has been expanded five folds to its current production capacity of 92,000 tonnes per annum of zinc. Zinc Smelter Debari employs Roast Leach Electro-winning Technology at its Hydro metallurgical zinc smelter. The plant has three roasting facilities, leaching and purification section, electrolysis and melting and casting sections. It produces surplus calcine, an intermediate product, which is supplied to the rest of the Hydro metallurgical zinc smelters.

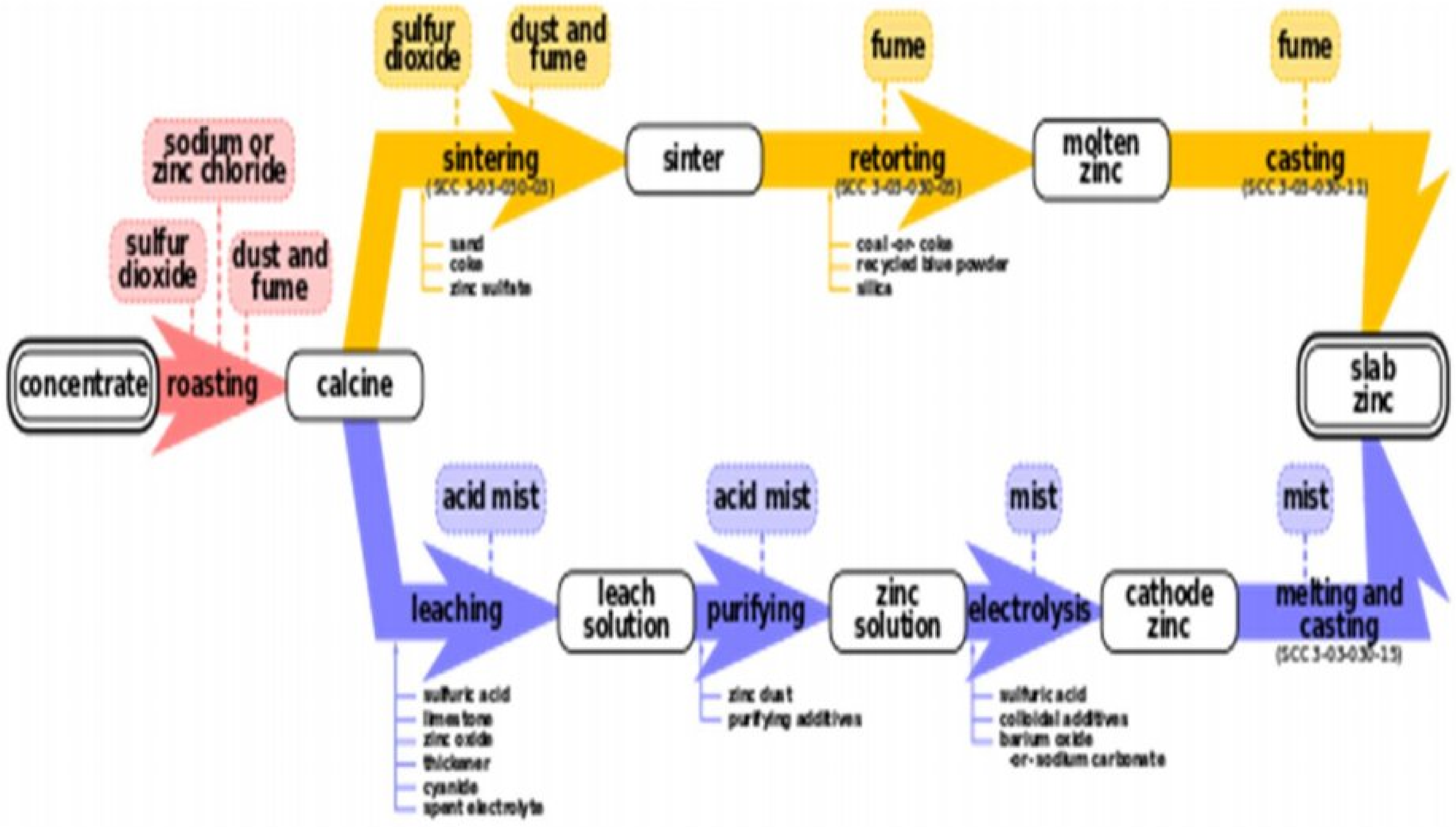
Zinc Smelter Debari sources power requirements from our captive thermal power plants located at Chanderiya and at Zawar while it also has 7.3 MW of power generation capacity from Waste Heat Recovery and another 12 MW of solar power capacity.

- *Roaster 2*
- *Roaster 3*
- *Leaching section*
- *Cell house*
- *Zinc melting section*

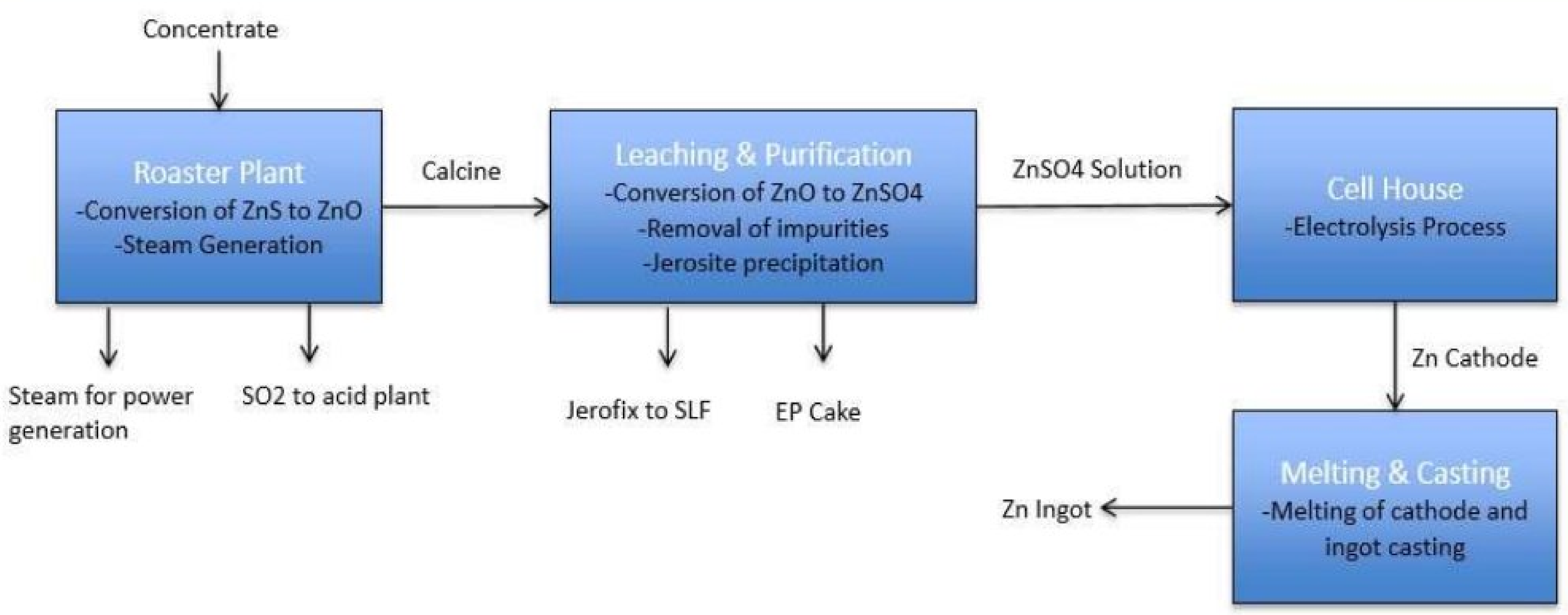
- *Effluent treatment plant*
- *RO plant*
- *DM plant*
- *Tail gas treatment plant*
- *Moorcake treatment plant*
- *Jarosite Plant*
- *Solar Power Plant*
- *Diesel Generator*

ZINC SMELTING PROCESS

Lead and zinc can be produced pyrometallurgically or hydrometallurgically, depending on the type of ore used as a charge. In the pyrometallurgical process, ore concentrate containing lead, zinc, or both is fed, in some cases after sintering, into a primary smelter. Lead concentrations can be 50–70%, and the sulfur content of sulfidic ores is in the range of 15–20%. Zinc concentration is in the range of 40–60%, with sulfur content in sulfidic ores in the range of 26–34%. Ores with a mixture of lead and zinc concentrate usually have lower respective metal concentrations. During sintering, a blast of hot air or oxygen is used to oxidize the sulfur present in the feed to sulfur dioxide (SO2). Blast furnaces are used in conventional processes for reduction and refining of lead compounds to produce lead. Modern direct smelting processes include QSL, Kivcet, AUSMELT, and TBRC.



Hydrometallurgical Process



It consists of following operations1

1. Roasting

2 Leaching

3 Electrolysis

1. ***Roasting***

Roasting is a process of oxidizing zinc sulfide concentrates at high temperatures into an impure zinc oxide, called "Zinc Calcine". The chemical reactions taking place during the process are:

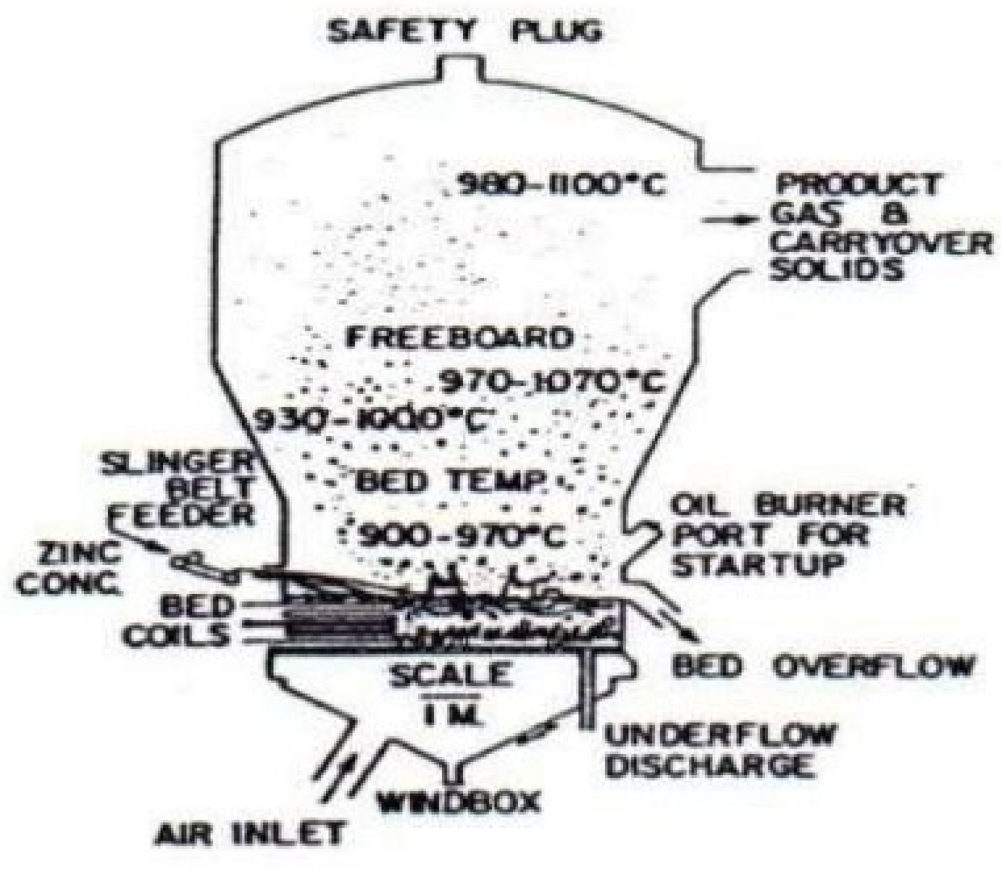
Approximately 90% of zinc in concentrates are oxidized to zinc oxide. However, at the roasting temperatures around 10% of the zinc reacts with the iron impurities of the zinc sulfide concentrates to form zinc ferrite. A byproduct of roasting is sulfur dioxide, which is further processed into sulfuric acid, a commodity. The linked refinery flow sheet shows a schematic of Noranda's eastern Canadian zinc roasting operation The process of roasting varies based on the type of roaster.used. There are three types of roasters: multiple-hearth, suspension, and fluidized-bed.

Fluidized-bed roaster

In a fluidized-bed roaster, finely ground sulfide concentrates are suspended and oxidized in a feedstock bed supported on an air column. As in the suspension roaster, the reaction rates for desulfurization are more rapid than in the older multiple-hearth processes. Fluidized-bed roasters operate under a pressure slightly lower than atmospheric and at temperatures averaging 1,000 °C (1,830 °F). In the fluidized-bed process, no additional fuel is required after ignition

Roaster Furnace Specifications:-

- Hearth Area 123M2
- Nozzles per square meter 100
- Bore Size of Nozzle 6mm
- Furnace Cooling coil area 50m2



has been achieved. The major advantages of this roaster are greater throughput capacities, greater sulfur removal capabilities, and lower maintenance.

2.Leaching

The basic leaching chemical formula that drives this process is:

This is achieved in practice through a process called double leaching. The calcine is first leached in a neutral or slightly acidic solution (of sulfuric acid) in order to leach the zinc out of the zinc oxide. The remaining calcine is then leached in strong sulfuric acid to leach the rest of the zinc out of the zinc oxide and zinc ferrite. The result of this process is a solid and a liquid; the liquid contains the zinc and is often called leach product; the solid is called leach residue and contains precious metals (usually lead and silver) which are sold as a by-product. There is also iron in the leach product from the strong acid leach, which is removed in an intermediate step, in the form of goethite, jarosite, and haematite. There is still cadmium, copper, arsenic, antimony, cobalt, germanium, nickel,and thallium in the leach product. Therefore, it needs to be purified.

Purification

The purification process utilizes the cementation process to further purify the zinc. It uses zinc dust and steam to remove copper, cadmium, cobalt, and nickel, which would interfere with the electrolysis process. After purification, concentrations of these impurities are limited to less than 0.05 milligram per liter (4×10^{-7} pound per

U.S. gallon). Purification is usually conducted in large agitated tanks. The process takes place at temperatures ranging from 40 to 85 °C (104 to 185 °F), and pressures ranging from atmospheric to 2.4 atm (240 kPa) (absolute scale). The by-products are sold for further refining. The zinc sulfate solution must be very pure for electrowinning to be at all efficient. Impurities can change the decomposition voltage enough to where the electrolysis cell produces largelyhydrogen gas rather than zinc metal.

Electrolysis;

Zinc is extracted from the purified zinc sulfate solution by electrowinning, which isa specialized form of electrolysis. The process works by passing an electric current through the solution in a series of cells. This causes the zinc to deposit on the cathodes (aluminium sheets) and oxygen to form at the anodes. Sulfuric acid is also formed in the process and reused in the leaching process. Every 24 to 48 hours, each cell is shut down, the zinc-coated cathodes are removed and rinsed, and the zinc is mechanically stripped from the aluminium plates.

Electrolytic zinc smelters contain as many as several hundred cells. A portion of the electrical energy is converted into heat, which increases the temperature of the electrolyte. Electrolytic cells operate at temperature ranges from 30 to 35 °C (86 to 95 °F) and at atmospheric pressure. A portion of the electrolyte is continuously circulated through the cooling towers both to cool and concentrate the electrolyte through evaporation of water. The cooled and concentrated electrolyte is then recycled to the cells.[1] This process accounts for approximately one-third of all the energy usage when smelting zinc.

Melting And Casting

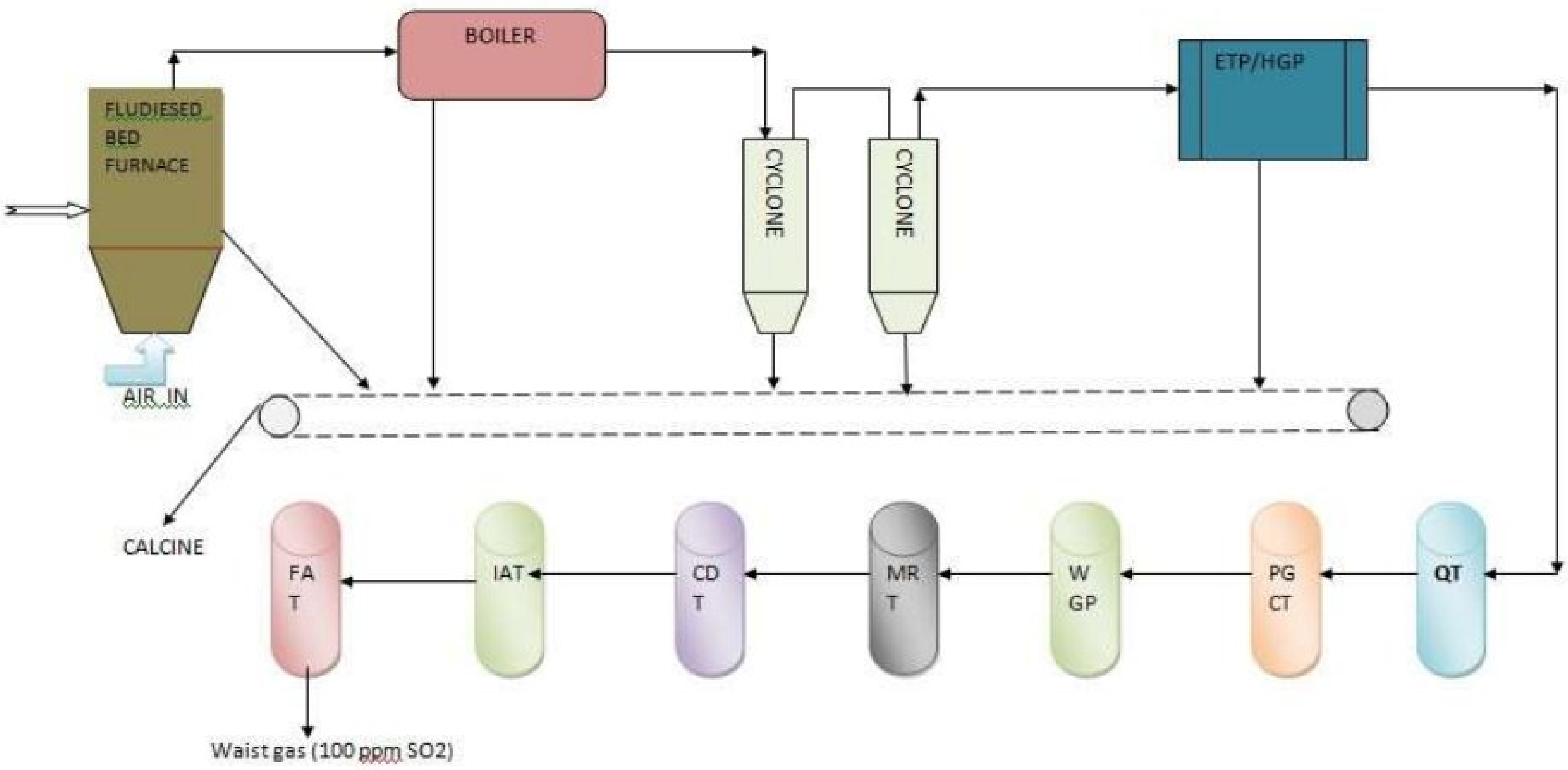
The final step is to melt the cathodes in an induction furnace. It is then either cast into pure zinc (99.995% pure) ingots or alloyed and cast into ingots.

Roaster

Roaster plant Zinc concentrate having zinc in the form of Zinc Sulphide is roasted to convert zinc oxide,SO2 which is converted into sulphuric acid in acid plant.

The following are the Roaster sections:-

- *RMH*
- *Roaster area*
- *Boiler*
- *Gas cleaning plant*
- *Mercury removal plant*



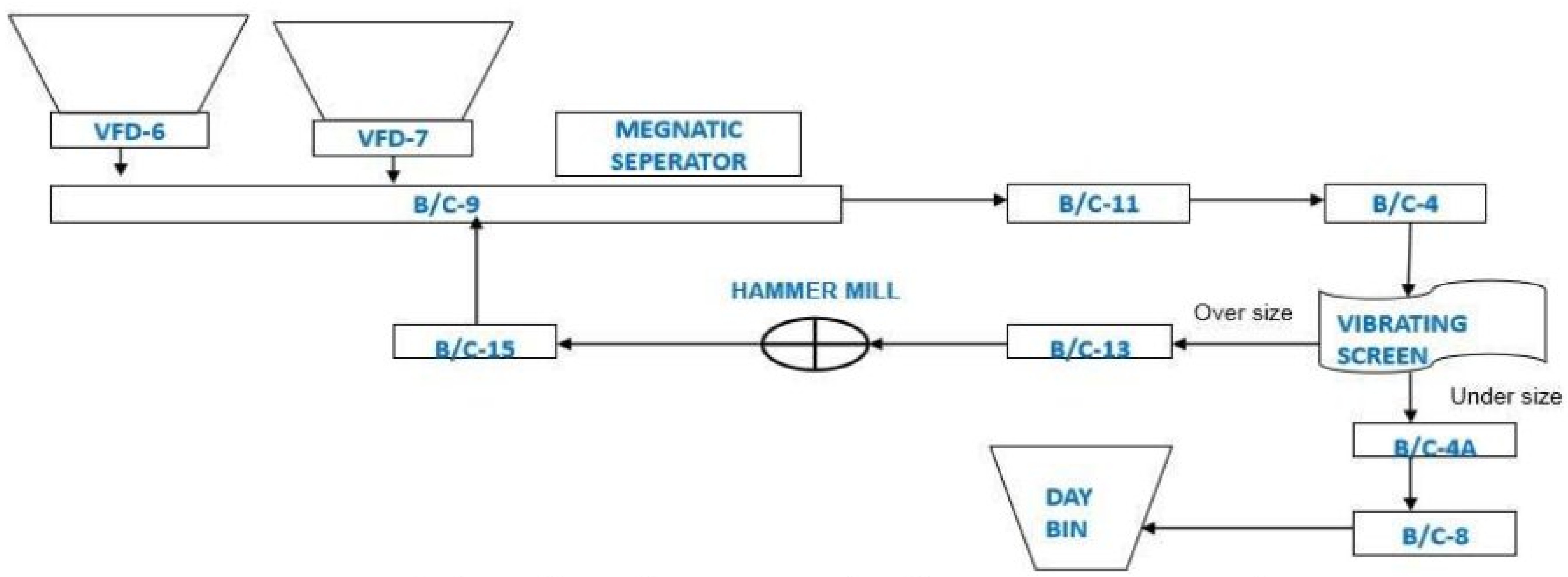
ROASTER

- *Acid plant*

Raw material handling (RMH)

Concentrate comes from Zawar Mines, RD Mines and RA Mines. These concentrates are transported by trucks and dumpers from mines and are unloaded on surface grizzly of under ground hopper. Series of belt conveyors transfers the concentrate from underground hopper to blende storage yard. Unloading on different heaps is done with the help of a trippler conveyor. The storage yard is divided into parts for ZM, RDM and RAM. To avoid wind losses water is sprayed through sprayer or manually by using hose pipes. This also helps to maintain required moisture in concentrates. The water spraying is done manually whenever needed.

