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15382

STUDY

ON

THE ROASTING OF AMJHORE PYRITES

AND

SULPHURIC ACID MANUFACTURE

(PHASE 2)

FOR

PYRITES, PHOSPHATES & CHEMICALS LTD

NEW DELHI

INDIA

SPONSORED BY

UNIDO - VIENNA

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Amjhore Study

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Chapter 1

Introduction

Chapter 1

1.1 Introduction

Contract No. 82/92 entered into between UNIDO, Vienna, and Lurgi for the Project No. DP/IND/81/018 has the objective of finding a viable process/es to utilize the pyrite bearing ores at Amjhore, of Pyrites, Phosphates and Chemicals Ltd., a Govt. of India Enterprise, New Delhi/India.

Under the aforesaid agreement the work to be done by Lurgi is divided into two phases

Phase 1:

The work under phase 1 comprised laboratory scale tests to produce a pyrite concentrate, suitable for roasting to produce sulphuric Acid. The results of the test-work under Phase 1 and budget estimates of a 560 t/d sulphuric Acid Plant and an Ore concentrator for 50 t/h capacity were worked out and submitted to UNIDO and PPCL along with operating costs of the plants. The study was submitted in August 1983 and accepted by UNIDO.

Based on the findings of the report on phase 1 UNIDO and PPCL gave the green signal to Lurgi to start work on phase 2 of the Contract.

Phase 2:

In a joint meeting with UNIDO, PPCL and Lurgi in Lurgi office on 24/25.10.83 the results of the phase 1 work were reviewed and the course of action for Phase 2 was decided (see Minutes of Meeting, dated 25.10.83). It was agreed that PPCL sends a bulk sample of the ore to be tested as follows:

Tailings of optical ore sorter: approx. 65 te
Concentrate of optical sorter : approx. 15 te
Screen undersize -20 mm : approx. 2 te
Tailings and concentrates of optical are sorter are "as if produced".
The test material arrived late in the spring of 1984, upsetting the preplanned test schedule to take place already in February 1984. As the laboratory facilities were sold for other tests of other clients the benificiation tests could take place only in September 84.

The report was submitted in February 1985, no. 4548.

In May 1984 PPCL wanted to amend the course of the test programme originally foreseen. This amendment consisted of dropping of the roasting test to be conducted with a blend of the flotation concentrates and the finely ground concentrates of the optical ore sorter. It was declared by PPCL that they will be satisfied with the judgement of Lurgi on the roastability of the blended Pyrite concentrates on the physical appearance and the chemical composition of the blende so produced.
The roastability of the blende is considered an established fact, as long as the size spectrum of the composite material can be kept uniform for feed to the roaster. PPCL wanted the above mentioned tests to be replaced by a direct roasting of the pyrite-ferrous shale-tailings of the optical sorter.
The reason behind this thinking was that the recovery in the flotation and the flotation step will not be satisfactory economically, thus adding to cost of procudtion.

Since the Amjhore pyrites do not contain any appreciable non-ferrous metals the pyrites remain the only value bearer. The underground mining of the pyrites is cost intensive, hence the raw material costs have to be kept down.

The shale pyrites contains only 10 per cent sulphur, hence the autogenous roasting was at first sight thought doubtful. The application of the circulating fluid bed principle was therefore thought of in the beginning. However the very low water content below 2% and the insignificant carbonate levels are positive towards heat consumption. It was decided at first to conduct the tests in a stationary fluid bed, as this system is simpler and cheaper. To get a sulphur dioxide gas of sufficient strength it was important to achieve a high degree of conversion of sulphur. This is valid also for the sake of the thermal balance. For the same reason the carbon conversion is also of importance.
The silica content of over 50% is also a phenomenon. To suppress the formation of silicates a low roasting temperature was selected. The commercial plant has to be suitably designed to tolerate the silica level and provide long life.
The roasting tests were conducted in July 1984 with a sample of 20 tons of the shale pyrites. The tests were extremely successful. The feed material was crushed to minus 2 mm and fed into the roaster at a rate of approx. 400 kg/h.

A self-sustained roasting operation was obtained with a stable fluidisation and a steady SO_2-concentration of 8 Vol.%. The roasting efficiency was 97% and the residual sulphur in cinder was below 0.4%. It is expected that in the larger size commercial roaster even better efficiency can be obtained. The residual carbon content was below 0.2%. The bulk density of the feed was approx. 1. The water content in the pyrite was approx. 3%.
Hydraulic tests with the cinder showed binding property which increases with lime addition. It can be safely predicted that the cinder can be used as a cement additive.
The test report 4498 was submitted in August 1984.
It can be safely predicted that the shale pyrites can be utilized as a suitable feed for a commercial-scale roasting plant when the composition and size analysis of the pyrite can be maintained uniform and the moisture content can be limited to below 3%. Constituents such as carbonates which can consume energy shall be negligible. The use of the shale pyrites will contribute to better economics of the Amjhore mines and reduce the environmental pollution arising from dumping of this material while mining of the high-grade pyrites.

1.2 Selected Process Route

Based on the test results submitted to PPCL and on subsequent discussions with them on 27th and 28th November 1984 in Frankfurt the process route to be followed for the study was decided. PPCL opined that the flotation step to produce pyrite concentrates from the tailings of the optical sorter will be too expensive due to the desliming step required and the not too high recovery of Sulphur obtainable.
Since a direct roasting of shale pyrites has been proved to be technically feasible the process step to enrich it can be spared to reduce investment and operation costs.
PPCL therefore requested to work out the study for a plant with the following structure: -

2 Roaster streams with a common gas scrubbing and purification unit and a common sulphuric acid section.

The two Roaster streams shall each consist of
R.1: Stream 1 to roast 217 tpd High Grade Pyrites
R.2: Stream 2 to roast 240 tpd Low Grade Pyrites

The size of stream R.2 is derived at on the basis of available quantums while mining, according to PPCL. The resulting sulphuric acid capacity will be of the order of 320 tpd Monohydrate.

The two streams run up to the hot gas precipitators and are joined together before gas scrubbing and purification.

Both streams are fitted with waste heat boilers for maximum steam recovery and power generation as requested by PPCL.

1.3 Objectives of the Study

The objectives of the study can be summerized as follows: -

- To investigate a viable technical route or routes for the direct utilization of the pyrite deposits
- To determine the investment and operation costs of the selected process route.

The proposed capacity of the plant is decided by PPCL based on the site conditions and the marketability of the products. The capacity of 320 tpd Acid must be considered as small. The specific costs are generally higher at lower capacities than for large-scale plants. Hence, in evaluating the data of this study this fact must be borne in mind. The two major factors determining the selling price of the acid are the cost of pyrite and the interest rate of the money invested to build the plant. The remaining costs contribute in comparison less to the price of the acid.

An additional revenue can be expected from the sale of the cinder ash from the shale pyrites due to its binding property.

1.4 Significance of Pyrites: -

The pyrites play a significant role in the supply of sulphur which is largely used in the production of fertilizers and chemicals. The production of pyrites in the world, excluding Eastern Bloc countries, stood at 3.8 Million tons in 1984. The main source of the pyrites is as a by-product from flotation plants of zinc, lead and copper metals and in a few places of coal. These are mostly flotation pyrites forming an ingredient of metal bearing ores. As a by-product such flotation pyrites can be cheaper than those pyrites which are directly mined and have no association with other valuable minerals or metals.
The pyrites of the second category must be able to be mined in an economical way to compete with the by-product pyrites.
Compared to sulphur pyrites are widely dispersed on the earths crust and therefore found in almost all countries. In the more developed countries with an established infrastructure pyrites, when available as a national resource, form the backbone of sulphuric acid production. Some major producers & consumers of pyrites are Spain, Portugal, Sweden, Finland, Italy, Norway, Turkey, China, Germany, South Africa, Romania, Bulgaria, Japan, Philippines, USSR, etc.
In contrast the use of pyrites in India for sulphuric acid is nil, even though the pyrite resources are immense, the own sulphur production is negligible and almost all sulphur is imported against foreign exchange. The by-product pyrites are dumped at present!
The main reasons seem to be

- no history of pyrite utilization in India
- the deposits are far way from consuming areas
- the lean nature of the pyrites with low sulphur contents.

The Indian pyrites as mined are extremely lean (20-25%s), contain no other metal values and are burdened with silica and earth minerals. In the absence of any pretreatment the ore can widely vary in its composition and disturb operation of a plant. A simple pretreatment will help to homogenize the feed material. Large-scale tests conducted by Lurgi with Indian pyrites have demonstrated the technical feasibility of roasting the pyrites.

It can be safely predicted that with properly designed plants the roasting of Indian pyrites can be made a commercial proposition.

Since the international sulphur prices have increased due to imbalance in the supply and demand of sulphur and this pattern is predicted to continue for a long time the use of domestic pyrites in future in India can be considered a logical step. With increasing consumption of pyrites the mining and pre-preparation costs can be brought down to relieve the cost of sulphuric acid.
The establishment of a fertilizer industry at the mines will reduce the transport problem of acid. An infrastructure for transport of acid by rail can lead to the development of acid terminals at major centres. These steps can help pyrites to compete successfully with imported sulphur.

1.5 General (Plant size and economics)

1.5.1 Plant size and Economics

The roasting and sulphuric acid plant with a capacity of 320 tpd Acid is too small in size to be fully economical from a purely commercial point of view. The perspectives in Amjhore are different. The plant size may have been fixed to match the present mine output and the marketability of the acid or its derivative - Fertilizer, presently.
The addition of a second roaster stream to consume the pyriteferrous shale with 10 % Sulphur content, which is a by-product companion of the pyrites mined and a waste until now, involves high investment costs, which can be justified only if an outlet for the calcine as a cement additive is considered to obtain additional revenue and as a waste utilization measure of the mine operations in the overall picture.
Otherwise it would be more economic to roast a mixture of pyrites and shale in a single roaster. This would save costs also in the ore preparation section.
Thus, the plant especially is to be seen as a demonstration unit, with the character of being a forerunner for larger units in the future.
This constraint must be properly evaluated in the economic and financial analysis that may be required for the investment decision, to dertermine the commerciability of the plant.

1.5.2 Impact of the Plant to People:

In the opinion of the authors of this study a part or whole of the investment money required to put up the plant must be available as soft loan to PPCL because pyrites, as a substitute for imported sulphur, have a strategic importance for the Indian economy and relieved funds can be utilized for other essential imports. Sulphuric acid as the mother of chemistry can facilitate the spurt of other industries in the region and allieviate poverty.

In a larger perspective the pyrites plant offers the benefit of employment to thousands of people in the region and in addition produces fertilizers which is a stragetic commodity for India to increase food output. Using a domestic raw material it helps to strengthen the economic base of India by decreasing the dependence on imported raw materials. As India has an adverse balance of payment the reduction in import of sulphur, which is a tight commodity now, can release funds for other purposes and thus help the people of India to benefit from their own resources.

1.6 Economic Comparison between Flotation Route and Direct Roasting Route

When the study was elaborated, two different ways of producing sulfuric acid from the ores won in the Amjohre mine were thoroughly discussed. The investigations and considerations of both stages permit a rough assessment of the economy of sulfuric acid production in the two routes:

- Photometric preseparation, flotation of the shale portion, roasting of a blend of photometric and flotation concentrates (Route 1)

- Photometric preseparation, separate roasting of post-comminuted concentrate resulting from photometric preseparation (high-grade pyrite) and shale (low-grade pyrite) (Route 2)

This economic appraisal is implemented by a comparison of the capital and operating costs incurred for every route. Both cases are based on an acid production of 320 t/d requiring a run-of-mine ore rate of 570 t/d for Route 1 and of 520 t/d for Route 2.

The comparison is related only to the actually deviating processes of the two routes, i.e. costs for photometric preseparation, infrastructure etc. have not been taken into account.

The following costs will be incurred:

		Route 1	Route 2
Capital cost			
Pyrite preparation, beneficiation		Rs 30 million	Rs 10 million
Roasting and sulfuric acid production	*	Rs 175 million (one stream)	Rs 186.6 mill. (two streams)
Total		Rs 205 Mill.	Rs 196.6 Mill.
Operating cost			
Pyrite preparation		Rs 74.8/tMH	Rs 9.75/tMH
Roasting and sulfuric acid production		no significant change.	

* Interpolated.

As regards pyrite preparation, major differences occur in the operating costs due to the expense required for grinding (energy and grinding media) and for flotation reagents.

The disadvantage to be considered of Route 1 is the loss of part of the sulfur in the slimes and tailings of beneficiation. These tailings might also cause some difficulties in an environmental respect.

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Chapter 2

Design Conditions, Production and Consumption Figures and Staff Requirements

Chapter 2

2.1 Design Conditions

2.1.1 Raw Materials

Raw Material delivered to plant from mines	:	ROM, crushed to minus 110 mm
Prescreening before ore sorter	:	minus 10 mm.

This material is taken out as agricultural grade pyrites.

Working hours of ore sorter: section: 12 hrs/day

Optical ore sorter separates

1. HGP = High grade pyrites.

2. LGP = Low grade pyrites.

Since the Amjhore pyrites have the property for self-ignition long storage of crushed pyrites is avoided. The roaster bins, with a capacity of 150 cu.m. is filled each day with freshly crushed pyrites.

Reference drawings ore preparation: L1A 00 2250 00001/2

This ore sorter section is designed to treat the necessary amount for one week operation of the roaster (240 t + 217 t)x7 = 3199 t plus agricultural grade pyrite within six days of operation.

The crushing section operates on the same cycle as the roasting plant, i. e. on seven days per week.
Buffer stock between these sections are the stockpiles for high and low grade coarse pyrites.

2.1.2 Pyrites Feed

Roaster Stream no. 1: 217 tpd HGP
Roaster Stream no. 2: 240 tpd LGP

PPCL supplied by telex on 02.07.34 the following analysis for HGP:

Chemical Analysis HGP

Sulphur (tot)	:	38.1	%
Iron (tot)	:	33.5	%
Carbon (tot)	:	1.4	%
Silica	:	22.5	%
Aluminium	:	0.8-1.2	%
Magnesium	:	0.15	%
Arsenic	: less than	0.1	%
Manganese	:	0.005	%
Lead	:	0.025	%
Cobalt	:	0.03	%
Nickel	:	0.015	%
Chromium	:	0.03	%
Vanadium	:	0.007	%
Copper	:	0.01	%
Zinc	:	0.01	%
Antimony	:	0.02	%
Molybdenum	:	0.005	%
Silver	:	0.0002	%

Moisture content: 5 %

We were asked to base design of Roaster no. 1 on above analysis.

Chemical Analysis LGP

tot. Sulphur	=	11.6	%
tot. Iron	=	11.8	%
tot. Carbon	=	2.7	%
Copper	=	0.05	%
Zinc	=	0.05	%
Lead	=	0.05	%
Arsenic	=	0.007	%
Mercury	=	less than 1 g/t	
Florine	=	0.08	%
Chlorine	=	0.03	%
Silica	=	52.2	%
Alumina	=	10.8	%
CaO	=	0.55	%
MgO	=	1.1	%
TiO_2	=	0.56	%
Potassium	=	2.8	%
Phosphorus	=	0.14	%
(CO_2-C	=	0.11	%)

Moisture content: 3 %

The pyrites are poor in non-ferrous metal contents. The high content of Silica is note-worthy. The moisture level is low. Dusting will be a nuisance in the ore preparation plant.

While designing the handling system by the company involved for pyrites appropriate measures shall be incorporated to avoid dusting of material during transfer and movement of pyrites.

- rubber skirts at transfer points
- wide slow belts
- minimum fall heights while transferring
- dust suction system
- fall pipes to remove spillage

Appropriate protection shall be provided against rain without hindrance to ventilation, especially the LGP do not tolerate higher moisture.

Typical size analyses of the LGP pyrites

greater than	2	mm	=	0.0 %
2	- 1.5	mm	=	9.6 %
1.5	- 1.0	mm	=	24.9 %
1.0	- 0.5	mm	=	29.2 %
0.5	- 0.315	mm	=	11.9 %
0.315	- 0.2	mm	=	9.8 %
0.2	- 0.125	mm	=	4.9 %
0.125	- 0.09	mm	=	2.6 %
0.09	- 0.063	mm	=	2.2 %
less than	0.063	mm	=	4.9 %

Bulk density : average 1.5 kg/dm³
Angle of repose : 40°

2.1.3 Location of the Plant: Amjhore, State Bihar India

Height above sea level	:	165 m
Earthquake danger	:	nil
Soil bearing strength	:	2 kg/cm²

Climate Conditions at Site.

Barometric pressue	:	980 mbar
Air temperature	:	min 4 °C max 48 °C
Average	:	25 °C
Air Humidity average	:	75 %

2.1.4 Cooling Water

Fresh water	:	min 15 °C max 30 °C
Average	:	25 °C

The cooling water for industrial purpose shall be filtered and free of impurities.
The pH value is assumed to be 7.
Supply pressure at B/L : 4 bar.

Fresh cooling water is required as make-up for the cooling water recirculation system.

Wet bulb temperature	:	27 °C
Cooling water temperature after cooling tower	:	30 °C
Cooling water temperature inlet c.t.	:	40 °C

2.1.5 Process Water

Temperature : average 25 °C

Pressure : 3 - 4 bar

Quality : drinking water quality

Process water is required as make-up water in the gas cleaning plant and in the acid plant.

2.1.6 Electricity

High voltage : 3.3 kV, 50 cycles

Low voltage : 415 V, 50 cycles

Control voltage : 220 V, 50 cycles

Signal voltage : 24 V, DC

Tropicalised design.

2.1.7 Compressed Air

Normal pressure : 7 - 8 bars

for continuous supply for boiler rapping instrument air shall available free of oil and moisture for electro-pneumatic actuators. Pressure: 5 - 6 bars

2.1.8 Fuel Oil

Light oil, free of water and impurities required for preheating the roasters and the converter
L.c.v. of oil : 9 500 kcal/kg
Viscosity : less than 350 Cs

2.1.9 Operating Time

The plant operating time
per year : 330 days

2.1.10 Roasting Process

Normal roasting process for dead roasting of the pyrites, with complete oxidation.

2.1.11 Steam

High pressure steam, 40 bars,
superheated to 350 °C will be generated in the waste heat boilers of both roaster streams.
The steam is used to run a turbo-generator for power generation.

2.1.12 Power Generation

A condensation turbine is attached to the Plant to expand the produced superheated steam in the plant and produce electric power, 3.3 kV.

The produced power is integrated into the captive circuit of the Plant.

An auxilliary condensor is provided for the full steam output in case the turbine is out of operation.

2.1.13 Boiler Feed Water

BFW is required as make-up for losses in the water-steam circuit.
Fully demineralised BFW must be prepared in a feed water treatment plant.
The BFW must have the following analysis: -

General condition	:	clear and colourless
Hardness	:	less than 0.02 mval/kg
Oxygen	:	less than 0.02 mval/kg
CO_2-bound	:	less than 25 mg/kg
free	:	not detectable
Fe-total	:	less than 0.05 mg/kg
Cu-total	:	less than 0.01 mg/kg
pH-value at 25 °C	:	over 9.0
$KMnO_4$-consumption	:	less than 10,0 mg/kg
Oil	:	less than 1,0 mg/kg
Conductivity	:	less than 0.02 micro S/cm
Temperature	:	25 °C average
Pressure	:	2.5 bar

Continuous steady supply required at boiler.

2.1.14 Cinder

The cinder produced in the plant are of two qualities. Cinder from Roaster no. 1 is cooled and wetted for further handling by storage and transport. It can be partly sold to cement plants for adjusting the iron module.

Cinder from Roaster no. 2 is indirectly cooled in a rotary cellular cooler and stored in a silo for further sale as an additive to make a hydraulic binding agent. For this reason this cinder is not wetted to avoid any build-up.

2.1.15 Wash Acid: -

The wash acid discharged from the gas scrubbing plant is turbid, but has a H_2SO_4 strength of approx. 15-20%. Usually for fertilizer production this acid can be used for mixing with rock phosphate. Thus a dumping can be avoided and the by-product valorized.

2.1.16 Turbo-Generator Set

Type: condensation turbine, terminal output 3.5 MW.

Inlet steam conditions:

Pressure : 40 bars
Temperature: 350 °C

Low pressure steam pass out: 5 bar
Exhaust steam pressure : 0.14 bar
Cooling water temperature : 30 °C

Steam flow rates:

Inlet to turbine	: normal	16 t/h
	max.	18 t/h
Pass-out	:	0 - 1.8 t/h
Exit steam	: max.	18 t/h

Output at generator terminals: max. 3.5 MW.

Specific steam consumption:

Output	kW	3 500	3 300
Live steam in.	t/h	18.0	18.0
Pass-out	t/h	0.0	1.8
Specific steam to energy ratio	kg/kWh	5.14	5.45

Generator design data.

Generator apparent power	:	4 375 kVA
Cos. Phi (power factor)	:	0.8
Terminal voltage	:	3.3 kV ± 5%
Frequency	:	50 cycles
Protection	:	IPR 44.

Condensor

Steam input	:	normal 16 t/h max. 18 t/h
Exhaust steam pressure	:	0.14 bar
Cooling water inlet	:	30 °C

2.2 Production Figures

At nominal capacity of the plant the production figures below are expected.

2.2.1 Acid Production

The main product of the plant is sulphuric acid monohydrate

Acid from roaster stream R.1:	240 tpd	(MH)
Acid from roaster stream R.2:	80 tpd	(MH)
Total:	320 tpd	(MH)

2.2.2 By-Products from the Plant

a. Superheated Steam: 41 bar, 350 °C

Stream R.1 :	approx.	12 t/h
Stream R.2 :	approx.	4 t/h
Total :	approx.	16 t/h

b. Electric power generation: max. 3.5 MW

c. Cinder:

Stream R.1 :	=	6 800 kg/h (dry)
Stream R.2 :	=	9 000 kg/h (dry)

2.3 Consumption Figures

At nominal capacity of plant

2.3.1 Pyrites

H.G.P for Stream 1: approx. 217 tpd (dry)

L.G.P for Stream 2: approx. 240 tpd (dry)

2.3.2 Cooling Water

a. Make-up water for cooling Tower : approx. 60 m^3/h

b. Fresh water : approx. 10 m^3/h

Water in circulation in the cooling tower is approx. 1 800 m^3/h; of which approx. 3% assumed lost.

Cold water temperature : 30 °C
Hot water temperature : 40 °C

2.3.3 Process Water

Process water is required in the gas cleaning plant as make-up and in the acid plant for adjusting acid concentration.

Demand : approx. 3 m^3/h

2.3.4 Electric Power

Installed motor capacity: approx. 3 460 kW

Power consumption is expected to be as follows:

a. Ore preparation plant (no ore sorter) : 170 kW

b. Roasting Plant, incl. HGP
Roaster stream 1 = 296 kW
Roaster stream 2 = 241 kW

BFW-Pump common for both = 36 kW

c. Gas Cleaning Plant = 160 kW

d. Acid Plant = 960 kW

e. Turbo-Alternator set = 30 kW

f. Water Treatment Plant = 267 kW

All figures are estimated approximately.

2.3.5 Compressed Air

Approx. 200 Nm^3/h for each boiler at intervals.
Pressure: 7 bar steady

2.3.6 Fuel Oil

Light oil is required only for preheating purposes at the roaster and the converter

max. consumption at roaster: 600 kg/h
max. consumption at converter: 600 kg/h

2.3.7 Instrument Air

approx. 20 m^3/h at 5 - 6 bar
for electro-pneumatic valves.

2.4 Operating Staff

The following personnel is recommended, but the actual number, grades, etc can change according to local conditions

1 plant manager
1 mechanical engineer
1 electrical engineer

Shift operation (3 x 8 hours)

4 foremen
4 operators (chemical workers)
4 boiler operators
8 assistant operators
10 helpers and loaders

Plant maintenance

A gang of 2 mechanics, 1 electrical foreman, 1 welder, 1 instrument mechanic and 2 helpers.

1 laboratory Chemist and 1 helper for sample taking

A total of approx. 50 persons is considered adequate.

2.5 PPCL has indicated vide their telex of 10.10.85 that the manpower requirement for running the plant under local conditions will be as follows:

Operation	:	37 persons
Maintenance	:	43 persons
Total	:	80 persons

2.5 Plant Effluents

2.5.1 Roasting Plant

- Blow-down from boiler: approx. 0.3 m^3/h
- Cinder from R.1 : approx. 6.8 t/h
- Cinder from R.2 can be used. ~ 9 t/h

2.5.2 Gas Cleaning Plant

- sludge (acidic) : approx. 240 kg/day

  To be mixed with cinder from R.1 before disposal

- Flushing water occasionally : 8 m^3/day

2.5.3 Sulphuric Acid Plant

- Tail gas (75 °C) : approx. 34.000 Nm^3/h

  SO_2 in tail gas : approx. 0.7 g/Nm^3

  Acid mist in tail gas: approx. 50 mg/Nm^3

- Flushing water : approx. 72 m^3/day

  at intervals, slightly acidic, after cleaning

2.5.4

Total effluent water: approx. 80 m^3/day (occasional)
The acidic water, emanating from the plant is due mainly by from ants in the closed system and subsequent washing with water, and not from any continuous source.
This effluent water, whenever it is acidic, can be diverted to a pit, where lime stone/soda is added for neutralization.
The pump installed in the pit can be used to circulate water in the pit or discharge it to canal for final disposal along with the mine water.

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Chapter 3

General Process and Plant Description

Chapter 3

3. General Process and Plant Description

3.1 Ore Preparation Plant

3.1.1 Screening and sorting section

The run-of-mine ore with a maximum grain size of 110 mm will be delivered from the mine by trucks with 7 tons capacity, these trucks will dump their load either to a feed hopper of approx. 70 tons (2 hours) capacity or an emergency dump near the hopper. According to the amount of ore in the hopper, ore from the emergency dump is reclaimed by a wheel loader.

The working time for the equipment of the ore preparation plant will be 18 hours per day. As the daily capacity of the plant will be 650 t/d, the nominal capacity of the equipment was chosen to be 36.1 t/h of feed.

From the hopper the ore is discharged at a controlled rate by a reciprocating feeder onto a conveyor belt. This feeds the screen above the sorting equipment. The screen is equipped with two decks to classify the ROM-ore into two fractions for photometric sorting (10-40 mm and 40-110 mm) and the undersize minus 10 mm (as agricultural grade pyrite). The screen undersize is transported by a belt conveyor to a dump outside the screening/sorting building.

The two coarse fractions flow to surge bins above the photometric sorters. Feeding to the sorters takes place by vibrating feeders.
The sorters are separating the material according to their different optical properties in high grade pyrite and shale. Two belt conveyors collect the pyrite respectively the shale from the two sorters.

A larger amount of material 10 - 110 mm will be stored outside on dumps. These dumps represent the main buffer stock between the mine and the two roasting plants. The dumps will have a life capacity of approx. 720 t pyrite resp. 530 t shale. Total capacity is approx. 4-fold this amount.

3.1.2 Crushing section

According to the requirements of the roasting plants the material has to be crushed to below 2 mm. This is done in the crushing and screening section alternatively for the two qualities of feed material. Crushed material is produced in an amount, which is sufficient for the daily production of each roasting plant. By storage of relatively small amounts of crushed material over a short period of time the danger of self-ignition shall be avoided as far as possible.

Beneath the two dumps of high grade pyrite resp. shale a tunnel is arranged. Inside the tunnel a belt conveyor is installed. Onto these belt conveyor either pyrite or shale is fed from the dumps by means of reciprocating feeders with remote controlled drive. A third feeding point between the two dumps may be used for both materials either in emergency cases or for blending purposes. The primary crushing is performed by an impact crusher. Crusher discharge is delivered by a belt conveyor to a double deck screen. The undersize below 2 mm is the final product. The size fraction 2 to 6 mm goes to secondary crushing, which is carried out by a roll crusher. Roll crusher discharge is recirculated to the double deck screen. Oversize plus 6 mm of this screen is recirculated to the primary crusher.

The screen undersize is fed onto a belt conveyor for transport to the day bins of the two roasting lines. By means of a motorized flap the material flow may be directed either to the bin of roasting line 1 or 2. By electric interlocking the flap can be shifted only, when a certain time is passed after stopping a reciprocating feeder. According to the position of the flap only the reciprocating feeder below the appertaining stockpile will be operated. By this interlocking mixing of the two different materials will be avoided.

3.2 Roasting Plants and Gas Cleaning Plant

Two independent roaster streams, starting from the roaster feed bins up to the hot electro-filters are provided to roast both types of pyrites - standard HGP and shale pyrites LGP - separately.
Stream no. 1, equivalent to an acid production capacity of approx. 240 tpd, can be operated solely as well.
Both streams are equipped with waste heat boilers for steam raising. Stream 1 generates approx. 12 t/h and stream 2 approx. 4 t/h of superheated steam. The steam is joined and led to a turbo-generator set for generating 3.5 MW power. The condensate from the turbine is cooled and recycled back to the feed water tank, in a closed loop.

The turbine has in parallel a reducer station to divert steam, when turbine is off. The condensor is designed to take care of cooling under emergency.
The boiler feed water preparation plant is designed for a capacity of approx. 4 m^3/h as its duty is only to make-up for losses in the closed circuit.
The feed water system is common for both streams.

A buffer tank (12 m^3) as stock, the feed water tank integrated with degaser and the feed water pumps to both boilers.
The plant arrangement is made as a grass-roots plant with no restrictions on site.

The roaster stream design features: -

3.2.1 Roaster Stream No. 1

This stream is designed to roast the high grade pyrites.
Incoming pyrites are stored in the day bin, capacity 150 m^3, with double extraction ends. A speed controlled extraction belt is attached to both bottom ends of the bin.
The extracted pyrites are fed into the roaster at two feed points, via intermediate conveyor belts. At the feed points of the roaster star type valves are fitted to seal the roaster.
The fluid bed roaster is a well proved Lurgi design, with a grate area of approx. 18 m^2.
Roasting air is introduced into the roaster by a roasting air blower, which has an inlet vane control for metering the air flow into the roaster.

For preheating the roaster 2 start-up burners with oil-firing are arranged at the bottom section of the roaster. Max. oil flow will be approx. 300 kg/h each.

The oil tanks (2 x 50 m^3) are common for both streams and also the acid plant.
When the roaster auxillary bed is preheated to the ignition temperature of the pyrites, pyrites will be fed into it under fluidisation with the roasting air supplied by the roasting air blower.
The temperature in the fluid bed is controlled via cooling coils inserted into the bed. The cooling coils are cooled with boiler water circulated via the circulating pumps. The cooling coils are designed to extract the surplus heat generated during roasting and keep the preset temperature in the fluid bed well below the fusion point of the pyrites.

The bed temperature shall be equal to or below approx. 800 °C.
The roaster has an underflow with a motorized valve for extraction of the cinder and thus keep the bed volume at permissible levels, as expressed by the bed pressure reading. Secondary air nozzles are arranged at the middle section of the roaster to inject secondary air into the roaster if found necessary.

The fluid bed roaster is bricklined to conserve heat and protect the furnace shell.
The roaster is lagged outside to keep the shell temperature well above the condensation point of SO_3 during operation.
The roasting gases together the fine cinders entrained in the gas are drawn out of the roaster into the waste heat boiler for cooling and steam raising.
The waste heat boiler is of special design to cater to dusty and erosive/corrosive gases. The gas passage through the boiler, the bundle design and the cleaning arrangement of the bundles are specially designed to give trouble-free and uninterrupted service.
The steam pressure is the whole system will be held constant at 42 - 45 bars during operation and in warm condition of the plant so as to keep the metal temperature above the condensation point to prevent corrosion attacks.
For efficient flooding of the boiler tubes a forced circulation boiler design is adopted. The gases cooled to 350 °C pass into a cyclone for dedusting and from there to the hot electrostatic precipitator for final cleaning to below 200 mg/Nm^3 dust level in the gas before wet scrubbing.

The cinder settling in the boiler, the cyclone and the HGP are collected by drag conveyors and forwarded to a cooling and wetting drum, where the cinder is conditioned by water jets for final transport and storage.
The down-stream equipment after the roaster is made gas-tight to prevent the ingress of air into the system, dilute the gas and also cause corrosion.
All these factors must be carefully looked into in detail to ensure prolonged and trouble-free operation of the plant.
The transport equipment must be designed to meet extreme erosion properties of the cinder.

Suction is maintained in the system, to draw off the produced SO_2-bearing roasting gas, by the SO_2-gas blower arranged in the sulphuric acid plant. At roaster outlet the suction pressure shall be plus minus zero.

The roasting gas freed of almost all dust is quenched in the scrubber by water circulated by centrifugal pumps. The hot gas evaporates a part of the water and cools down to the saturation point. The wet gas is then indirectly cooled in a star-type lead cooler to the gas temperature prescribed by the acid plant to maintain the water balance there. This usually lies in the range of 40 °C.
The cooled saturated roasting gas is finally purified and freed of all water and mist in two parallel wet electrostatic filters.

The water separated in the star cooler and the wet filters are collected and flow back into a pump tank. Since the roasting gas contains some SO_3 the water is slowly acidified.
The acid strength of the wash acid is maintained at a constant level by discharging a certain amount of liquid from the system. This wash acid containing some impurities can however be used for normal phosphate rock digestion internally in the plant.
The remnants of particulates contained in the wash acid are separated in a settling tank arranged in the circuit. The settled sludge is to be removed from time to time from the settling tank and can be added to the cinder for disposal.

For efficient functioning of the HGP and WGP automatic voltage regulators are used to keep the discharge electrodes at highest possible voltage level before arcing takes place.

3.2.2 Roaster Stream No. 2

The roaster stream no. 2 is designed to roast the very lean pyrite-ferrous shale, having only approx. 10% S. The roaster has a size of 10 m^2 grate area. Approx. 240 tpd of shale pyrites are roasted to generate only approx. 80 tpd Acid MH.
The plant design differs from the stream no. 1 on following points:

A hot cyclone is arranged after the roaster to dedust the gas before cooling in the waste heat boiler. Due to high content of inert solids in the lean shale pyrites the dust concentration in the gas rises to over 900 g/Nm^3. The hot cyclone removes the major part of the dust from the gas so as to relieve the boiler and down-stream equipment from the dust load. The roasting gas is dedusted in a separate HGP because of its different behaviour and then the roasting gas joins the stream no. 1 to enter the wet gas cleaning section which is common for both streams.

To adjust the pressure drops in both streams and stabilize the gas flow motorized dampers are provided in both gas ducts.

Because of the binding property of the cinder from stream 2 a rotary cellular cooler with indirect water cooling is provided to receive the hot cinder and cool it to below 80 °C.

This cinder is dry and stored in a silo for further sale as cement additive.

The steam generation is this line is less than 4 t/h.

The cooling water required at the major consumers is recycled in closed loop between the cooling tower and the consumers.
The cooling tower is designed to cool a total of approx. 2000 m^3/h water by 10 °C and has 4 cells arranged as 2 x 2. The warm water is pumped up from the sump.

The fresh water requirement is reduced to make-up for losses in the system.

The plant design follows the most modern principles and incorporates the latest know-how and technology.

3.3 Sulphuric Acid Plant

The dedusted, demisted and cooled but humid gases from the wet electrostatic precipitators are conveyed to the drying tower, where they come into an intensive contact with sulphuric acid of about 96%.

The tower, which is packed with filling bodies, is irrigated with the sulphuric acid in a countercurrent flow.

The sulphuric acid absorbs the moisture content of the gas and is thus heated-up. The acid is recycled by means of a vertical pump and cooled in acid coolers by means of water.

To prevent acid droplets from being entrained in the gas, the gases leaving the drying tower are passing through a wire-mesh filter.

The dry gas is now conveyed to the SO_2-gas blower and from here via the heat exchangers T2.140, 141, 110 and 130 to the converter, in which the SO_2 is converted into SO_3. The converter comprises the vanadium containing catalyst, distributed over 4 trays. This catalyst becomes active at a temperature of about 420 °C and causes the exothermic oxidation of SO_2 to SO_3.

To initiate the reaction, the SO_2 containing gas has to be preheated to about 440 - 450 °C. For this purpose, the above heat exchangers are provided. On one side, the heat exchangers are traversed by incoming SO_2 gas and on the other by the precatalyzed gas. The gas leaving each tray has to be cooled to such a degree, that in the following tray an optimum conversion efficiency is achieved at a specific temperature.

After the second tray, the gas passes through the heat exchangers T2.120/121 and then to the intermediate absorber, which is designed similar to the drying tower. In this tower, the SO_3, which has been formed after the first and second tray, is extracted from the gas. By this SO_3-absorption, the reaction equilibrium in the last two trays of the converter is shifted towards the SO_3-formation. The circulation acid is pumped by a vertical acid pump from the pump tank via the acid coolers to the irrigation system of the intermediate absorber.

Before the SO_3 free gas returns to the heat exchangers T2.120/121, it is freed from droplets by means of a filter. In heat exchangers T2.120/121, the gas is heated to reaction temperature and then conveyed to tray no. 3.

The final absorption of the SO_3 gas is achieved in the final absorber. In heat exchangers T2.140/141, the gas is cooled in such a way, that its temperature is approx. 200 °C at the absorber inlet (at normal laod).

The design of the final absorber corresponds in principle with the design of the drying tower. The product acid is taken as 98.5% H_2SO_4 and is delivered by means of the circuit acid pump to the battery limit. The product acid is cooled in an acid cooler by means of water.

The gas leaving the final absorption tower, passes through a candle-type-filter to minimise acid mists from being entrained in the stack gas.

In the drying tower, the moisture is withdrawn from the SO_2 gas by the acid. To avoid a decrease of the dryer acid concentration, cross flow lines are arranged between the drying tower and the intermediate absorber. In these lines, the diluted acid from the drying flows to the absorber and from the absorber 98.5% is pumped to the drying tower.

As mentioned above, the catalyst only becomes sufficiently active at a temperature of 420 - 450 °C. While during plant operation, the system is in a thermal equilibrium, i.e. the reaction heat produced is sufficient to preheat the incoming cold SO_2 gases and to compensate the unavoidable radiation loss, it is during the plant start-up necessary to preheat the catalyst to the adequate temperature by means of an additional heat source. For this purpose, a preheater is provided, consisting of a combustion chamber with heat exchanger. The burner is supplied with oil by an oil pump and with combustion air through the burner air fan. The air to be preheated is circulated through the heat exchanger, and then enters tray 1 and 3 of the converter.

3.4 Effluents from Plant

Effluents of solid nature will be sludge collected at the settling tank of lyers scrubber unit. This sludge will be collected in a wheel barrow and dumped into the main cinder of the R.1 stream for final disposal.
Effluents in gaseous form will be in the form of SO_2 and SO_3/Acid mist for the tail gas chimney of the plant. The conversion efficiency of 99.7 % and the separation efficacy of the candle filters at the AT will ensure that the levels are kept below tolerable limits.
Regarding liquid effluents these will be mainly due to any leaks in the gas cleaning and acid plant sections. The spillage shall be collected via the effluent canals.
A pH-meter in the gully can put an alarm if the water gets too acidic. In that case the water is diverted to a neutralization pit, which has a pump and lime/soda is added to the pit to neutralize. As soon as the water is neutral the pump circulation is changed over to discharge the water into the disposal canal, so as to the join the mine water, for any further treatment etc.

Chapter 4

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Chapter 4

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4.1.7 IND — Feed bin for ore sorter
approx. 2 m³ volume

4.1.8 IND — Feed bin for ore sorter
approx. 2 m³ volume

4.1.9 IND — These items are under the scope of PPCL:-
Feeder for ore sorter

Feeder for ore sorter

Ore sorter

Feeder for ore sorter

Ore sorter

4.1.10 IND — Belt conveyor, 500 mm width,
center distance 8 m

4.1.11 IND — Belt conveyor, 500 mm width,
center distance 8 m

4.1.12 IND — Belt conveyor, 500 mm width,
center distance 45 m, lift 15 m

4.1.13 IND — Belt conveyor, 500 mm width,
center distance 45 m, lift 15 m

4.1.14 IND — Reciprocating feeder with variable drive, width 600 mm

4.1.15 IND — Reciprocating feeder with variable drive, width 600 mm

4.1.16 IND — Belt conveyor, 500 mm width, center distance 75 m, lift 8 m

4.1.17 IND — Single roller belt weigher for belt conveyor 500 mm width

4.1.18 IND — Impact crusher
Rotor diameter 1000 mm
Rotor width 1000 mm

4.1.19 IND — Belt conveyor, 500 mm width, center distance 38 m, lift 12 m

4.1.20 IND — Double deck vibration screen, 2 m width, 5 m length

4.1.21 IND — Screen decks 6 and 2 mm openings

4.1.22 IND — Belt conveyor, 500 mm width, center distance 35 m, lift 6 m

4.1.23 IND	Vibration feeder, 1000 mm width
4.1.24 IND	Roller crusher with two rolls, roll diameter 800 mm, roll width 1000 mm
4.1.25 IND	Belt conveyor, 500 mm width, center distance 42 m, lift 6 m
4.1.26 IND	Belt conveyor, 500 mm width, center distance 85 m, lift 19 m
4.1.27 IND	Dedusting equipment for impact crusher
4.1.28 IND	Dedusting equipment for screen and roller crusher

4.2 Pyrite Storage and Feed System

4.2.0 IND Conveyor belt for supply of pyrites from 4.1.26. To reversible conveyor on top of Bin no. 2 of roasting line no. 2. Center distance: 25 m, width 500 mm.

4.2.1 Roasting Line 1

4.2.1.1 IND Pyrite feed chute to feed reversible conveyor on top of Feed bin no. 1.

4.2.1.2 IND Reversible conveyor on top of Feed bin no. 1.

Center distance: 3 m, width: 500 mm.

4.2.1.3 IND Double Discharge Feed Bin

Volume: approx. 150 cu.m.

4.2.1.4 GER Plastic Lining for lining the inside walls of the bin, with the special bolts and washers.

4.2.1.5	2 Discharge belt conveyors
IND	with speed variable gear motors
	and remote control actuators
	complete with frame and belts
	center distance: 3.6 m, width: 1000 mm
GER:	multiply rubber belts
GER:	the PIV gear with actuator

4.2.1.6	2 Intermediate belt conveyors
IND	center distance: 8 m, width 650 mm.

4.2.1.7	2 Feeder belts
IND	center distance: 2.2 m, width 650 mm.

4.2.1.8	2 Rotary star feeders
GER	with gear motors (constant speed).

4.2.1.9	2 Feed chutes between rotary valves
IND	and feed pockets of FBR
GER	partly made of stainless steel.

4.2.2 Roasting Line 2

4.2.2.1 IND Reversible conveyor on top of Feed bin no. 1.

Center distance: 3 m
width: 500 mm

4.2.2.2 IND Double Discharge Feed Bin

Volume: approx. 150 cu.m.

4.2.2.3 GER Plastic lining for lining the inside walls of the bin, with the special bolts and washers.

4.2.2.4 IND 2 Discharge belt conveyors with speed variable gear motors and remote control actuators complete with frame and belts

Center distance: 3.6 m, width: 1000 mm

GER multiple rubber belts

GER the PIV gear with actuator

4.2.2.5 IND 2 Intermediate belt conveyors center distance: 8 m, width 650 mm

4.2.2.6 IND 2 Feeder belts center distance: 3.3 m, width 650 mm

4.2.2.7 2 Rotary star feeders
GER with gear motors (constant speed)

4.2.2.8 2 Feed chutes between rotary valves
IND and feed pockets of FBR
GER partly made of stainless steel.

4.3 Roasting Plant with Waste Heat Boilers

4.3.1 Roasting Line No. 1

4.3.1.1 1 Roaster shell

IND in gas tight welded design, made of mild steel plates;

the upper part of the roaster is provided with a gas outlet, which will be connected to the gas inlet of the waste heat boiler, by means of a special designed connection duct.

4.3.1.2 The refractory material

IND for inside lining of the roaster shell;

consisting of:

2 layers of fire clay bricks, 230 mm thick, each

1 layer of insulation brick, 150 mm thick,

- the necessary mortar and water glass;

GER with heat resistant supporting bars and ceramic mats.

4.3.1.3 The thermal insulation material

IND for the outside insulation of the roaster.

4.3.1.4 Nozzles

GER for the roaster grate;

of special design,
made of highly heat resistant stainless cast steel
including the required electrodes
to weld-in nozzles.

4.3.1.5 1 Set of cooling coils

GER connected to the circulating system of the waste heat boiler;

the coils are made of seamless tubes of special design,

supporting bars are made of highly heat resistant material.

4.3.1.6 The large fittings

for the roaster;

comprising:

IND inspection and cleaning doors,
sight glasses with accessories,

GER - one wearing plate at the lower cinders outlet,

GER - one shut-off gate at the wind-box outlet.

4.3.1.7 Expansion joints

GER one arranged at the roaster gas outlet duct,
one arranged at the boiler gas outlet duct,

qualified for horizontal and vertical expansion.

4.3.1.8 Start-up burner equipment

consisting of:

GER - oil burners, hinged type
including frames and burner bricks,
each burner designed for a capacity
of 300 kg/h of fuel oil;

IND - oil pump and oil tank;

IND - the necessary oil and air pipes
with flanges, hangers, bolts, nuts and
gaskets;

IND - oil filter,
including the necessary fittings
for the burner equipment.

4.3.1.9 Roaster air blower

GER scroll shell made of welded and bolted steel plates, drain cock at the lowest part of the scroll shell;

included is a guide vane regulation, furthermore a common base plate for blower and motor;

the vane control for the blower;

the regulating rings for common adjustment of all vanes are electrically operated;

the blower will be mounted at vibration absorbers;

the blower will be equipped with two silencers (one for the suction and one for the pressure side).

4.3.1.10 The duct work

IND for roasting air at suction and pressure side at the blower,
as well as flanges and hangers/supporting structure.

4.3.1.11 The air pipelines

IND for the burners, secondary and flushing air, including the necessary flanges and hangers, supporting structure.

4.3.1.12 Hermetic shut-off flap valve (special design)

GER O-ring type,

for the roaster air duct,
serving as shut-off valve for blower start-up, with indication "open-closed".

4.3.1.13 Gate valves

IND for burner air,
for secondary air,
for flushing air.

4.3.1.14 Small parts and accessories

IND consisting of:

flexible hoses:
for the oil burners,
for the secondary air lines,
for the flushing air lines,

bolts, nuts and gaskets.

Waste Heat Boiler Plant

1 Waste heat boiler

the specially designed waste heat boiler with horizontal gas-flow working according to the forced circulation principle;

consisting of:-

4.3.1.15 1 Welded high-pressure boiler drum

IND with heads, manhole and stubs, including all necessary internals and the drum support, including surface attemperator.

4.3.1.16 1 Front-evaporator tube bundle

GER with vertical tube coils, inlet and outlet headers.

4.3.1.17 1 Superheater tube bundle

GER with vertical tube bundles,
inlet and outlet headers.

4.3.1.18 Rear-evaporator tube bundles

GER with vertical tube coils,
inlet and outlet headers.

4.3.1.19 Interconnecting piping

IND within the forced circulation system of the waste heat boiler up to the turbulent layer cooling coils,
including their headers and suspensions.

4.3.1.20 Saturated and superheated steam piping

IND between boiler drum, superheater and pressure regulation station, feed water pump turbine, circulating pump turbine and pressure regulating station.

4.3.1.21 1 Blow-down tank
IND with connection flanges for all blowdown pipes, cooling water connections and blowdown pipe to the drain.

4.3.1.22 1 Sample cooler
IND for boiler water and saturated steam.

4.3.1.23 Start-up pipe-line

IND with silencer.

4.3.1.24 Supporting structure

IND for the individual removable tube bundles.

4.3.1.25 Boiler casing

IND as brick lined, gas tight welded, corstruction including the necessary stiffeners and suspensions.

4.3.1.26 Boiler steel structure

IND made of mild steel.

4.3.1.27 Large fittings

IND the necessary cleaning openings, inspection doors, measuring holes, sampling branches, etc.

4.3.1.28 Small fittings

IND for the boiler drum, the evaporator and superheater, pressure regulating station; superheated steam temperature regulator, including level indicators, safety valves, non-return valves, pressure gauges and thermometers, as well as vent and drain valves.

4.3.1.29 Circulating pumps

GER 2 Centrifugal pumps
with couplings, guards and common base plates for pumps and motors or steam turbine and small fittings.

4.3.1.30 1 Steam turbine

GER to drive the stand-by circulating pump, with automatic starting device and small fittings.

4.3.1.31 1 Special boiler rapping and cleaning device

GER to remote the dust deposits from the boiler tubes with automatic sequence switch centre.

4.3.1.32 Thermal insulation
IND

Calcine Handling System

4.3.1.33 1 Single-trough chain conveyor

GER of air-cooled design,
arranged underneath the waste heat boiler.

4.3.1.34 1 Double-trough chain conveyor

GER of water-cooled design,
for cinder from FBR and boiler.

4.3.1.35 1 Single-trough chain conveyor

GER of water-cooled design,
for collecting cinder from all centres.

4.3.1.36 The supporting structure

IND made of sectional steel,
for the chain conveyors.

4.3.1.37 1 Cooling air and burner air fan

IND for cooling the chain conveyor and to serve the
oil burners of the fluid bed roaster.

4.3.1.38 The cooling air and burner air lines

IND required,
including valves for individual air adjustment,
including flanges and hangers supports.

4.3.1.39 Rotary star discharger

GER arranged at the calcine outlet of the boiler chain conveyor;

comprising:

water-cooled casing and shaft,
the star and the gear motor.

4.3.1.40 2 Roller type shut-off devices for Under- and Overflow

GER 1 electrically operated
1 manually operated,
arranged at the lower fluid bed outlet of the roaster.

4.3.1.41 All connecting chutes

within the calcine handling system,

IND partly made of mild steel,

GER partly made of highly heat resistant steel,
in welded construction,

GER x equipped with inspection/cleaning doors,
flanges and necessary x expansion joints.

4.3.1.42 The pipe work for cooling water

IND inside the battery limits, including valves and gaskets, as well as hangers/supports.

4.3.1.43 The pipe word for compressed air

IND inside the battery limits, including shut-off valves and hangers/supports.

4.3.1.44 Small parts

IND + GER such as bolts, nuts, electrodes, gaskets, etc. special packings.

4.3.1.45 1 Cooling and wetting drum

IND consisting of:

drum, shell, inlet- and outlet casing, rims and running rollers, gear rim, base frame, drive station, water piping with spray-nozzles,

GER gear box, coupling, lubricating device, wear resistant inside lining.

4.3.1.46 1 Vapour washing system

GER for dedusting the vapour;

consisting of:

casing, flanges, sockets, fittings, etc.

4.3.1.47 1 Vapour discharge fan

IND consisting of:

impeller, shaft, bearing, casing sealing, base frame, V-belt-drive, guards, etc.

4.3.1.48 1 Vapour discharge piping

IND consisting of:

blow-out stack, connecting ducts, butterfly valves, blind disc, supports etc.

4.3.1.49 1 Louvre type damper

motorized, in the gas duct, leading to scrubbing tower.

4.3.2 Roasting Line No. 2

4.3.2.1 1 Roaster shell

IND in gas tight welded design, made of mild steel plates;

the upper part of the roaster is provided with a gas outlet, which will be connected to the gas inlet of the waste heat boiler, by means of a special designed connection duct.

4.3.2.2 The refractory material

IND for inside lining of the roaster shell;

consisting of:

2 layers of fire clay bricks, 230 mm thick, each

1 layer of insulation brick, 150 mm thick,

- the necessary mortar and water glass;

GER with heat resistant supporting bars and ceramic mats.

4.3.2.3 The thermal insulation material

IND for the outside insulation of the roaster.

4.3.2.4 Nozzles

GER for the roaster grate;

of special design,
made of highly heat resistant stainless cast steel including the required electrodes in weld-in nozzles.

4.3.2.5 1 Set of cooling coils

GER connected to the circulating system of the waste heat boiler;

the coils are made of seamless tubes of special design;

supporting bars are made of highly heat resistant material.

4.3.2.6 The large fittings

for the roaster;

comprising:

IND inspection and cleaning doors,
sight glasses with accessories,

GER one wearing plate at the lower cinders outlet,

GER one shut-off gate at the wind-box outlet.

4.3.2.7 Expansion joints

GER one arranged at the roaster gas outlet duct,
one arranged at the boiler gas outlet duct,

qualified for horizontal and vertical expansion.