RMH Charging Group Overview



Raw material handling having a facility to storage of approx 8000MT concentrate .Concentrate charging heap is prepare there by adding moisture .We maintain 10-11% moisture in feed .The mixture of different concentrate (Called blende) is transported to bins of Roaster with the help of series of belt conveyors and a vibrating screen, which allows only undersize material to go to bins. Oversize material is ground in a hammer Mill and charged back to hoppers. An *electromagnet is provided on one of the conveyors to attract and separate iron pieces, if any, going to bins. Water is also sprayed on belt conveyor to increase moisture in blende feed. Minimum 7% moisture is maintained in blende feed. Sample is drawn from extraction belt and is analysed for moisture twice in a shift.*

Samples of Zinc concentrate from each truck are collected by laboratory representative for moisture and metal analysis. Records of samples analysis are kept in electronic data form by Control Laboratory at Zinc Smelter Debari.

Typical Analysis for Zinc Concentrate

Zinc	*48% - 52%*
Sulfur S	*30% -33%*
Iron -	*8% - 12%*
Lead	*0.5% - 3%*
Copper	*<0.2%*
Cadmium	*<0.2%*

Average particle size distribution of a standard concentrate feed

Size (in μm)	*Weight %*
> 210	*3*
210 – 150	*10*
150 – 105	*15*
105 – 75	*13*
75 – 53	*13*
< 53	*46*

Roasting Section

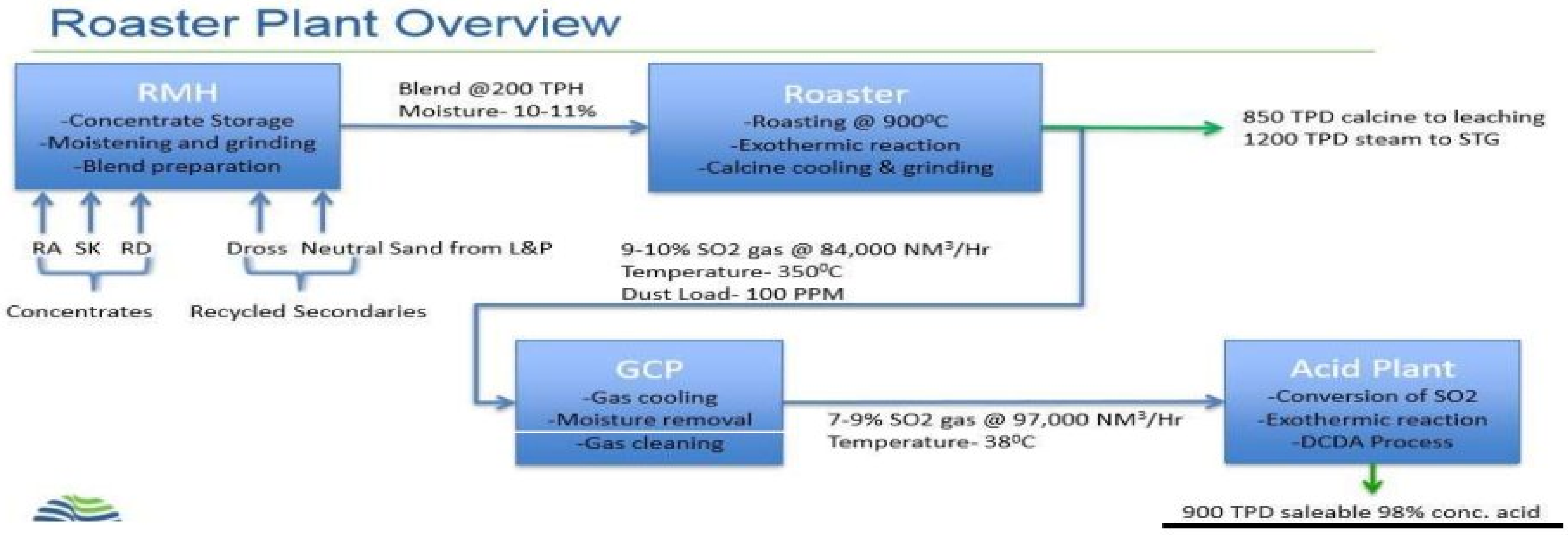
Zinc blende is taken from the blende bin through extraction belt to rotary table feeder and high speed feed machine. Then blende is fed to fluidized bed roaster through furnace feed hole. Zinc blende is roasted to produce calcine and sulphur dioxide gas.

Air for roasting of zinc blende is supplied through roaster air blower continuously to roaster furnace through nozzles. Calcine from furnace comes out through over flow, under flow, boiler, cyclone and Hot gas precipitator which is sent to leachingplant

The roasting reaction is exothermic and heat generated is sufficient to sustain the roasting reaction at 900 –950 Deg C.

$2ZnS + 3O2 = 2\ ZnO + 2SO_2 + heat$

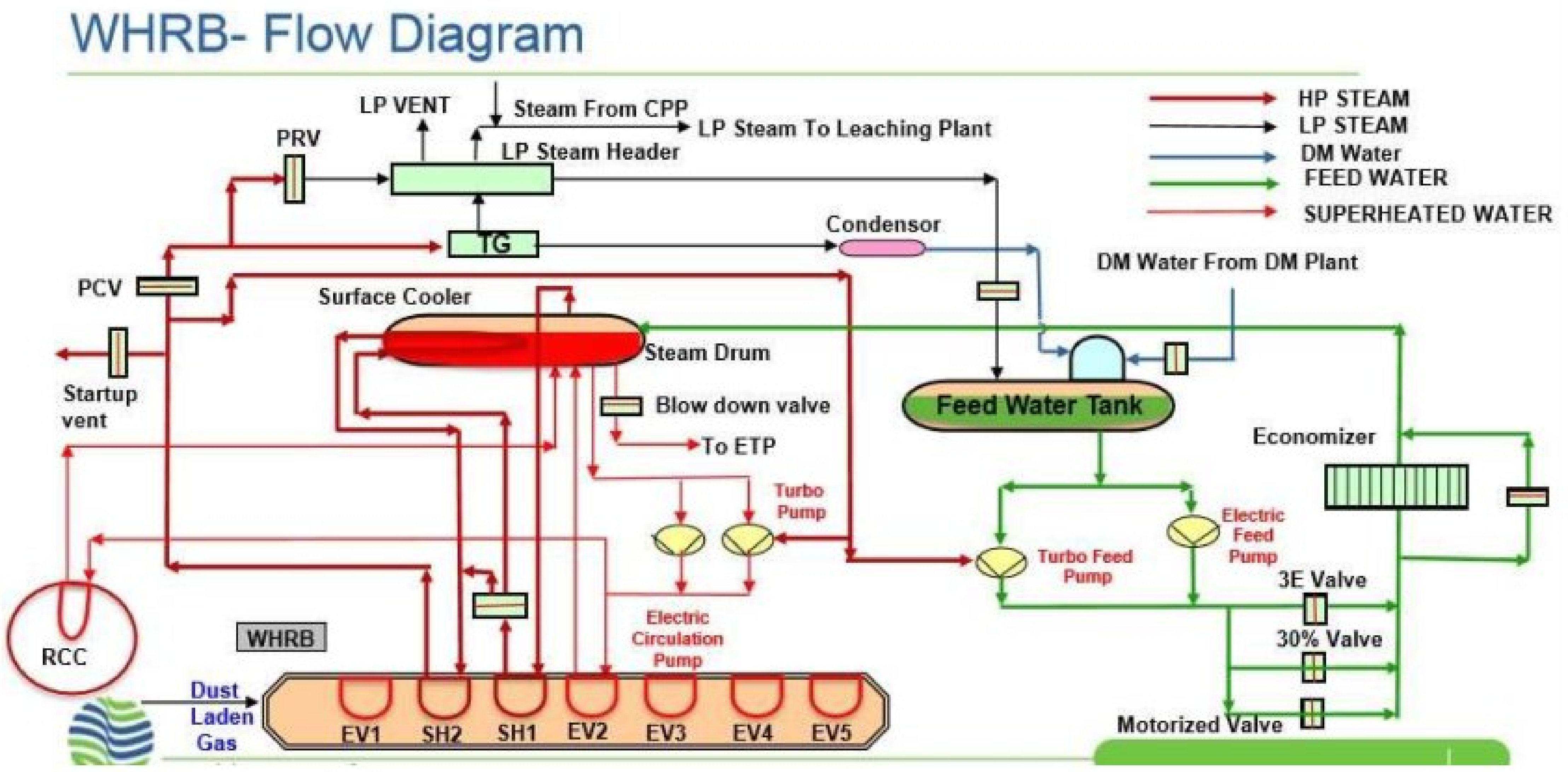
Hot gases with fine calcine particles coming from roaster furnace pass through waste heat boiler in which hot gases are cooled, and steam is produced by circulation of DM Water in boiler tube bundles. This steam is used for producing power through STG plant. Water is also circulated in furnace cooling coils installed in furnace hearth to maintain the desired bed temperature.



Waste Heat Recovery Boiler

Theroasting gas has a temperature of about 950 to 1000 °C at the furnace exit and a SO_2-content of approximately 10.5 %(Vol.). In a waste heat boiler, the gas is cooled to about 350 °C. The waste heat boiler is of the forced circulation type. It isdesigned to produce superheated steam at 40 bar / 400 °C. The boiler design provides for tube lined walls and the use of evaporator bundles. All the bundles are suspended at the boiler roof. To avoid any air in leakages, the roof is tight welded. As part of the flue dust may adhere on the tube surface, all the bundles are equipped with an effective rapping device, controlled by a timer.

Only de-aerated and treated feed water should be used for the boiler. This water is prepared in the demineralised water treatment plant. It is fed into the boiler drum by means of a boiler feed pump. From the drum, the circulating pump delivers the water into the evaporator bundles and wall tubes and the cooling coils of the roaster.



The boiler consists of –

- *Evaporator*
- *Superheater*

The calcine, collected in the waste heat boiler, drops into a longitudinal hopper arranged underneath the boiler and is discharged by a continuous air cooled chain conveyor and water cooled rotary valve. The calcine, collected from the roaster and waste heat boiler, passes through a rotating drum cooler to be cooled to a temperature below 150 °C. The cooler discharge then passes through a ball mill. The mill discharge and the fine dust coming from the hot gas precipitator are combined and transported to an intermediate bin. From the intermediate bin the calcine is pneumatically transported to the Silos.

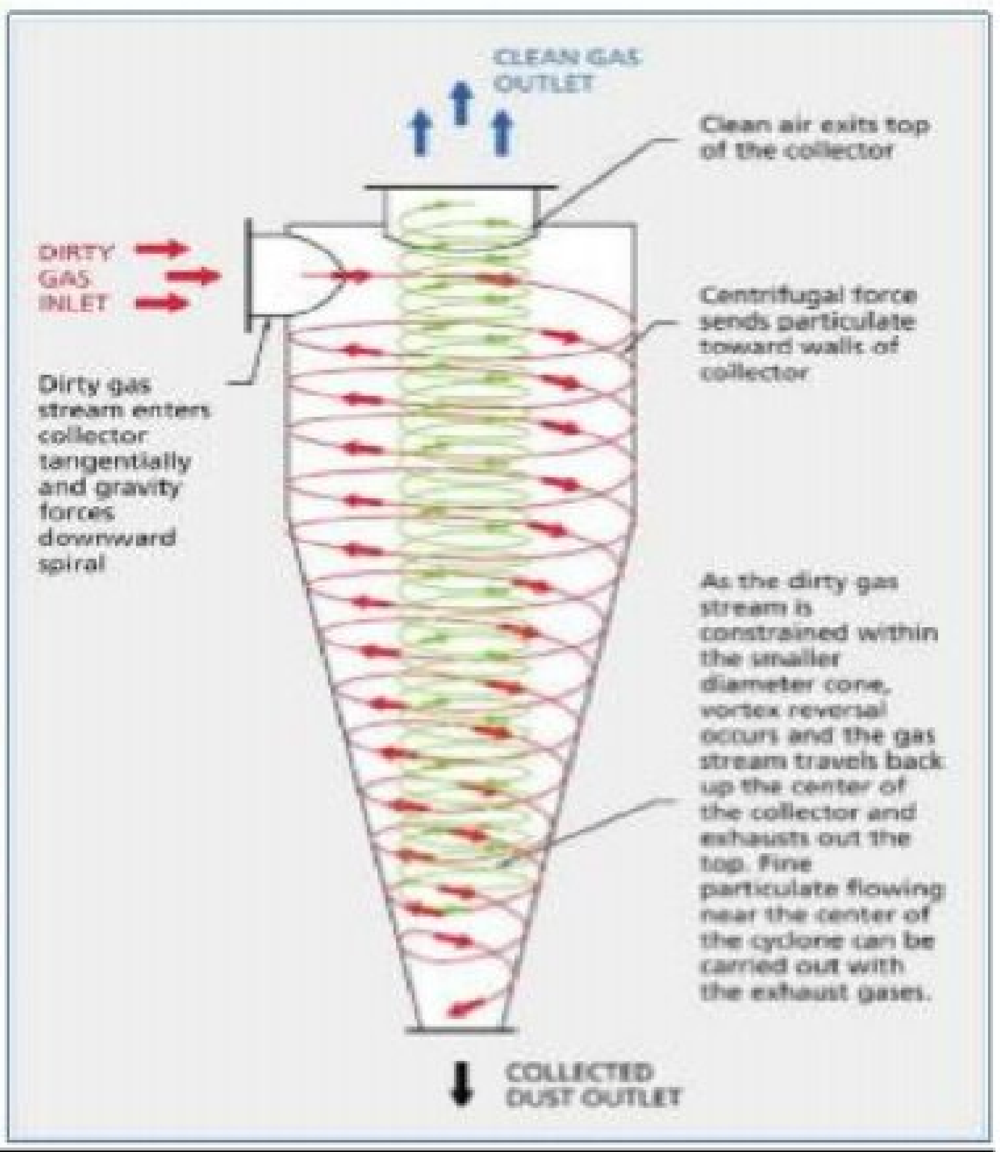
A bag house filter is provided to ensure de-dusting of the calcine handling system.

Cyclone Separator

Cyclonic separation *is a method of removing particulates from an air, gas or liquid stream, without the use of filters through vortex separation. When removing particulate matter from liquids, ahydrocycloneis used ; while from gas, a gascyclone is used. Rotational effects and gravity are used to separate mixtures of solids and fluids. The method can also be used to separate fine droplets of liquid from a gaseous stream.*

Cyclones are used to separate particles from SO_2 gas by centrifugal forces. The Calcine contain gas stream is fed into the cyclone, where a rotary motion isinduced. The solid particles, due to their higher density, are separated to the wall of the cyclone and flow downwards to the solid exit, while the gas leaves the cyclone via the vortex finder.

The gases leaving the cyclone separator enters the electrostatic separator for furtherpurification.



Hot gas Precipitator

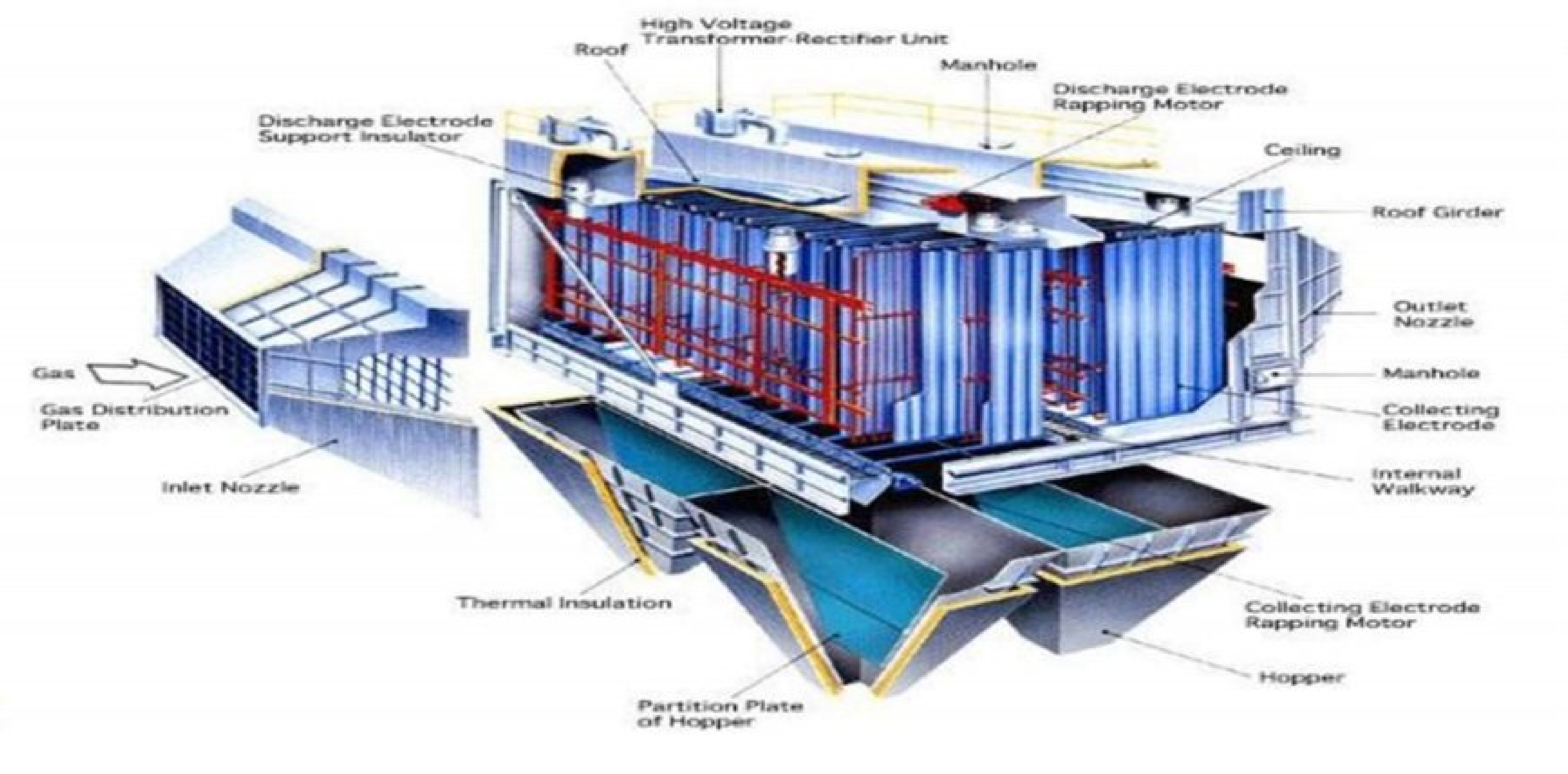
The main function of hot gas precipitator is to precipitate dust & free particle from inlet gases of roaster plant and to enhance the performance of gas cleaning plant.

Hot gas precipitators is equipped with collecting electrodes consisting of parallel vertical plates. They form passages, in the center of which the discharge electrodes are suspended from insulators. The plates are shaped to provide quiescent zones to prevent the collected dust from being dislodged up and re- entrained by the gas stream. Hot gas precipitator has three field.

The calcine particles suspended in the gas are electrically charged and migrate under the influence of a strong electric field towards the collecting electrodes where they are deposited.

The gas leaving HGP goes in acid plant.

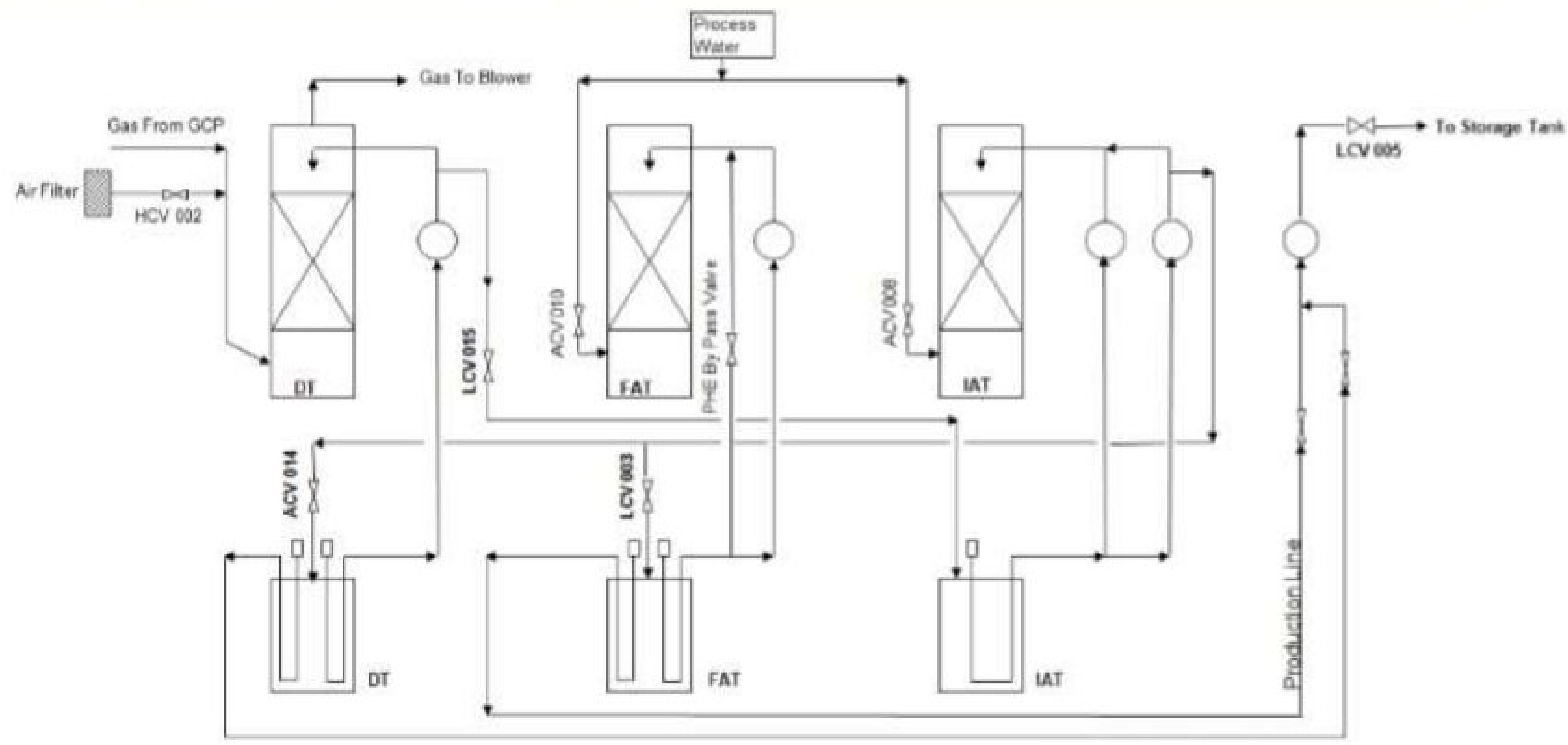
HGP Diagram



Acid plant

Gases leaving the Hg removal plant are passed through drying tower from bottom to remove the moisture by spraying sulphuric acid from top. During the removal of moisture from the gases heat is liberated which increases the temperature of the circulating acid. Cooling of circulating acid is done by passing

Acid Circuit Flow Diagram



the acid through PHE, where soft water is used as coolant.