4.3.2.8 Start-up burner equipment

consisting of:

GER - oil burners, hinged type
including frames and burner bricks,
each burner designed for a capacity
of 300 kg/h of fuel oil;

IND - oil pump and oil tank;

IND - the necessary oil and air pipes
with flanges, hangers, bolts, nuts and
gaskets;

IND - oil filter,
including the necessary fittings
for the burner equipment.

4.3.2.9 Roaster air blower

GER shell made of welded and bolted steel plates,
drain cock at the lowest part of the scroll shell;

included is a guide vane regulation, furthermore a
common base plate for blower and motor;

the regulating rings for common adjustment of all
vanes are electrically operated;

the blower will be mounted a vibration absorbers;

the blower will be equipped with two silencers
(one for the suction and one for the pressure
side).

4.3.2.10 The duct work

IND for roasting air at suction and pressure side at the blower,
as well as flanges and hangers/supporting structure.

4.3.2.11 The air pipelines

IND for the burners, secondary and flushing air, including the necessary flanges and hangers, supporting structure.

4.3.2.12 Hermetic shut-off flap valve (special design)

GER O-ring type,

for the roaster air duct,
serving as shut-off valve for blower start-up,
with indication "open-closed".

4.3.2.13 Gate valves

IND for burner air,
for secondary air,
for flushing air.

4.3.2.14 Small parts and accessories

IND consisting of:

flexible hoses:
for the oil burners,
for the secondary air lines,
for the flushing air lines,

bolts, nuts and gaskets.

4.3.2.15 Hot Cyclone

IND for operating at temperatures
of approx. 900 °C

consisting of
mild steel shell,
inside refractory lining, and insulating lining,
external lagging of mineral wool;

GER ceramic mats and special anchor bolts of heat
resistant steel.

4.3.2.16 Gas ducts

IND connecting roaster with hot
cyclone and to the waste heat
boiler inlet nozzle
with refractory linings
and external lagging.

4.3.2.17 Expansion joints

GER at the gas ducts
for hot operation
made of special ceramic materials,
allowing for vertical and horizontal expansion.

4.3.2.18 Rotary discharger

GER of water cooled design
under gas tight conditions,
with gear motor,
for expulsion of 900 °C
hot calcines.

Waste Heat Boiler Plant

1 Waste heat boiler

the specially designed waste heat boiler with horizontal gas-flow working according to the forced circulation principle,

consisting of:

4.3.2.19 1 Welded high-pressure boiler drum

IND with heads, manhole and stubs, including all necessary internals and the drum support, including surface attemperator.

4.3.2.20 1 Front-evaporator tube bundle

GER with vertical tube coils, inlet and outlet headers.

4.3.2.21 1 Superheater tube bundle

GER with vertical tube bundles, inlet and outlet headers.

4.3.2.22 Rear-evaporator tube bundles

GER with vertical tube coils, inlet and outlet headers.

4.3.2.23 Interconnecting piping

IND within the forced circulation system of the waste heat boiler up to the turbulent layer cooling coils,
including their headers and suspensions.

4.3.2.24 Saturated and superheated steam piping

IND between boiler drum, superheater and pressure regulation station, feed water pump turbine, circulating pump turbine and pressure regulating station.

4.3.2.25 1 Blow-down tank
IND with connection flanges for all blowdown pipes, cooling water connections and blowdown pipe to the drain.

4.3.2.26 1 Sample cooler
IND for boiler water and saturated steam.

4.3.2.27 Start-up pipe-line

IND with silencer.

4.3.2.28 Supporting structure

IND for the individual removable tube bundles.

4.3.2.29 Boiler casing

IND as bricklined, gas tight welded, construction including the necessary stiffeners and suspensions.

4.3.2.30 Boiler steel structure

IND made of mild steel.

4.3.2.31 Large fittings

IND the necessary cleaning openings, inspection doors, measuring holes, sampling branches, etc.

4.3.2.32 Small fittings

IND for the boiler drum, the evaporator and superheater, pressure regulating station; superheated steam temperature regulator, including level indicators, safety valves, non-return valves, pressure gauges and thermometers, as well as vent and drain valves.

4.3.2.33 Circulating pumps

GER 2 Centrifugal pumps
with couplings, guards and common base plates for pumps and motors or steam turbine and small fittings.

4.3.2.34 1 Steam turbine

GER to drive the stand-by circulating pump, with automatic starting device and small fittings.

4.3.2.35 1 Special boiler rapping and cleaning device

GER to remote the dust deposits from the boiler tubes with automatic sequence switch centre.

4.3.2.36 Thermal insulation

IND

Calcine Handling System

4.3.2.37 1 Single-trough chain conveyor

GER of air-cooled design,
arranged underneath the waste heat boiler.

4.3.2.38 Rotary cellular cooler

GER for the indirect cooling of calcines,
water cooled walls,
with 900 °C, all accessories,
with gear acid flanged motor.

4.3.2.39 2 Single-trough chain conveyors

GER for transport of cooled calcines
to the bucket elevator.

4.3.2.40 1 Bucket elevator

IND vertical design,
to transport the calcine receiving from the chain conveyor to the top of the calcine silo.

4.3.2.41 The supporting structure

IND made of sectional steel,
for the chain conveyors and for the bucket elevator.

4.3.2.42 1 Cooling air and burner air fan

IND for cooling the chain conveyor and to serve the oil burners of the fluid bed roaster.

4.3.2.43 The cooling air and burner air lines

required,
made of mild steel,
including valves for individual air adjustment,
including flanges and hangers supports.

4.3.2.44 Rotary star discharger

GER arranged at the calcine outlet of the boiler chain conveyor;

comprising:

water-cooled casing and shaft,
the star and the gear motor.

4.3.2.45 Roller type shut-off device for Under- and Overflow

GER 1 electrically operated
1 manually operated,
arranged at the lower fluid bed outlet of the roaster.

4.3.2.46 Calcine silo

IND consisting of:

- stiffened mild steel plates in various thicknesses,
- sockets for material inlet and outlet.

4.3.2.47 Silo shut-off slide valve

GER electrically operated.

4.3.2.48 Fluidization system

IND for conical parts of calcine silo,

consisting of:

pneumatic rapping slides
with ring duct, valves and fittings,
rotary piston blower and air duct work.

4.3.2.49 Silo filter

IND with cleaning mechanism and centrifugal fan for clean air.

4.3.2.50 All connecting chutes

IND within the calcine handling system,
partly made of mild steel,

GER partly made of highly heat resistant steel,
in welded construction,

IND equipped with inspection/cleaning doors,
flanges and necessary expansion joints.

4.3.2.51 The pipe work for cooling water

IND inside the battery limits,
including valves and gaskets,
as well as hangers/supports.

4.3.2.52 The pipe work for compressed air

IND inside the battery limits,
including shut-off valves and
hangers/supports.

4.3.2.53 Small parts

I + G such as bolts, nuts, electrodes, gaskets, etc.

4.3.2.54 1 Louvre type damper
motorized, in the gas duct
to scrubbing tower
to adjust the suction pressure.

4.3.3 Common Systems for both Lines

1 Feed water plant

consisting of:

4.3.3.1 IND — 1 Feed water tank with internal fittings, water level indicator, gauges, thermometers and small fittings.

4.3.3.2 — 1 Deaerator for the deaeration of the feed water.

4.3.3.3 — 1 Stream pressure control device for keeping the deaerator pressure constant.

4.3.3.4 — 1 Water flow control for keeping the water level in the feed water tank constant.

4.3.3.5 GER — 2 Feed water pumps (centrifugal pumps), each with coupling, guard and common base plate for the pump and motor or steam turbine and small fittings.

4.3.3.6 GER — 1 Steam turbine
for the drive of the stand-by feed water pump, with small fittings.

4.3.3.7 IND — 1 Reducing station
for steam to deaerator

4.3.3.8 IND — 1 Sample cooler
for feed water

4.3.3.9 IND — Interconnecting piping

- condensate pipe from condensate pumps to deaerator
- feed water pipe from boiler feed water tank to boiler feed water pumps
- vent and drain pipes

4.3.3.10 IND — 1 Dosing equipment
for deaerator with dosing pump and PVC-tank.

4.3.3.11 IND — Thermal insulation
for the parts of the feed water plant.

4.3.3.12 Set interconnectiong piping

IND
- feed water pipe from feed water pumps to each steam drum
- feed water pipe for injection water from feed water pumps to spray-in cooler.

Hot Steam Piping

4.3.3.13 1 Set superheated steam piping between pressure regulating stations to the turbine inlet controller.

1 Re-cooling plant

consisting of:

4.3.3.14 IND 2 Cooling towers with tower fill, water distribution system, drift eliminator.

4.3.3.15 IND 1 Cold water basin reinforced concrete

4.3.3.16 IND 4 Axial fans with couplings direct driven by c-motor

4.3.3.17 2 Centrifugal pumps
IND with couplings and common base plates for pumps and motors.

4.3.3.18 Interconnecting piping

IND
- cooling water suction pipe
- cooling water pipe from cooling water pumps to condensers
- return cooling water pipe from condensers to cooling tower

4.3.3.19 1 Water treatment plant

IND only for make up water (BFW)

consisting of the necessary equipment to guarantee the quality of boiler feed water.

4.3.3.20 1 Demin. water tank
IND with connection flanges

4.3.3.21 2 Demin. water pumps
IND with couplings and common base plates for pumps and motors.

4.3.3.22 Interconnecting piping

IND
- pipes within the plant for water and chemicals
- demin. water pipe from water treatment plant to demin. water pumps
- demin. water discharge pipe from demin. water pumps to dearator.

4.4 Gas Cleaning Plant

4.4.1 Cyclone and Hot Precipitator Lines

4.4.1.1 1 High-efficiency Centrifugal Dust Collector (Cyclone)

IND each made of sheet steel with gas inlet connection duct and gas outlet connection duct with flanges for fastening the incoming and outgoing gas ducts, with dust hopper, including flange at the outlet for the connection of the dust expulsion system, included all the required bolts and gaskets, as well as the support brackets.

4.4.1.2 - the dust expulsion system

GER consisting of one rotary valve with motorized drive, arranged beneath the hopper of cyclone.

4.4.1.3 - the material for the thermal insulation of each cyclone

IND consisting of insulation mats of 100 mm thickness and of a protective aluminium sheet covering.

Electrostatic Hot Gas Precipitator

4.4.1.4 Precipitator Casing with Ancillaries

IND 1 casing for the horizontal type electrostatic precipitator of 5 mm steel plate construction, with stiffeners for a max. suction of 30 mbar and a max. temperature of 380 °C;
the casing would extend from raw gas inlet up to clean gas outlet and would comprise:

- one longitudinal hopper with connection flange for dust conveyor,
- box type roof beams for supporting the precipitator roof and the collecting electrodes and to accommodate the H.T.-insulators for the discharge electrode suspension,
- precipitator top allowing transit,
- inspection doors with clamp down device,
- catwalk on one precipitator longside, with open mesh flooring,
  including railings;

IND - gas inlet and gas outlet transition of 5 mm steel plate construction with stiffeners;

IND - gas distribution plates at precipitator inlet;

GER - motorized rapper for gas distribution plates, including geared motor;

IND - precipitator support structure,
consisting of the lattice type construction with movable supports;
the precipitator casing is considered as load bearing member, the lattice ties transmitting the wind forces into the foundations;

IND - 150 mm thick heat insulation for precipitator casing and associated gas inlet and outlet transitions. The heat insulation would consist of mats, attached to galvanized wire netting and covered on the outside by a 1 mm thick aluminium sheeting. Included are seam cover strips and self-tapping screws.
The heat insulation for the precipitator roof would be 250 mm thick, without metal sheeting;

GER 1 motorized dust conveyor underneath the precipitator hopper, with geared motor;

GER 1 motorized rotary dust valve at dust outlet of the dust conveyor, with geared motor;

IND - the mechanical interlocking system for the high voltage switches and the doors of the electrostatic precipitator.

4.4.1.5 The Internal Equipment for the Precipitator

comprising:

GER - discharge electrodes;

GER - frames for the discharge electrodes;

GER - suspension system and support for the discharge frames, including spacers;

GER - high voltage insulators for the suspension system and support;

GER - electric heating system for the high voltage insulators;

GER - control and monitoring instruments for connection to plant voltage, including branch sockets and heat-resistant junction lines from the sockets to the heating bodies;

GER - collecting electrodes with guides and upper spacers;

GER - rapping rods;

GER - motorized rappers for the discharge system, including geared motors;

GER - motorized rappers for the collecting electrodes, including geared motors.

4.4.1.6 The Electrical Equipment

(corresponding to the relevant GERMAN-regulations)

GER 2 single-phase transformer-rectifier sets as per VDE 0146, provided for being installed in an enclosed high voltage room,

each with the following data:

power supply	:	415 V, 50 cps
connection value	:	35 kVA *)
signal voltage	:	220 V, 50 cps
nominal high voltage	:	50 kV ar.
nominal output current	:	560 mA *)
ambient temperature	:	40 °C

*) the exact date depends upon the make to be supplied.

Each plant comprises:

- a control cabinet in sheet metal design, with built-in thyristor controller, solid-state automatic control of precipitator operation and all switching and monitoring equipment required for operation. The ON-OFF-switches, the signal lamps ON and FAILURE, as well as the measuring equipment for the current and voltage values on the primary and secondary side are arranged in the front door.

  The cabinet is suitable for the connection up to remote control and remote monitoring system. All internals are accessible from the front and exchangeable. The cable intake is from below.

  Enclosure: at least IP 20
  RAL 7032

- a hermetically sealed rectifier set with the following oil-immersed parts:

  high voltage transformer with a rectifier set with silicone diodes;
  throttle on the low voltage side for current limitation and improvement of the form factor;
  high frequency throttle or Ohmic resistance for attenuating the high frequency peak voltages on the direct current side, as well as a measuring resistance for connecting the measurement system of the secondary voltage and for the kV-measurement.

  The required monitoring equipment is mounted on the vessel cover. There is a shunt for the measurement of the precipitator current in the earthed conductor next to the secondary voltage measurement in the laterally arranged terminal box. The direct current connection is effected via a high voltage bushing, which can be arranged vertically or horizontally.

  Enclosure:

- Vessel	:	IP 65
- Terminal box	:	IP 43
- High voltage bushing	:	IP 00
Colour	:	RAL 7033

The electrical installation material

comprising:

GER - high voltage switches
with manual actuation
for change-over and earthing;

GER - connection ducts
on the high voltage side
with terminal and support insulators;

IND - protective covering
for the high voltage cells
in the form of wire grates
and access doors;

GER - cabling of the units on the low voltage side with interlocking of the cell doors, including warning lights;

GER - the copper earth wires
in the area of the electrostatic precipitator plant, as well as in the area of the switching and unit cells,
for connection to the works earth;

GER - earthing equipment,
i.e. earth rods and earth wires;

GER - attenuating systems;

GER - 100 m single core high voltage cable,
for connecting the high voltage switches with the electrostatic precipitator,
including terminal boxes and fastening material. (We will invoice the supply of additional cables for the respective current price);

GER - bushing insulators;

GER - 1 switchboard control panel
totally enclosed, enclosure IP 44,
completely mounted and wired to the
terminal board, ready for connection.
The board comprises all required switching,
monitoring and operating devices for the
auxiliary equipment of the electrostatic
precipitator plant listed below:

GER supply via low voltage high breaking
capacity fuse,

GER outlets for transformer rectifier sets,

GER motorized rappers for the discharge
system,

GER motorized rappers for the collecting
electrodes,

GER motorized rappers for the gas distribution
plates,

GER electrical heating system for the insulators,

GER dust expulsion device (included rotary dust
valves of the cyclone).

4.4.1.7 Gas Shut-off Devices

IND consisting of a cast iron damper,
arranged at the gas inlet and outlet HGP
designed for manual operation.

4.4.2 Hot Precipitator Line 2

Electrostatic Hot Gas Precipitator

4.4.2.1 Precipitator Casing with Ancillaries

IND 1 casing for the horizontal type electrostatic precipitator of 5 mm steel plate construction, with stiffeners for a max. suction of 30 mbar and a max. temperature of 380 °C;
the casing would extend from raw gas inlet up to clean gas outlet and would comprise:

- one longitudinal hopper with connection flange for dust conveyor,
- box type roof beams for supporting the precipitator roof and the collecting electrodes and to accommodate the H.T.-insulators for the discharge electrode suspensions,
- precipitator top allowing transit,
- inspection doors with clamp down device,
- catwalk on one precipitator longside, with open mesh flooring, including railings;

IND - gas inlet and gas outlet transition of 5 mm steel plate construction with stiffeners;

IND - gas distribution plates at precipitator inlet;

GER - motorized rapper for gas distribution plates, including geared motor;

IND - precipitator support structure, consisting of the lattice type construction with movable supports;
the precipitator casing is considered as load bearing member, the lattice ties transmitting the wind forces into the foundations;

IND - 150 mm thick heat insulation for precipitator casing and associated gas inlet and outlet transitions. The heat insulation would consist of mats, attached to galvanized wire netting and covered on the outside by a 1 mm thick aluminium sheeting. Included are seam cover strips and self-tapping screws.
The heat insulation for the precipitator roof would be 250 mm thick, without metal sheeting;

GER 1 motorized dust conveyor underneath the precipitator hopper, with geared motor;

GER 1 motorized rotary dust valve at dust outlet of the dust conveyor, with geared motor;

IND - the mechanical interlocking system for the high voltage switches and the doors of the electrostatic precipitator.

4.4.2.2 The Internal Equipment for the Precipitator

comprising:

GER - discharge electrodes;

GER - frames for the discharge electrodes;

GER - suspension system and support for the discharge frames,
including spacers;

GER - high voltage insulators
for the suspension system and support;

GER - electric heating system
for the high voltage insulators;

GER - control and monitoring instruments
for connection to plant voltage,
including branch sockets and heat-resistant
junction lines from the sockets to the
heating bodies;

GER - collecting electrodes
with guides and upper spacers;

GER - rapping rods;

GER - motorized rappers
for the discharge system,
including geared motors;

GER - motorized rappers
for the collecting electrodes,
including geared motors;

GER - the rapping cycle control
for the third field
for controlling the motorized plate
rapping mechanisms.

4.4.2.3 The Electrical Equipment

(corresponding to the relevant GERMAN-regulations.)

GER 3 single-phase transformer-rectifier sets as per VDE 0146, provided for being installed in an enclosed high voltage room,

each with the following data:

power supply	:	415 V, 50 cps
connection value	:	35 kVA *)
signal voltage	:	220 V, 50 cps
nominal high voltage	:	50 kV ar.
nominal cutput current	:	560 mA *)
ambient temperature	:	40 °C

*) the exact data depends upon the make to be supplied.

Each plant comprises:

- a control cabinet in sheet metal design, with built-in thyristor controller, solid-state automatic control of precipitator operation and all switching and monitoring equipment required for operation. The ON-OFF-switches, the signal lamps ON and FAILURE, as well as the measuring equipment for the current and voltage values on the primary and secondary side are arranged in the front door.

The cabinet is suitable for the connecting up to remote control and remote monitoring system. All internals are accessible from the front and exchangeable. The cable intake is from below.

Enclosure	:	at least IP 20
Colour	:	RAL 7032

- a hermetically sealed rectifier set with the following oil-immersed parts:

  High voltage transformer with a rectifier set with silicone diodes;
  throttle on the low voltage side for current limitation and improvement of the form factor;
  high frequency throttle or Ohmic resistance for attenuating the high frequency peak voltages on the direct current side, as well as a measuring resistance for connecting the measurement system of the secondary voltage and for the kV-measurement.

  The required monitoring equipment is mounted on the vessel cover. There is a shunt for the measurement of the precipitator current in the earthed conductor next to the secondary voltage measurement in the laterally arranged terminal box. The direct current connection is effected via a high voltage bushing, which can be arranged vertically or horizontally.

  Enclosure:

- Vessel	:	IP 65
- Terminal box	:	IP 43
- High voltage bushing	:	IP 00
Colour	:	RAL 7033

The electrical installation material

comprising:

GER - high voltage switches
with manual actuation
for change-over and earthing;

GER - connection ducts
on the high voltage side
with terminal and support insulators;

IND - protective covering
for the high voltage cells
in the form of wire grates
and access doors;

IND - cabling of the units on the low voltage side with interlocking of the cell doors, including warning lights;

GER - the copper earth wires
in the area of the electrostatic precipitator plant, as well as in the area of the switching and unit cells,
for connection to the works earth;

GER - earthing equipment,
i.e. earth rods and earth wires;

GER - attenuating systems;

GER - 150 m single core high voltage cable,
for connecting the high voltage switches with the electrostatic precipitator,
including terminal boxes and fastening material.
(We will invoice the supply of additional cables for the respective current price);

GER - bushing insulators.

- 1 switchboard control panel
  totally enclosed, enclosure IP 44,
  completely mounted and wired to the terminal board, ready for connection.
  The board comprises all required switching, monitoring and operating devices for the auxiliary equipment of the electrostatic precipitator plant listed below:

  supply via low voltage high breaking capacity fuse,

  outlets for transformer rectifier sets,

  motorized rappers for the discharge system,

  motorized rappers for the collecting electrodes,

  motorized rappers for the gas distribution plates,

  electrical heating system for the insulators,

  dust expulsion devices.

4.4.2.4 Gas Shut-off Device

consisting of a cast iron damper, arranged at the gas outlet, designed for manual operation.

4.4.3 Common Gas Cleaning Plant

4.4.3.1 1 Washing Tower

consisting of:

IND mild steel casing;

IND rubber lining;

IND acid resistant bricks and mortar for bricklining;

GER requisite acid nozzles with nozzle tubes;

IND support structure made of sectional steel;

IND service platform and stairway, floors and handrails, made of sectional steel.

4.4.3.2 1 Settling Tank

consisting of:

IND mild steel casing / or plastic with conical bottom, including flanges, bolts and gaskets;

IND support structure made of sectional steel, including ladder.

4.4.3.3 2 Pump Tanks
IND

consisting of:

plastic with flanges bolts and gaskets;

(for washing Tower and Starcooler circuits).

4.4.3.4 2 Centrifugal Pumps
ER

(1 operating, 1 stand-by pump for washing Tower circuit),

designed for direct motor coupling with base plates, anchoring elements, flexible couplings and motors.

4.4.3.5 1 SO_2-stripper
IND

made of plastic;

IND - the rings for packing including the grid made of plastic;

IND 1 damper for manual operation made of plastic;

IND - the required flanges, bolts and gaskets.

4.4.3.6 1 Humidifier Tower

IND - casing with gas inlet connecting duct made of fibre-glass reinforced plastic (FGRP);

designed as a pump tank, with gas outlet connection duct;

GER - spraying system consisting of nozzle pipes and nozzle, both made of plastic for installation inside the Humidifier top.

4.4.3.7 4 Centrifugal Pumps
GER

(2 operating and 2 stand-by pump for humidifier tower and gas cooler circuit or for wet precipitator flushing),

designed for direct motor coupling with base plates, anchoring elements, flexible couplings and motors.

4.4.3.8 1 Indirect Gas Cooler

double section model with vertical gas passage, consisting of:

GER 2 cooling bundles, arranged one above the other;

each bundle composed of:

- shell welded to upper and lower tube plates, which are homogeneously lead lined steel on the gas side; shell inside provided with a multiple paint coating for protection against corrosion;
- lead tubes with inside (gas side) provided with longitudinal fins, arranged in star pattern; the tubes soldered into the tube plates;
- cooling water baffles, made of plastic;
- water supply and drain nozzles;

IND - cooler top with gas inlet connection duct of FGRP, prepared for installation spraying system;

IND - cooler midsection between steel tube bundles, homogeneously lead lined on the inside;

IND - cooler bottom part, with gas outlet connection duct made of FGRP;

IND - all necessary flanges, bolts and gaskets;

IND - supporting structure of steel beam design;

IND - operating platform and stairway, made of sectional steel, including flooring and railing;

GER - spraying system, consisting of nozzle pipes and nozzles both made of plastic for installation inside the cooler top.

4.4.3.9 3 Electrostatic Wet Gas Precipitators

tubular wet gas precipitators,
partly in plastic construction,
two units are arranged in the first and
one in the second stage:

each precipitator consisting of:

IND - the casing

made of fibre glass reinforced plastic (FRGRP);

IND the casing top with:

- the gas inlet connection, respectively the gas outlet connection;
- the connections for the insulator housings;
- the connections for the flushing device;
- the gas distribution plates, made of plastic, including supports (only for the second stage unit);
- the inspection and clean-out manholes, as well as the inspection glasses with the required seals.

IND the casing centre with:

- the top plastic tube sheet for accomodation of the collecting tubes;
- the support grate for the tube sheet, made of homogeneously lead coated steel;
- the plastic grate for central alignment and guiding of the bottom ends of the collecting tubes.

IND the casing bottom with:

- the gas outlet connection, respectively the gas inlet connection;
- the gas distribution plates, made of plastic, including supports (only for the first stage units);
- the connections for the insulator housings;
- the inspection and clean-out manholes, as well as the inspection glasses with the required seals.

GER - the collecting tubes

made of plastic
with welded collar and O-ring seal.

4.4.3.10 - the high tension section
GER ----------

GER - the special discharge electrodes,
made of lead;

IND - the upper frame
for supporting and spacing the discharge electrodes,
made of homogeneously lead coated steel;

IND - the lower frame
for guiding and spacing the discharge electrodes,
made of homogeneously lead coated steel;

IND - the insulated support,
of the discharge system,
made of homogeneously lead coated steel;

GER - the insulators
for supporting the discharge system,
as well as the current intake.

4.4.3.11 The Insulator Housing
----

each consisting of:

IND - the lower part
made of homogeneously lead coated steel
to accomodate the insulators;

IND - the upper part
made of steel
for tightly covering the insulators;

IND - the 100 mm thick heat insulation
with a 1 mm thick aluminium plate
protective cover.

4.4.3.12 The Electrical Equipment
GER ----------

(corresponding to the relevant GERMAN regulations.