For continuous circulation there is a circulation acid vessel at the bottom of drying tower. Stream of gases are sucked by blower and passed via heat exchanger, gas mixture and converter. In converter sulphur dioxide gas is converted into sulphur trioxide gas in presence of vanadium pentaoxide catalyst. There are four catalyst beds in the converter. Gases are passed through all beds successively. Conversion of sulphur dioxide to sulphur trioxide is an exothermic *reaction. The heat of reaction is utilised to preheat the incoming gases through four heat exchangers.*

After this, the gases are passed through Intermediate absorption tower and final absorption tower.

The sulphuric acid plant mainly consists of 2 plant sections:

- *The drying and absorption section*
- *The converter section with the gas to gas heat exchangers*

Drying Section

The drying and section consists of the drying tower , in which acid is sprayed to remove the moisture content of gases. Acid absorbs the moisture due to its hydrophillic nature and dry gas leaves the tower.

Converter System

The converter system consists of a stainless steel 4-layer converter. The converter itself is an insulated, vertical and cylindrical vessel divided in four sections: called layers or trays. Catalytic converter is to convert inlet SO_2 to SO_3 in presence of catalyst vanadium pentoxide , the conversion configuration is 3+1

Convertor is consist of four bed. SO_2 gas enters the converter through first mass and goes to IAT after third bed. After absorption through the IAT gas goes to fourth bed and then FAT.

Catalytic conversion of SO_2 to SO_3 is exothermic reaction.

$SO_2 (g) + ½ O_2 (g) \longrightarrow SO_3 (g)$

Absorption Section:-

It consists of two towers – IAT and FAT .These towers are of identical construction: each tower consists of a bricklined steel shell with a filling of ceramic Intalox saddles. The layer of Intalox saddles is supported by a supporting structure made of acid resistant stoneware. The irrigated acid is distributed uniformly over the packing by the irrigation system.

The gas flow through the towers is countercurrent to the acid flow, i.e. the gas flows from the bottom to the top of the tower. From the bottom of the tower(s) the acid flows to the pump sump and is pumped from there by the acid pumps (via the acid coolers) back to the irrigation system.

Reaction in absorption tower areSO_3

$(g) + H_2SO_4 = H_2S_2O_7$

$H_2S_2O_7 + H_2O = 2H_2SO_4$

Tail Gas Treatment Plant

Tail gas Treatment plant of sulfuric acid plants is for SO_2 removal from the tail gas and SO_3 mist.

The Scrubber system is for cleaning off gases containing SO_2 from Final Absorption Tower of Sulphuric Acid Plants. The off gases are taken from thetapping at the Duct from FAT to Chimney and sent to the Tail Gas Treatment system. Two separate Fans are provided to take gases from

The gases enter Absorption Tower at bottom and travel upward. Circulating Scrubber liquor is introduced in counter current fashion in this tower by means of splashers arranged in stages.

The circulating fluid absorbs SO_2 from flue gas. The scrubber liquor reacts with the flue gases forming Zinc Sulphite.

Reactions involved are -

Absorbing:

$ZnO + SO_2 + 2\frac{1}{2} H_2O$ $ZnSO_3 + 2\frac{1}{2} H_2O$ (Main Reaction)

$ZnO + 2 SO_2 + H_2O$ $Zn(HSO_3)_2$

$ZnSO_3 + SO_2 + H_2O$ $Zn(HSO_3)_2$

Aeration:

$ZnSO_3.2\frac{1}{2} H_2O + \frac{1}{2} O_2$ $ZnSO_4 + 2\frac{1}{2} H_2O$ (Main Reaction)

The sections involved in this plant are –

1. *Blending section*
2. *Absorbing section*
3. *Aeration section*

Blending section –

The zinc concentrate calcine used as absorbent is stored in a Storage Bin. A dedicated pneumatic conveying system is provided for zinc oxide transport from HGP-2bottom and cyclone bottom to storage silo. Calcine is mixed with normal water at Mixing tank . Slurry concentration adjusted to 200-250 gm/litter.

Absorbing section –

The tail gas from Sulfuric Acid Plant 1 and 2 is introduced by booster fan. The absorbing tower is the non-packed type and the absorbent slurry is atomized using splashers, whilst being mixed with the gas containing the SO_2. The ZnO Slurry solution absorbed SO_2 from Off gases in a absorbing tower and get converted to $ZnSO_4$, and then $ZnSO_3$ to $ZnSO_4$ in a Circulation tank due to aeration with the help of four aerators. Calcine slurry is fed to Circulation Tank. Splashers islocated in three stage on absorption tower, two splashers is installed at eachstage

Washing Slurry is fed at top of tower by washing pump continuously through tangential nozzles and top entry nozzles on conical portion of absorber.

Aeration Tank -

ZnSO3 Slurry is oxidized by air blown by aerators thereby converting to ZnSO4, over 90% in a circulation tank , and scaling trouble is reduced. Slurry from Circulation Tank is introduced to a Final aeration Tank in the form of bleed inbatch operation, where ZnSO3 slurry is converted to ZnSO4 over 95% by aerator. Circulation slurry at tower is taken to Final Aeration by Washing pump. Aerated *slurry is taken to Storage Tank. In storage tank air is sparged through sparger arrangement. Finally, Storage slurry is fed to Electrolysis Refinery Plant .*

NOW,the calcine obtained from roaster section is sent to leaching and purification plant for the production of zinc.

LEACHING AND PURIFICATION PLANT

The leaching plant main task is to dissolve and to recover the zinc contained in the calcine as a solid free, pre-purified neutral zinc sulphate solution. At the same time a leach residue containing most of the copper and cadmium contained in thecalcine shall be

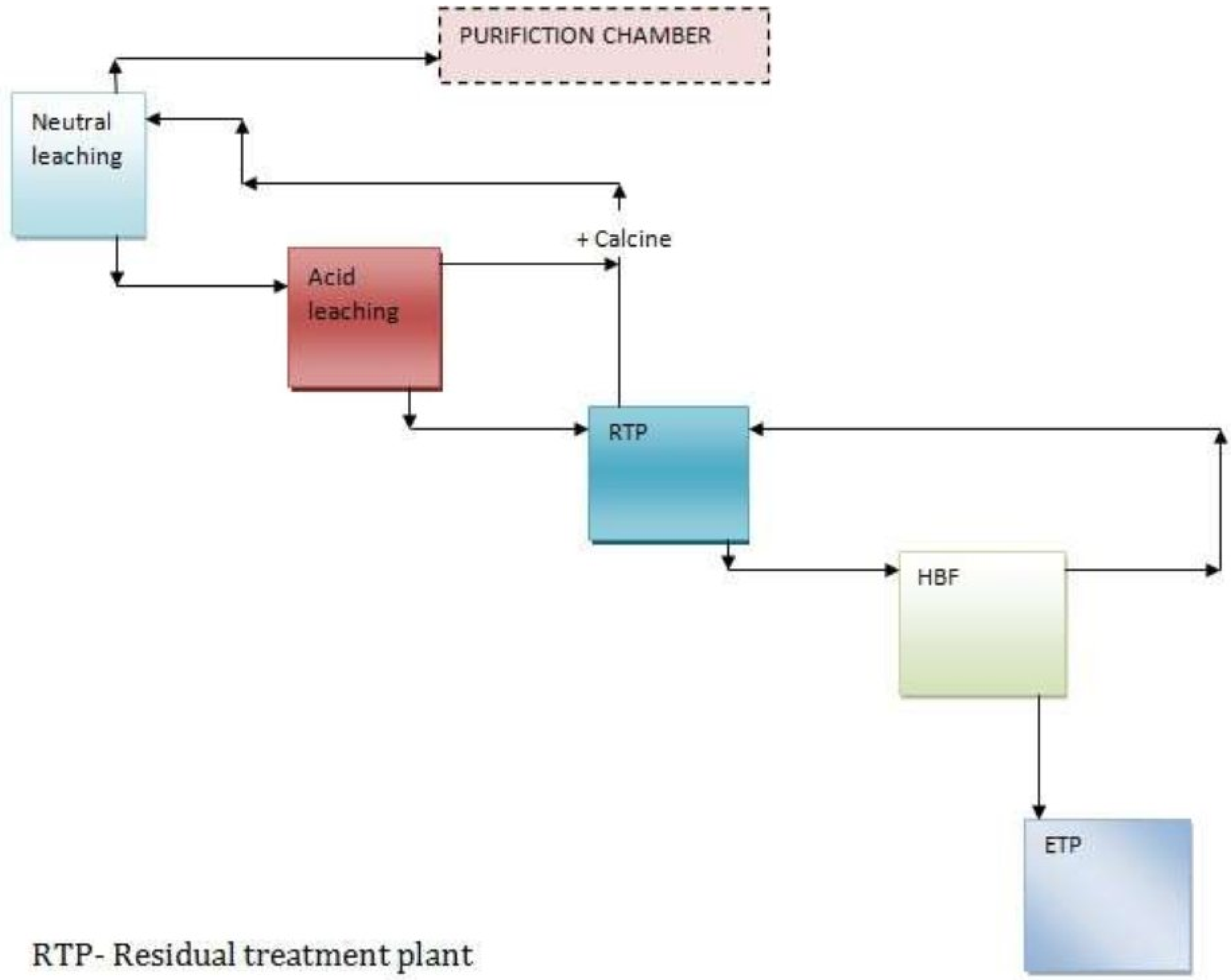
recovered as a Enrichment cake. The iron, which is also dissolved during the calcine leaching process, is discharged as a jarosite cake with an iron content of approx.: 22 - 28 %.

The feed material to the leaching plant is calcine, which is produced at the roasting plant.

Chemical composition of calcine obtained from roaster is as follows –

Zn	59.87%
Fe	8.86%
Cao	1.17%
Co	50ppm
SiO_2	2.22%
Insoluble	0.94%
Pb	1.94%
Ag	90ppm

MgO	.44%
Ni	40ppm
S/SO_4	1.8%
Cu	.12%
Cd	.25%
Mn	.22%
As	50ppm
S/S	.3%



RTP- Residual treatment plant

HBF- Horizontal belt filter

ETP- Effliated treatment plan

fig. Leaching plant over view

The calcine is first leached in a neutral or slightly acidic solution in order to leach the zinc out of zinc oxide. The remaining calcine is then leached in strong sulfuric acid to leach the rest of the zinc out of the zinc oxide and zinc ferrite. The result is a solid and a liquid ; the liquid contains zinc and is often called leach product. There is also iron in the leach product from the strong acid leach which is removed as jarosite. The basic reactions that takes place are –

$$ZnO + H_2SO_4 \longrightarrow ZnSO_4 + H_2O$$

$$MO + H_2SO_4 \longrightarrow MSO_4 + H_2O$$

Where M is metal other than zinc present in concentrate.Leaching area has following sections :

- *Weak acid leaching*
- *Jarosite precipitation*
- *Purification*
- *Gypsum removal*

There is still cadmium, arsenic, copper, antimony, cobalt, germanium, and nickelin leach product. Therefore it needs to be purified.

After the purification process , pure zinc is obtained by electrolysis of the solution.The pure zinc obtained is than melted and casted into desired shapes.

CELL HOUSE

Only the high-hydrogen overvoltage on zinc permits the deposition of zinc at the cathode since thermodynamics favor decomposition of water and evolution of hydrogen.

Pure aluminum cathodes have been used since the inception of the ***zinc electrowinning*** *process. However, the problem of deposited zinc sticking to the aluminum cathode has plagued the industry for many years; it causes metal losses and discourages automation. It is agreed generally that sticking is caused byfluoride ions in solution that attack and etch the aluminum cathode. Subsequent intergrowth of the zinc deposit into the pits and crevices results in mechanical interlocking, making stripping of the zinc deposit difficult, if not impossible.*

Neutral zinc sulfate solution was prepared by dissolving stoichiometric amounts of lead-free photoconductive zinc oxide or zinc calcine in reagent-grade sulfuric acid and distilled water. The solution then was purified by the standard commercial practice of oxidation with MnO2 to precipitate ferric hydroxide (iron purification), followed by two successive treatments with zinc dust (copper - cadmium purification). Purified neutral solution, concentrated H2SO4, anddistilled water were mixed to give a cell solution with a nominal concentration of 65 g/l Zn++ and 200 g/l free acid.

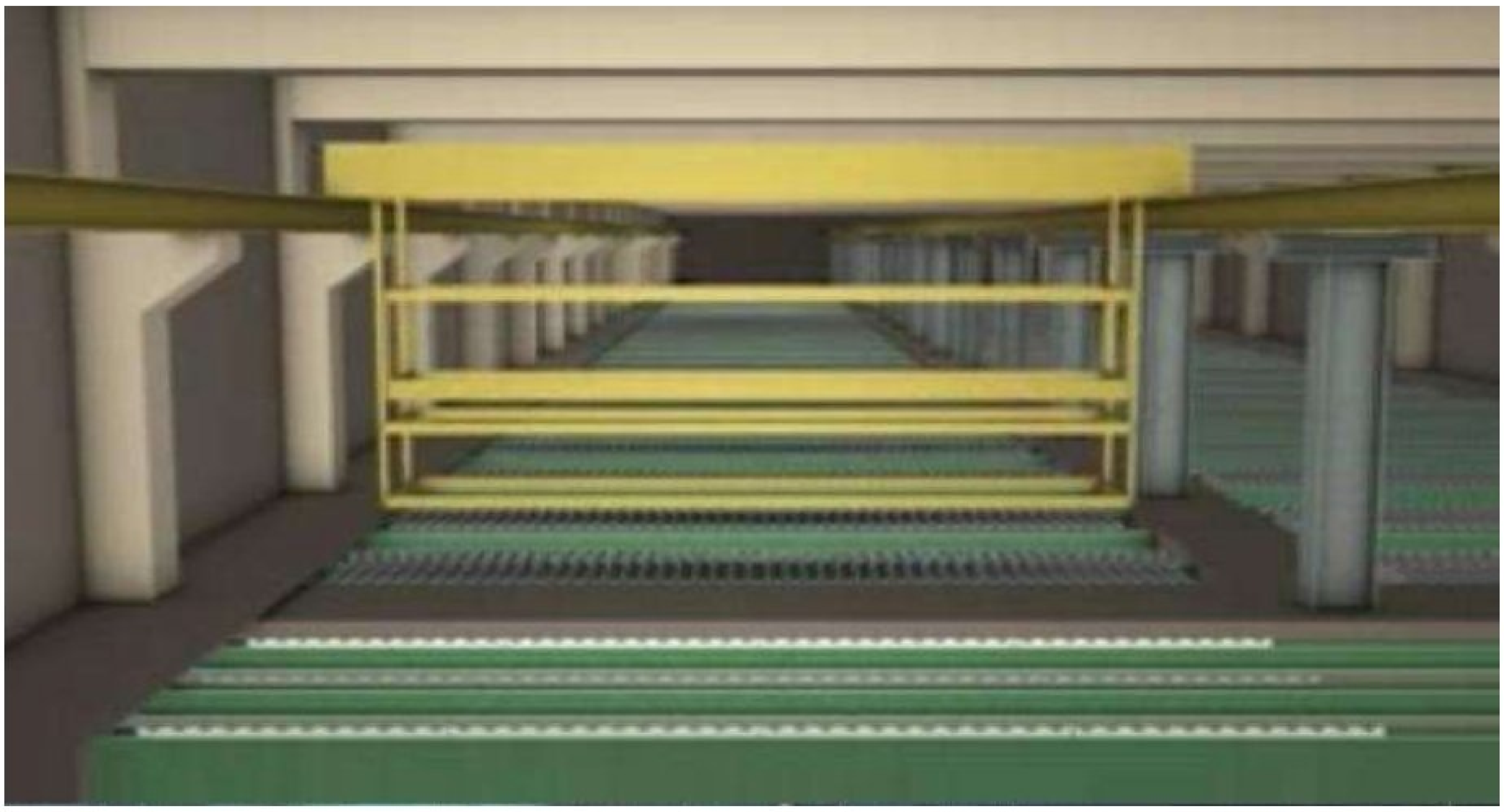
The zinc dust used for purification in the initial experiments was purchased from a commercial chemical supplier. Later, the particle size of the dust was found to have an important bearing on the degree of purification obtained, therefore, coarse- and fine-mesh dust were obtained from a ***zinc electrowinning*** *plant.*

The clean, dry cell was filled with a solution containing 65 g/l Zn++ and 200 g/l H2SO4, and the temperature was allowed to stabilize between 35° and 40° C. A magnetic stirrer was activated to spin a Teflon-covered magnet for stirring the solution.

The cathode, with the Teflon edge strips in place, was inserted into the slot in the plastic top and slid into the center. The anodes then were placed through the slots on both sides of the cathode, and the entire assembly was flushed with distilled H2O and blotted dry. Leads from the power supply were attached, the electrodes were placed into the cell, and the power supply was turned to the desired current setting immediately.

As soon as the power was on, plastic tubing from a peristaltic pump was fitted into a small hole in the plastic top in back of one of the anodes, and neutral solution was pumped from a reservoir into the bottom of the cell. Simultaneously, and at the same rate, cell solution was pumped out at the top of the cell. Constant zinc ion and sulfuric acid concentrations were maintained in the electrolytic cell by varying the pumping rate.

After completing electrolysis, the cathode was removed as rapidly as possible and flushed with distilled water. A handheld dryer was used to rapidly dry the cathode to prevent discoloration or staining. Once the deposit was completely dry, it was stripped from the aluminum by flexing. With some deposits that were strongly adherent, a knife or razor blade was inserted under one edge to pry them loose.



Steam System in the Debari Plant

STEAM LINE COMPONENTS

- Pipes
- Flanges
- Gaskets
- PRDS
- Control Valves
- Flow meter
- Traps
- Gate Valves
- Insulating Material
- Insulating Sheets
- Safety Valve
- Pressure Gauge
- Non Return Valve/Check Valve

Pipes:

These are the main component of the entire steam line these are made of boiler material i.e. made from stress relieved mild steel so that they ca withstand high pressure and temperature. These pipes are insulated in order to reduce heat energy loss.

Pipe Classification

Pipes can be classified By ANSI(The American National Standards) as the following classes:

- *Class 150*
- *Class 300*
- *Class 600*
- *Class 900*
- *Class 1500*
- *Class 2500*

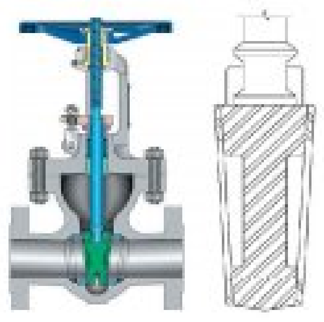
Different materials may have different pressure rating under similar conditions. The stronger the material, the higher the maximum pressure that the flange can withstand at a given temperature.

Temperature and Pressure Ratings for ASTM 105 Carbon Steel Flange							
Pressure Class	150	300	400	600	900	1500	2500
PN Number	20	50	68	100	150	250	420
Service Temperature (F)	Maximum Non-Shock Pressure (Psig)						
100	285	740	990	1480	2200	3705	6170
200	260	675	900	1350	2025	3375	5625
300	230	655	875	1315	1970	3280	5470
400	200	635	845	1270	1900	3170	5280
500	170	600	800	1200	1795	2995	4990
600	140	550	730	1095	1640	2735	4560
650	125	535	715	1075	1610	2685	4475
700	110	535	710	1065	1600	2665	4440
750	95	505	670	1010	1510	2520	4200
800	NOT RECOMMENDED ABOVE 800						

Types of Valves

1. Gate valve: (Types of valves)

Gate valve functions by the reciprocating action of disc in its body. Gate valves are available in various sizes ranging from 12 mm to 300 mm and even more.

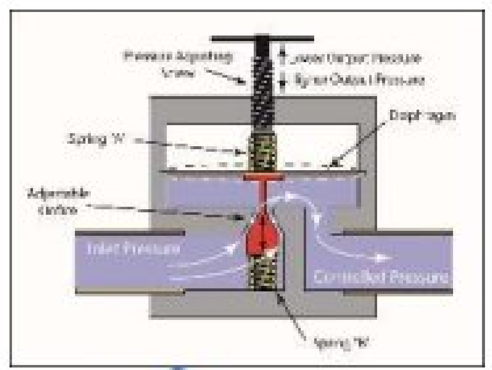


2. Control Valve: (Types of valves)

It is necessary for automatic process control system. It can be used either for controlling level, flow rate, temperature, pressure etc. The selection of control valve involves its operation mechanism, process conditions as well as requirements. It can be manual or power operated. The main parts of a control valve are actuator and body.

3. Pressure regulating valve: (Types of valves)

It is used for regulating steam pressure if it exceeds the desired level.

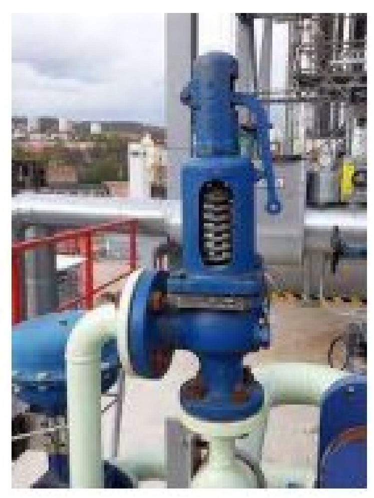


4. Check valve: (Types of valves)

It is used to prevent flow reversal. Fluid pressure keeps the valve open. It is closed either by back pressure of fluid or by weight of the check system.