GER 3 single-phase transformer-rectifier sets as per VDE 0146, provided for being installed in an enclosed high voltage room,

each designed for the following data:

power supply	:	415 V, 50 cps
connection value	:	27 kVA *)
signal voltage	:	220 V, 50 cps
nominal high voltage	:	40 kV ar.
nominal output current	:	560 mA *)
ambient temperature	:	40 °C

*) the exact data depends upon the make to be supplied.

each plant comprises:

- a control cabinet in sheet metal design, with built-in thyristor controller, solid-state automatic control of precipitator operation and all switching and monitoring equipment required for operation. The ON-OFF-switches, the signal lamsp ON and FAILURE, as well as the measuring equipment for the current and voltage values on the primary and secondary side are arranged in the door front.

The cabinet is suitable for the connection up to remote control and remote monitoring system. All internals are accessible from the front and exchangeable. The cable intake is from below.

Enclosure: at least IP 20
Colour : RAL 7032;

- a hermetically sealed rectifier set with the following oil-immersed parts:

  High voltage transformer with a rectifier set with silicone diodes;
  throttle on the low voltage side for current limitation and improvement of the form factor;
  high frequency throttle or Ohmic resistance for attenuating the high frequency peak voltages on the direct current side, as well as a measuring resistance for connecting the measurement system of the secondary voltage and for the kV-measurement.

  The required monitoring equipment is mounted on the vessel cover. There is a shunt for the measurement of the precipitator current in the earthed conductor next to the secondary voltage measurement in the laterally arranged terminal box. The direct current connection is effected via a high voltage bushing, which can be arranged vertically or horizontally.

  Enclosure:

- Vessel	:	IP 65
- Terminal box	:	IP 43
- High voltage bushing	:	IP 00
Colour	:	RAL 7033.

The Electrical Installation Material

comprising:

GER - high voltage switches
with manual actuation
for change-over and earthing;

GER - connection ducts
on the high voltage side
with terminal and support insulators;

IND - protective covering
for the high voltage cells
in the form of wire grates
and access doors;

IND - cabling of the units on the low voltage
side with interlocking of the cell doors,
including warning lights;

GER - the copper earth wires
in the area of the electrostatic precipitator
plant, as well as in the area of the switching
and unit cells,
for connection to the works earth;

GER - earthing equipment,
i.e. earth rods and earth wires;

GER - attenuating systems;

GER - 150 m single core high voltage cable,
for connecting the high voltage switches
with the electrostatic precipitators,
including terminal boxes and fastening
material. (We will invoice the supply of
additional cables for the respective current
price);

GER - bushing insulators;

- 1 switchboard control panel
  totally enclosed, enclosure IP 44,
  completely mounted and wired to the
  terminal board, ready for connection.
  The board comprises all required switching,
  monitoring and operating devices for the
  auxiliary equipment of the gas cleaning
  plant listed below:

  supply via low voltage high breaking
  capacity fuse,

  outlets for transformer rectifier sets,

  compressors,

  pumps.

4.4.3.13 The Equipment for flushing the Insulators with heatead Air

comprising:

GER - the required compressors
with electrical drives;

GER - the required air filters
with filter inserts;

GER - the required compensators;

IND - the air ducts
between compressors and insulators,
made of steel with the required fastening
material and the heat insulation.

4.4.3.14 The Equipment for the Filter flushing with Wash Liquor

GER - the required nozzles and nozzle tubes made of plastic;

IND - the plastic piping for distribution of the flushing liquid;

IND - the required shut-off valves for manual control.

4.4.3.15 The Gas Shut-Off Devices

IND

consisting of five throttles and slip plates on the gas inlet side and the gas outlet side of each precipitator
for manual operation,
made of plastic.

4.4.3.16 Support Structures, Platforms and Stairways

IND the precipitator support structure welded of structural steel;

IND the precipitator platforms with protective railing and stairways, including supports.

4.4.3.17 Ducts and Pipelines

consisting of:

IND - gas connection ducts
from the outlet of the cyclone to the inlet of the washing tower,
made of steel,
including supports, expansion joints, flanges, bolts and gaskets;

IND - thermal insulation for the hot gas duct, 100 mm thick,
bound with galvanized wire mesh and protected on the outside with aluminium cladding, 1 mm thick;

IND - gas connection ducts
from the outlet of the washing tower to the inlet of the drying tower, as well as to the start-up stack,
made of plastic with steel reinforcements,
including supports, flanges, bolts and gaskets;

IND compensators;

IND safety valve;

IND operating platform and ladder
for safety valve,
made of sectional steel;

IND - pressurized acid lines,
made of rubber lined steel / or plastic,
including flanges, bolts, gaskets and supports;

IND - unpressurized acid lines,
(condensate and vent lines)
made of plastic,
including flanges, bolts, gaskets and supports;

IND - valves and sight glasses for acid lines;

IND - water lines,
made of seamless mild steel piping,
with valves, flanges, bolts, gaskets and supports.

4.4.3.18 Start-up Devices

IND 1 radial compressor
steel rubber-lined, (or PVC/FRP)
designed for direct motor coupling,
with base plate, anchoring elements,
flexible coupling and motor;

GER 1 damper,
made of plastic, motor controlled;

IND 1 damper,
made of plastic, for manuell operation;

IND 1 start-up stack
made of PVC/FRP.

4.5 Sulphuric Acid Plant

4.5.1 Drying-, Absorption- and Production Section

4.5.1.1 1 Air Filter

IND

for filtering the required dilution air;

consisting of:

a mild steel casing with filter mats.

4.5.1.2 1 Drying Tower

The drying tower is working according to the counterflow-irrigation system;

consisting of:

IND The cylindrical shell of mild steel in welded construction, with dished bottom, gas-inlet, gas-outlet and acid in- and outlets. The gas outlet with cover and bend will be made of stainless steel. Bottom and shell will receive a multi-layer acid resistant lining; before bricklining with acid bricks a plastic foil
GER will be provided in the lower area.

GER Before the gases are leaving the drying tower. they pass a wire mesh filter.

For uniform distribution of acid over the entire cross section of the tower, an irrigation system, made of special designed cast iron pipes, is arranged.

The acid is fed to the irrigation system by means of cast iron pipes.

IND A filling, consisting of INTALOX-saddles, which will be supported by a special grate, all made of acid resistant stone ware, will be provided for the irrigation tower.

Above the INTALOX-saddles, a filter will be provided.

The drying tower will be also equipped with sight glasses.

4.5.1.3 1 Intermediate Absorption Tower

IND+GER

consisting of:

IND

The cylindrical shell of mild steel in welded construction, with dished bottom, gas-inlet, gas-outlet and acid in- and outlets.

Bottom and shell will receive a multi-layer acid resistant lining.

GER

Before the gases are leaving the intermediate absorption tower, they pass a wire-mesh-filter, arranged in the upper part.

For distribution of acid over the entire cross section of the absorption tower, irrigation pipes, made of special designed cast iron, are arranged.

The acid is fed to the irrigation system by means of cast iron pipes.

The cover, as well as the gas outlet socket with elbow, are made of stainless steel.

A filling, consisting of INTALOX-saddles, made of acid resistant stone ware, will be provided for the intermediate absorption tower.

The absorption tower will be also equipped with sight glasses and 1 mechanical level indicator for measuring the acid level in the lower part.

4.5.1.4 1 Final Absorption Tower

consisting of:

IND The cylindrical shell of mild steel in welded construction, with dished bottom, gas-inlet, gas-outlet and acid in- and outlets.

Bottom and shell will receive a multi-layer acid resistant lining.

GER Before the gases are leaving the final absorption tower, they pass a wire mesh filter, arranged in the upper part.

For uniform distribution of acid over the entire cross section of the tower, an irrigation system, made of specially designed cast iron pipes, is arranged.

The acid is fed to the irrigation system by means of cast iron pipes.

The cover of the gas outlet with dome and elbow will be made of stainless steel.

A filling, consisting of INTALOX-saddles, made of acid resistant stone ware, will be provided for the final absorption tower.

The absorption tower will be also equipped with sight glasses and one mechanical level indicator for measuring the acid level in the lower part.

4.5.1.5 3 Pump Tanks

IND one tank for the drying tower circuit,
one tank for the intermediate absorption circuit,
one tank for the final absorption circuit,

each consisting of:

a vertical cylindrical shell with vaulted bottom, made of mild steel;

the acid resistant lining material, as well as a mechanical level indicator;

branches are provided for acid filling, acid pumps, circulating acid and level indicator.

4.5.1.6 - Water Injectors

GER for the addition of dilution water, made of teflon-coated steel, will be provided for the intermediate absorption tower and final absorption tower, one for each tower.

4.5.1.7 - The Acid Coolers

IND for the drying tower circuit.

4.5.1.8 - The Acid Coolers

IND for the intermediate absorption- and final absorption circuits and production acid.

4.5.1.9 - The Gas Ducts

IND in welded steel construction within the drying and absorption section for air, SO_2- and SO_3-gases, incl. the necessary expansion joints with lift limitations, as well as blind flanges/shut-off plates;

	Material		
GER	for gas ducts:	partly:	mild steel,
		partly:	boiler plate,
		partly:	heat resistant steel,
		partly:	plastic (for dilution air only)
IND/GER	Expansion joints:	partly:	boiler plate,
		partly:	stainless steel;
	Flanges for stainless steel expansion joints:		mild steel.

4.5.1.10 - Butterfly Damper

IND one for gas tight design, manually operated;

IND one for atmospheric dilution air, made of plastic material, motor-operated;

two for SO_2/SO_3-gases, made in welded steel construction; manually operated by hand-wheel or sprocket wheel with chain.

4.5.1.11 - The Acid Pipe Lines

GER mainly of acid resistant cast iron,
partly made of enamelled cast iron,
partly made of mild steel welded tubes.

4.5.1.12 - The Acid Valves

GER of acid resistant material,
designed for the various temperatures and concentrations of acid to serve;

- body, cover and gate,
  all made of stainless steel cast,
- hand wheel,
  made of ordinary cast iron.

4.5.1.13 - The sight Glasses

IND for observing the flow of acid,
the sight glasses, made of pressed hard glass,
fitted in acid resistant cast iron bodies.

4.5.1.14 - The Lines

IND for dilution water, as well as one small level tank, including fittings and valves, made of mild steel.

4.5.1.15 - The Density-Meter Feed- and Discharge Pipes

IND incl. accessories,

as well as the analysis and pressure measuring pipes,

including valves and accessories,

all made of stainless steel.

4.5.1.16 - The Vent Pipes

IND

made of mild steel.

4.5.1.17 - The Water Pipelines

IND for cooling water,

made of mild steel,

including valves, to connect the acid coolers of the various circuits with the feed pipe for the cooling water at battery limits.

4.5.1.18 2 Wire-Mesh-Filters

GER - one filter,
arranged in the drying tower.

Materials: hostaflon knitmesh and stainless steel top and bottom structure;

- one wire-mesh filter,
arranged in the intermediate absorber,
in one-stage design.

Materials: hostaflon knitmesh and stainless steel top and bottom structure.

4.5.1.19 1 Candle Type Filter

GER arranged in the top of the final absorption tower, material: glass fibre in stainless steel cages

4.5.1.20 - Instrument Air Pipes

IND made of stainless steel, as well as the necessary ball valves, also made of stainless steel.

4.5.1.21 - Lifting Equipment

IND 2 hoists, manually operated,
- 1 for serving the shut-off plate,
- 1 to serve the acid pumps.

4.5.1.22 - The Ladders, Platforms and Handrails

IND within the drying and absorption section, for the irrigation towers and pump tanks, made of welded sectional steel construction; flooring for platforms, made of galvanized grate.

4.5.1.23 - The Supports

IND made of steel sections for the gas-, acid- and other ducts and pipe lines within the drying and absorption section.

4.5.1.24 - The Supports and Platforms
IND

with ladder,
for dilution water level tank.

4.5.1.25 - The supporting Beams and Gantries
IND

for the cable tray system and lifting equipment.

4.5.1.26 - The required small Materials
IND

consisting of bolts, nuts, packings, glass ware, etc.

4.5.1.27 - The Insulation
IND

- for acoustic purposes
  for the gas ducts on the inlet side, as well as on the outlet side, of the SO_2-gas compressor;

- for thermal purposes
  for the duct from the intermediate absorption tower to the intermediate heat exchanger, as well as for the duct from the heat exchanger II to the final absorption irrigation tower;

consisting of mineral wool blankets and a 1 mm aluminium cover sheeting.

4.5.1.28 - Emergency Showers
IND

arranged near the acid pumps within the drying and absorption section,

including eye-washers,
to be operated by hand or foot.

4.5.1.29 - Centrifugal Acid Pumps
GER

vertical design,

for the following duties:

1 vertical pump
for the drying tower circuit,

1 vertical pump
for the intermediate absorption circuit,

1 vertical pump
for the final absorption circuit,

1 vertical pump
for the production acid.

The above mentioned pumps will be Chemical Process Pumps for concentrated sulphuric acid.

The material for the pumps will be provided for the actual temperatures and concentrations, including flexible couplings with guards.

The pumps are provided for electrical motor drive.

4.5.1.30 1 SO_2-Gas Blower
GER

Medium: gas with approx. 8 % SO_2

Details of Design

Single-inlet centrifugal compressor with open impeller in overhung position;

consisting of:

Scroll housing horizontally split, made of cast iron;

Transition diffuser on the outlet;

Open steel impeller with forged impeller body and welded-on, radially ending blades;

Shaft;

Shell at the shaft passage through the blower housing, horizontally split, designed as carbon ring sealing with sealing gas connection;

Welded steel bearing pedestal with integral sleeve bearings. Bearing pedestal and sleeve bearings horizontally split; common lubrication.

Bar thermometers to control the bearing temperatures;

The coupling between blower and turbine, (coupling guards included);

The base frame to receive the fan and the turbine of fabricated welded construction using mild steel plates and sections;

- Oil Supply Equipment

water oil cooler, oil filter, electric gear oil pump for starting and stand-by, oil manometers, oil thermometers, pressostat, oil reservoir (arranged in the base frame), oil piping and the required fittings flow detector;

1 Sound Absorging Hood

to reduce the noise level to 85 dB(A), measured at a distance of 2 m from the hood;

the hood is equipped with a forced ventilation system.

4.5.1.31 IND 1 Final Gas Stack

in self-supporting structure;

Material: mild steel;
top of stack will be made of stainless steel.

Converter Group

4.5.1.32 1 Tray Type Converter
IND

The converter consists of a stiffened shell made of boiler plate and heat resistant steel; acid resistant lining material is provided for the protection of the shell; all parts of the shell, top cover and gas in- and outlets not bricklined, which come into contact with hot gases above 420 °C will be spraycoated with aluminium after sand blasting, where boiler plate is utilized only.

For reaching every individual tray for inspection purposes, the shell is equipped with two manholes for each tray. Inside the converter four trays will be provided to receive the catalyst material.

The converter comprises:

GER(partly) the shell,
partly made of boiler plate,
partly made of heat resistant steel
with flat bottom, conical top;

rectangular gas inlets and gas outlets with manholes above all trays;

GER(partly) the trays are made of perforated heat resistant materials;

the bricklining materials
for lining the complete converter shell and bottom with one layer of bricks;
the material used will be an acid resistant brick;

the necessary mortar for bricklining the converter, viz. potassium silicate and water glass.

4.5.1.33 - Vanadium containing Catalyst
IND

of different hardnesses.

4.5.1.34 - RASCHIG-rings 25 x 25 x 3 mm

IND

made of ceramic material as covering layer for the catalyst.

4.5.1.35 - INTALOX-saddles 3/4"

IND

made of ceramic material as supporting layer for the catalyst.

4.5.1.36 1 Heat Exchanger I

IND

for heating up the preheated gases coming from the heat exchangers IV by means of the gases coming from the first layer of catalyst of the converter; operating in accordance with the cross current principle;

the heat exchanger comprises:
a straight bottom,
a cylindrical lower and upper part,
an intermediate part with tubes and tube plates,
expansion joint with guide plates, as well as gas inlet and outlet;

the bottom of the heat exchanger will be lined with one layer of acid resistant bricks, for protection against condensate;

the tubes of the heat exchanger are made of mild steel.

4.5.1.37 2 Heat Exchangers II

IND for heating up the preheated gases coming from the intermediate absorption by means of the gases coming from the second layer of catalyst of the converter;
operating in accordance with the cross current principle;

each heat exchanger comprises:
a straight bottom,
a cylindrical lower and upper part,
an intermediate part with tubes and tube plates,
expansion joint with guide plates, as well as gas inlet and outlet;

the bottom of the heat exchanger will be lined with one layer of acid resistant bricks, for protection against condensate;

the gas-inlet chambers will be spray-coated with aluminium after sand blasting,
the tubes of the heat exchanger are made of mild steel.

4.5.1.38 1 Heat Exchangers IV

IND for heating up the gases coming from the drying tower by means of the gases coming from the fourth layer of catalyst of the converter;
operating in accordance with the cross current principle;

the heat exchanger comprises:
a straight bottom,
a cylindrical lower and upper part,
an intermediate part with tubes and tube plates,
expansion joint with guide plates, as well as gas inlet and outlet;

the bottom of the heat excharger will be lined with one layer of acid resistant bricks, for protection against condensate;

the tubes of the heat exchanger are made of mild steel.

4.5.1.39 1 Heat Exchanger III

IND for preheating the gases coming from the SO_2-gas blower by means of the gases coming from the third layer of catalyst;
operating in accordance with the cross current principle;

the heat exchanger comprises:
a straight bottom,
a cylindrical lower and upper part,
an intermediate part with tubes and tube plates,
expansion joint with guide plates, as well as gas inlet and outlet;

the bottom of the heat exchanger will be lined with one layer of acid resistant bricks, for protection against condensate;

the tubes of the heat exchanger are made of mild steel.

4.5.1.40 - Preheater Unit

consisting of:

IND
- refractory lined combustor, complete with oil burner and flue gas distribution ring;
- tube bundle with refractory lined casing;
- combustion air fan;
- combustion controls as required for the system.

The preheater unit will be designed for initial preheating of the converter system, including catalyst for start-up purposes, as well as reheating after idle operations.

4.5.1.41 - The Oil Piping

IND for the preheater unit;

for the connection from battery limits to the oil pump and the oil pump to the oil burner, including fittings and other accessories.

4.5.1.42 - All necessary connecting Duct Work

for the different gases within the converter group,

including the required expansion joints, with the necessary lift limitations;

partly made of mild steel,
partly made of boiler plate,
GER partly made of heat resistant steel;

the ducts and expansion joints, coming into contact with hot SO_3-gases of more than 420 °C, will be spray-coated with aluminium after sandblasting where carbon steel is utilized only.

4.5.1.43 - Shut-off Plates
IND

manually operated,

made of boiler plate
or heat resistant steel.

4.5.1.44 - Butterfly Dampers

IND off butterfly dampers to be manually operated with sprocket wheel and chain, off butterfly damper to be pneumatically operated;

all made of boiler plate or heat resistant steel in welded construction.

4.5.1.45 - Gas-Gate Valves

IND bodies made of meehanite cast iron;

partly equipped with electric actuator,
partly equipped with sprocket wheel and chain for manual operation.

4.5.1.46 - Analysis and Pressure Measuring Pipes

IND as well as the instrument pipes;

for the converter group,
including valves;

the pipes are made of stainless steel, as well as the ball valves and the condensate valves.

4.5.1.47 - Service Platforms and structural Steel Supports

IND within the converter sections,

for the converter and the ducts in different design,

including saddles, hangers and springs, as well as rollers.

4.5.1.48 - All necessary Insulation Material

IND for thermal and acoustic insulation of equipment and duct work within the converter group;

Materials:

mineral wool blankets or blocks bound with chicken mesh of appropriate thickness;

for outside protection aluminium sheets have been included.

4.5.1.49 - Hoist

IND for serving a shut-off plate,

manually operated.

4.5.1.50 - All necessary small Parts

IND such as nuts and bolts, gaskets, small steel parts, etc.;

required within the converter group.

4.6 Electrical Equipment and Turbo-Generator Plant

4.6.1 IND Turbo-Alternator-Set

Rating

- live steam pressure	:	40 bar
- live steam temperature	:	350 °C
- operating voltage	:	3.3 kV, 3-phase
- frequency	:	50 Hz

Design

The turbo-alternator-set will consist of a condensation turbine with a generator and will be designed for island operation and for operation in parallel with the 6 kV network.

Technical Data

a) turbine

- swallowing capacity	:	normal 16 000 kg/h
		max. 18 000 kg/h
- speed	:	11 900 rpm
- extraction	:	0...1 800 kg/h at 5 bar

b) generator

- output at 18 000 kg/h without extraction live steam of 40 bar and 350 °C	:	3 500 kW
- output at 18 000 kg/h with extraction 1 800 kg/h		3 300 kW
- power factor	:	0.8
- speed	:	1 500 rpm
- system	:	3-phase, 50 Hz
- construction	:	B3/D6
- protection	:	IPR 44

Additional Data for Generator Control and Protection

a) Turbine-Operation

The turbine will be capable of operation both in parallel with the network or as an isolated generator feeding only the plant.

During parallel operation, the turbine control objective will be to maximise the use of available steam. Governor control action will therefore be to open the steam valve as far as possible without the high pressure steam line pressure falling below 40 bar. In this way maximum electrical power will be generated under any given combination of steam supply and plant operation conditions. It is important to note that during parallel operation the speed of the turbine-alternator-set is rigidly determined by the net frequency.

When operating as an isolated generator, governor action will be based solely on speed in order to ensure a proper 50 Hz supply to the electrical drives. Should there be inadequate steam available to the turbine, it will be necessary to disconnect some electrical load, before a speed drop of the turbine will occur.

If the operation of the alternator will be changed from parallel operation to isolated operation, the change over from pressure controlling to speed control will be done automatically.

b) Turbine-Protection

In the event any of the mechanical and/or electrical protection or the emergency push button are calling for a shut down, the quick shut-off valve or the alternator circuit breaker or both will be tripped automatically. If the quick shut-off valve is tripped only, the alternator circuit breaker will be tripped by the reverse power relay before the alternator will be feeded by the network. The required de-excitation will be done automatically. If for some reasons the turbine will be suddenly unloaded, the turbine speed will intercepted before a dangerous overspeed can occur, which would effect a trip of the quick shut-off valve.

c) Alternator-Operation

When connected in parallel with the network, the alternator will be unable to exercise any significant control over the 3.3 kV voltage thus the automatic voltage regulator (A.V.R.) will be controlled on the basis of the power factor of the alternator.

Should the net supply be lost, the A.V.R. will assume normal voltage control fully automatically. This changeover is effected by the turbine generator control equipment.

d) Alternator-Protection

The following protections and/or protection relays will be provided:

- overcurrent time relay
- differential relay
- reverse power relay
- stator earth fault relay
- high voltage relay
- winding overtemperature
  temperature transducers embedded in the stator will protect against winding over-temperature
- bearing overtemperature
  this transducer will guard against bearing failure
- overvoltage
  subject to the advice of the net regulating on 50 Hz dynamic overvoltage relay will be installed.

Fault conditions in the electrical circuit of the alternator will be detected by a high impendance, unbiased differential relay and earth fault protection.

The C.T.'s for this protection will be located at the (external) star point of the alternator winding and on the 3.3 kV bus side of the alternator circuit breaker;

- undervoltage- underfrequency relay
- A.V.R. relay
- underfrequency relay
- unbalanced-load protection
- overfrequency relay.

e) Busbar and H.V. Circuits-Operation

During normal operation the alternator circuit breaker will be closed giving parallel operation with the network supply. In the event of a serious disturbance in the network, the 3.5 MW turbine alternator set will either speed up or slow down and possible run at reduced voltage; the exact situation depending on the nature and location of the disturbance. Since the nature of the disturbance will be unknown at the control room, mains failure can only be inferred by frequency deviations. It is therefore proposed to supply two relays to detect both high and low frequency. In the event of either relay operation the circuit breaker will be tripped, locked out and the turbine alternator revert to independant running.

It is understood, that the network is subject to earth faults. To prevent these faults unduly affecting the operation of the turbine alternator, the circuit breaker will be fitted with directional overcurrent and earth fault protection so that should the alternator feed a fault in the network, the circuit breaker will trip and lock-out.

To facilitate synchronisation of the turbine alternator to the network supply an half-automatic synchronizer will be supplied.

This design renders to bring the turbine up to speed by hand and if the frequency and the phases are synchron to the network, the alternator circuit breaker will be closed automatically. This operation prevents unnecessary stresses of mechanical and electrical equipment.

For synchronising a synchronoscope dual-voltmeters and dual-frequencymeters will be provided.

Whilst facilities will be provided adjacent to the turbine to run it up to speed, we believe that the paralleling operation should only be carried out in a quiet room to avoid as many causes of operator distraction possible.

f) Plant Metering

We will supply MW, MVar and kWh metering on the bus couples and turbine alternator circuit breakers. The turbine alternator circuit breaker will also carry power factor, current, voltage and frequency metering.

g) Surge Protection

We have made provision for station class surge divertors with blow-out valves in view of lighting activities and the fact, that the alternator is directly connected to the 6 kV-system.

Scope of Supply

- turbine with alternator;
- auxiliary- and main exciter (brushless);
- main condenser; auxiliary condenser;
- vacuum pumps;
- oil pumps;
- control panel for instruments, push buttons, signalling lamps, etc.;
- switch board for contactors, auxiliary relays, fuses etc., for auxiliaries and controls.

4.6.2 Electrical Equipment for Pyrit Storage and Handling, Roasting Plant, Gas Cleaning Plant, Sulphuric Acid Plant

IND

DESIGN DATA

High voltage	:	3.3 kV, 50 cps
Low voltage	:	415 V, 50 cps
Control voltage	:	220 V, 50 cps
Signal voltage	:	24 V, D.C.
Standards	:	DIN, IEC.

High Voltage Switchgear Plant

Rating:

Operating voltage	:	3.3 kV, 50 cps
Breaking capacity	:	350 MVA
Control voltage	:	220 V, D.C.

Design

Sheet metal-clad type (IP 21), with partions between the cells, single busbar system, single-row layout of the switch cell, switchgear truck with motor-operated circuit breaker, switching cycle counter, front door of the switchgear truck with installed control instruments, emergency off momentary contact switch for circuit breaker, earth isolator, indoor installation;

signalling display built in switch-cells for fault signalization as well as for overcurrent, over-temperature, Buchholz etc.