5. Safety Valve

Safety valve is used to protect the system against overpressure. Overpressure occurs when the pressure exceeds the Maximum Allowable Working Pressure (MWAP) or the pressure for which the system is designed.



Pressure Reducing & Desuperheating Station (PRDS)

Most modern boilers generate steam at high pressures & temperatures. High pressure steam has lesser volume than steam at atmospheric pressure, thereby translating into smaller boiler size & lower diameter of steam piping. Also, high temperature (superheated) steam has more energy, which translates into higher efficiency for power generating steam turbines.

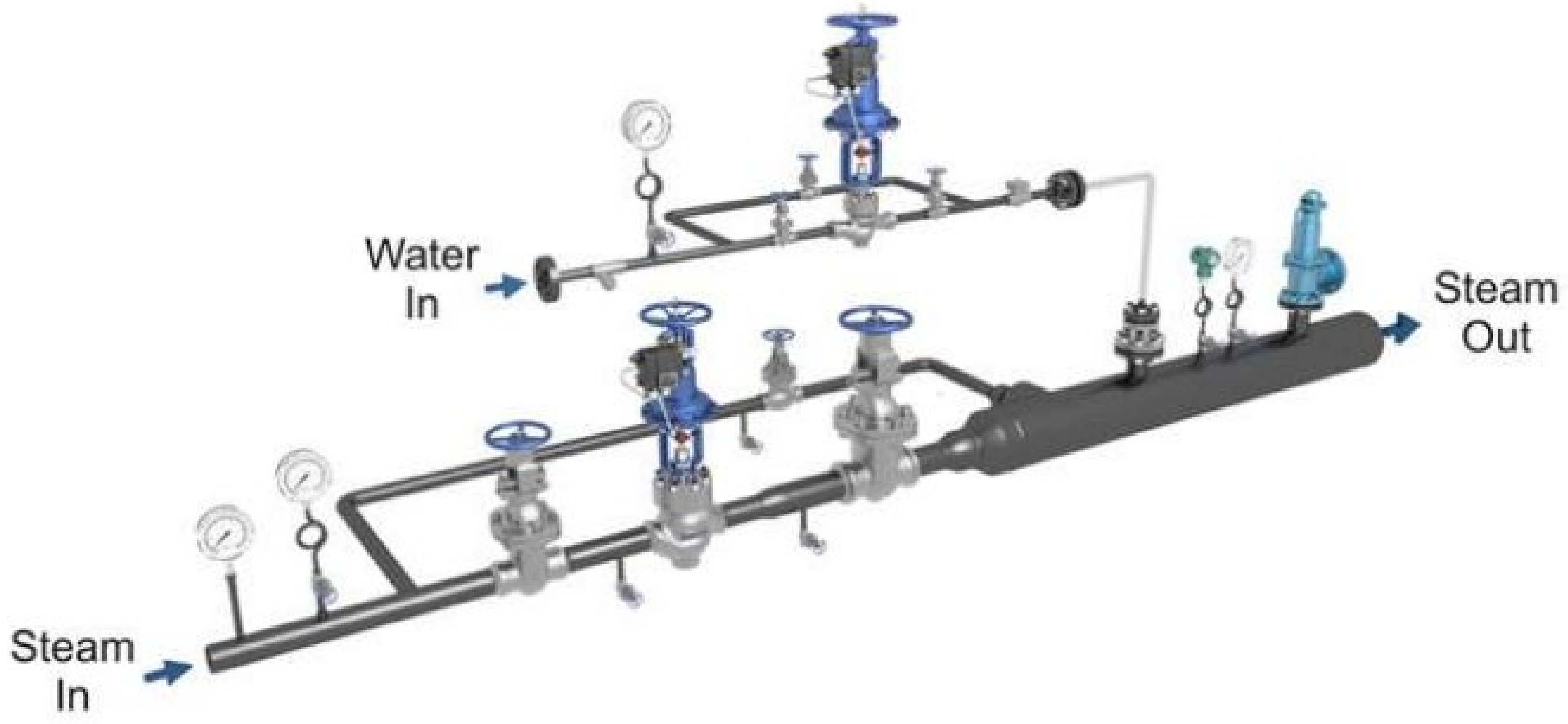
On the other hand, all process industries use low pressure low temperature saturated steam, primarily due to the following reasons:

- Saturated steam has the highest heat transfer efficiency.
- Lower pressures & temperatures translate into thinner pipes, lighter flanges & less expensive materials thereby significantly reducing initial plant cost.

In any industry, steam is required at different locations, but the required steam pressure & temperature at each location varies according to the application. Therefore, high pressure superheated steam is generated at a central location (boiler), distributed to various locations in the plant through a steam piping network, and then reduced to the operating pressure & temperature just upstream of the usage points.

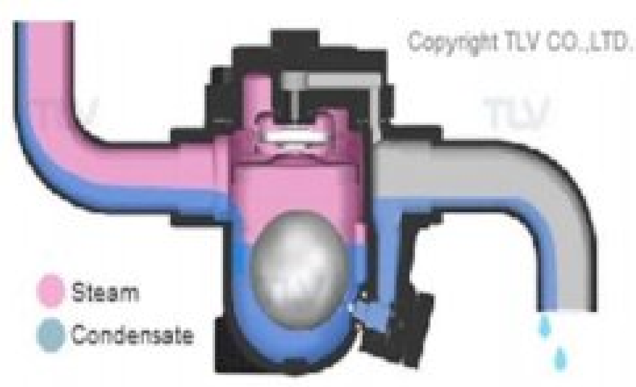
PRDS Station Operation Principle

The steam pressure control valve reduces the pressure of the steam. The steam inlet isolation valve along with the outlet isolation valve is used to isolate the steam pressure control valve, whenever maintenance of the control valve is to be carried out. The steam bypass valve allows steam flow at reduced pressure to continue when the steam pressure control valve is under maintenance or becomes inoperable. The spray water enters the water line as shown in the figure. The water strainer at the inlet prevents entry of foreign particles into the water control valve & desuperheater spray nozzles.



The water flow control valve regulates the quantity of the spray water going into the spray nozzles depending on the steam load. The non-return valve prevents back flow of steam into the water pipe line. The desuperheater lowers the temperature of the steam to the required outlet temperature by injecting atomized water in the form of a very fine mist into the steam flow. The pressure transmitter and temperature transmitter sense the outlet steam pressure and temperature respectively and give a proportional current signal as output to the PID controller. The PID controller then compares the measured value with a set point, and generates an error signal, which is then given to the positioner of the steam pressure control valve and water flow control valve.

Steam Trap



Steam traps are a type of automatic valve that filters out condensate (i.e., condensed steam) and non-condensable gases such as air without letting steam escape. In industry, steam is used regularly for heating or as a driving force for mechanical power. Steam traps are used in such applications to ensure that steam is not wasted.

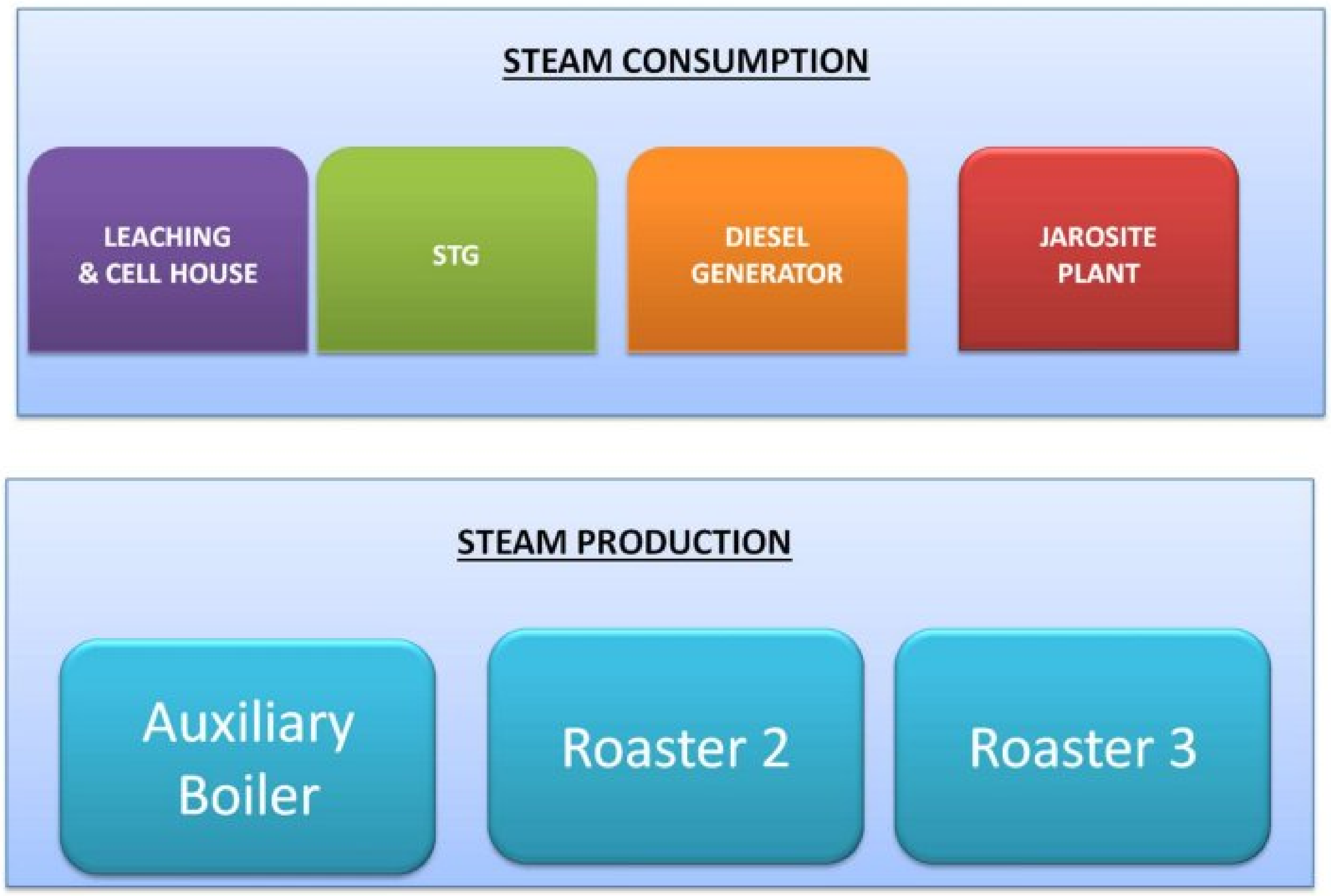
It is a Self-contained valve which automatically drains the condensate from a steam containing enclosure while remaining tight to live steam, or if necessary, allowing steam to flow at a controlled or adjusted rate. Most steam traps will also pass non-condensable gases while remaining tight to live steam.

Distribution of steam in Zinc Smelter Debari

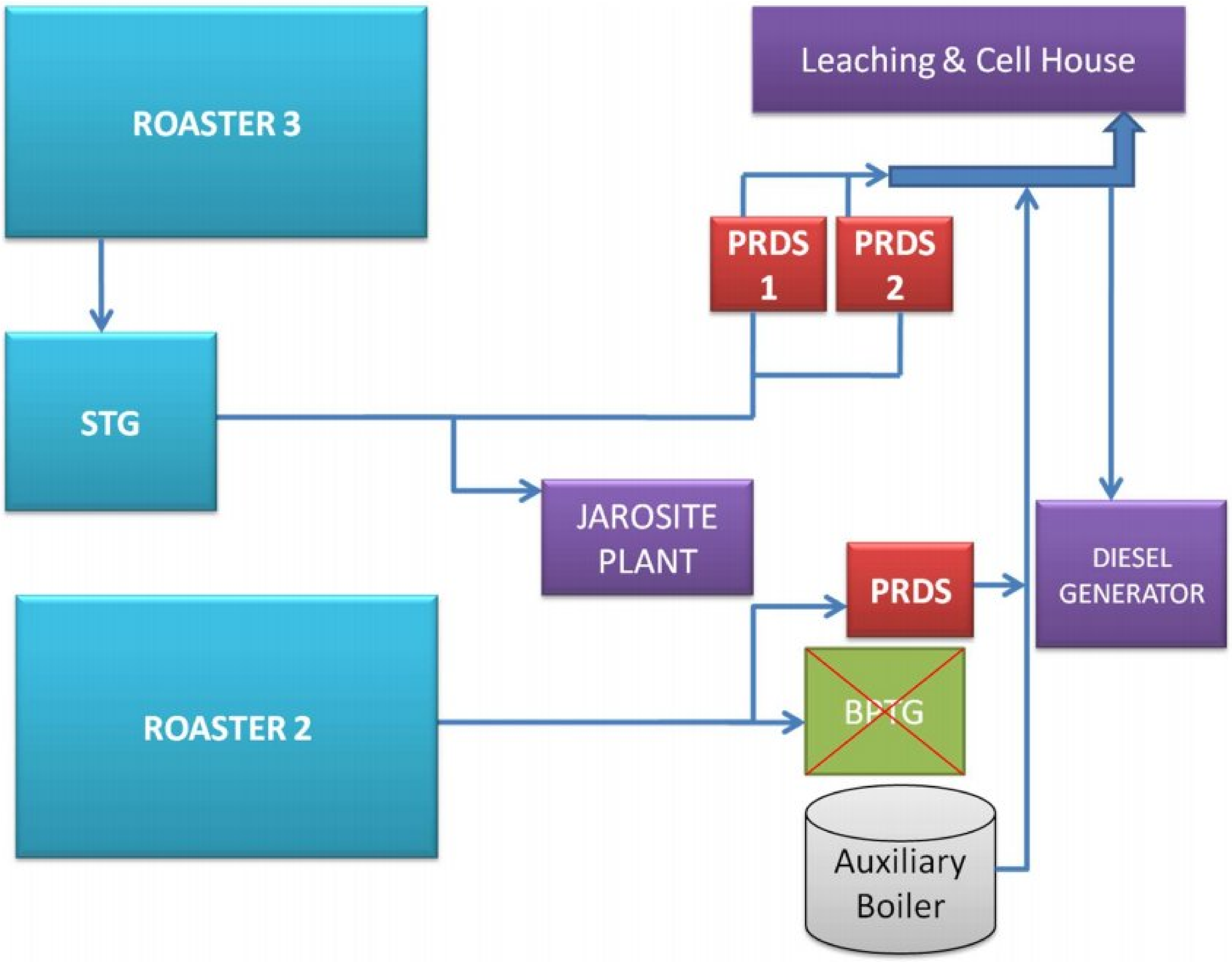
Majority of the steam is produced inside Debari Plant by WHRS (Waste Heat Recovery System). The roasting gas has a temperature of about 950 to 1000 °C at the furnace exit and a SO_2-content of approximately 10.5 %(Vol). In a waste heat boiler, the gas is cooled to about 350 °C. The waste heat boiler is of the forced circulation type. It is designed to produce superheated steam at 40 bar / 400 °C.

This steam is utilized in different processes and plants across the Debari smelter

- Leaching & Cell House Plant
- Jarosite Plant
- Diesel Generator Plant
- STG



STEAM DISTRIBUTION AND CIRCULATION DIAGRAM

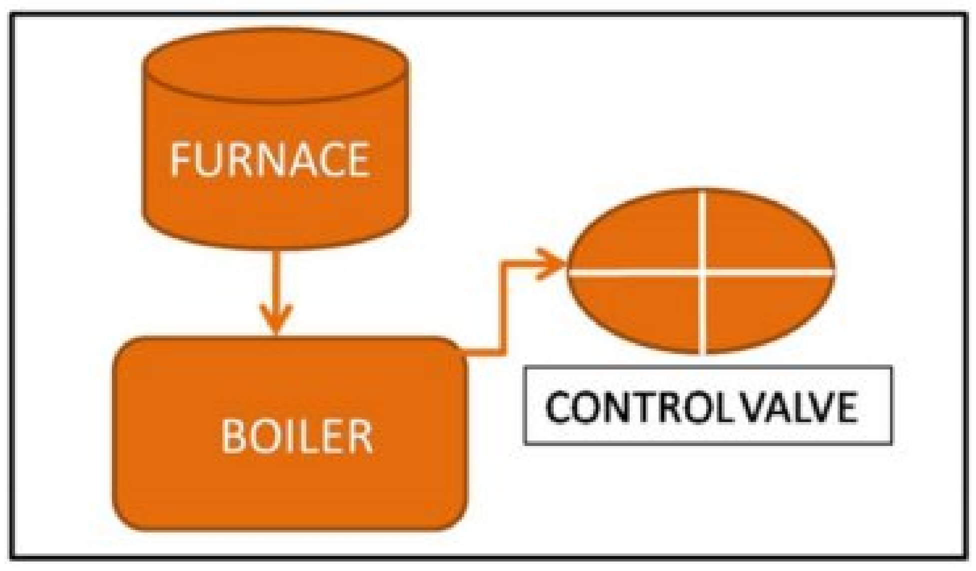


The steam is Produced inside

1. *Roaster 2*

   From roaster 2 the steam is goes to the BPTG plant since the plant is temporarily closed it is bypasses and it enters the main steam line to the leaching and cell house plant.

Roaster 2 Steam System



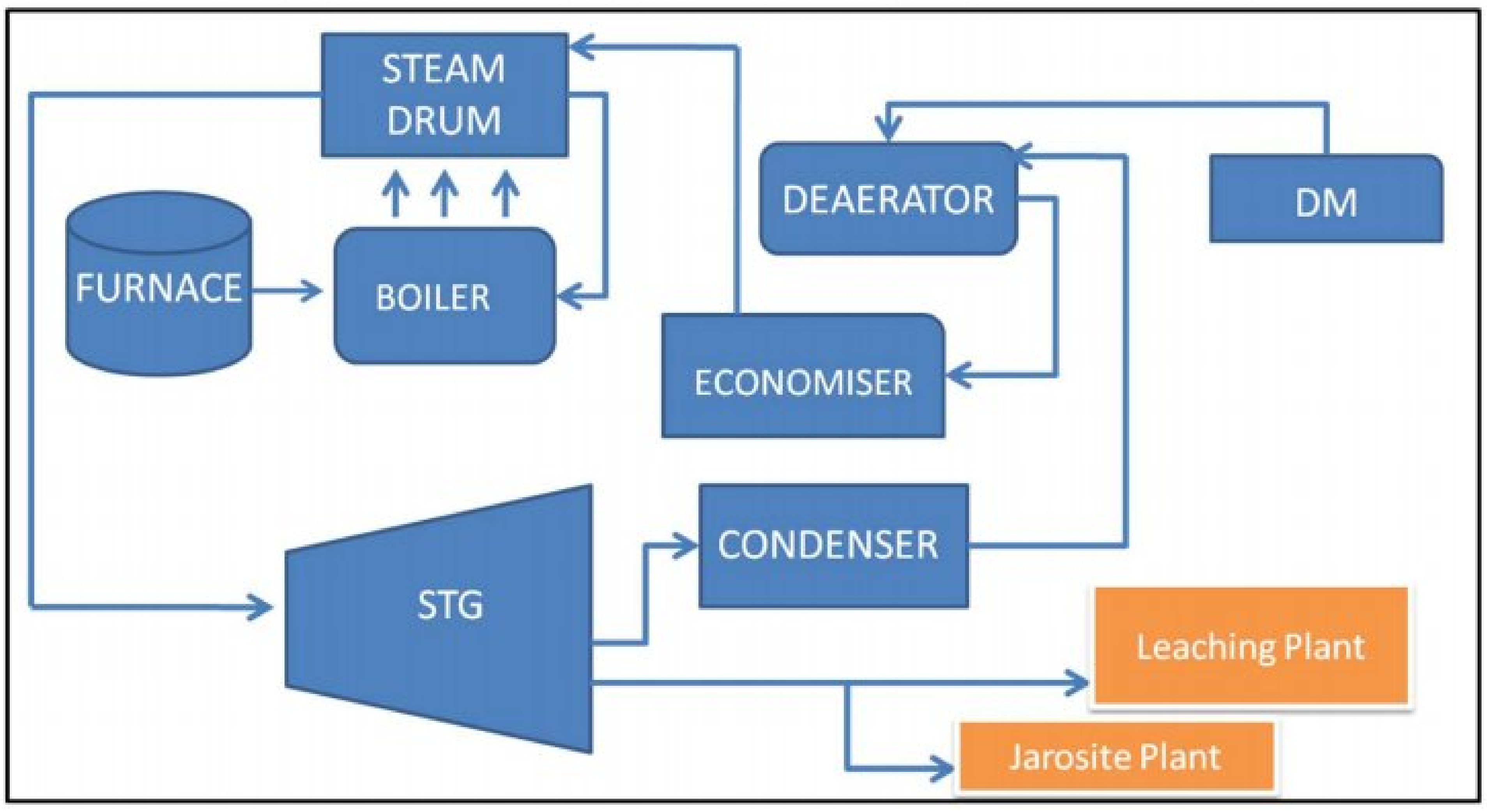
2. *Roster 3*

   From Roaster 3 the produced steam is sent to the STG plant

   Some of the steam is utilized for the power generation inside the turbine and the rest is extracted out of the turbine for later utilization.

   This extracted steam is thus distributed to Jarosite Plant and to Leaching plant through the Main steam line.

Roaster 3 Steam System



3. *Auxiliary Boiler:*

   This is a diesel powered Boiler which is used to supply steam to the plant in case one of the plant i.e Roaster 3 is down.

   This provides extra steam in order to maintain the flow and pressure in the main steam line.