Outfittings

1 incoming feeder panel;
circuit breaker, 3 current and 3 voltage transformers, 1 voltmeter, voltmeter switch, wattmeter, frequency meter, earth leakage relay, protective and auxiliary equipment;

4 outgoing feeder panels for high-voltage motors;
circuit breaker, current and voltage transformer, 1 ammeter, wattmeter, hourmeter, thermal overload relays in 3 phases, protective and auxiliary equipment;

2 outgoing feeder panels for transformer, 630 A, 3 kV;
circuit breaker, current transformer, protective auxiliary equipment;

1 measuring panel;

1 turbo-alternator feeding panel,
circuit breaker, 3 current transformers, overload and short circuit protection with time lag, Wmeter, kWh meter, ammeter, protective and aux. equipment.

Transformers for the low Tension Power Switchboard

Rating	:	1 250 kVA
Voltage	:	3.3 / 0.415 kV
Impedance voltage	:	u_k = 6 %

three-phase oil-cooled transformer for indoor installation, off-circuit ratio adjuster ± 10 %, neutral brought out, tank cover with thermometer well, tank with oil drain device, cable terminal, expansion tank with liquid-level indicator, transformer with lifting eye, normal coat of paint, thermal switch for alarm and tripping, Buchholz relay for alarm and tripping.

Scope of Supply

2 transformers.

Batteries and Charges for DC-Control Voltage and Emergency Supply

Rating	:	415 V, 50 Hz
Input voltage	:	220 V.

Design

For the tripping supply of the 3.3 kV circuit breakers, consumers with charger for continuous charging are designed.

Outfitting

The batteries will be lead acid type.
The charger unit includes the transformer, rectifier, control devices etc.

Scope of Supply

1 battery with ca. 100 cells for 220 V,

2 battery chargers:

input voltage : 415 V, 50 Hz
output voltage controlled;

1 DC-voltage switch gear.

4 High-Voltage Motors

Voltage	:	3.3 kV, 50 cps
Enclosure	:	totally enclosed, IP 54 (T.E.F.C.)
Type	:	squirrel cage motor, fan-cooled;

suited for direct on-line starting.

Design

The motors will be a 3-phase squirrel cage induction machine for 6.0 kV, 50 cycles, and suitable for direct on-line starting.

The enclosure of the motors will be of a totally enclosed fan-cooled type;
insulating class "F", temperature rise in accordance with class "B" will be provided.

Scope of Supply

2 high-tension motors, 200 kW,

1 high-tension motor, 250 kW,

1 high-tension motor, 1000 kW.

Low-Voltage Switch Gear

Rating

- operating voltage	:	415 V, 3-pbhase 50 Hz
- bus bars system	:	single bus bar
- control voltage	:	220 V, 50 Hz

Design

Generally, the switch gear will consist of two main parts:

a) power section
built as MCC with withdrawable units

b) control section
with fixed mounted equipment.

The switchgear will be a metal-enclosed type for in-door installation and completely wired.

Protection: IP 40

The power section will be equipped with:

- 2 incoming feeders
- 1 bus bar coupler
- transformers for control voltage for all contactors, relays, etc. with sufficient capacity
- 3 pol. bus bars and PEN
- feeders for motors and/or consumers as required.

The control section will comprise all required auxiliary relays for motor controls and/or interlockings. The auxiliary relays will be fixed mounted.

Technical Data

The incoming feeder will be equipped with:

1 only 3-pol. hand-operated breaker,
with over-load and over-current protection,
3 ammeters,
1 only voltmeter with selector switch,
1 only kWh-meter,
- current transformers, as required,
- miniature circuit breakers for control and measuring devices, as required.

The feeders for motors and/or consumers will be equipped with:

1 only 3-pol. load-break isolating switch and HRC-fuses,
1 only 3-pol. main contactor,
1 only 3-pol. thermal over-load protection relay,
1 only 1-pole miniature circuit breaker for control voltage,
- current transformer, as required.

As mentioned before, the control section will comprise all required auxiliary relays, time relays, etc.

The motors will be controlled locally only or at the instrument control panel in the control room. Motors that are controlled from this panel can be controlled locally too. For that purpose, a delocking switch with start- and stop-button will be installed near the motor. To prevent accidents, motors which are provided with remote control can only be started after a start-up warning has been given. The button for this warning will be installed at the instrument and control panel and the required control system in the control section.

Scope of Supply

1 only low tension switch board,

consisting of power and control section, as described above for roasting gas cleaning and H_2SO_4 plant.

1 only low tension switch board consisting of power and control section as described above per pyrite ore preparation plant.

Low-Voltage Motors

Voltage	:	415 V, 50 cps
Enclosure	:	totally enclosed, IP 54 (T.E.F.C.)
Type	:	squirrel cage motor, fan cooled;

suited for direct on-line starting.

Scope of Supply

number of consumers according to consumer list.

Local push Button Stations

The motors can be locally operated through start-stop push buttons located inside enclosed box next to each motor.

For motors over 7.5 kW, an ammeter is incorporated in this box.

For interlocking drives, operation of sequences possible from instrument control panel; an interlocking switch is also provided in the local push button station.

Signalisation

Motor and process alarms, number as required, to be mounted in a separate cubicle, withdrawable relay-type design, output voltage 24 V D.C., the signalling lamps and momentary contact push buttons for lamp control and fault signal acknowledgement will be built into the control panel.

Operating voltage : 24 V DC

Layout of the signalling plant according to the following diagram:

	operating state	signal lamp	horn
Motor signal	off	off	off
	on	steady light	off
	cut off	off	off
	failure	rapid flashing	on
	acknowledge	slow flashing	off
Process signal	no fault	off	off
	fault	rapid flashing	on
	acknowledge	slow flashing	off
	fault cleared	off	off

Lighting Plant, Socket Devices

The lighting distributon will be included in a separate cubicle of the low-tension switchboard.

Fluorescent fixtures and HQL-lamps will be used for lighting.

Lighting will be provided with low-voltage tubular lamps.

The following light intensities will be used:

30-60 Lux - in the plant, on the walkways, stairs, access ways, motors, valves etc.

350 Lux - in the instrument control panel room,

300 Lux - in the switchgear plant room.

Two 220 V socket outlets each are provided in the instrument control panel and in the low tension switching plant room.

415 V socket outlets are arranged in the plant, so that a cable of 30 m length will reach every point of the plant.

Emergency lighters will be provided by means of incandescent lamp 25 W, situated next to emergency way-outs, important stair cases, control rooms and switch gear.

Cables

For power supply, control and lighting PVC insulated, PVC sheathed, cables with copper conductors will be used. The smallest cross section is 2.5 mm^2 for motors and socket outlets and 1.5 mm^2 for control cables and lighting.

The maximum voltage drop is 4 % of motor rated current.

Provision has been made for the required cables between high-voltage switchgear plant, transformers and 6 kV-HT-motors, low-voltage switchgear plant, motors, lamps, socket outlets and local control devices.

Installation Material

For the above mentioned items and complete installation material, which is required for the erection of the plant, ready for operation, installation material has been provided such as ascending cable route with fixtures and supports, cable racks, rack brackets, sectional irons, clamps, clips, screwed connections, protecting tubes etc.

Earthing System

The earthing system will be executed with galvanized strip steel 30 x 3.5 mm.

The scope of supply comprises all materials including fastening material required for earthing of containers and of the low-tension switchgear plant.

Connection of the earthing system to the connecting points above ground in required number.

Earthing rods and their electrical interconnection.

4.7 Measuring and Control Instruments

4.7.1 Roasting Plant

IND

Concentrate Bins Level Alarm

consisting of:

8 paddle type level switches

Temperature Measurement Roaster, Waste Heat Boiler and Gas Ducts

consisting of:

24 double thermocouples NiCr-Ni with stop and counter flange

2 measuring point selector switches for 24 measuring points

2 electric indicators

2 electric 12-colour dot recorders

2 cold junction boxes for 24 thermocouples NiCr-Ni.

Local Cooling Water Flow

consisting of:

1 flow meter (rotameter)

Temperature Monitoring System Roasting Air Blower Motors Windings

consisting of:

12 resistance thermometers (incl. in mech. supply)

2 electr. indicators each for 6 points

2 signal units with 2 limit contacts

2 selector units

2 R/I converters

Local Level Measurement Fuel Oil Tank

consisting of:

2 float type level indicators (incl. in mech. supply)

Roasting Air Pressure

consisting of:

2 shut-off valves

2 electric pressure transmitters

2 electric two-line recorders (second line roasting air flow)

2 protection boxes for transm.

2 power supply units for transmitters.

Roasting Air Flow

consisting of:

2 orifice plates

4 shut-off valves

2 3-valve manifolds

2 electric differential pressure transmitters

(recorded with roasting air pressure)

2 power supply units for transmitters with square-root extraction.

Pressure Measurement Roaster Outlet

consisting of:

2 shut-off valves

2 electric pressure transmitters

2 electric indicators

2 air purge units with diff. pressure controller

2 protection boxes for transmitter

2 power supply units for transmitters

2 air press. red. station.

Waste Heat Boiler and Cyclone Outlet Pressure

consisting of:

4 shut-off valves

4 electric pressure transmitters

2 electric indicators

4 air purge units with diff. pressure controllers

4 protection boxes for transmitters

4 power supply units for transmitters

4 air press. red. station

Remote Control Roaster Air Damper and Inlet Vane

consisting of:

4 push buttons "more-0-less"

4 electric position indicators

4 supply units for position transmitter

4 dampers with electric actuator and position transmitter
(incl. in mech. supply)

Remote Control Discharge Conveyor

consisting of:

4 electric speed indicators

4 electric speed transmitters

4 push-buttons "more-0-less"

4 control drives with tacho-generator
(incl. in mech. supply)

Secondary Air Flow

consisting of:

2 orifice plates with armoured edges

4 shut-off valves

2 3-valve manifold

2 differential pressure indicator

2 protection box

Miscell. Local Temperature Measurements, Cooling Air

consisting of:

2 bimetallic thermometers with protection tubes.

Local Pressure Measurement, Cooling Air

consisting of:

1 capsule-type pressure gauge

1 shut-off valve

Pressure Measurement Electric Precipitator Outlet

consisting of:

2 shut-off valves

2 electr. pressure transmitters

2 electr. 1-line recorders

2 power supply units for transmitters

2 protection boxes for transmitters

Remote Control of Butterfly Dampers

consisting of:

3 push buttons "more-0-less"

3 electric position indicators

3 power supply units for position transmitters

3 butterfly valves with electr. actuators
and with electr. position transmitters
(incl. in mech. supply)

Miscell. Local Temperature Measurements

consisting of:

12 bimetallic thermometers with protection tubes

Local Pressure Measurement, Cooling Water

consisting of:

2 shut-off valves

2 bourdon type pressure gauges

Time Control of Raco-Cylinder for Shutter

consisting of:

4 time relays

2 hand/auto. switches

2 open/closed switches

1 motor control cubicle with its auxiliaries
(incl. in the electr. scope of supply)

2 Raco-cylinders with electr. actuator
(incl. in mech. supply)

Current Measurement of Roasting Air Blower Motors

consisting of:

2 on/off switches

2 ammeters

2 I/I-converters
(incl. in the electr. scope of supply)

Current and Voltage Measurement of Precipitators

8 on/off switches

4 ammeters

4 voltmeters

4 U/I converters

4 I/I converters

Flow Measurement Pyrite Feed to Roasters

consisting of:

1 idler weigher

1 control cubicle for local installation
with flow indicator, counter, weighing bridge and band speed meter
(incl. in mech. supply)

1 electr. 1-line recorder

1 electr. integrator with counter

Oxygen Gas Analysis Outlet of
Electrostatic-Precipitators

consisting of:

2 gas sampling devices with filter

2 gas flowmeters with needle valve

2 paramagnetic gas analyzers with power supply unit

2 analysis cabinets made out of polyester, glass fibre reinforced, completely mounted, wired and hosed with auxiliaries, ready for connection, for local installation

1 electric 2-line recorder

4.7.2 Waste Heat Boiler

IND

Temperature Control Superheated Steam

consisting of:

2 double thermocouples NiCr-Ni with protecting well, weld-in type

2 U/I-converters

2 electrical PI-controllers

2 el./pn. positioners

2 electric two-line recorders (second-line steam flow)

2 3-way mixing slide valves with pneum. actuator (incl. in mech. supply)

2 supply pressure regulator stations

Steam Drum Pressure

consisting of:

2 shut-off valves

2 electric pressure transmitters

2 electric indicators

2 protection boxes for transmitters

2 syphon tubes

Steam Pressure Control

consisting of:

2 shut-off valves

2 electric pressure transmitters

2 electric single-line recorders

2 protection boxes for transmitters

2 syphon tubes

2 electric controllers

2 el./pn. positioners

2 control valves with pneum. actuators

2 supply pressure regulator stations

Local Pressure Indication Steam Drum and Steam Line

consisting of:

5 Bourdon type pressure gauges

5 syphon tubes

5 shut-off valves

Local Pressure Indication Feed Water and Circulating Pumps

consisting of:

12 Bourdon type pressure gauges

12 shut-off valves

Local Pressure Indication Deaerator

consisting of:

1 Bourdon type pressure gauges

1 syphon tubes

1 shut-off valves

Local Temperature Indication Water and Steam Lines, Feed Water

consisting of:

11 bimetallic thermometers with protection tube

Pressure Control Steam Reducing-Stations

consisting of:

2 direct-acting electro-hydraulic pressure controller

Pressure Control Deaerator and Turbo Set

consisting of:

2 direct-acting pressure controller

Circulating Water Flow
---

consisting of:

4 orifice plates

8 shut-off valves

4 3-valve manifolds

4 electric differential pressure transmitters

4 electric indicators with limit contacts

2 electr. double-line recorders

4 protection boxes for transmitters

4 power supply units for transmitters
with square-root extraction

pH-Measurement in Condenser Line
---

consisting of:

1 flow chamber for pH

1 set of measuring and reference electrodes

1 pH-amplifier

1 electr. indicator with limit contacts

1 electr. single-line recorder

Flow Control Feed Water

consisting of:

2 orifice plates

4 shut-off valves

2 3-valve manifolds

2 electric differential pressure transmitters

2 electric PI-controllers (cascade controller)

2 electric 2-line recorders
(second line level steam drum)

2 protection boxes for transmitters

2 power supply units for transmitters
with square-root extraction

Steam Flow

consisting of:

2 annular chamber type standard orifice plates

4 balancing vessels

4 shut-off valves

2 5-valve manifolds

2 electric differential pressure transmitters
(recorded with temperature superheated steam)

2 protection boxes for transmitters

2 power supply units for transmitters
with square-root extraction

Level Control Steam Drum

consisting of:

2 balancing devices with condensate vessel

4 shut-off valves

2 3-valve manifolds

2 electric differential pressure transmitters (recorded with feed water flow)

2 electric PI-controllers (master controller)

2 computing relays (adder-substractor)

2 feedwater control valves with pneum. actuator and el./pn. positioner

2 supply pressure regulator stations

2 protection boxes for transmitters

2 power supply units for transmitters

Local Level Indication Steam Drum

consisting of:

4 level gauges

Local Level Alarm Steam Drum

consisting of:

2 float type alarm unit with minimum and maximum contact

Local Level Indication Feed Water Tank

consisting of:

1 level gauge

Local Level Control Feed Water Tank

consisting of:

1 direct acting level controller

Local Level Control Condensers

consisting of:

2 direct acting level controllers

Remote Control Start-Up Steam Valve

consisting of:

2 push buttons "less-0-more"

2 electric indicators for position indication

2 electric actuators with position transmitters

2 power unit for position transmitters

Local Level Alarm Feed Water Tank

consisting of:

1 float type alarm unit with min. and max. contact

Local Temperature Control Feed Water to Reducing Station

consisting of:

1 hydrolic temperature controller

1 control valve with pneum. actuator

Temperature Measurement Condenser Lines

consisting of:

2 resistance thermometers with protection tube

2 R/I converters

2 electr. indicators

4.7.3 Gas Cleaning Plant

IND

Gas Cleaning Section Inlet and Outlet Temperature

consisting of:

2 single resistance thermometers Pt 100

2 electric indicators

2 R/I converters

Temperature Measurement and Alarm Outlet Washing Tower

consisting of:

1 double-type resistance thermometer Pt 100

1 single-line recorder (electric)

1 electric indicator with limit contacts

1 auxiliary relay

1 solenoid valve

1 pneum. on-off valve

1 supply press. red. station

1 R/I converter

Local Temperature Measurement Gas-, Weak Acid- and Water Lines

consisting of:

6 bimetallic thermometers with protection tube

Local Pressure Measurement Gas Lines

consisting of:

5 U-tube pressure gauges, mounted on beechwood boards, with shut-off valves

Local Pressure Measurement Acid and Water Lines

consisting of:

4 diaphragm pressure gauges with open flange

Pressure Measurement Inlet and Outlet Gas Cleaning Section

consisting of:

2 shut-off valves

2 electric pressure transmitters

2 protection boxes

2 electr. indicators

2 power supply units for transmitters

4.7.4 Drying and Absorption Plant

IND

Local Differential Pressure Measurement Filters at Drying Tower, Intermediate and Final Absorbers

consisting of:

3 U-tube differential pressure gauges

6 shut-off valves

Local Temperature Measurement Cooling Water

consisting of:

5 bimetallic thermometers with protection tubes

Local Temperature Measurement Acid Lines

1 bimetallic thermometer with protection tube

Local Flow Measurements Dilution Water

consisting of:

2 flowmeters (rotameters)

6 shut-off valves

Local Level Control Process Water Tank

consisting of:

1 float type level controller with valve

Local Level Measurement Acid Pump Tanks

consisting of:

3 Local floats type-level-indicators

Local Temperature Measurement Gas Ducts

consisting of:

4 bimetallic thermometers with protection tubes

Acid Line Temperatures

consisting of:

6 resistance thermometers Pt 100

1 measuring point selector switch for 12 measuring points

1 electric indicator

1 power supply unit

Level Control and Alarm Acid Pump Tanks

consisting of:

3 bubbling tubes
(incl. in mech. equipment)

3 air purge units with differential pressure controller

3 electr. diff. pressure transmitters

3 electr. indicators with limit contacts

3 electr. PI-controllers

3 el./pn. positioners

3 supply pressure regulator stations

3 protection boxes for transmitters

3 control valves with pneum. actuators

3 power supply units for transmitters

pH-Measurement and Supervision Cooling Water

consisting of:

1 flow chamber

1 reference electrode

1 measuring electrode

1 resistance thermometer

1 electr. pH-transmitter

1 electr. indicator with limit contacts

1 protection box for transmitter

Acid Concentration Measurement and Control

consisting of:

3 acid coolers

3 flow chambers

3 conductivity electrodes

3 measuring transducers with electric indicators for local installation

3 electric PI-controllers

3 el./pn. positioners

3 control valves with pneum. actuator

3 electric one-line recorders

3 supply pressure regulation stations

3 protection boxes for transmitter

Remote Adjustment Air Damper

consisting of:

1 push-button "less-0-more"

1 electric indicator for position indication

1 electric actuator with position transmitter (incl. in mech. equipment)

1 power unit for position transmitter

4.7.5 Converter Plant

IND

Temperature Measurement Converter and Gas Line

consisting of:

8 single thermocouples NiCr-Ni (type K)

6 double thermocouples NiCr-Ni (type K)

1 measuring point selector switch for 24 measuring points

1 electric indicator

1 electric 6-point dot recorder

1 cold junction box for 24 thermocouples (NiCr-Ni)

Pressure Measurement SO_2 Blower Outlet

consisting of:

1 shut-off valve

1 electr. pressure transmitter

1 protection box for transmitter

1 electr. indicator

1 power supply unit for transmitter

SO_2-Gas Flow

consisting of:

1 orifice plate with armoured edge

2 shut-off valves

1 3-valve manifold

1 electric differential pressure transmitter

1 electric single-line recorder

1 protection box for transmitter

1 power supply unit for transmitter with square-root extraction

SO_2-Gas Analysis

consisting of:

1 gas sampling device with filter

1 washing and drying bottle

1 gas filter with filling

1 gas flowmeter with needle valve

1 thermal conductivity gas analyser with power supply unit

1 analyses cabinet made of polyester, glass fibre reinforced, completely mounted and wired/hosed ready for connection, for local installation

1 electric single-line recor

Remote Adjustment Vane Control SO_2-Blower and Cold Gas Valves

consisting of:

3 push-buttons "less-0-more"

3 electric indicators for position indication

3 electric actuators with position transmitters (incl. in mech. supply)

3 power units for position transmitters

Temperature Monitoring System SO_2-Blower Motor Windings and Blower Bearings

consisting of:

12 resistance thermometers (incl. in mech. supply)

2 electric indicators each for 6 points

2 signal units with 2 limit contacts

2 selector units

2 R/I converters

Preheater Temperature Measurement (cold gas inlet and outlet)

consisting of:

2 resistance thermometers Pt 100

2 electric indicators with limit contacts

1 protection box above

1 power supply unit

Local Differential Pressure Measurement Preheater

consisting of:

1 capsule-type manometer with limit contacts

2 shut-off valves

Local Temperature Measurement Outlet
Heat Exchanger III

consisting of:

1 bimetallic thermometer with protection tube

4.7.6 1 Instrument Panel

IND for accommodation of the measuring, recording and control instruments, completely mounted and fitted with wired and tubes ready for connection up to the terminal strips, with synoptic diagram including signalling lamps for process failures. It further included signal lamps for the motor drives as well as the required momentary-contact switches to start the motors or motor groups, which are installed in the plant.

The alarm system is included in the scope of the electric power distribution.

The instrument panel is:

open on the top and on the rear,
closed on the sides;

length:	approx.	8 000 mm
height:	approx.	2 500 mm
depth :	approx.	800 mm

4.7.7 Measuring Cables, Impulse Lines as well as Installation Material

IND

This item comprises all required cables, tubes, small parts and mounting materials for the above-mentioned measuring and control instruments.

Multi-core cables of the NYY type are mainly used; special cables will be used as far as required.

4.8 Civil Work, including Building and Structural Steel Work

IND

General

The cost estimate for the determination of the investment costs has been based on the relevant German Standards (DIN) and cost situation ruling in the F.R.G., 1985 June.

The quantity survey has been based on the following assumptions:

- allowable soil bearing pressure: not less than 20 N/cm² approx. 1.0 m below datum level;
- the plant site has been suitably graded by others (rough grading);
- the solids as well as subsoil water do not include corrosive properties; subsoil water table can be expected to be below the founding level;
- electric power as well as water consumption for building purposes will be free of charge.

Work included:

The coat estimate includes:

The engineering services:

- the static and dynamic computations,
- the design and workshop detailing for steel structure,
- the civil arrangement drawings,
- reinforcing drawings,
- bending schedules and list of embedded items,
- the architectural details,
- the placing plans for cladding.

The execution of:

- excavation, backfilling, removal of surplus material, blinding, concrete, reinforcement, formwork, surface treatment, plastering, decorating, painting and coating; PVC-tiling as well as acid proof tilings and linings were required; steel structure for buildings including floor coverings, corrosion, protection (gid blasting and painting, 200 µm dry film thickness), corrugated galvanized metal sheeting with all necessary flashings, metal doors, illuminated ceilings in the control rooms, windows or translucent sheeting inside the battery limits.

Battery Limits:

Included in the estimate are the buildings and plant sections themselves.

Not included are any work, storm water and sewage drainage systems, earth work for cables and piping, effluent treatment plant.

The rough grading, soil investigation and subsequent investigation report as well as costs for building permits, insurances, taxes and duties shall be borne by others.

The following buildings and plant sections have been included in the estimate:

Ore Preparation Plant

plant structures,
electrical substation,
foundations for screens,
crushers,
conveyors,
concrete pads for storage.

Roasting Plant

roofed pyrite storage,
pyrite unloading station,
conveyor bridge system to roasting building,
roasting building with cooling drum support,
hot gas cleaning section,
wet gas cleaning section,
sulphuric acid plant section,
SO_2-blower building,
electrical substation (high tension switch room).

Effluent Treatment Unit
for neutralizing the liquid effluents from the Plant

1. Effluent treatment pit,
   capacity approx. 200 m^3
   with concrete walls and anti-acid lining of walls.

2. ime/or Soda bin
   capacity approx. 10 cu.m.
   made of steel
   with a rotary valve (motorized) at the bottom, speed controlled, to adjust the feed rate of lime/or soda.

3. 1 circulating-cum-discharge pump,
   in acid-proof design, of
   suitable plastic material,
   capacity approx. 6 m^3/hr.
   Pressure-head: 2 bars
   to circulate or discharge the pit liquid.

4. Liquid pipe-lines, made of plastic material,
   i.d.: 2 inches, will the required valves and fittings.

5. 2 pH meters to measure and monitor the pH in the effluents!
   One instrument with remote indication/alarm in the control panel.

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Chapter 5

Budget Estimates of Costs of Equipment

5.1 Budget Estimates of Costs of Equipment in Plant

		RS	plus	DM
5.1.1	Pyrite Ore Preparation Plant and Pyrite Handling	: 7 100 000.—		-
5.1.2	Roasting Line 1 incl. HGP	: 10 200 000.—		3 670 000.—
5.1.3	Roasting Line 2 incl. HGP	: 10 100 000.—		3 280 000.—
5.1.4	Common BFW System for both Boilers	: 3 000 000.—		340 000.—
5.1.5	Wet Gas Cleaning Plant	: 12 500 000.—		2 430 000.—
5.1.6	Sulphuric Acid Plant	: 22 700 000.—		1 480 000.—
5.1.7	Electrical Equipment	: 12 100 000.—		-
5.1.8	Turbo-Alternativ Plant	: 14.200.000.—		-
5.1.9	Water Treatment Plant and Recooling Tower System	: 4 900 000.—		-
5.1.10	Measuring and Control Instruments	: 4 400 000.—		-
5.1.11	Steel support Structure (erected cost)	: 10 300 000.—		-
5.1.12	Civil Work incl. Concrete	: 3 300 000.—		-
5.1.13	Erection Cost of Plant Equipment	: 21 000 000.—		-
	Total Equipment and Plant Costs	: 135 800 000.—		11 200 000.—
	Total Weight of Equipment	: approx. 3 300 t		
	Total Weight of Steel Structure	: approx. 735 t		

The above German prices are based on actual wage tarifs and material costs ruling ont June 1985. The foreign portion is for supply FOB North Sea Port, incl. packing as far as required.

The Indian costs are based on current conditions and for delivery free to site, including packing as far as necessary.

Taxes, custom duties, levies or any surcharges are not included in the above prices.

In case of a contract the services and supplies can be divided between Indian and Foreign, whereby Lurgi is in a position to offer the foreign portion, following an enquiry.

The estimates are as follows:-

Basic Engineering and Know-How Fee (Lurgi Technology)	:	DM 3 100 000.--
Supply of Essential Parts, to be imported	:	DM 8 100 000.--

All prices are purely indicative and not binding to anyone.

Delegation of Personnel for Supervisory Services	:	DM 1 000 000.--

The tabulated equipment prices under 5.1 include the costs for -

- machinery
- vessels
- piping items, pipe supports and service platforms
- the external lagging
- the linings
- the painting
- the detail engineering and the basic engineering

Time Schedule

The completion time for the plant from zero date to commencement of production can be estimated to be approx. 30 months, when competent and experienced companies are engaged in the project execution.

Estimated Capital Investment

for Roasting & Acid Plant Amjhore

Capacity 320 tpd., 2 roaster Streams.

Exchange rate 1 DM = Rs 4.5

(Figures in Rs. Lakhs)

	Indian	German	Total
1. Equipment + Materials	994.72	371.28	1366.0
2. Freight, Insur. & Handling cif & free site (free flag)	55.00	37.00	92.0
3. Sales Tax	39.80	-	39.80
4. Custom Duty	-	-	-
5. Civil Works	33.00	-	33.00
6. Engineering & Procurement	79.20	146.48	225.68
7. Tax on Eng. fee	36.62	-	36.62
8. Erection, incl. Supervn. :	210.0	45.0	255.0
9. Tax on Supervn. :	29.25	-	29.25
10. Sub-Total :	1477.59	599.76	2077.35
11. Contigency :	44.41	10.0	54,41
12. Erected Plant Cost :	1522.00	609.76	2131.76

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Chapter 6

Operating Cost Estimates

6.1 Operating Cost Estimates

The costs are estimated at nominal load condition of the Plant.

Actually, similar plants elsewhere in the world give a working time or availability of over 95 %.

In the study considering more idle time due to familiarization of personnel with the plant operation and its maintenance in the initial stage an availability factor of only 90 % (330 days per annum) is assumed.

Plant operating Conditions:-

6.1.1 Working days per annum : 330 days

6.1.2 Daily acid production : 320 tpd

Annual acid production : 105 600 tpy

6.1.3 Pyrites consumption:

High grade Pyrites : 217 tpd = 71 610 tpy

Low grade Pyrites : 240 tpd = 79 200 tpy

6.1.4 Electrical power consumption
Total consumption for plant and off-sites assumed at 2400 kW (180 kW/t Acid) = 19 000 MWh/year

6.1.5 Internal power generation = 23 250 MWh/year

6.1.6 Estimated surplus power for export from plant = 4 250 MWh/year

6.1.7 Steam generation

Stream no. 1	:	95 040 t/a
Stream no. 2	:	31 680 t/a
Total		126 720 t/a

All steam is utilized in the T/G-set for power generation.

6.1.8 Fresh water consumption = 70 m^3/h

Fresh water supply yearly = 554 400 m^3/a

6.1.9 Chemicals consumptions:

Chemicals will be required as consumables for the demineralisation of boiler feed water. However the consumption will depend on raw water quality, but the costs involved are considered as insignificant on cost of production. The boiler feed water can be value added to cover these costs.

Boiler feed water requirement : 3 168 t/a
(approx. 2.5 % of circulated water)

6.1.10 The wash acid bleed can be utilized for the reaction in the SSP plant, provided toxic substances do not abound in the pyrites, such as Mercury, Arsenic, etc.

Since this is not the case the wash acid can be added in clear condition to the production acid.

Wash acid generation (assumed) = 4.8 tpd as MH

= 1 584 tpy as MH

6.1.11 Total Acid Production: 107 184 tpy as MH

6.1.12 Cinder Production:

Cinder of HGP: 6.8 t/h = 53 856 t/a

Cinder of LGP: 9.0 t/h = 71 280 t/a

Cinder from HGP can be partly added to cement during klinkering to adjust the iron module. Total use will depend on cement plants capacity to absorb the material and also the type of raw material used there.

The cinder from stream no. 2 has been found to have binding properties and can be used as a binder after proper conditioning. This can add to the revenue of the plant.

6.1.13 Plant manning:

For employing 80 persons at an average cost of Rs 1900/-month

annual expenditure will be: Rs 1 824 000.--

6.1.14 Repair and Maintenance

It is assumed that for repair and maintenance of the Plant approx. 3 % of equipment investment will do, though in the initial years the intensity of these costs can be considered less.

6.1.15 Cost of Pyrites:

The HGP has according to PPCL a cost of Rs 876.-- per tonne (PPCL telex of 10.10.85). It is assumed that the LGP being a waste by-product has nill-value.

6.1.16 Table of Approx. Operating Costs:

All costs in Indian Rupees

	Unit cost	yearly consumption	yearly cost
1. H.G. Pyrites :	876.--/te	72 000 te	63 072 000.--
2. L.G. Pyrites :	nil	79 200 te	-.-
3. Cooling water :	2.--/m³	555 000 m³	1 110 000.--
4. Boiler Feed water :	5.--/m³	3 168 m³	15 840.--
5. Chemicals & Lubricants :	-	Lump sum	50 000.--
6. Repair & Maintenance :	3% of equip. cost		4 100 000.--
7. Personnel :	1900.--/month	80	1 824 000.--
8. Compressed air :	0.1/m³	3 200 000 m³	320 000.--
9. Start-up oil :	4.--/kg	250 te	1 000 000.--
10. Cinder disposal :	10/te	125 136 te	1 251 360.--
Total operating costs :			Rs 72 743 200.--
Specific operating cost per ton of acid :			Rs 678.67/te Acid (MH)

6.1.17 Revenue from Production

All figures in Rupees

	Unit cost	yearly production	revenue
1. Sulphuric Acic :	1 350.--/t	107 184 te	144 698 400.--
2. Electric power :	0.75/kWh	4 250 000 kWh	3 187 500.--
Total revenue			Rs 147 885 900.--
Income per ton of produced acid:			Rs 1 380.--

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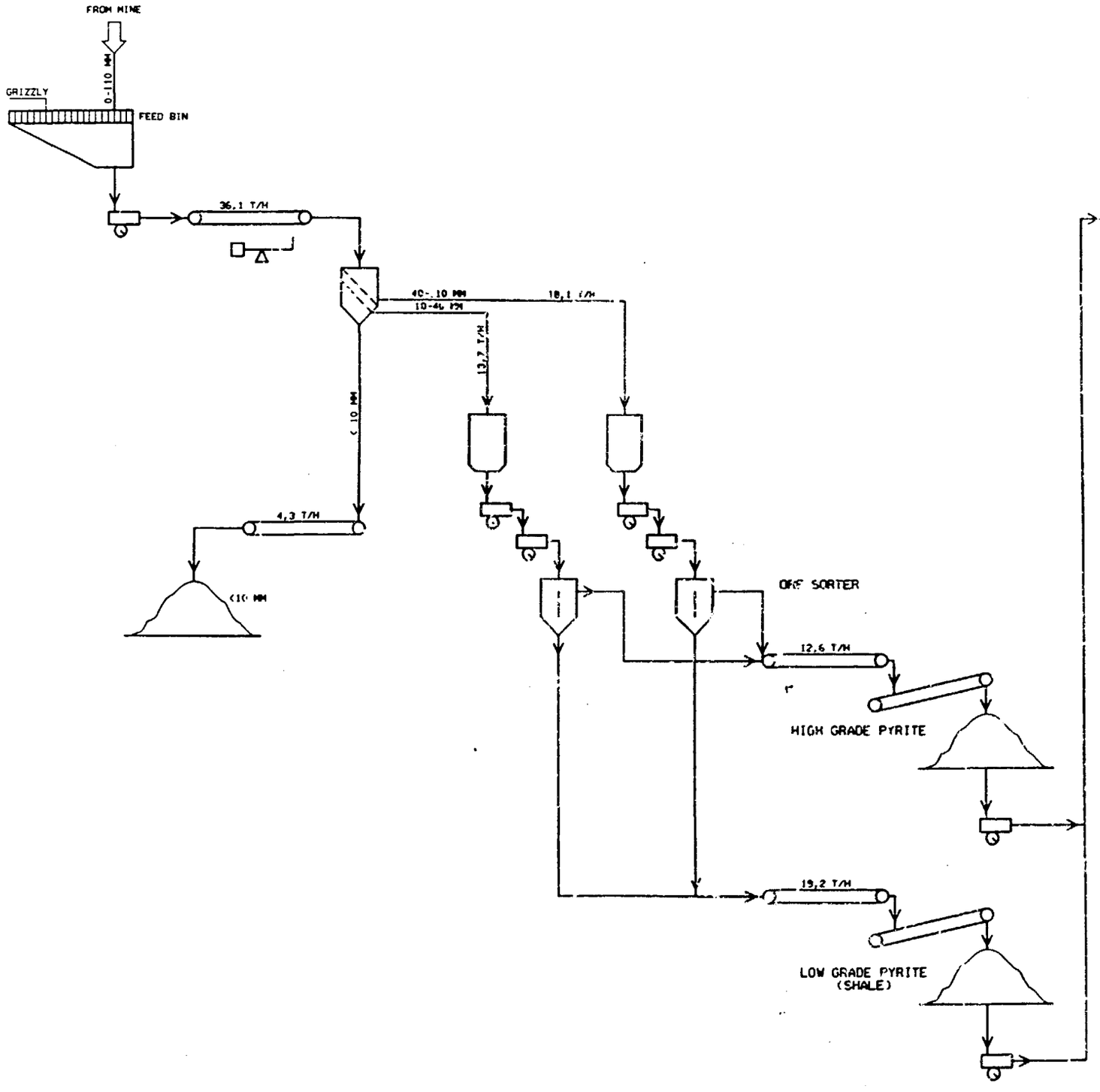
Chapter 7

List of Drawings

7.0 List of Drawings

L1A 00 2250 0000 1 00	Pyrite Ore Preparation Plant
L1A 00 2250 0000 2 00	General Arrangement of Pyrite Ore Preparation Plant
L0A 01 2250 0000 1	Process Flow Sheet Roasting Plant
L1A 01 2250 0000 2	Waste Heat Utilization Sheets 1 - 2
L0A 01 2250 0000 3	General Arrangement Roasting Plant
L0A 01 2250 0000 4	General Arrangement Roasting Plant
LA 01 2250 0000 5	General Arrangement Pyrite Plant
L1A 03 2250 0000 1	Gas Cleaning Plant
L1A 03 2250 0000 2	General Arrangement Gas Cleaning Plant
L1A 02 2250 0000 1	Flow-Sheet Drying and Absorption Plant
L1A 02 2250 0000 2	Flow-Sheet Converter Group
L3A 00 2250 0000 3	List of Consumers



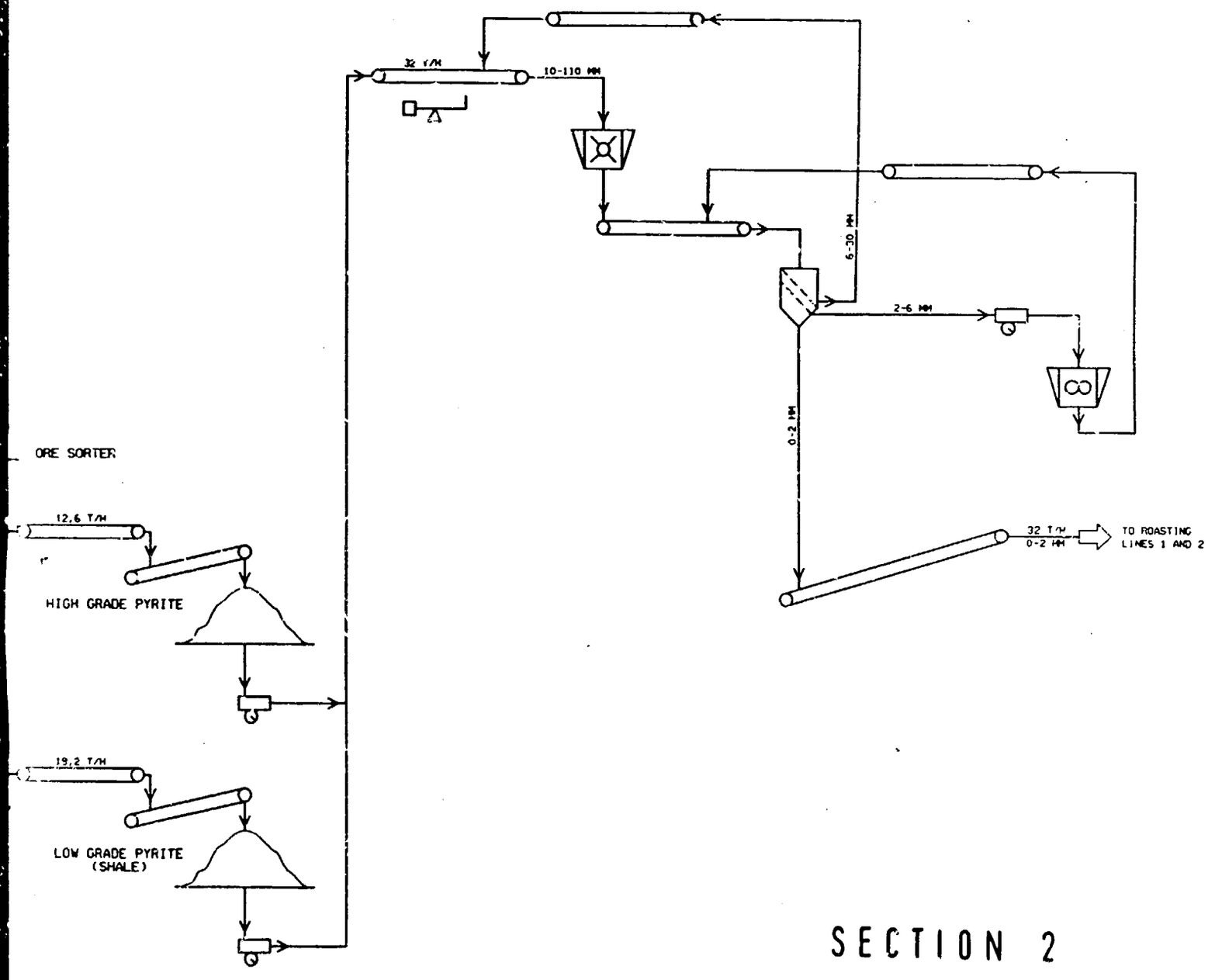
SECTION 1

CAD2

[211.002]A2250V001.DGN 16.04.85 GUTS 00.2

CS

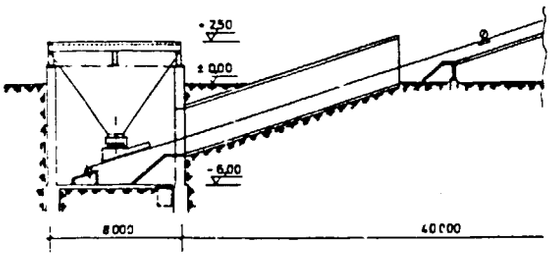
a

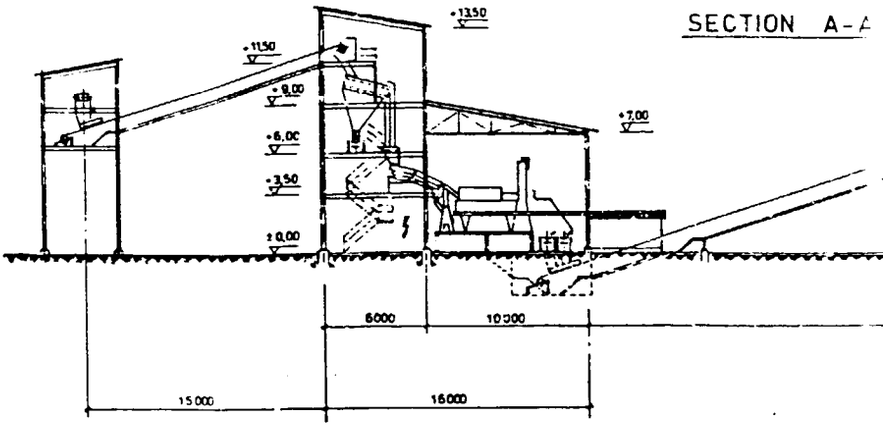


SECTION 2

Prepared	26.03.95	LOESEL/VCK	Lurgi Chemie und Hüttentechnik GmbH
Checked			
Sheet	Title/Characteristic Features: PYRITE ORE PREPARATION PLANT		
Standard	Drawing Type: 203 FLOWSHEET		
Processor: HA	Job or Project No.: 0.5.2.2.5.0	Job: AMJHOF	
Drawing No.: L1A00225000001	Rev.: 0	Reference Dwg.-No.:	

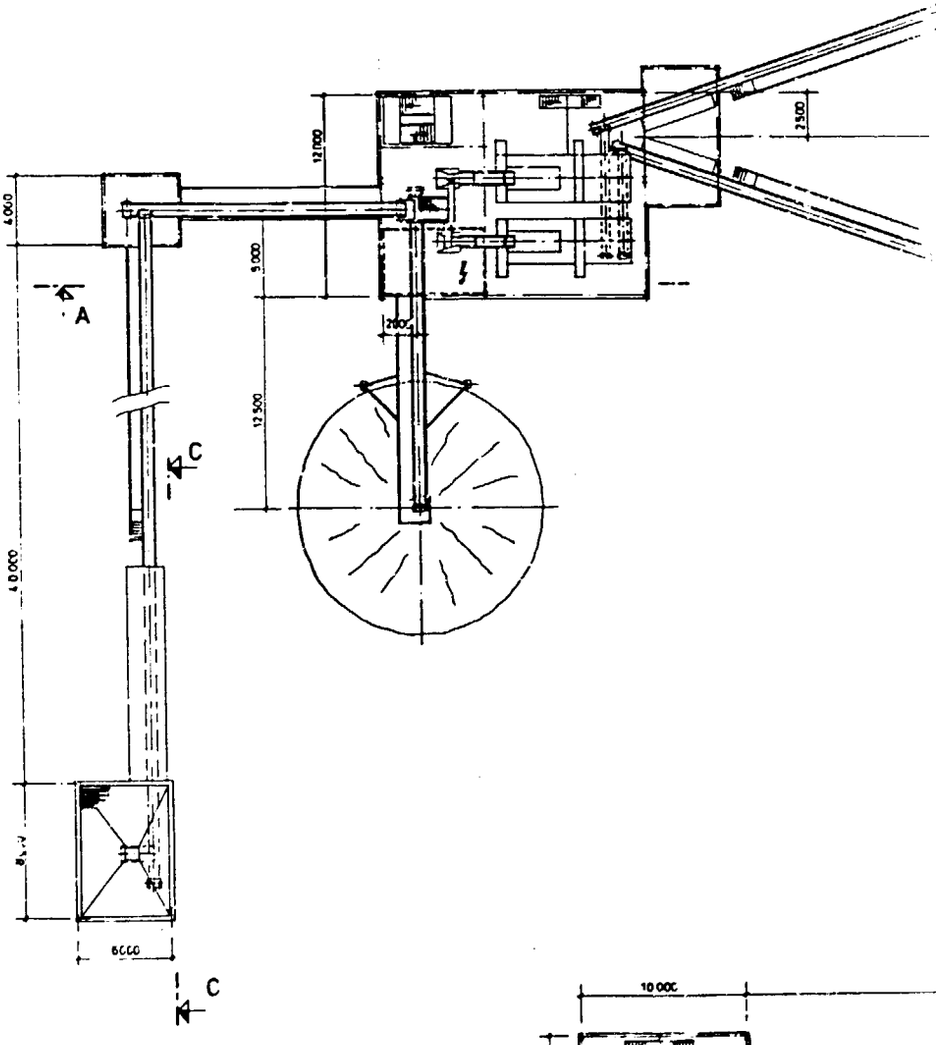
Rev.	Date	Changed	Checked	Kind of Revision
0	26.3.			FIRST ISSUE