   The produced steam is also fed to the main steam line

- *From the main stream line one tapping goes to Diesel Generator plant and the rest goes to the leaching and cell house plant.*

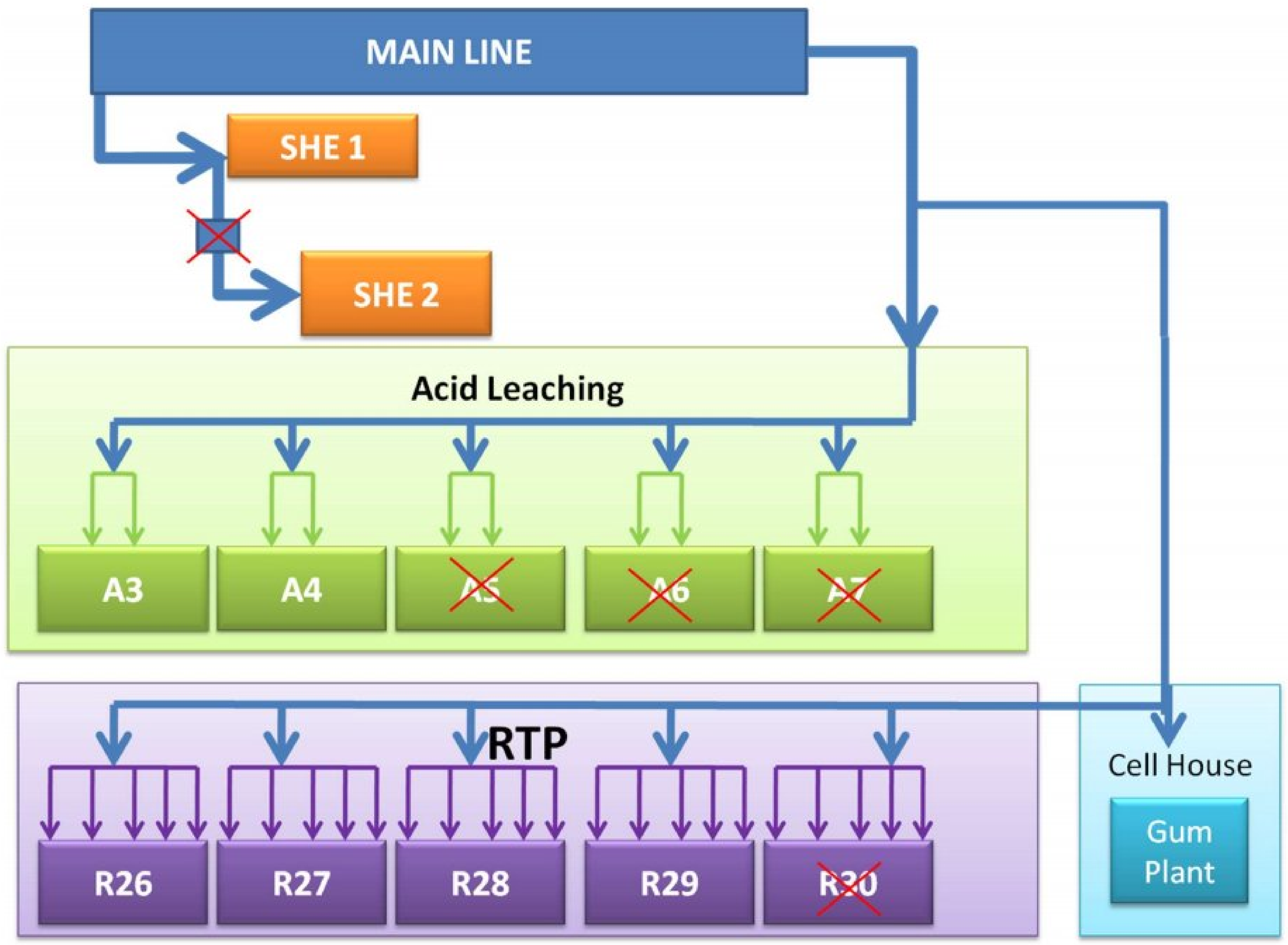
  PRDS(Pressure Reducing and De-superheating System are installed on all the line which from the roaster 2 and Roaster 3. Pressure and Temperature are controlled as per the requirement.

Leaching Plant.

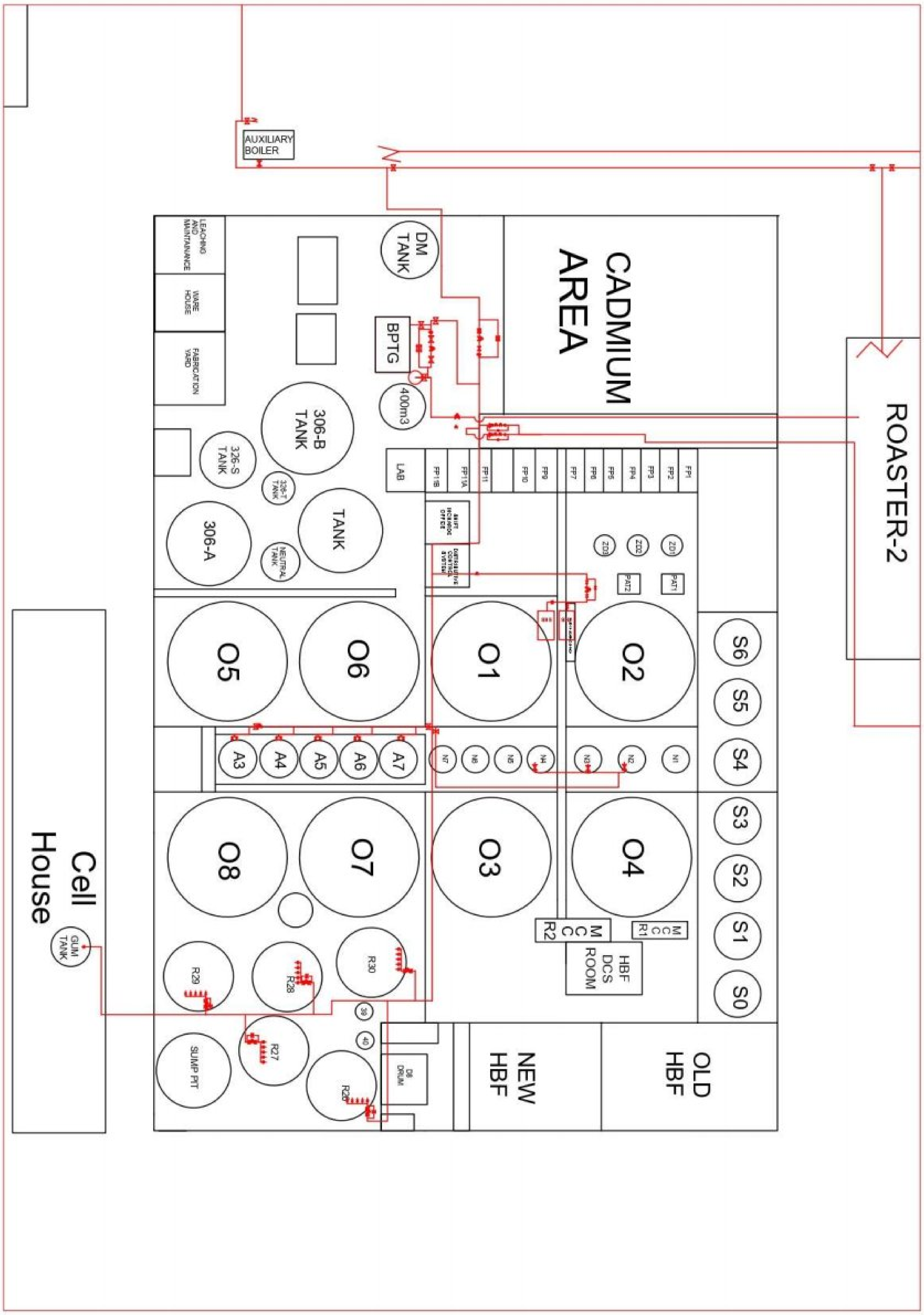
The steam is utilized in many processes inside the leaching plant such as
1. Purification

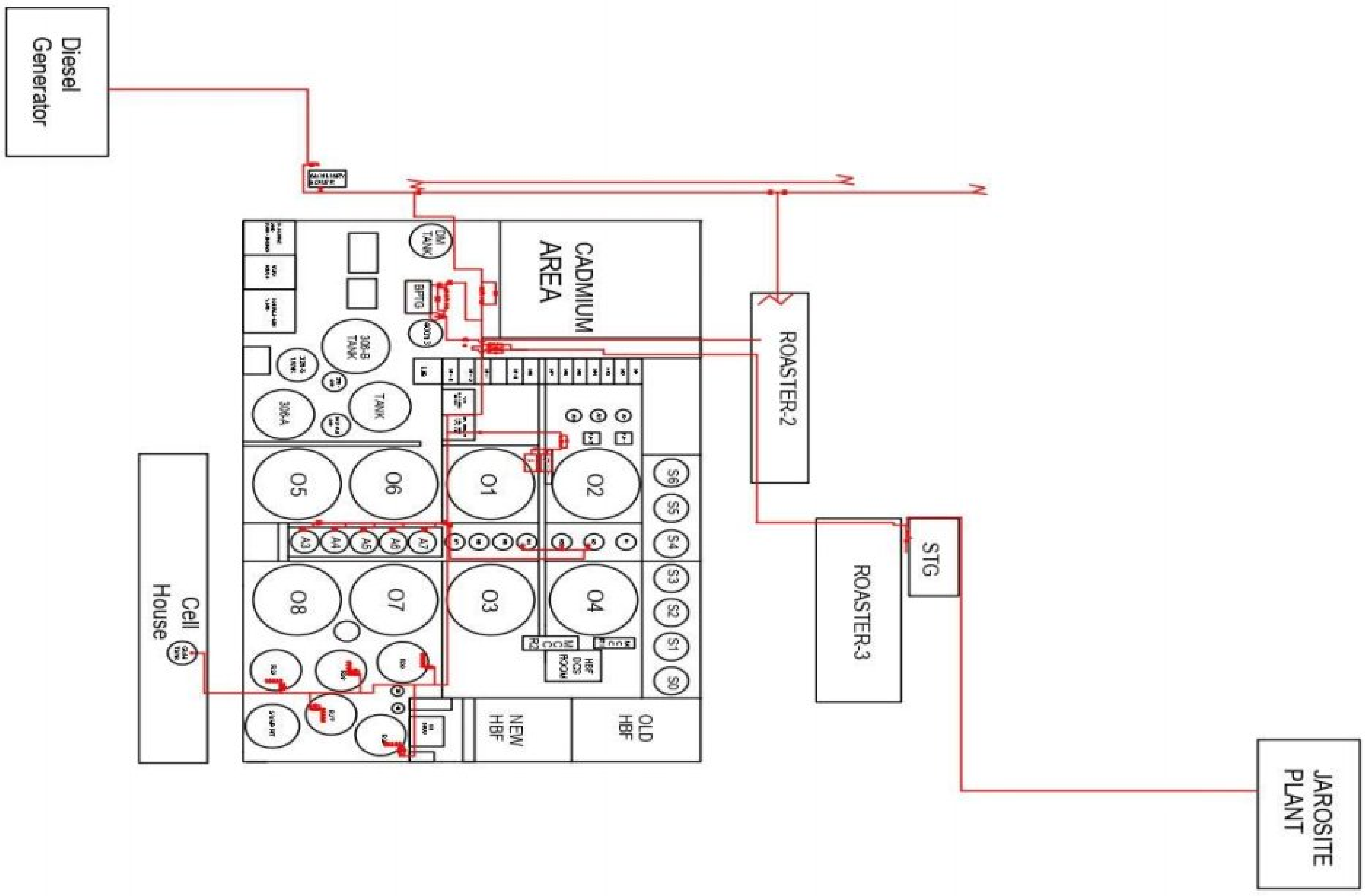
2. RTP (Residual Treatment Plant)

3. Weak Acid Leaching

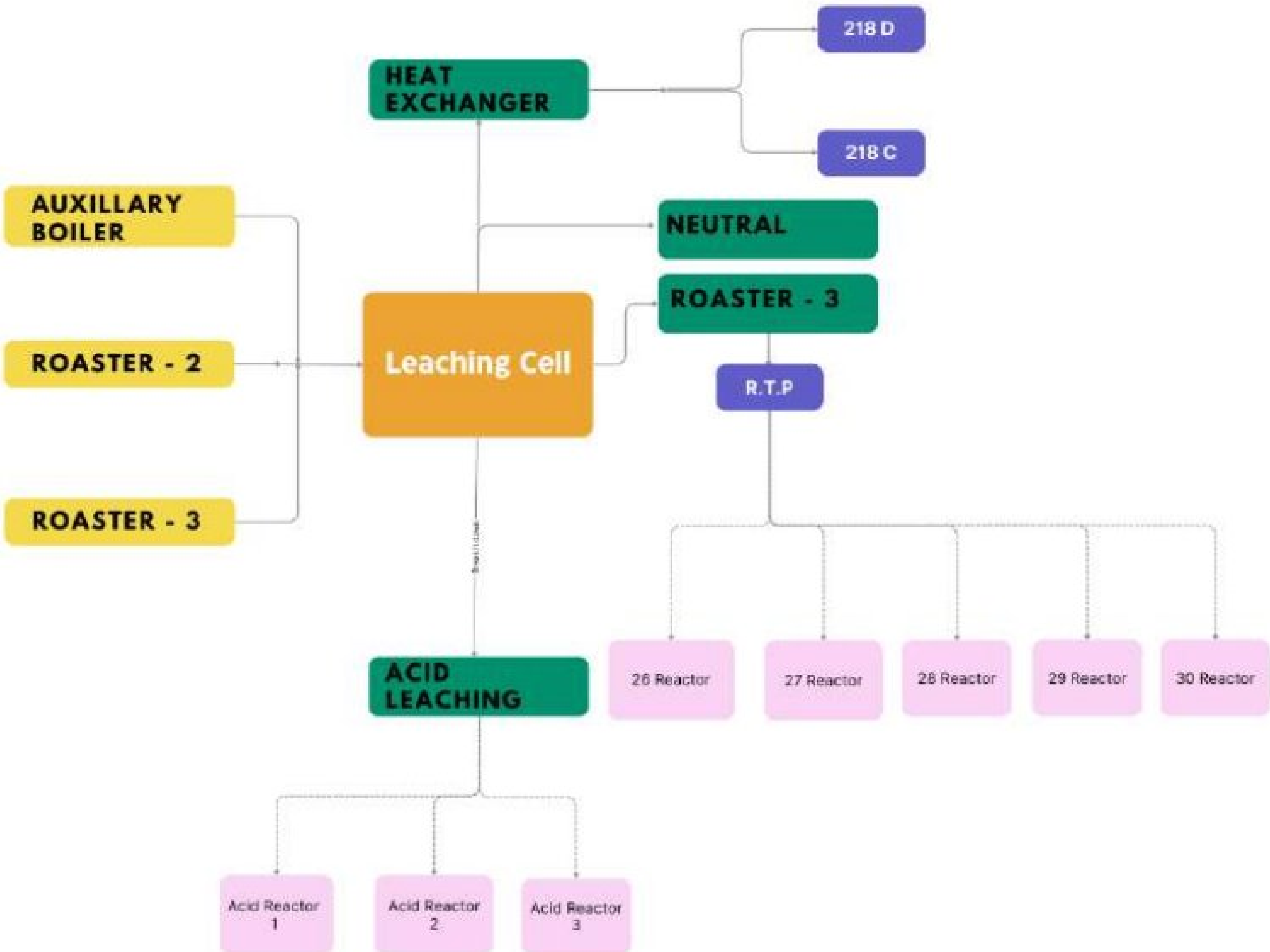


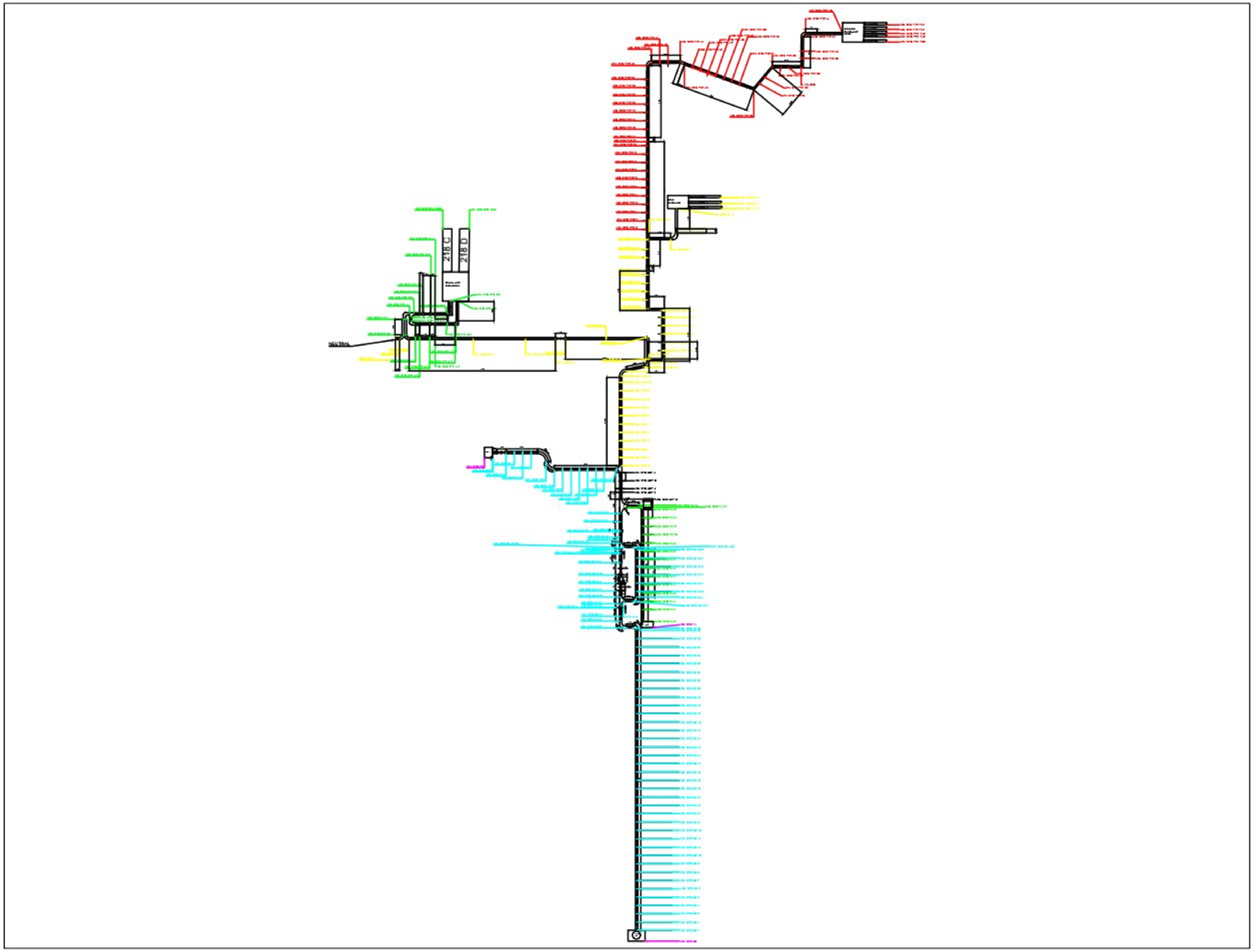
Leaching Plant Steam Lines distribution

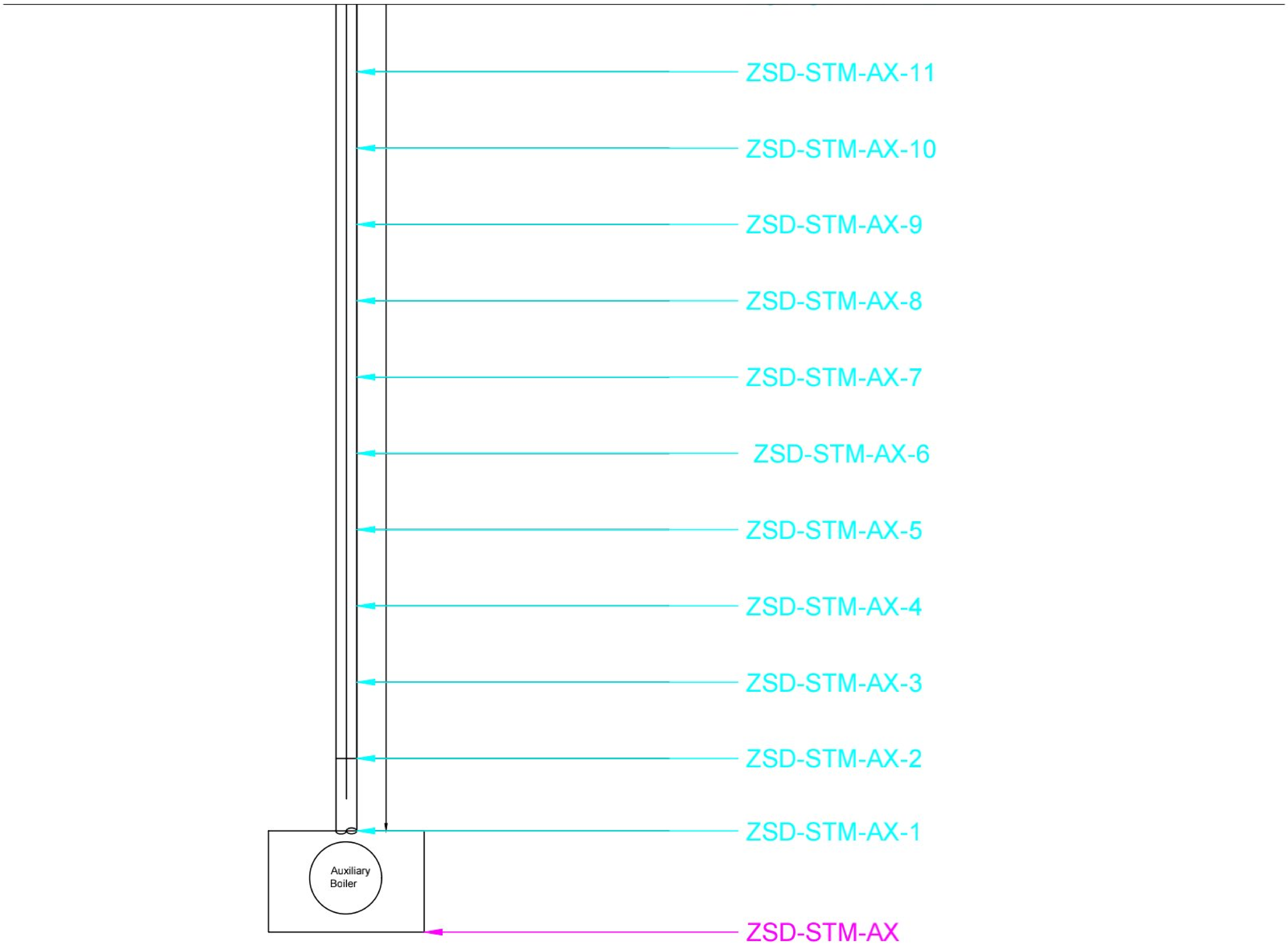

AUXILIARY BOILER
CADMIUM AREA
ROASTER-2
DM TANK
BPTG
400m3
LEACHING AND MAINTANANCE
WARE HOUSE
FABRICATION YARD
306-B TANK
326-S TANK
TANK
306-A
NEUTRAL TANK
LAB
FP11B
FP11A
FP11
FP10
FP9
FP7
FP6
FP5
FP4
FP3
FP2
FP1
ZD1
ZD2
ZD3
PAT1
PAT2
O1
O2
O3
O4
O5
O6
O7
O8
S0
S1
S2
S3
S4
S5
S6
A3
A4
A5
A6
A7
MCC R1
MCC R2
HBF DCS ROOM
OLD HBF
NEW HBF
Cell House
GUM TANK
R26
R27
R28
R29
R30
39
40
SUMP PIT
DE DRUM