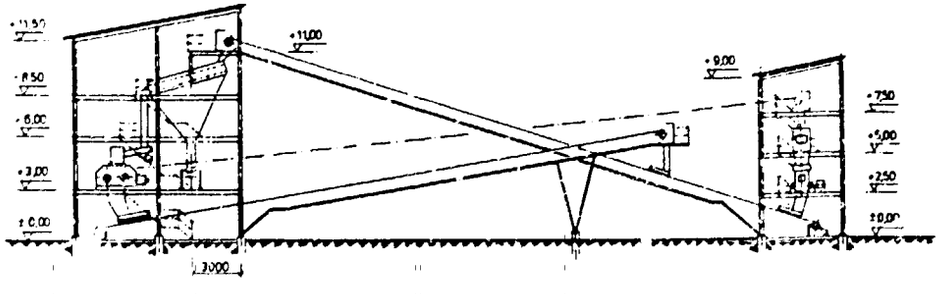
SECTION A-A

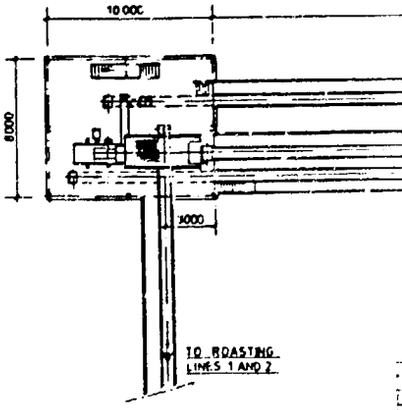
SECTION C-C

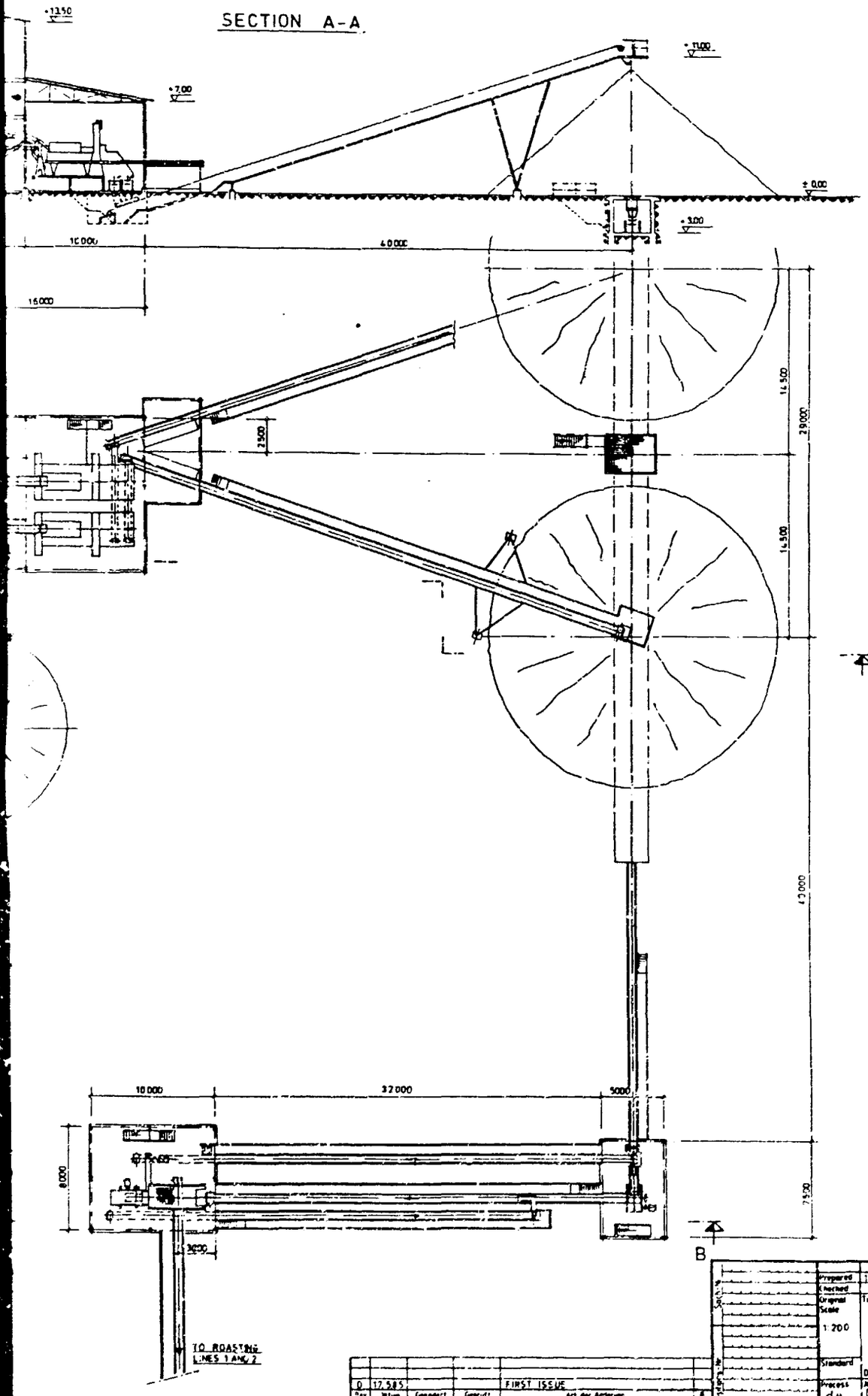


SECTION 1

SECTION B-B





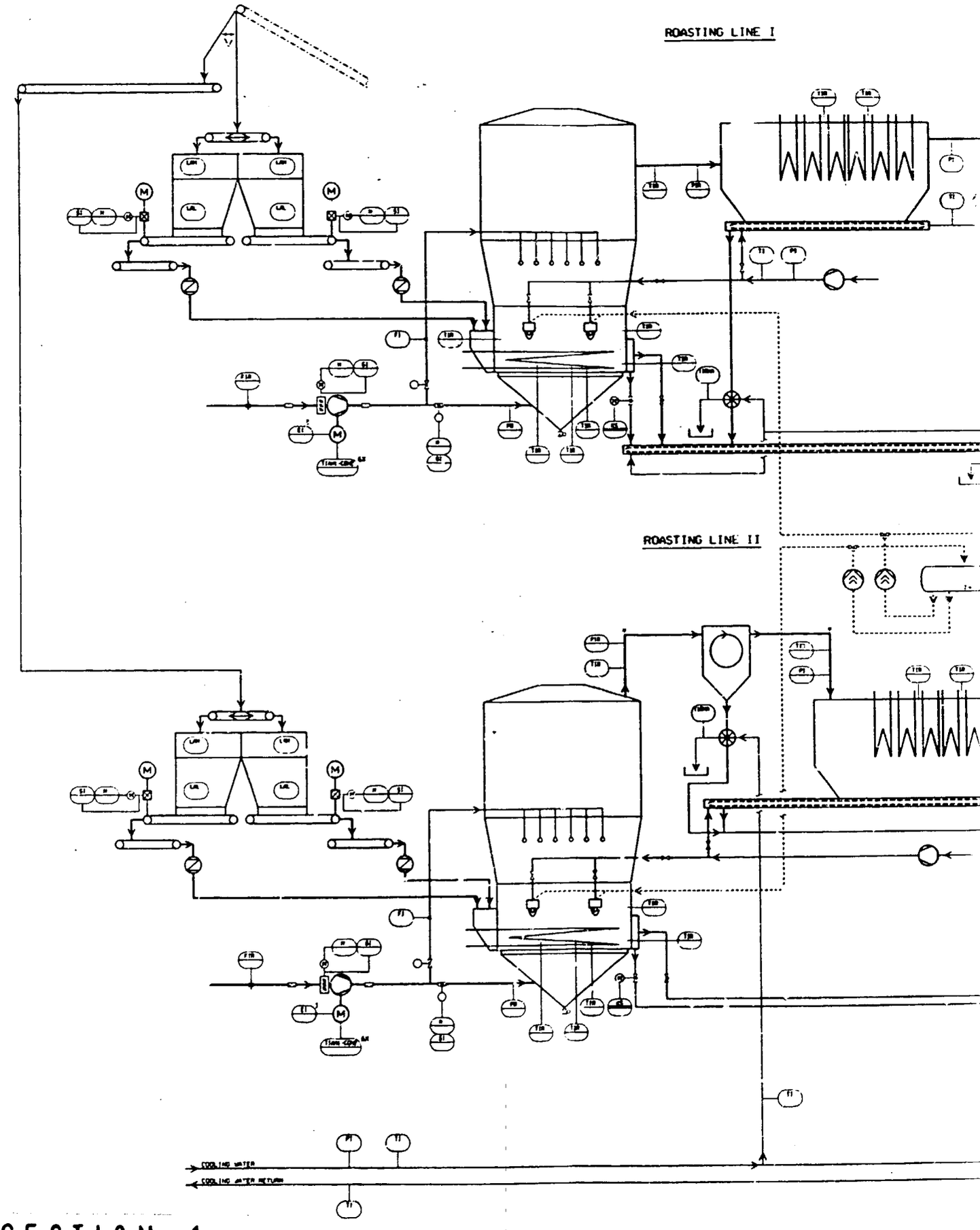


SECTION 2

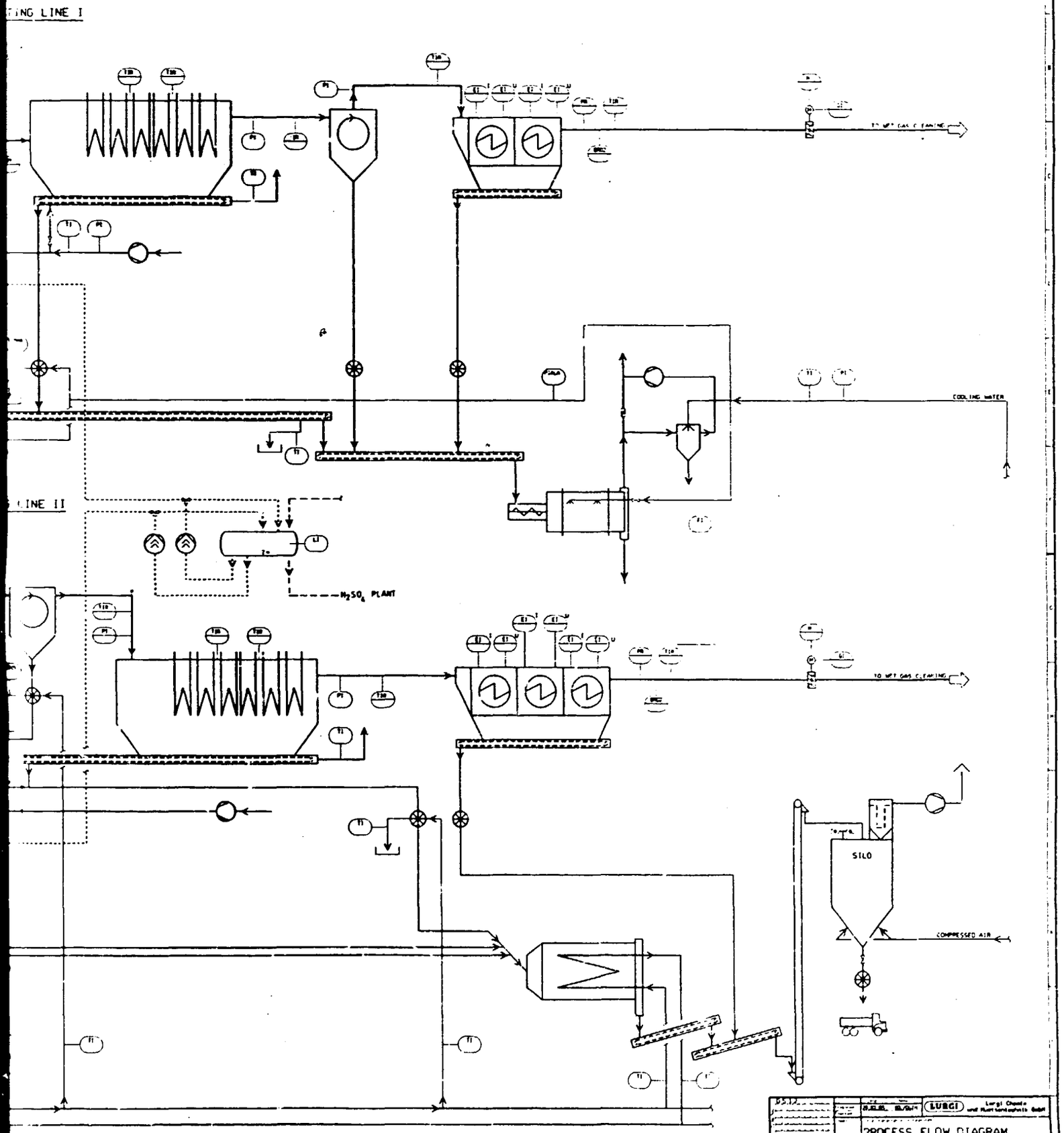
0	17.5.85		FIRST ISSUE	
Rev.	Datum	Geändert	Gepruft	Art der Änderung

Weitergabe sowie Vervielfältigung dieser Unterlage, Verwertung und Mitteilung ihres Inhalts nicht gestattet, soweit nicht von LURGI ausdrücklich zugestanden. Zuwiderhandlungen verpflichten zu Schadenersatz. Alle Rechte für den Fall der Patenterteilung oder Gebrauchsmuster-Eintragung vorbehalten.

Prepared	Date 17.5.85	Name WOF	LURGI Lurgi Chemie und Hüttentechnik GmbH
Checked			
Original Scale	1:200	Title / Characteristic Features	GENERAL ARRANGEMENT OF PYRITE ORE PREPARATION PLANT
Standard		Drawing Type 1.14	
Process AM	Job or Project No. 100.225.0	Job AMJHORE	
Drawing No.	L1A00225000002	Rev. 0	Reference Dwg.
			Original Size A


ROASTING LINE I
ROASTING LINE II
COOLING WATER
COOLING WATER RETURN

SECTION 1

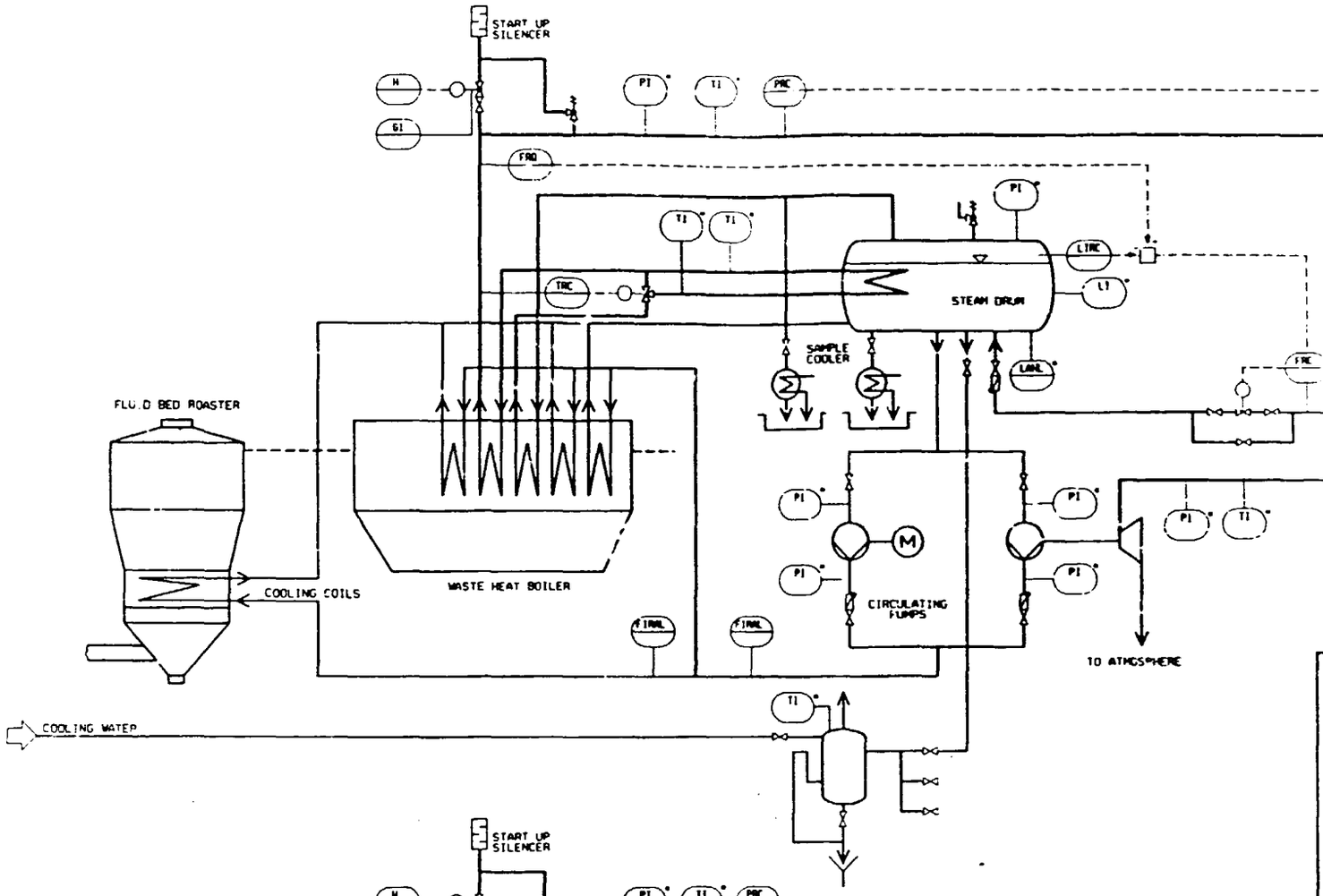


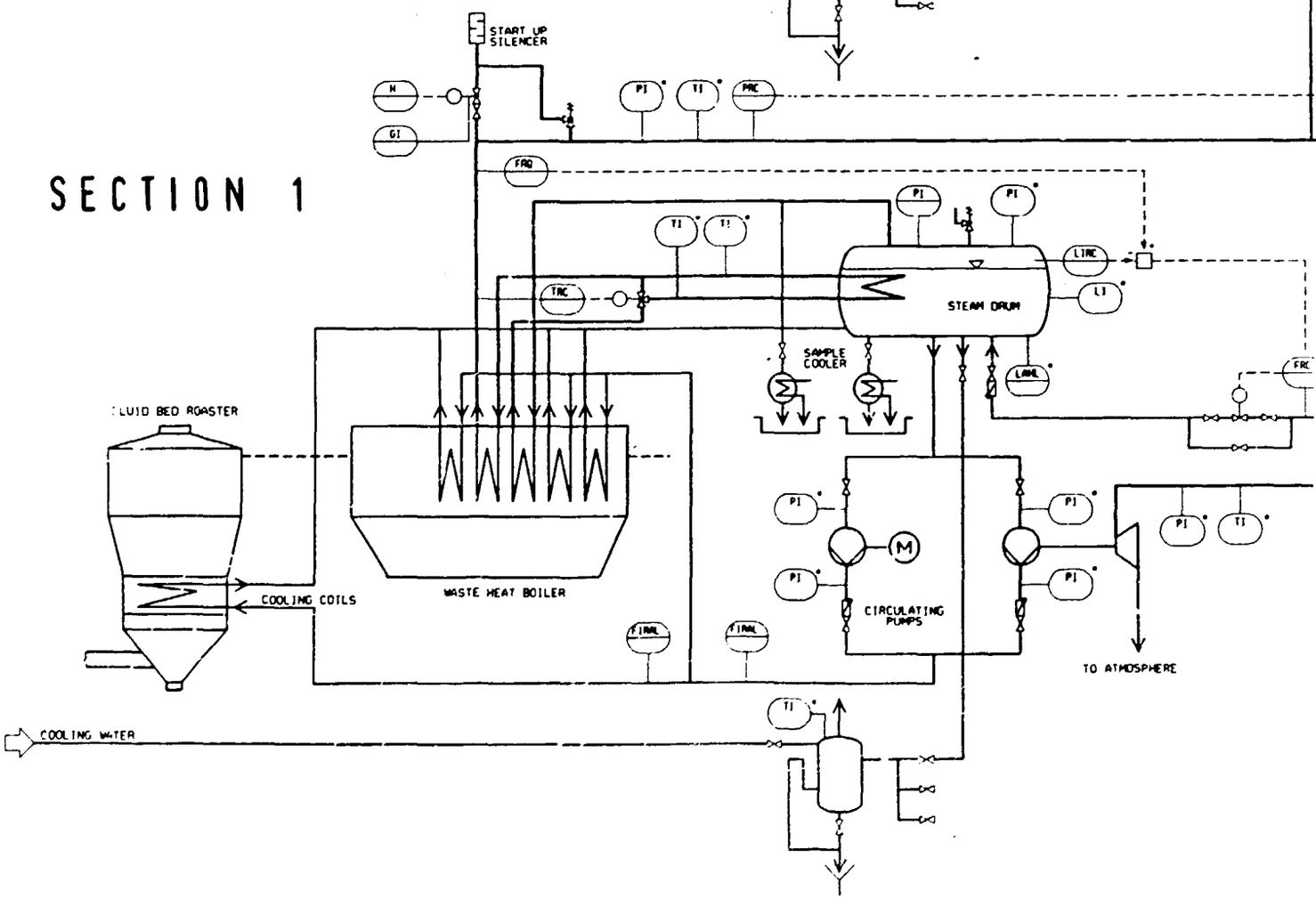
SECTION 2

PROCESS FLOW DIAGRAM
TURBULENT LAYER ROASTING
PLANT FOR PYRITE

LUBGI

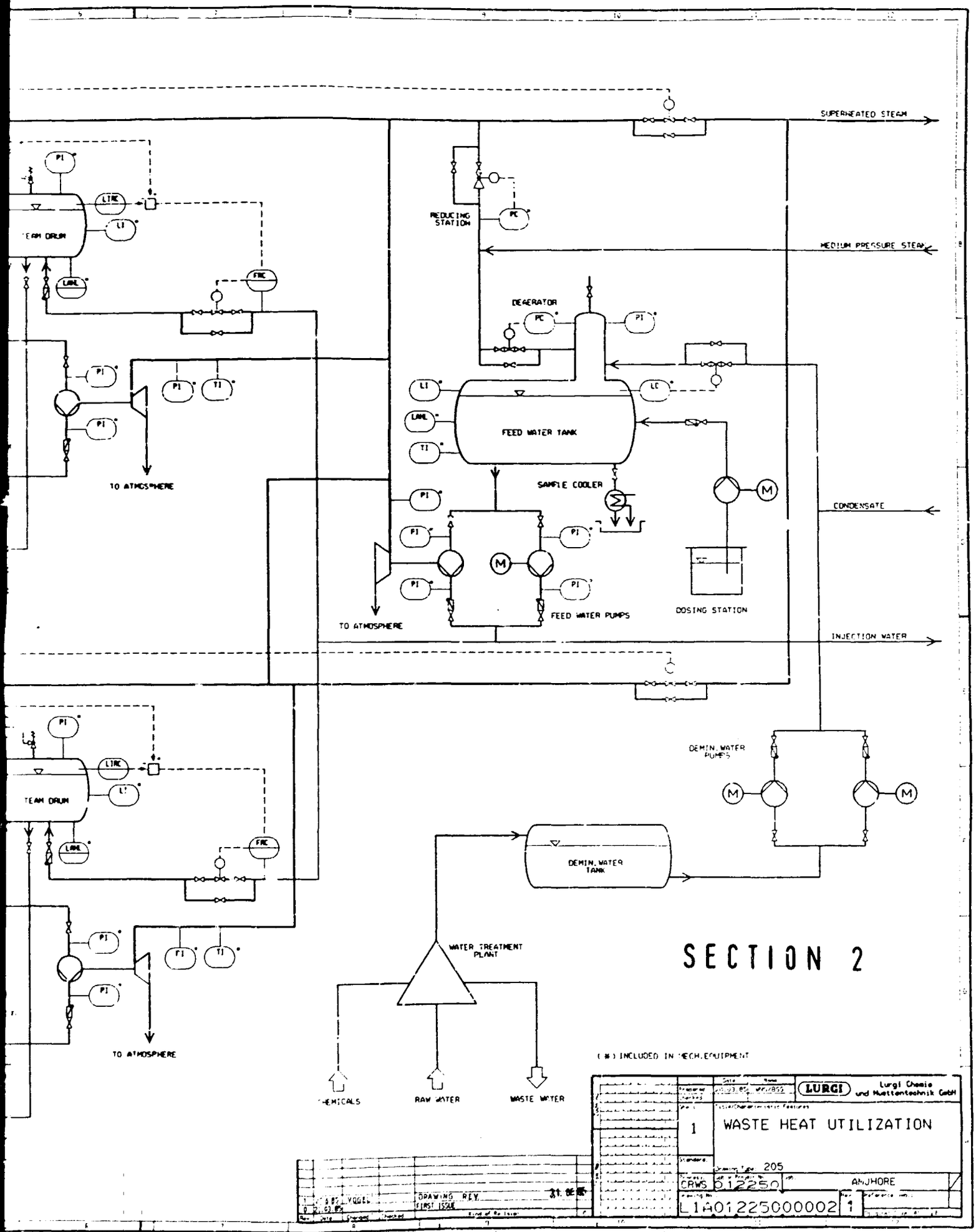
LOA01225000001 0

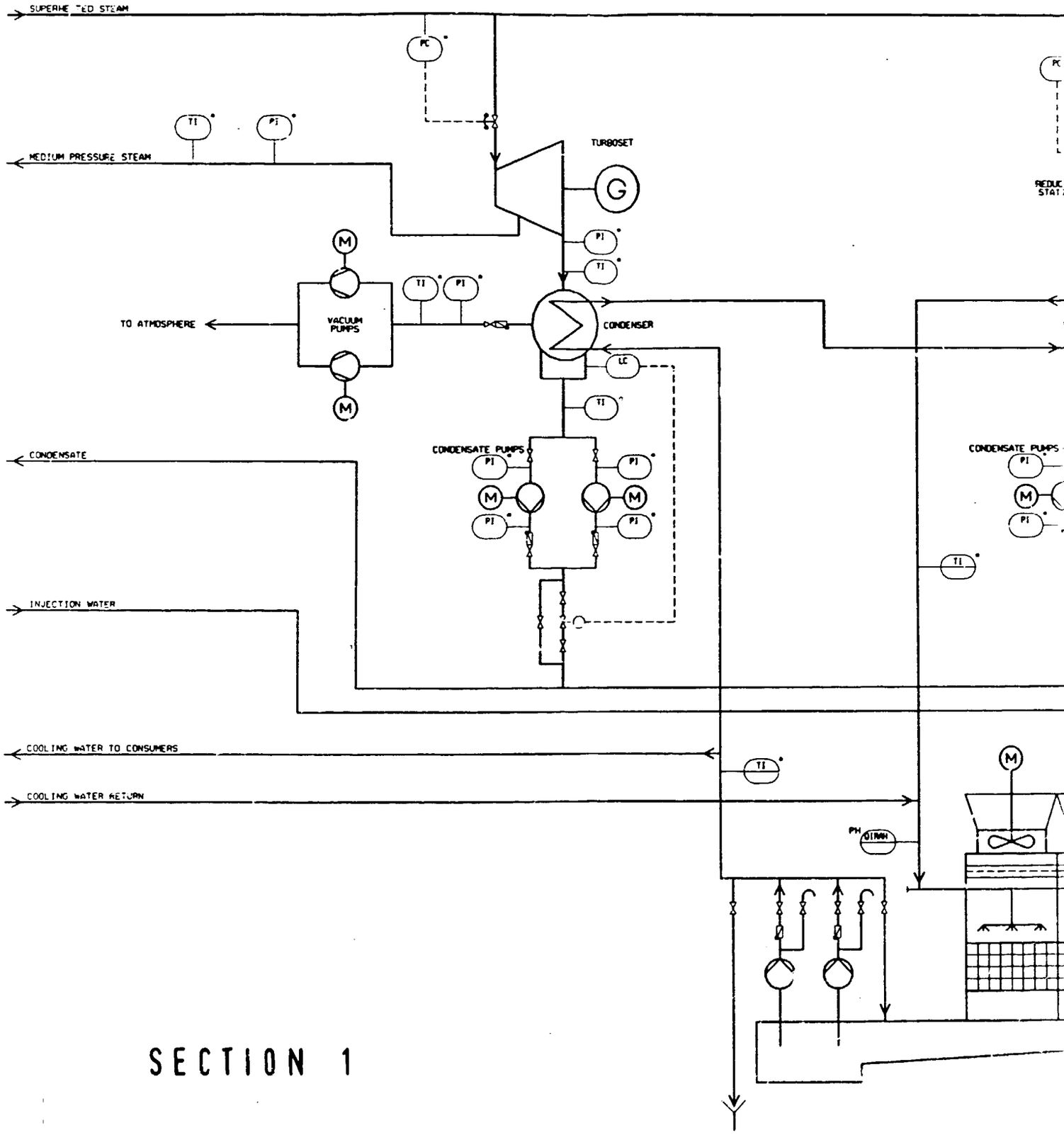




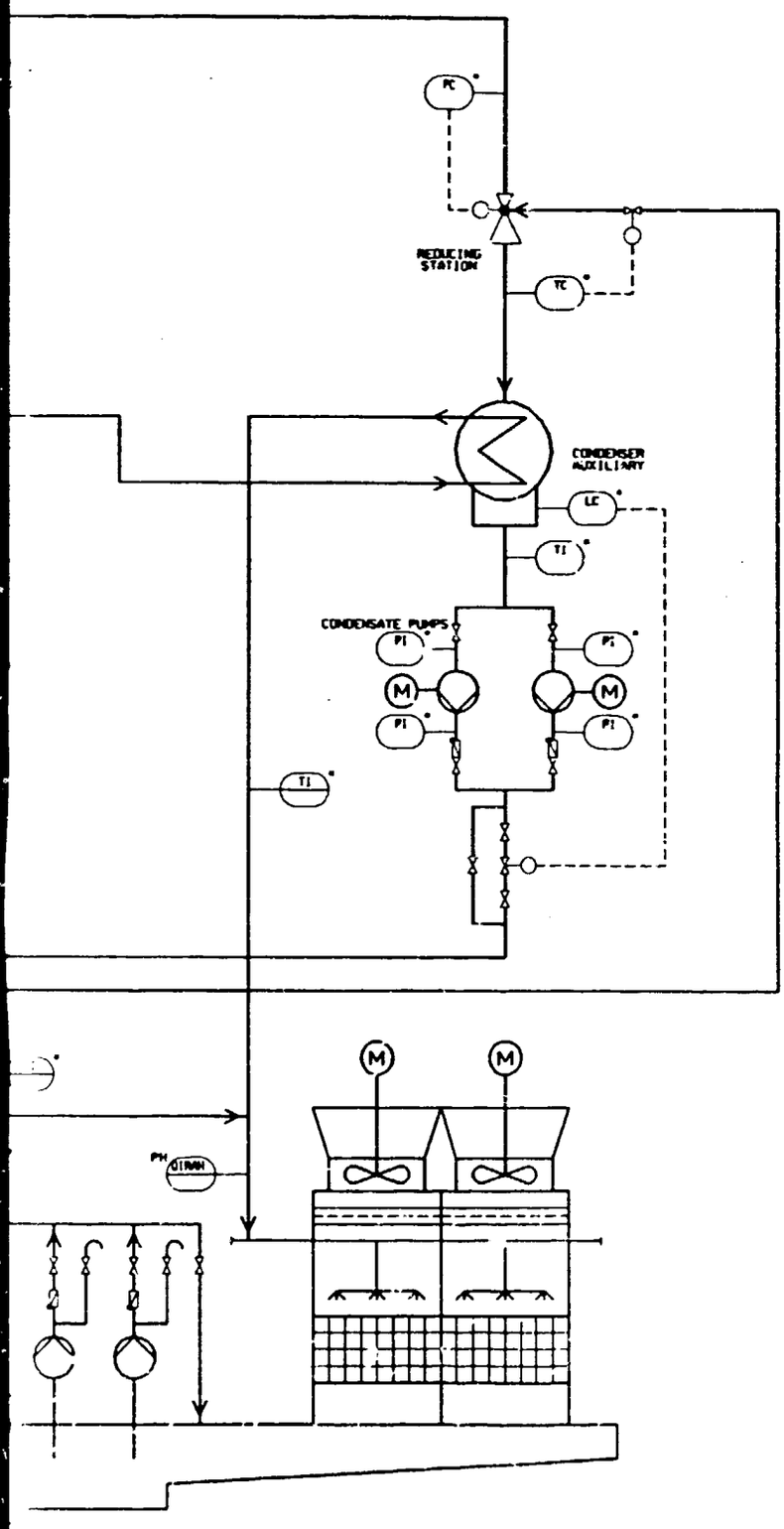
SECTION 1

(211,002)A2250V004.DGN 30.05.85 BSS 01


SUPERHEATED STEAM
MEDIUM PRESSURE STEAM
CONDENSATE
INJECTION WATER
REDUCING STATION
DEGERATOR
FEED WATER TANK
SAMPLE COOLER
FEED WATER PUMPS
DOSING STATION
TO ATMOSPHERE
TO ATMOSPHERE
TO ATMOSPHERE
DEMIN. WATER PUMPS
DEMIN. WATER TANK
WATER TREATMENT PLANT
CHEMICALS
RAW WATER
WASTE WATER
(*) INCLUDED IN MECH. EQUIPMENT
SECTION 2
LURGI
Lurgi Chemie und Hüttentechnik GmbH
WASTE HEAT UTILIZATION
205
CRWS 012250
ANJHORE
L1A01225000002
DRAWING REV.
FIRST ISSUE