Diesel Generator
CADMIUM AREA
DM TANK
BPTG
308-B TANK
308-A
TANK
ROASTER-2
ROASTER-3
STG
JAROSITE PLANT
Cell House
O1
O2
O3
O4
O5
O6
O7
O8
A3
A4
A5
A6
A7
S0
S1
S2
S3
S4
S5
S6
HBF DCS ROOM
NEW HBF
OLD HBF

FLOW OF STEAM LINE IN LEACHING




218 C
218 D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ZSD-STM-AX-5
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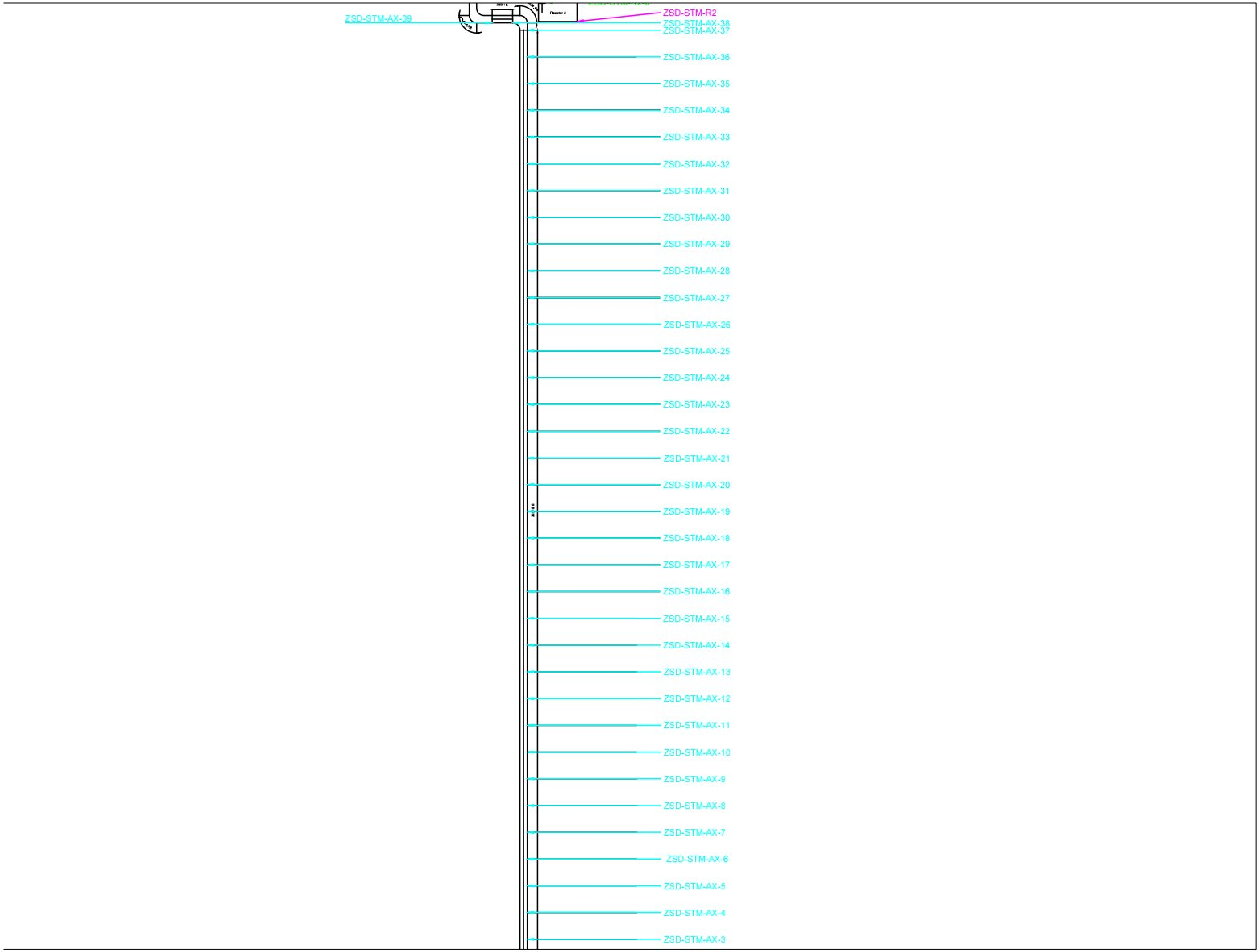
ZSD-STM-AX-3
ZSD-STM-AX-2
ZSD-STM-AX-1
Auxiliary Boiler
ZSD-STM-AX



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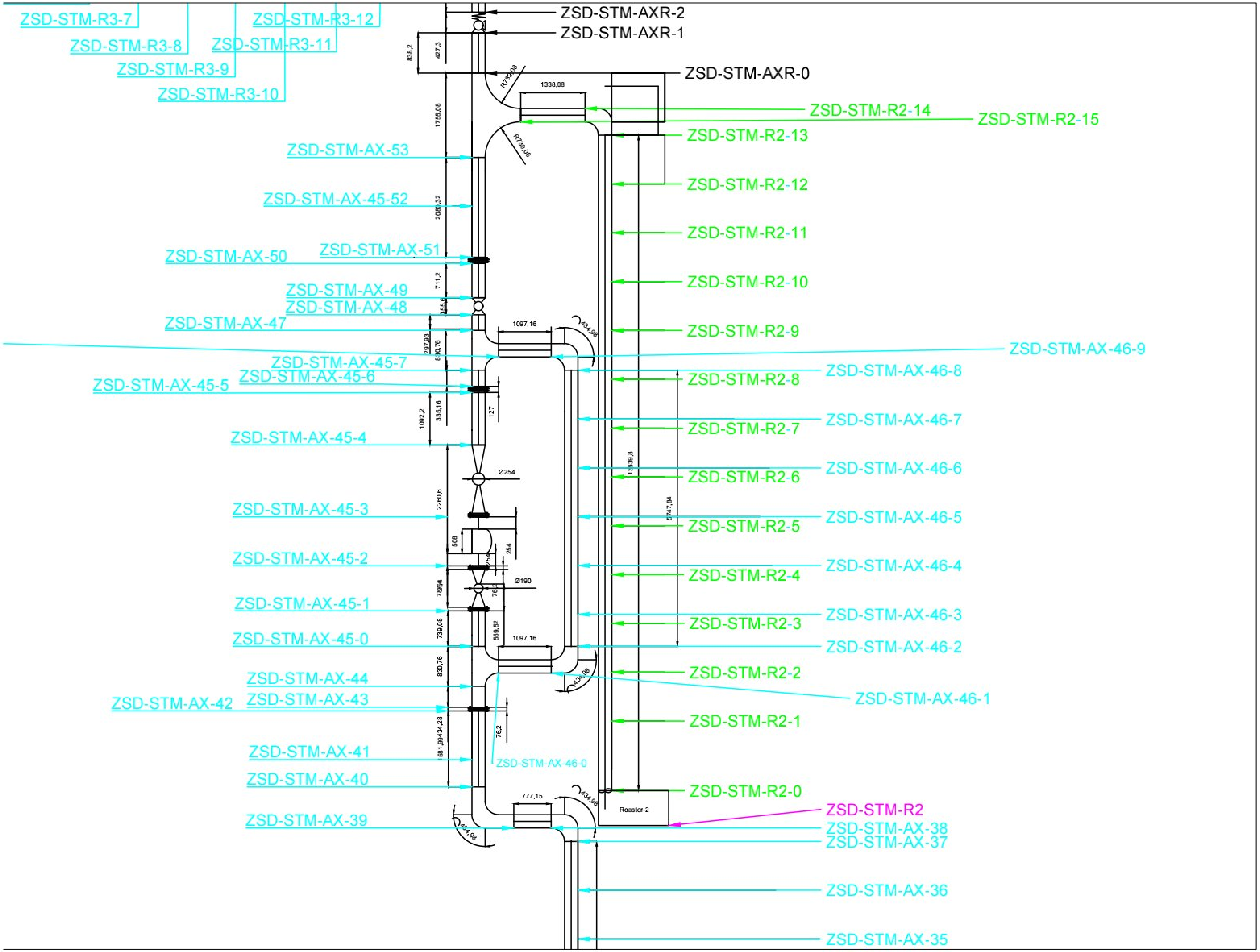
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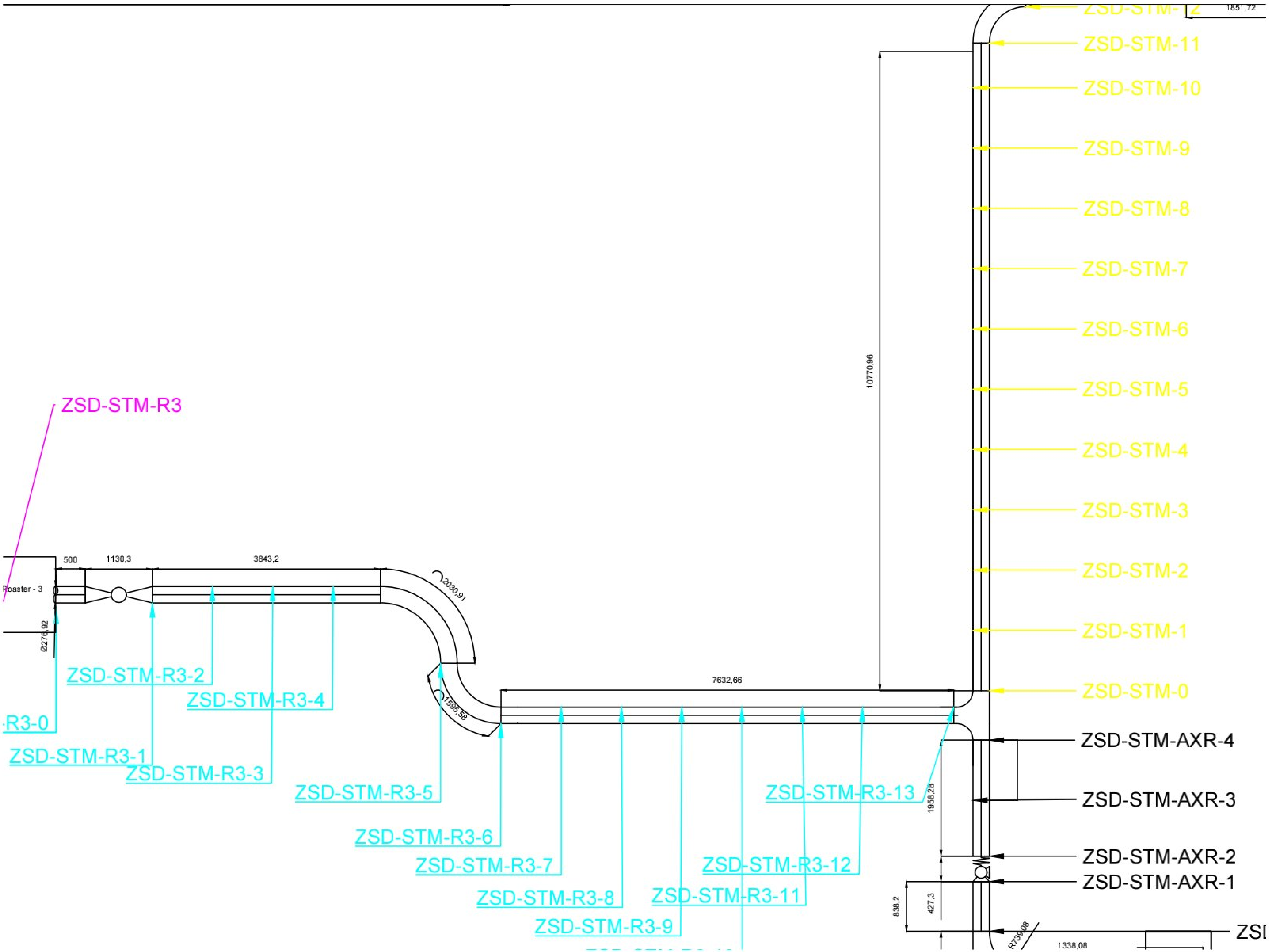

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Roaster - 3
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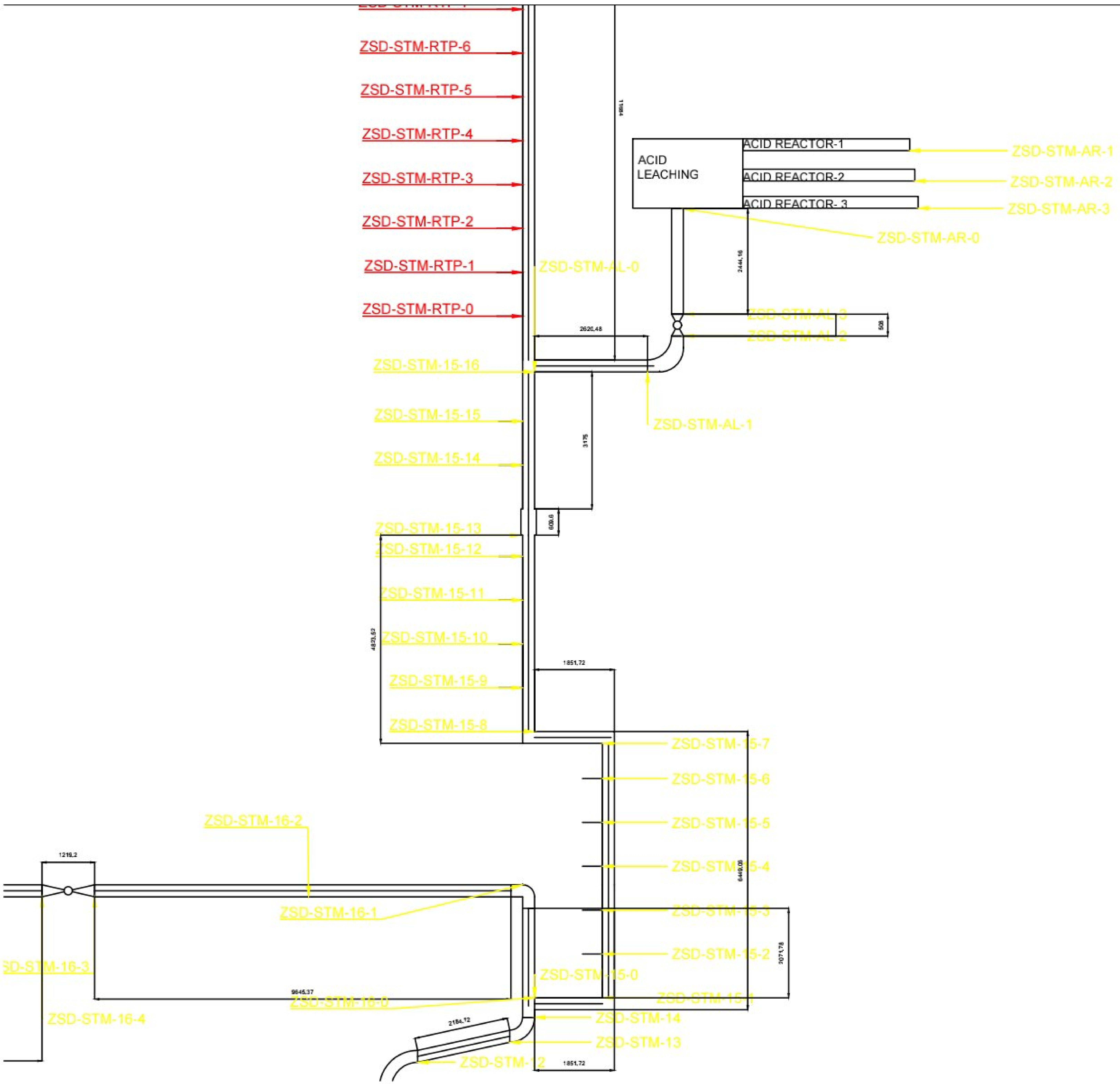

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ACID LEACHING
ACID REACTOR-1
ACID REACTOR-2
ACID REACTOR- 3
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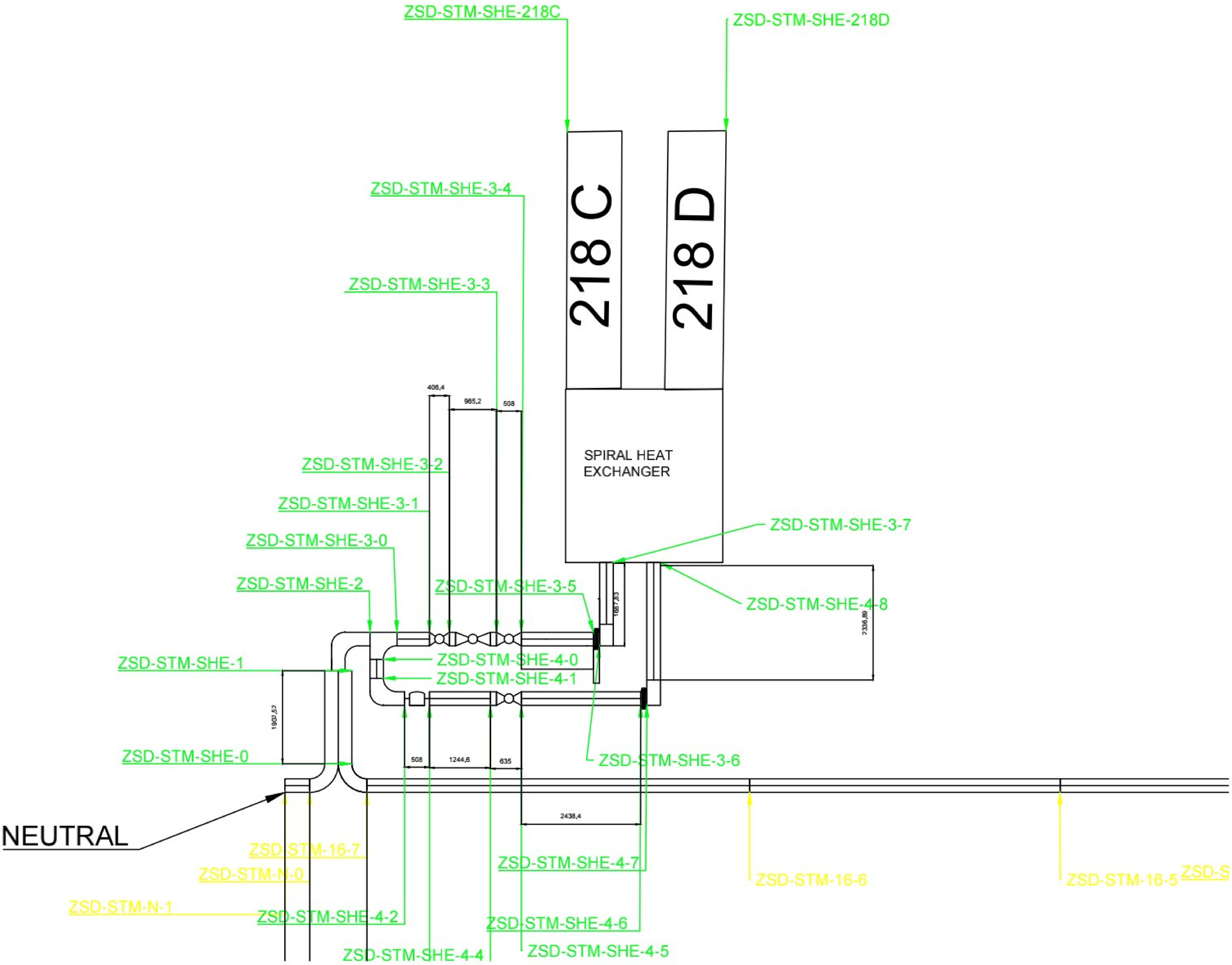
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EXCHANGER
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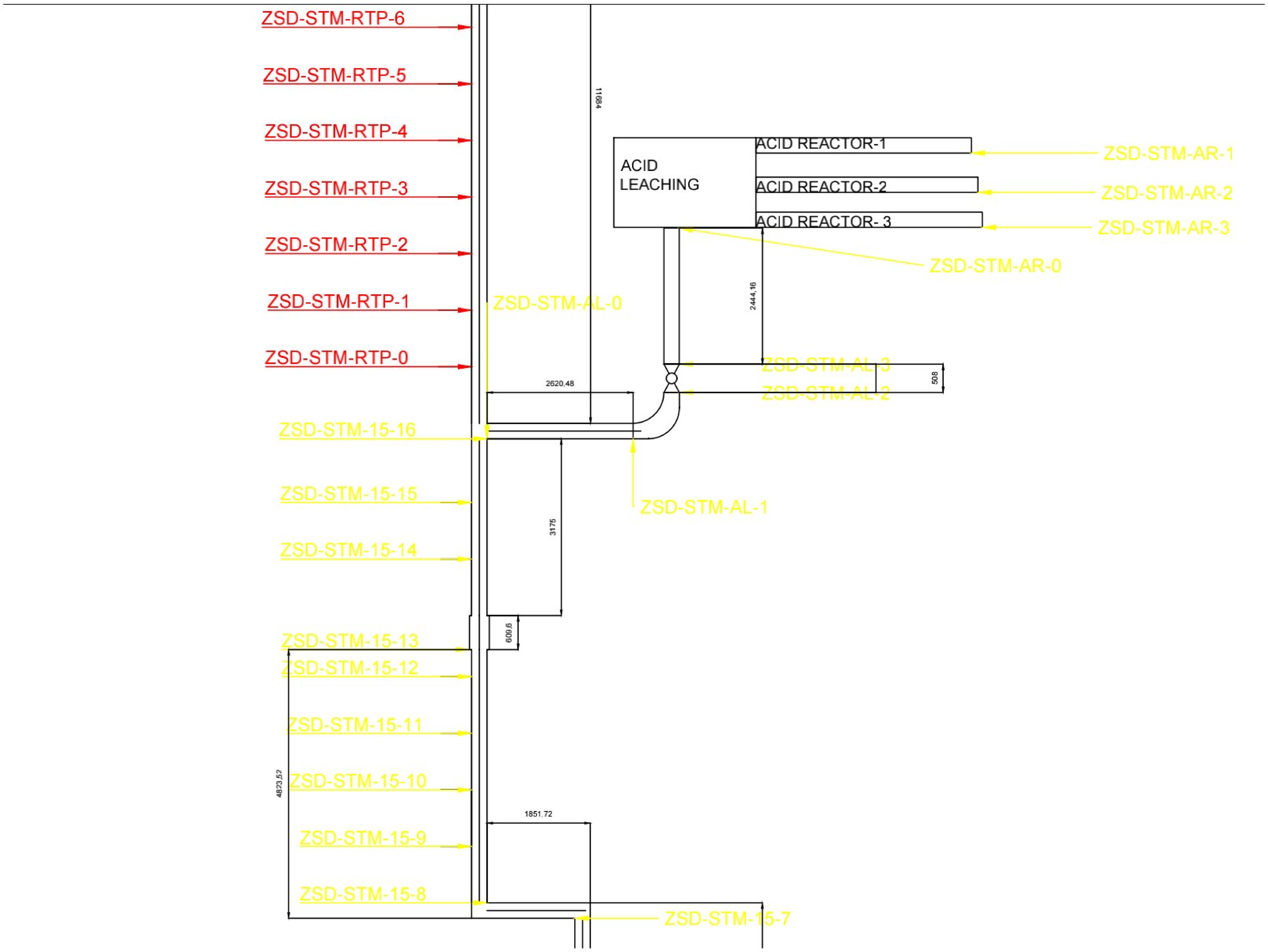
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11684
ACID
LEACHING
ACID REACTOR-1
ACID REACTOR-2
ACID REACTOR- 3
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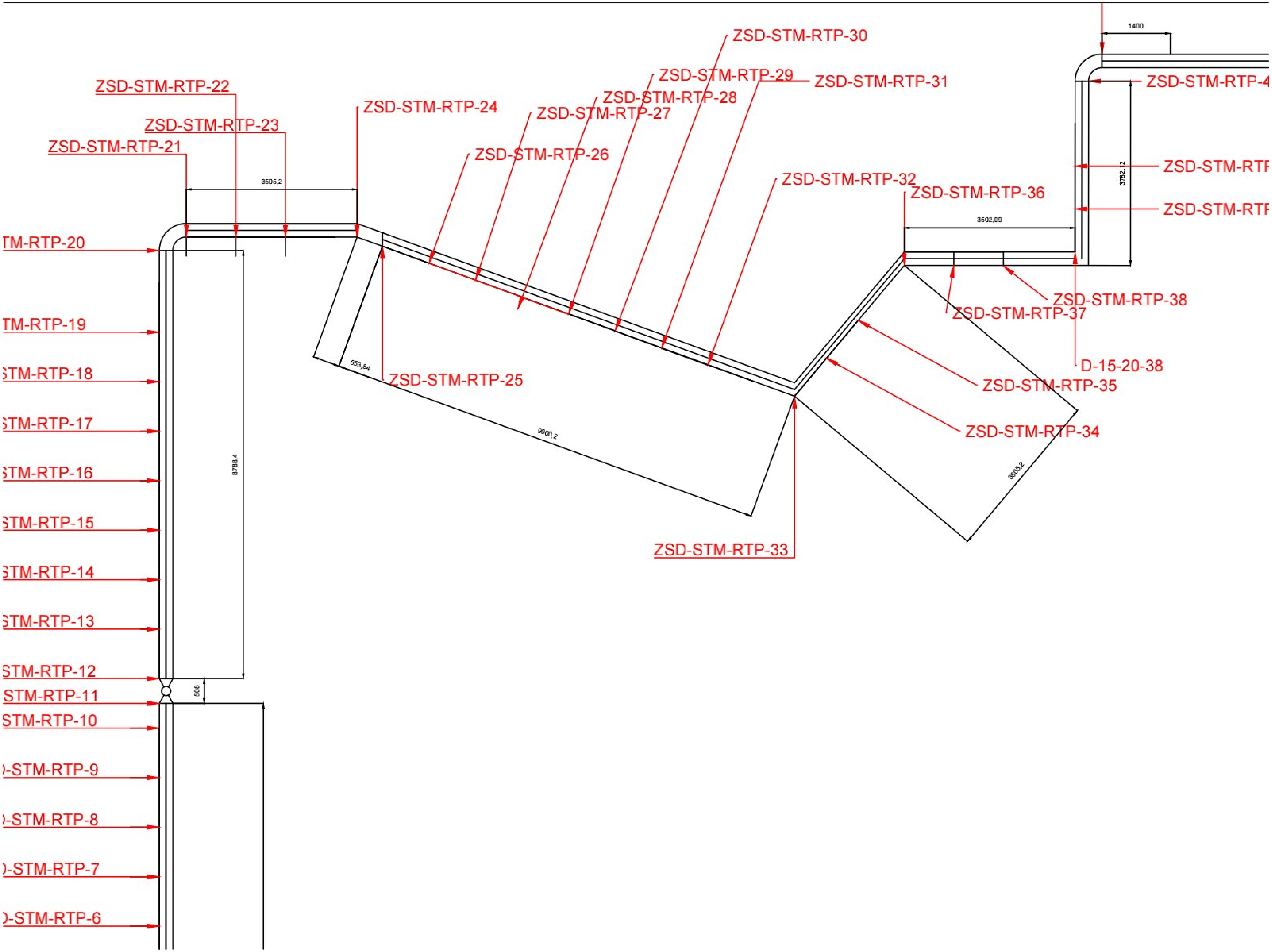
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ZSD-STM-RTP-24
ZSD-STM-RTP-27
ZSD-STM-RTP-23
ZSD-STM-RTP-21
ZSD-STM-RTP-26
ZSD-STM-RTP-32
ZSD-STM-RTP-36
1400
ZSD-STM-RTP-4
ZSD-STM-RTF
ZSD-STM-RTF
3782,12
3505,2
3502,09
TM-RTP-20
TM-RTP-19
ZSD-STM-RTP-38
ZSD-STM-RTP-37
STM-RTP-18
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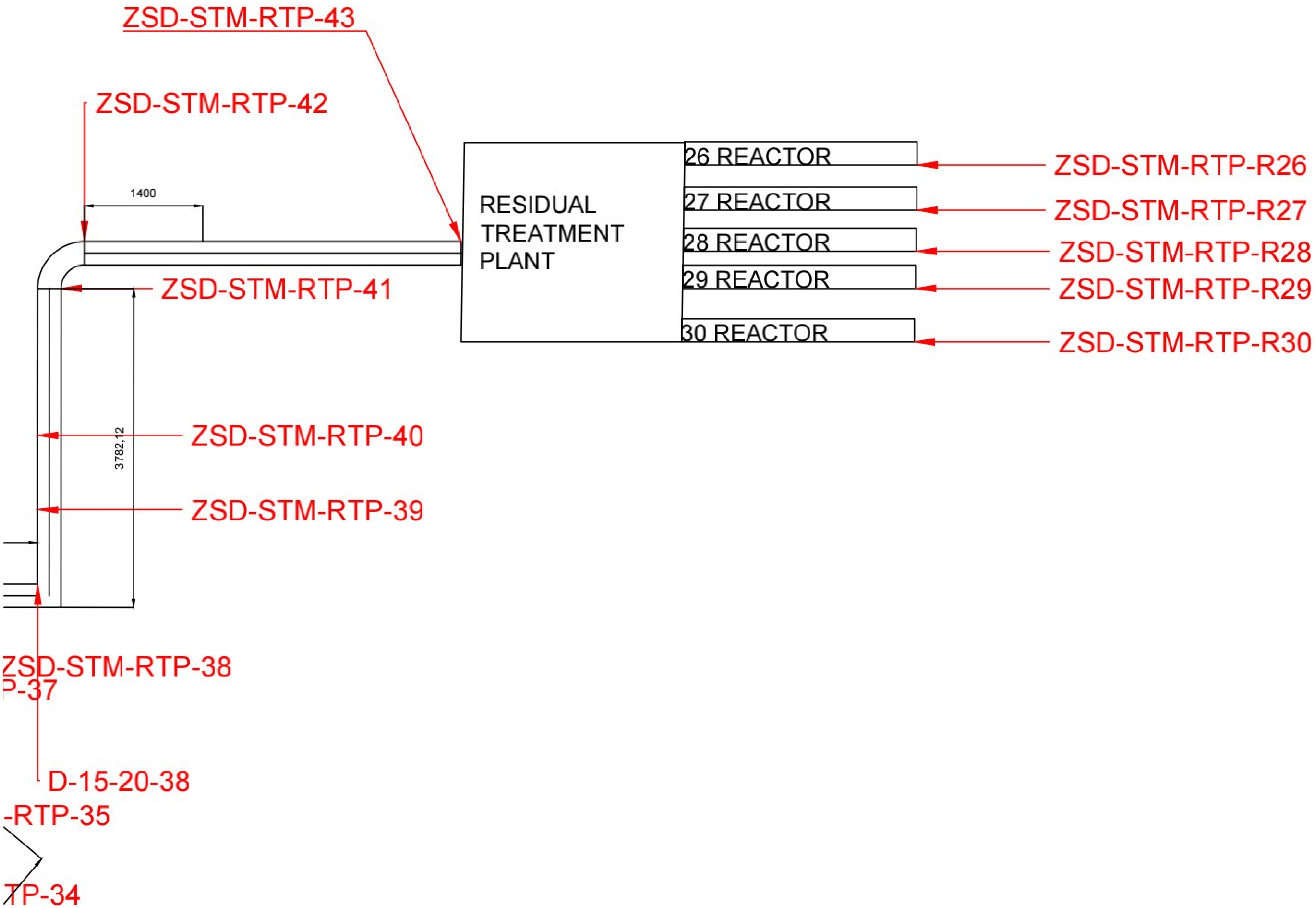
ZSD-STM-RTP-25
D-15-20-38
ZSD-STM-RTP-35
STM-RTP-17
ZSD-STM-RTP-34
9000,2
8788,4
STM-RTP-16
3605,2
STM-RTP-15
ZSD-STM-RTP-33
STM-RTP-14
STM-RTP-13
STM-RTP-12
508
STM-RTP-11
STM-RTP-10
)-STM-RTP-9
)-STM-RTP-8
)-STM-RTP-7
)-STM-RTP-6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1400
RESIDUAL TREATMENT PLANT
26 REACTOR
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ZSD-STM-RTP-R26
ZSD-STM-RTP-R27
ZSD-STM-RTP-R28
ZSD-STM-RTP-R29
ZSD-STM-RTP-R30
ZSD-STM-RTP-41
ZSD-STM-RTP-40
3782,12
ZSD-STM-RTP-39
ZSD-STM-RTP-38
P-37
D-15-20-38
-RTP-35
TP-34

SUMMER INTERNSHIP PROJECT REPORT 2023 - HINDUSTAN ZINC SMELTER, DEBARI

INTERNSHIP PERIOD	PREPARED BY		
5TH JUNE, 2023 - 5TH JULY, 2023	Mohammed Danish Gouri	2nd YEAR MECHANICAL ENGINEERING	COLLEGE OF TECHNOLOGY AND ENGINEERING, UDAIPUR

STEAM LINE LINEAR ASSET MANAGEMENT

KEY MILESTONE AND ACCOMPLISHMENTS

DESCRIPTION	DATE
Safety Induction and Orientation	5TH JUNE - 6TH JUNE
Plant Visit and Understanding Roaster Leaching Cell House	7TH JUNE - 12TH JUNE
Analyzing and Tracing Steam Line in Leaching	13TH JUNE - 15TH JUNE
Taking Measurements	16TH JUNE - 24TH JUNE
Design Layout	25TH JUNE - 1ST JULY
Data Documentation	2ND JULY - 5th July

STEAM LINE TRACK DETAILS

LRP No	DESCRIPTION	MARKER	MARKER TYPE	MARKER DESCRIPTION	LINE DIAMETER	LOCATION	LENGTH	MEASURES	TECHNICAL OBJECT
STM-L-R3	Steam Line from R-3	**ZSD-STM-R3**	R-3	Steam Line Roaster 3, R3	276,92	0	O	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-0	R-3	Steam Line Roaster 3, R3→ R3-0	276,92	1,016	1,016	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-1	R-3	Steam Valve, R3-0 → R3-1	276,92	2,6463	1,6303	M	Valve
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-2	R-3	Steam Line Roaster 3, R3-1 → R3-2	276,92	3,6623	1,016	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-3	R-3	Steam Line Roaster 3 R3-2→R3-3	276,92	4,6783	1,016	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-4	R-3	Steam Line Roaster 3,	276,92	5,6943	1,016	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-5	R-3	Steam Line Roaster 3 R3-4→R3-5	276,92	7,7253	2,031	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-6	R-3	Steam Line Roaster 3 R3-5→R3-6	276,92	9,3213	1,596	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-7	R-3	Steam Line Roaster 3 R3-6→ R3-7	276,92	10,34	1,016	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-8	R-3	Steam Line Roaster 3 R3-7→ R3-8	276,92	11,35	1,016	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-9	R-3	Steam Line Roaster 3 R3-8→ R3-9	276,92	12,37	1,016	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-10	R-3	Steam Line Roaster 3 R3-9→ R3-10	276,92	13,38	1,016	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-11	R-3	Steam Line Roaster 3 R3-10→ R3-11	276,92	14,40	1,016	M	Pipe
STM-L-R3	Steam Line from R-3	ZSD-STM-R3-12	R-3	Steam Line Roaster 3 R3-11→ R3-12	276,92	15,50	1,016	M	Pipe

STM-L-R3	Steam Line from R-3	ZSD-STM-R3-13	R-3	Steam Line Roaster 3 R3-12→ R3-13	276,92	17,05	1,545	M	Pipe
STM-L-AX	Steam Line from AX	**ZSD-STM-AX**	AX	Steam Line Auxiliary Boiler STM-AX	276,92	0	0	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-1	AX	Steam Line Auxiliary Boiler STM-AX →STM-AX-1	276,92	1,016	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-2	AX	Steam Line Auxiliary Boiler STM-AX-1→STM-AX-2	276,92	2,032	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-3	AX	Steam Line Auxiliary Boiler STM-AX-2→STM-AX-3	276,92	3,048	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-4	AX	Steam Line Auxiliary Boiler STM-AX-3→STM-AX-4	276,92	4,064	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-5	AX	Steam Line Auxiliary Boiler STM-AX-3→STM-AX-4	276,92	5,08	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-6	AX	Steam Line Auxiliary Boiler STM-AX-5→STM-AX-6	276,92	6,096	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-7	AX	Steam Line Auxiliary Boiler STM-AX-6→STM-AX-7	276,92	7,112	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-8	AX	Steam Line Auxiliary Boiler STM-AX-7→STM-AX-8	276,92	8,128	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-9	AX	Steam Line Auxiliary Boiler STM-AX-8→STM-AX-9	276,92	9,144	1,016	M	Auxiliary Boiler

STM-L-AX	Steam Line from AX	ZSD-STM-AX-10	AX	Steam Line Auxiliary Boiler STM-AX-9→STM-AX-10	276,92	10,16	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-11	AX	Steam Line Auxiliary Boiler STM-AX-10→STM-AX-11	276,92	11,176	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-12	AX	Steam Line Auxiliary Boiler STM-AX-10→STM-AX-12	276,92	12,192	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-13	AX	Steam Line Auxiliary Boiler STM-AX-12→STM-AX-13	276,92	13,208	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-14	AX	Steam Line Auxiliary Boiler STM-AX-13→ STM-AX-14	276,92	14,224	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-15	AX	Steam Line Auxiliary Boiler STM-AX-14→ STM-AX-15	276,92	15,24	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-16	AX	Steam Line Auxiliary Boiler STM-AX-15→ STM-AX-16	276,92	16,256	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-17	AX	Steam Line Auxiliary Boiler STM-AX-16→ STM-AX-17	276,92	17,272	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-18	AX	Steam Line Auxiliary Boiler STM-AX-17→ STM-AX-18	276,92	18,288	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-19	AX	Steam Line Auxiliary Boiler STM-AX-18→ STM-AX-19	276,92	19,304	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-20	AX	Steam Line Auxiliary Boiler STM-AX-19→ STM-AX-20	276,92	20,32	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-21	AX	Steam Line Auxiliary Boiler STM-AX-21→ STM-AX-22	276,92	21,336	1,016	M	Auxiliary Boiler

STM-L-AX	Steam Line from AX	ZSD-STM-AX-22	AX	Steam Line Auxiliary Boiler STM-AX-21→ STM-AX-22	276,92	22,352	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-23	AX	Steam Line Auxiliary Boiler STM-AX-22→ STM-AX-23	276,92	23,368	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-24	AX	Steam Line Auxiliary Boiler STM-AX-23→ STM-AX-24	276,92	24,384	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-25	AX	Steam Line Auxiliary Boiler STM-AX-24→ STM-AX-25	276,92	25,4	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-26	AX	Steam Line Auxiliary Boiler STM-AX-25→ STM-AX-26	276,92	26,416	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-27	AX	Steam Line Auxiliary Boiler STM-AX-26→ STM-AX-27	276,92	27,432	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-28	AX	Steam Line Auxiliary Boiler STM-AX-27→ STM-AX-28	276,92	28,448	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-29	AX	Steam Line Auxiliary Boiler STM-AX-28→ STM-AX-29	276,92	29,464	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-30	AX	Steam Line Auxiliary Boiler STM-AX-29→ STM-AX-30	276,92	30,48	1,016		Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-31	AX	Steam Line Auxiliary Boiler STM-AX-30→ STM-AX-31	276,92	31,496	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-32	AX	Steam Line Auxiliary Boiler STM-AX-31→ STM-AX-32	276,92	32,512	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-33	AX	Steam Line Auxiliary Boiler STM-AX-32→ STM-AX-33	276,92	33,528	1,016	M	Auxiliary Boiler

STM-L-AX	Steam Line from AX	ZSD-STM-AX-34	AX	Steam Line Auxiliary Boiler STM-AX-33→ STM-AX-34	276,92	34,544	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-35	AX	Steam Line Auxiliary Boiler STM-AX-34→ STM-AX-35	276,92	35,56	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-36	AX	Steam Line Auxiliary Boiler STM-AX-35→ STM-AX-36	276,92	36,576	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-37	AX	Steam Line Auxiliary Boiler STM-AX-36→ STM-AX-37	276,92	37,592	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-38	AX	Steam Line Auxiliary Boiler STM-AX-37→ STM-AX-38	276,92	38,027	0,435	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-39	AX	Steam Line Auxiliary Boiler STM-AX-38→ STM-AX-39	276,92	38,804	0,777	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-40	AX	Steam Line Auxiliary Boiler STM-AX-39→ STM-AX-40	276,92	39,816	1,012	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-41	AX	Steam Line Auxiliary Boiler STM-AX-40→ STM-AX-41	276,92	40,382	0,566	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-42	AX	Steam Line Flange STM-AX-40→ STM-AX-41	276,92	41,398	1,016	M	Flange
STM-L-AX	Steam Line from AX	ZSD-STM-AX-43	AX	Steam Line Flange STM-AX-42→ STM-AX-43	276,92	41,474	0,076	M	Flange
STM-L-AX	Steam Line from AX	ZSD-STM-AX-44	AX	Steam Line Auxiliary Boiler STM-AX-43→ STM-AX-44	276,92	41,908	0,434	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-45-0	AX	Steam Line Auxiliary Boiler STM-AX-44→ STM-AX-45-0	276,92	42,739	0,831	M	Auxiliary Boiler

STM-L-AX	Steam Line from AX	ZSD-STM-AX-45-1	AX	Steam Line Ball Valve STM-AX-45-0→ STM-AX-45-1	276,92	43,469	0,730	M	Ball Valve
STM-L-AX	Steam Line from AX	ZSD-STM-AX-45-2	AX	Steam Line Stainer STM-AX-45-1→ STM-AX-45-2	276,92	44,256	0,787	M	Stainer
STM-L-AX	Steam Line from AX	ZSD-STM-AX-45-3	AX	Steam Line Steam Valve STM-AX-45-2→ STM-AX-45-3	276,92	45,272	1,016	M	Steam Valve
STM-L-AX	Steam Line from AX	ZSD-STM-AX-45-4	AX	Steam Line Steam Valve STM-AX-45-3→ STM-AX-45-4	276,92	46,77	1,498	M	Steam Valve
STM-L-AX	Steam Line from AX	ZSD-STM-AX-45-5	AX	Steam Line Flange STM-AX-45-4→ STM-AX-45-5	276,92	47,862	1,092	M	Flange
STM-L-AX	Steam Line from AX	ZSD-STM-AX-45-6	AX	Steam Line Flange STM-AX-45-5→ STM-AX-45-6	276,92	47,989	0,127	M	Flange
STM-L-AX	Steam Line from AX	ZSD-STM-AX-45-7	AX	Steam Line Main Line STM-AX-45-6→ STM-AX-45-7	276,92	48,324	0,335	M	Main Line
STM-L-AX	Steam Line from AX	ZSD-STM-AX-47	AX	Steam Line Auxiliary Boiler STM-AX-45-7→ STM-AX-47	276,92	49,155	0,831	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	**ZSD-STM-AX-46-0**	AX	Steam Line Auxiliary Boiler STM-AX-47→ STM-AX-46-0	276,92	0	0	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-46-1	AX	Steam Line Auxiliary Boiler STM-AX-46-0→ STM-AX-46-1	276,92	1,097	1,097	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-46-2	AX	Steam Line Auxiliary Boiler STM-AX-46-1→ STM-AX-46-2	276,92	1,532	0,435	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-46-3	AX	Steam Line Auxiliary Boiler STM-AX-46-2→ STM-AX-46-3	276,92	2,2	0,668	M	Auxiliary Boiler

STM-L-AX	Steam Line from AX	ZSD-STM-AX-46-4	AX	Steam Line Auxiliary Boiler STM-AX-46-3→ STM-AX-46-4	276,92	3,216	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-46-5	AX	Steam Line Auxiliary Boiler STM-AX-46-4→ STM-AX-46-5	276,92	4,232	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-46-6	AX	Steam Line Auxiliary Boiler STM-AX-46-5→ STM-AX-46-6	276,92	5,248	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-46-7	AX	Steam Line Auxiliary Boiler STM-AX-46-6→ STM-AX-46-7	276,92	6,264	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-46-8	AX	Steam Line Auxiliary Boiler STM-AX-46-7→ STM-AX-46-8	276,92	7,28	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-46-9	AX	Steam Line Auxiliary Boiler STM-AX-46-8→ STM-AX-46-9	276,92	7,715	0,435	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-46-10	AX	Steam Line Auxiliary Boiler STM-AX-46-9→ STM-AX-46-10	276,92	8,812	1,097	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	**ZSD-STM-AX-47**	AX	Steam Line Auxiliary Boiler STM-AX-46-10 → STM-AX-47	276,92	9,247	0,435	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-48	AX	Steam Line Auxiliary Boiler STM-AX-47→ STM-AX-48	276,92	49,453	0,298	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-49	AX	Steam Line Ball Valve STM-AX-48 → STM-AX-49	276,92	49,809	0,356	M	Ball Valve
STM-L-AX	Steam Line from AX	ZSD-STM-AX-50	AX	Steam Line Flange STM-AX-49 → STM-AX-50	276,92	50,52	0,711	M	Flange
STM-L-AX	Steam Line from AX	ZSD-STM-AX-51	AX	Steam Line Flange STM-AX-50 → STM-AX-51	276,92	50.647	0,127	M	Flange

STM-L-AX	Steam Line from AX	ZSD-STM-AX-52	AX	Steam Line Flange STM-AX-51 → STM-AX-52	276,92	51,741	1,094	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AX-53	AX	Steam Line Flange STM-AX-52 → STM-AX-53	276,92	52,757	1,016	M	Auxiliary Boiler
STM-L-AX	Steam Line from AX	ZSD-STM-AXR-0	AXR	Steam Line Auxiliary Boiler & Roaster-2 STM-AX-53 → STM-AXR-0	276,92	54,512	1,755	M	Auxiliary Boiler & Roaster-2
STM-L-R2	Steam Line from R2	**ZSD-STM-R2**	R-2	Steam Line Roaster-2 STM-AXR-0 → STM-R2	276,92	0	0	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-0	R-2	Steam Line Roaster-2 STM-R2 → STM-R2-0	276,92	1,448	1,448	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-1	R-2	Steam Line Roaster-2 STM-R2-0 → STM-R2-1	276,92	2,464	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-2	R-2	Steam Line Roaster-2 STM-R2-1 → STM-R2-2	276,92	3,48	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-3	R-2	Steam Line Roaster-2 STM-R2-2 → STM-R2-3	276,92	4,496	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-4	R-2	Steam Line Roaster-2 STM-R2-3 → STM-R2-4	276,92	5,512	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-5	R-2	Steam Line Roaster-2 STM-R2-4 → STM-R2-5	276,92	6,528	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-6	R-2	Steam Line Roaster-2 STM-R2-5 → STM-R2-6	276,92	7,544	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-7	R-2	Steam Line Roaster-2 STM-R2-6 → STM-R2-7	276,92	8,56	1,016	M	Roaster-2

STM-L-R2	Steam Line from R2	ZSD-STM-R2-8	R-2	Steam Line Roaster-2 STM-R2-7 → STM-R2-8	276,92	9,576	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-9	R-2	Steam Line Roaster-2 STM-R2-8 → STM-R2-9	276,92	10,592	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-10	R-2	Steam Line Roaster-2 STM-R2-9 → STM-R2-10	276,92	11,614	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-11	R-2	Steam Line Roaster-2 STM-R2-10 → STM-R2-11	276,92	12,63	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-12	R-2	Steam Line Roaster-2 STM-R2-11 → STM-R2-12	276,92	13,646	1,016	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-13	R-2	Steam Line Roaster-2 STM-R2-12 → STM-R2-13	276,92	14,081	0,435	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-14	R-2	Steam Line Roaster-2 STM-R2-13 → STM-R2-14	276,92	15,419	1,338	M	Roaster-2
STM-L-R2	Steam Line from R2	ZSD-STM-R2-15	R-2	Steam Line Roaster-2 STM-R2-14 → STM-R2-15	276,92	15,854	0,435	M	Roaster-2
STM-L-AXR	Steam Line from AX and R2	**ZSD-STM-AXR-1**	AXR	Steam Line Auxiliary Boiler & Roaster-2 STM-R2-15 → STM-AXR-1	276,92	55,35	0,838	M	Pressure Gauge
STM-L-AXR	Steam Line from AX and R2	ZSD-STM-AXR-2	AXR	Steam Line Auxiliary Boiler & Roaster-2 STM-AXR-1→ STM-AXR-2	276,92	55,77	0,427	M	Auxiliary Boiler & Roaster-2
STM-L-AXR	Steam Line from AX and R2	ZSD-STM-AXR-3	AXR	Steam Line Auxiliary Boiler & Roaster-2 STM-AXR-2 → STM-AXR-3	276,92	56,719	0,942	M	Auxiliary Boiler & Roaster-2
STM-L-AXR	Steam Line from AX and R2	ZSD-STM-AXR-4	AXR	Steam Line Auxiliary Boiler & Roaster-2 STM-AXR-3→ STM-AXR-4	276,92	57,735	1,016	M	Auxiliary Boiler & Roaster-2

STM-L-ML	Main Line ML	ZSD-STM-0	ML	Steam Line Main Line STM-AXR-4 → STM-0	276,92	58,751	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-1	ML	Steam Line Auxiliary Boiler & Roaster-2 STM-0→ STM-1	276,92	59,767	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-2	ML	Steam Line Main Line STM-1 → STM-2	276,92	60,783	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-3	ML	Steam Line Main Line STM-2 → STM-3	276,92	61,799	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-4	ML	Steam Line Main Line STM-3 → STM-4	276,92	62,815	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-5	ML	Steam Line Main Line STM-4 → STM-5	276,92	63,831	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-6	ML	Steam Line Main Line STM-5 → STM-6	276,92	64,847	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-7	ML	Steam Line Main Line STM-6 → STM-7	276,92	65,863	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-8	ML	Steam Line Main Line STM-7 → STM-8	276,92	66,879	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-9	ML	Steam Line Main Line STM-8 → STM-9	276,92	67,895	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-10	ML	Steam Line Main Line STM-9 → STM-10	276,92	68,911	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-11	ML	Steam Line Main Line STM-10 → STM-11	276,92	69,664	0,753	M	Pipe

STM-L-ML	Main Line ML	ZSD-STM-12	ML	Steam Line Main Line STM-11 → STM-12	276,92	70,099	0,435	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-13	ML	Steam Line Main Line STM-12 → STM-13	276,92	72,283	2,184	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-14	ML	Steam Line Main Line STM-13 → STM-14	276,92	72,718	0,435	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-0	ML	Steam Line Main Line STM-14 → STM-15-0	276,92	0	0	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-1	ML	Steam Line Main Line STM-15-0 → STM-16	276,92	1,575	1,575	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-2	ML	Steam Line Main Line STM-15-1 → STM-15-2	276,92	2,591	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-3	ML	Steam Line Main Line STM-15-2 → STM-15-3	276,92	3,607	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-4	ML	Steam Line Main Line STM-15-3 → STM-15-4	276,92	4,623	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-5	ML	Steam Line Main Line STM-15-4 → STM-15-5	276,92	5,639	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-6	ML	Steam Line Main Line STM-15-5 → STM-15-6	276,92	6,655	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-7	ML	Steam Line Main Line STM-15-6 → STM-15-7	276,92	7,47	0,815	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-8	ML	Steam Line Main Line STM-15-7 → STM-15-8	276,92	9,045	1,575	M	Pipe

STM-L-ML	Main Line ML	ZSD-STM-15-9	ML	Steam Line Main Line STM-15-8 → STM-15-9	276,92	10,061	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-10	ML	Steam Line Main Line STM-15-9→ STM-15-10	276,92	11,122	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-11	ML	Steam Line Main Line STM-15-10→ STM-15-11	276,92	12,138	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-12	ML	Steam Line Main Line STM-15-11→ STM-15-12	276,92	13,154	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-13	ML	Steam Line Main Line STM-15-12→ STM-15-13	276,92	13,64	0,486	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-14	ML	Steam Line Main Line STM-15-13→ STM-15-14	276,92	15,266	1,626	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-15	ML	Steam Line Main Line STM-15-14→ STM-15-15	276,92	16,282	1,016	M	Pipe
STM-L-ML	Main Line ML	ZSD-STM-15-16	ML	Steam Line Main Line STM-15-15 → STM-15-16	276,92	17,425	1,143	M	Pipe
STM-L-AL	MAIN LINE to AL	**ZSD-STM-AL-0**	AL	Steam Line Acid Leaching STM-15-16 → STM-AL-0	276,92	0	0	M	Acid Leaching
STM-L-AL	MAIN LINE to AL	ZSD-STM-AL-1	AL	Steam Line Acid Leaching STM-AL-0 → STM-AL-1	276,92	2,62	2,62	M	Acid Leaching
STM-L-AL	MAIN LINE to AL	ZSD-STM-AL-2	AL	Steam Line Acid Leaching STM-AL-1 → STM-AL-2	276,92	3,055	0,435	M	Acid Leaching
STM-L-AL	MAIN LINE to AL	ZSD-STM-AL-3	AL	Steam Line Acid Leaching STM-AL-2 → STM-AL-3	276,92	3,563	0,508	M	Ball Valve

STM-L-AR	MAIN LINE to AL	ZSD-STM-AR-4	AR	Steam Line Acid Reactor STM-AL-3 → STM-AR-3	276,92	6,007	2,444	M	Acid Reactor
STM-L-AR	MAIN LINE to AL	ZSD-STM-AR-5	AR	Steam Line Acid Reactor STM-AR-3 → STM-AR-4	276,92	-	-		Acid Reactor
STM-L-AR	MAIN LINE to AL	ZSD-STM-AR-5	AR	Steam Line Acid Reactor STM-AR-4→ STM-AR-5	276,92	-	-		Acid Reactor
STM-L-AR	MAIN LINE to AL	**ZSD-STM-AR-6**	AR	Steam Line Acid Reactor STM-AR-5 → STM-AR-6	276,92	-	-		Acid Reactor
STM-L-RTP	Main Line to RTP	**ZSD-STM-RTP-0**	RTP	Steam Line Residual Treatment Plant STM-AR-5 → STM-RTP-0	276,92	18,718	1,293	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-1	RTP	Steam Line Residual Treatment Plant STM-RTP-0 → STM-RTP-1	276,92	19,734	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-2	RTP	Steam Line Residual Treatment Plant STM-RTP-1 → STM-RTP-2	276,92	20,75	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-3	RTP	Steam Line Residual Treatment Plant STM-RTP-2 → STM-RTP-3	276,92	21,766	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-4	RTP	Steam Line Residual Treatment Plant STM-RTP-3 → STM-RTP-4	276,92	22,782	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-5	RTP	Steam Line Residual Treatment Plant STM-RTP-4 → STM-RTP-5	276,92	23,798	1,016	M	Residual Treatment Plant

STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-6	RTP	Steam Line Residual Treatment Plant STM-RTP-5 → STM-RTP-6	276,92	24,814	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-7	RTP	Steam Line Residual Treatment Plant STM-RTP-6 → STM-RTP-7	276,92	25,83	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-8	RTP	Steam Line Residual Treatment Plant STM-RTP-7 → STM-RTP-8	276,92	26,846	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-9	RTP	Steam Line Residual Treatment Plant STM-RTP-8 → STM-RTP-9	276,92	27,862	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-10	RTP	Steam Line Residual Treatment Plant STM-RTP-9 → STM-RTP-10	276,92	28,878	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-11	RTP	Steam Line Residual Treatment Plant STM-RTP-10 → STM-RTP-11	276,92	29,386	0,508	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-12	RTP	Steam Line Residual Treatment Plant STM-RTP-11 → STM-RTP-12	276,92	29,894	0,508	M	Steam Valve
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-13	RTP	Steam Line Residual Treatment Plant STM-RTP-12 → STM-RTP-13	276,92	30,91	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-14	RTP	Steam Line Residual Treatment Plant STM-RTP-13 → STM-RTP-14	276,92	31,926	1,016	M	Residual Treatment Plant

STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-15	RTP	Steam Line Residual Treatment Plant STM-RTP-14 → STM-RTP-15	276,92	32,942	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-16	RTP	Steam Line Residual Treatment Plant STM-RTP-15 → STM-RTP-16	276,92	33,958	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-17	RTP	Steam Line Residual Treatment Plant STM-RTP-16 → STM-RTP-17	276,92	34,974	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-18	RTP	Steam Line Residual Treatment Plant STM-RTP-17 → STM-RTP-18	276,92	35,99	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-19	RTP	Steam Line Residual Treatment Plant STM-RTP-18 → STM-RTP-19	276,92	37,006	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-20	RTP	Steam Line Residual Treatment Plant STM-RTP-19 → STM-RTP-20	276,92	38,682	1,676	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-21	RTP	Steam Line Residual Treatment Plant STM-RTP-20 → STM-RTP-21	276,92	39,117	0,435	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-22	RTP	Steam Line Residual Treatment Plant STM-RTP-21 → STM-RTP-22	276,92	40,133	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-23	RTP	Steam Line Residual Treatment Plant STM-RTP-22 → STM-RTP-23	276,92	41,149	1,016	M	Residual Treatment Plant

STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-24	RTP	Steam Line Residual Treatment Plant STM-RTP-23 → STM-RTP-24	276,92	42,622	1,473	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-25	RTP	Steam Line Residual Treatment Plant STM-RTP-24 → STM-RTP-25	276,92	43,176	0,554	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-26	RTP	Steam Line Residual Treatment Plant STM-RTP-25 → STM-RTP-26	276,92	44,192	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-27	RTP	Steam Line Residual Treatment Plant STM-RTP-26 → STM-RTP-27	276,92	45,208	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-28	RTP	Steam Line Residual Treatment Plant STM-RTP-27 → STM-RTP-28	276,92	46,224	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-29	RTP	Steam Line Residual Treatment Plant STM-RTP-28 → STM-RTP-29	276,92	47,24	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-30	RTP	Steam Line Residual Treatment Plant STM-RTP-29 → STM-RTP-30	276,92	48,256	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-31	RTP	Steam Line Residual Treatment Plant STM-RTP-30 → STM-RTP-31	276,92	49,272	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-32	RTP	Steam Line Residual Treatment Plant STM-RTP-31 → STM-RTP-32	276,92	50,288	1,016	M	Residual Treatment Plant

STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-33	RTP	Steam Line Residual Treatment Plant STM-RTP-32 → STM-RTP-33	276,92	52,2	1,912	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-34	RTP	Steam Line Residual Treatment Plant STM-RTP-33 → STM-RTP-34	276,92	53,216	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-35	RTP	Steam Line Residual Treatment Plant STM-RTP-34 → STM-RTP-35	276,92	54,232	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-36	RTP	Steam Line Residual Treatment Plant STM-RTP-35 → STM-RTP-36	276,92	55,705	1,473	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-37	RTP	Steam Line Residual Treatment Plant STM-RTP-36 → STM-RTP-37	276,92	56,721	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-38	RTP	Steam Line Residual Treatment Plant STM-RTP-37 → STM-RTP-38	276,92	57,737	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-39	RTP	Steam Line Residual Treatment Plant STM-RTP-38 → STM-RTP-39	276,92	59,21	1,473	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-40	RTP	Steam Line Residual Treatment Plant STM-RTP-39 → STM-RTP-40	276,92	60,226	1,016	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-41	RTP	Steam Line Residual Treatment Plant STM-RTP-40 → STM-RTP-41	276,92	61,242	1,016	M	Residual Treatment Plant

STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-42	RTP	Steam Line Residual Treatment Plant STM-RTP-41 → STM-RTP-42	276,92	62,985	1,743	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-43	RTP	Steam Line Residual Treatment Plant STM-RTP-42 → STM-RTP-43	276,92	63,42	0,435	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-44	RTP	Steam Line Residual Treatment Plant STM-RTP-43 → STM-RTP-44	276,92	67,905	4,485	M	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-R26	RTP	Steam Line Residual Treatment Plant STM-RTP-44 → STM-RTP-R26	276,92	-	-	-	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-R27	RTP	Steam Line Residual Treatment Plant STM-RTP-R26 → STM-RTP-R27	276,92	-	-	-	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-R28	RTP	Steam Line Residual Treatment Plant STM-RTP-R27 → STM-RTP-R28	276,92	-	-	-	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	ZSD-STM-RTP-R29	RTP	Steam Line Residual Treatment Plant STM-RTP-R28 → STM-RTP-R29	276,92	-	-	-	Residual Treatment Plant
STM-L-RTP	Main Line to RTP	**ZSD-STM-RTP-R30**	RTP	Steam Line Residual Treatment Plant STM-RTP-R29 → STM-RTP-R30	276,92	-	-	-	Residual Treatment Plant

STM-L-SHE	Main Line to SHE	ZSD-STM-16-0	ML	Steam Line Main Line STM-RTP-30→ STM-16-0	276,92	0	0	M	Pipe
STM-L-SHE	Main Line to SHE	ZSD-STM-16-1	ML	Steam Line Main Line STM-16-0→ STM-16-1	276,92	2,517	2,517	M	Pipe
STM-L-SHE	Main Line to SHE	ZSD-STM-16-2	ML	Steam Line Main Line STM-16-1→ STM-16-2	276,92	7,477	4,96	M	Pipe
STM-L-SHE	Main Line to SHE	ZSD-STM-16-3	ML	Steam Line Ball Valve STM-16-2→ STM-16-3	276,92	12,437	4,96	M	Ball Valve
STM-L-SHE	Main Line to SHE	ZSD-STM-16-4	ML	Steam Line Ball Valve STM-16-3→ STM-16-4	276,92	13,656	1,219	M	Ball Valve
STM-L-SHE	Main Line to SHE	ZSD-STM-16-5	ML	Steam Line Main Line STM-16-4→ STM-16-5	276,92	17,394	3,738	M	Pipe
STM-L-SHE	Main Line to SHE	ZSD-STM-16-6	ML	Steam Line Main Line STM-16-5→ STM-16-6	276,92	23,744	6,35	M	Pipe
STM-L-SHE	Main Line to SHE	ZSD-STM-16-7	ML	Steam Line Main Line STM-16-6→ STM-16-7	276,92	31,567	7,823	M	Pipe
STM-L-N	Main Line to N	**ZSD-STM-N-0**	N	Steam Line Neutral STM-16-7 → STM-N-0	276,92	-	-		Neutral
STM-L-N	Main Line to N	ZSD-STM-N-1	N	Steam Line Neutral STM-N-0 → STM-N-1	276,92	-	-		Neutral
STM-L-SHE	Main Line to SHE	**ZSD-STM-SHE-0**	SHE	Steam Line Spiral Heat Exchanger STM-N-1 → STM-SHE-0	276,92	0	0	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-1	SHE	Steam Line Spiral Heat Exchanger STM-SHE-0 → STM-SHE-1	276,92	1,903	1,903	M	Spiral Heat Exchanger

STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-2	SHE	Steam Line Spiral Heat Exchanger STM-SHE-1 → STM-SHE-2	276,92	2,338	0,435	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	**ZSD-STM-SHE-3-0**	SHE	Steam Line Spiral Heat Exchanger STM-SHE-2 → STM-SHE-3-0	276,92	2,892	0,554	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-3-1	SHE	Steam Line Ball Valve STM-SHE-3 → STM-SHE-3-0	276,92	3,555	0,663	M	Ball Valve
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-3-2	SHE	Steam Line Steam Valve STM-SHE-3-1 → STM-SHE-3-2	276,92	3,961	0,406	M	Steam Valve
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-3-3	SHE	Steam Line Steam Valve STM-SHE-3-2 → STM-SHE-3-3	276,92	4,927	0,966	M	Steam Valve
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-3-4	SHE	Steam Line Spiral Heat Exchanger STM-SHE-3-3 → STM-SHE-3-4	276,92	5,435	0,508	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-3-5	SHE	Steam Line Spiral Heat Exchanger STM-SHE-3-4 → STM-SHE-3-5	276,92	6,908	1,473	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-3-6	SHE	Steam Line Spiral Heat Exchanger STM-SHE-3-5 → STM-SHE-3-6	276,92	7,035	0,127	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-3-7	SHE	Steam Line Spiral Heat Exchanger STM-SHE-3-6 → STM-SHE-3-7	276,92	8,46	1,425	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-218D	SHE	Steam Line Spiral Heat Exchanger STM-SHE-3-7 → STM-SHE-218D	276,92	-	-	-	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	**ZSD-STM-SHE-4-0**	SHE	Steam Line Spiral Heat Exchanger STM-SHE-4-0	276,92	0	0	M	Spiral Heat Exchanger

STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-4-1	SHE	Steam Line Spiral Heat Exchanger STM-SHE-4-0→ STM-SHE-4-1	276,92	0,389	0,389	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-4-2	SHE	Steam Line Spiral Heat Exchanger STM-SHE-4-1→ STM- SHE-4-2	276,92	0,824	0,435	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-4-3	SHE	Steam Line Stainer STM-SHE-4-2→ STM-SHE-4-3	276,92	1,332	0,508	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-4-4	SHE	Steam Line Main Line STM-SHE-4-3→ STM-SHE-4-4	276,92	2,577	1,245	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-4-5	SHE	Steam Line Steam Valve STM-SHE-4-4→ STM-SHE-4-5	276,92	3,212	0,635	M	Steam Valve
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-4-6	SHE	Steam Line Steam Heat Exchanger STM-SHE-4-5→ STM-SHE-4-6	276,92	5,65	2,438	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-4-7	SHE	Steam Line Flange STM-SHE-4-6→ STM-SHE-4-7	276,92	5,777	0,127	M	Flange
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-4-8	SHE	Steam Line Steam Heat Exchanger STM-SHE-4-7→ STM-SHE-4-8	276,92	8,783	3,006	M	Spiral Heat Exchanger
STM-L-SHE	Main Line to SHE	ZSD-STM-SHE-218C	SHE	Steam Line Steam Heat Exchanger STM-SHE-4-7→ STM-SHE-218C	276,92	-	-	-	Spiral Heat Exchanger

PROJECT OVERVIEW

The "Steam-Line Linear Asset Management" project aims to optimise the steam distribution system in the leaching and purification department. The project involves identifying the sources of steam, namely the auxiliary boiler, roaster 2, and roaster 3, and mapping their output destinations, including the spiral heat exchanger (at 218C and 218D), acid leaching reactors 3, 4, 5, 6, and RTP-reactors 26, 27, 28, 29, 30.

Using AutoCAD, a comprehensive layout will be designed to visualise the steam-line and its components. Additionally, an Excel sheet will be created to track essential details of the system. Practical experience will be gained through on-site work at the Hindustan Zinc smelter plant, specifically in the roaster department, acid leaching department, cell house, and melting department. Furthermore, observations at the solar plant will provide insights into renewable energy integration.

Overall, the project aims to enhance efficiency, reduce energy wastage, and gain valuable hands-on experience in industrial steam-line management and renewable energy systems.

APPROVED BY NAME AND TITLE	APPROVED BY SIGNATURE	DATE
Anurag Srivastava Deputy Mgr-mech HZL, Debari	[signature]	07/07/2023