SECTION 1



SECTION 2

(*) INCLUDED IN MECH. EQUIPMENT

LURGI Lurgi Chemie und Hüttentechnik GmbH

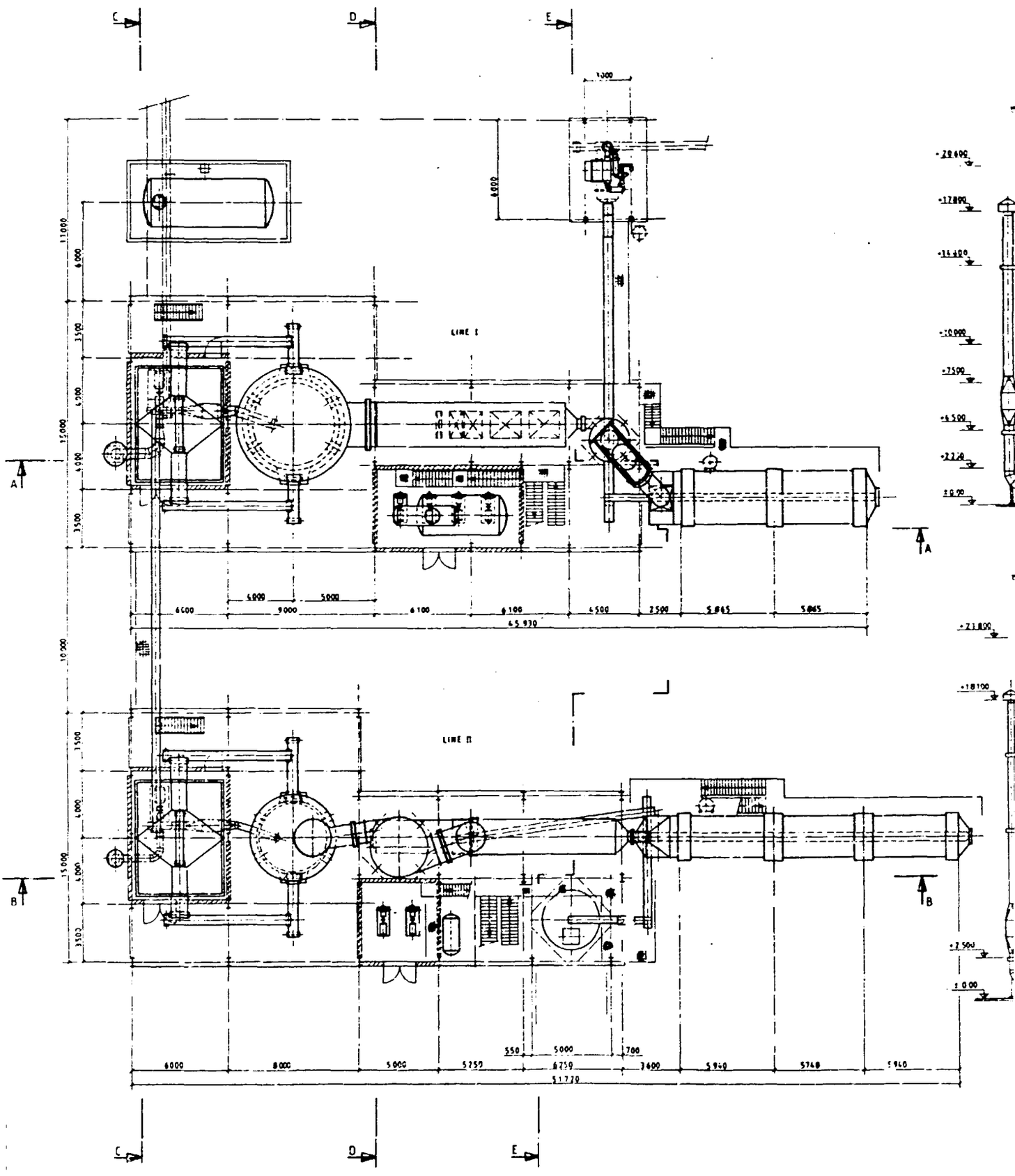
2 WASTE HEAT UTILIZATION

205

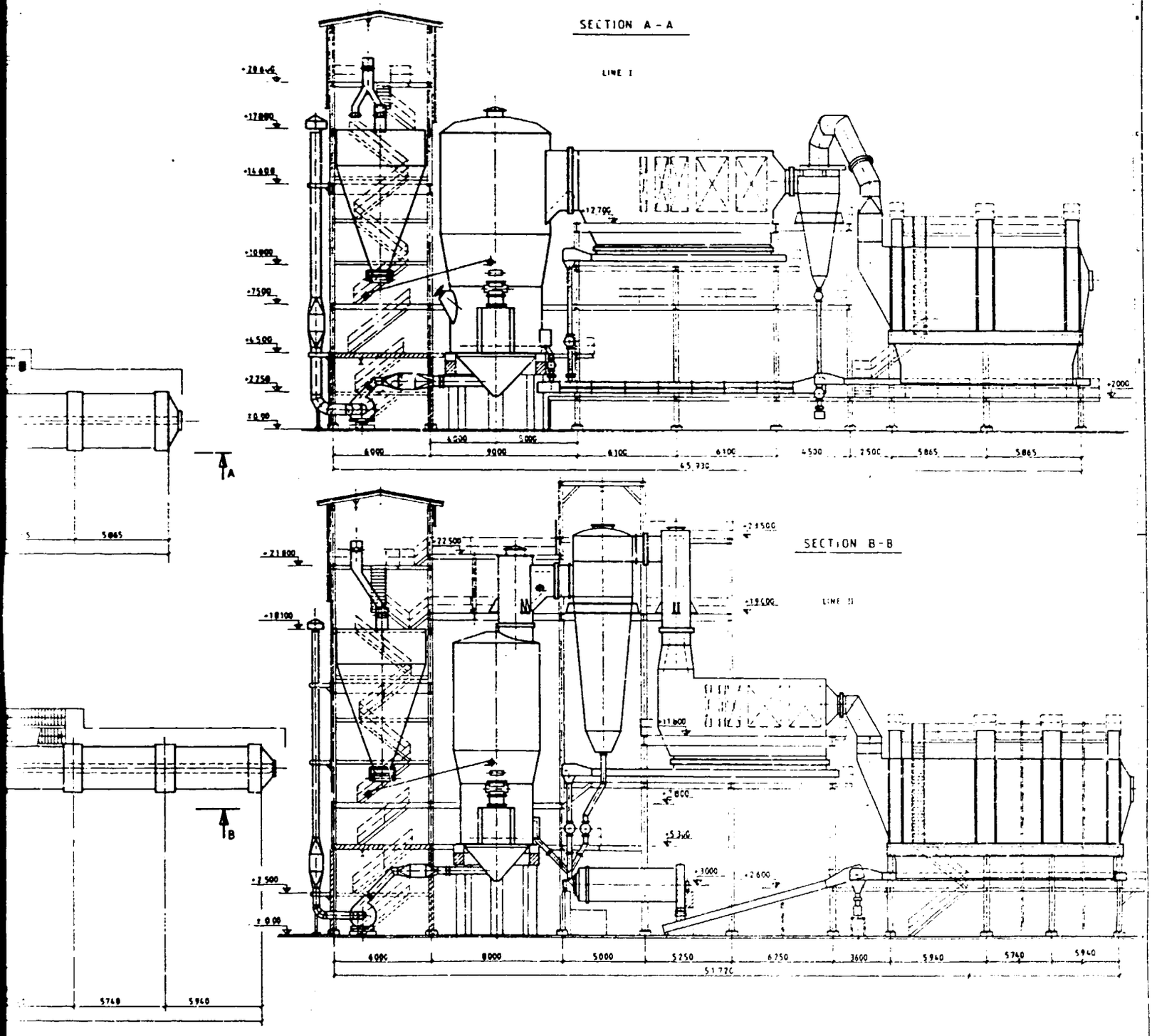
CRWD 01225 AMJHORE

L1A01225000002 1

COOLING WATER (COOL)


C
D
E
LINE I
LINE II
A
B
6600
9000
6100
6100
4500
2500
5865
5865
65930
6000
8000
5000
5750
8750
7600
5940
5760
5940
51770
550
5000
700
+20400
+17800
+15400
+10900
+7500
+4500
+2250
±0.00
+21800
+18100
+2500
±0.00

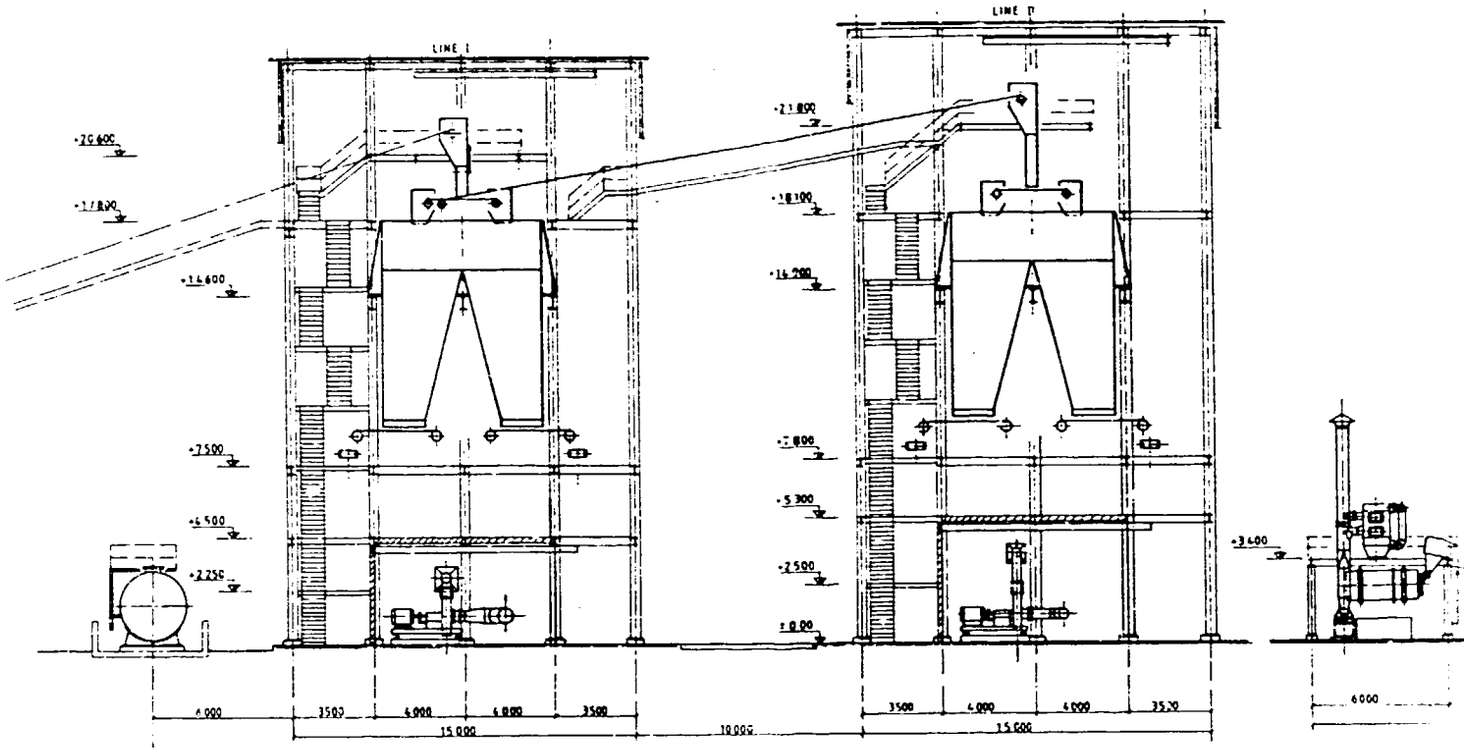
SECTION 1



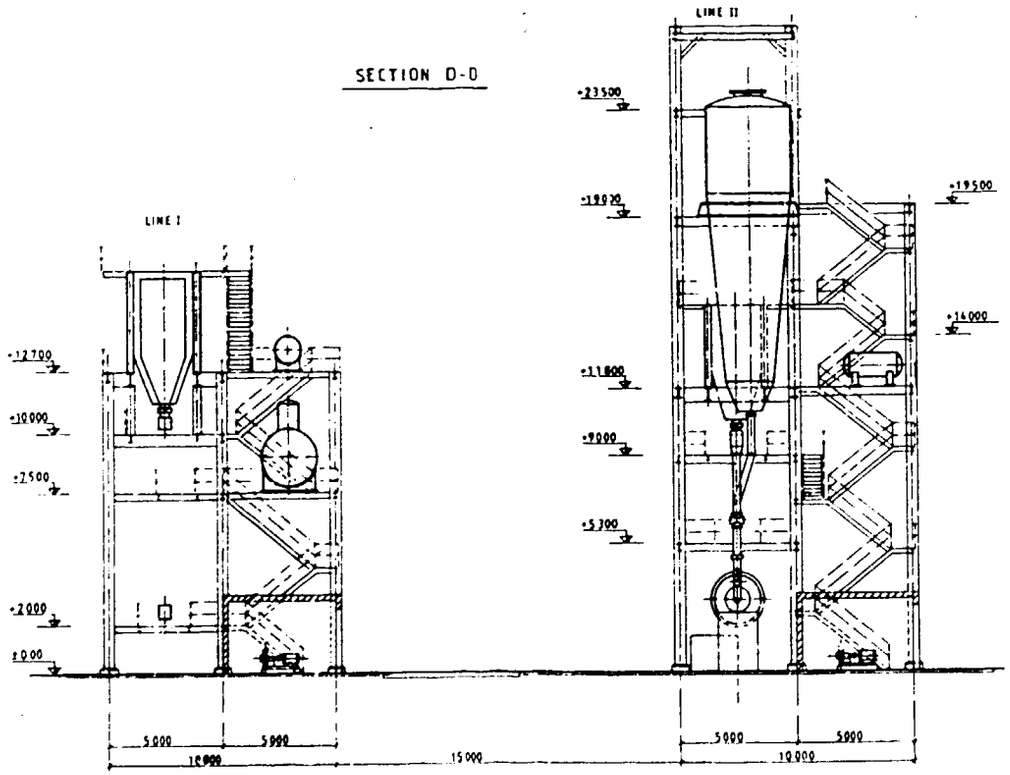
SECTION 2

			Lurgi Chemie und Hüttenwerksanlagen GmbH
			GENERAL ARRANGEMENT ROASTING PLANT 217/240 P/D PYRITE
		1:100	GROUNDFLOOR AND SECTION A-A, B-B
			AMMORE
			10A01225000003 0
	FIRST ISSUE		

SECTION C-C

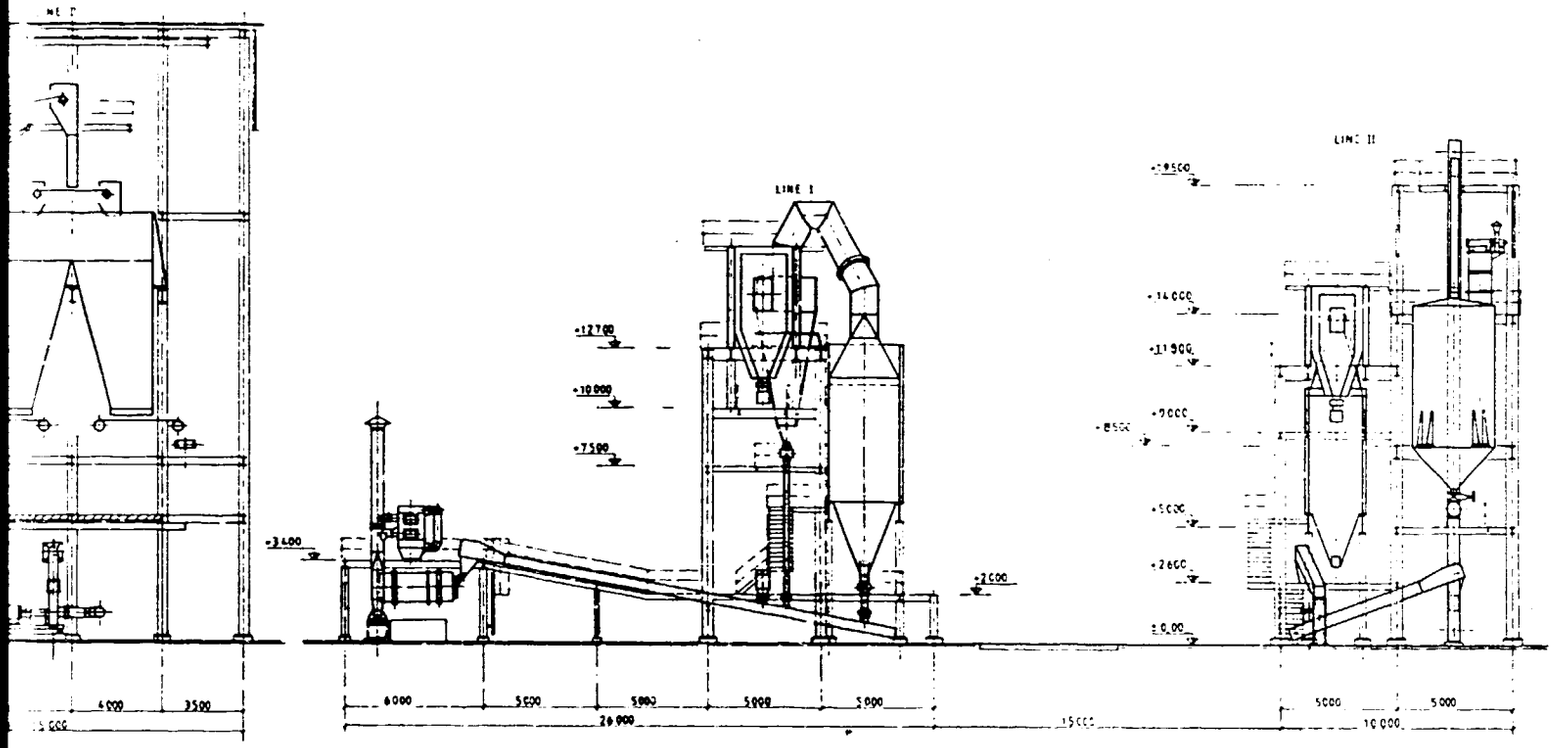


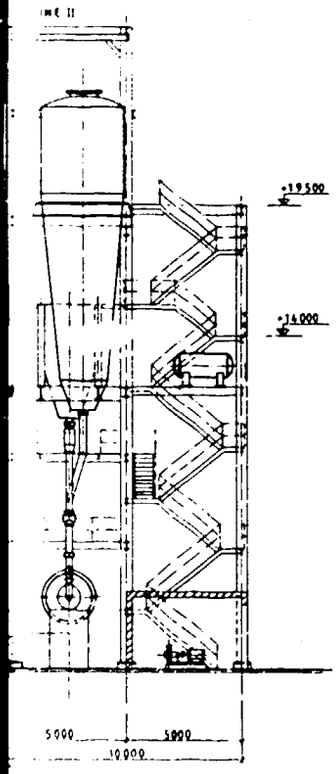
SECTION D-D



SECTION 1

SECTION C - E



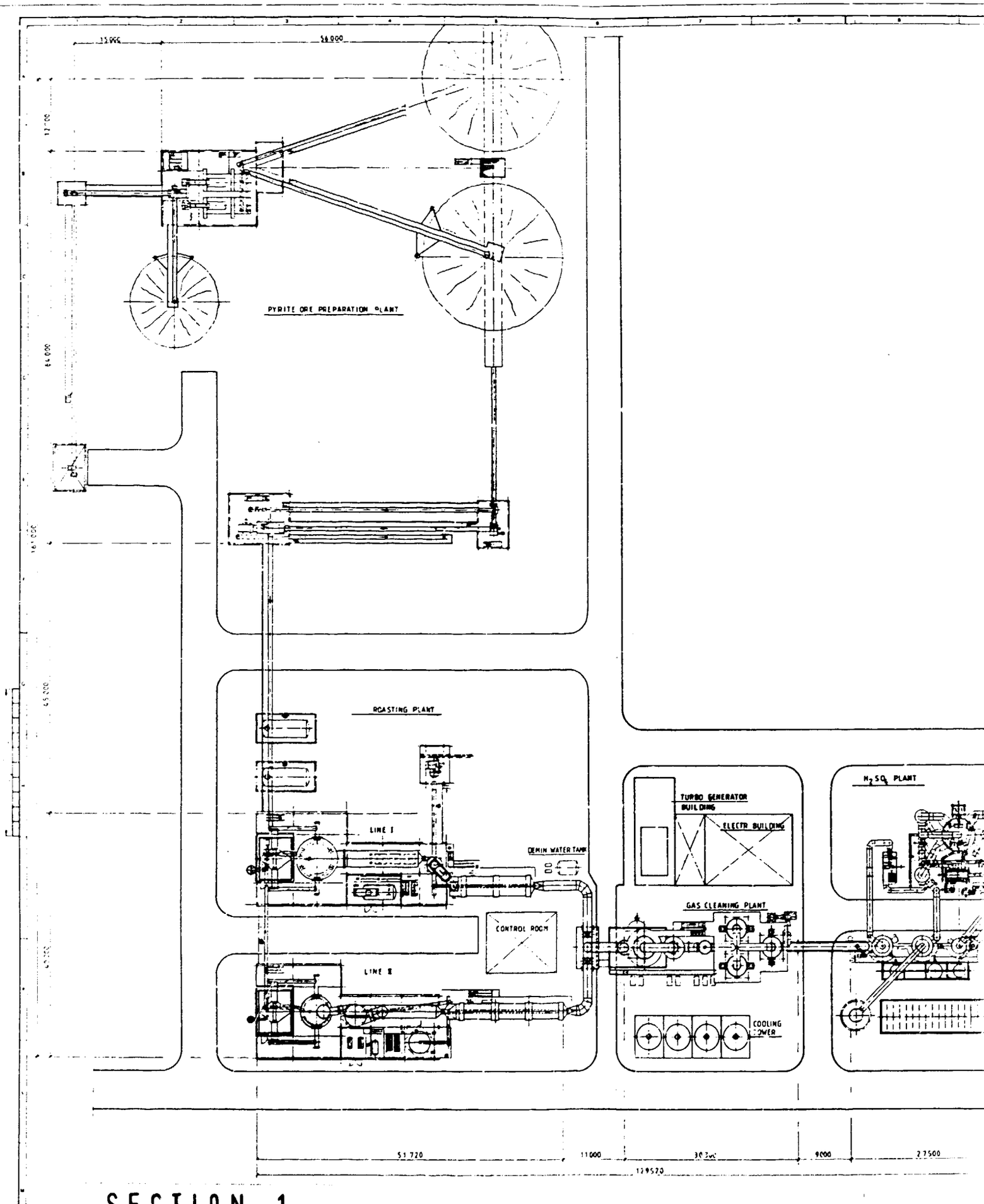


SECTION 2

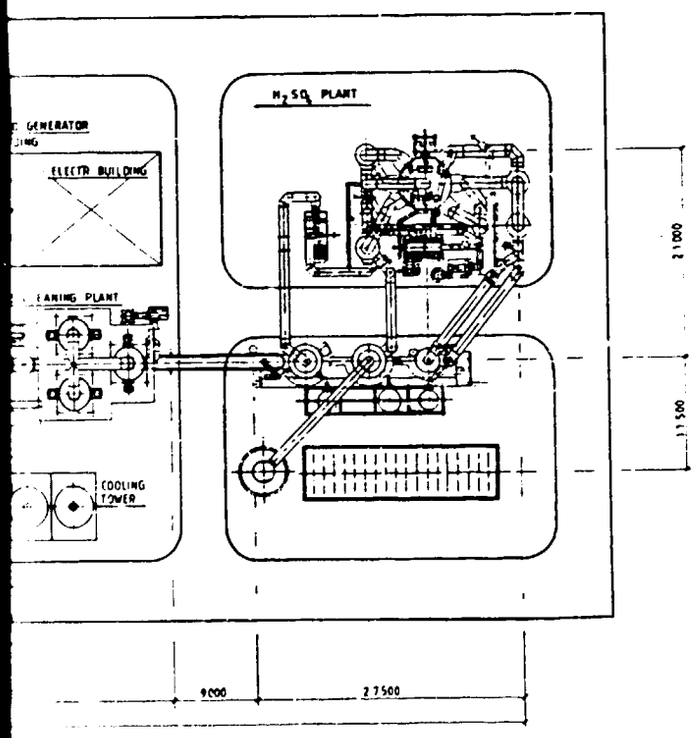
GENERAL ARRANGEMENT
ROASTING PLANT 217/240 t/D
SECTION C-C, D-D, E-E, PYRITE

AMJHORE

LOA01225000004 0


PYRITE ORE PREPARATION PLANT
ROASTING PLANT
LINE I
LINE II
DEMIN WATER TANK
CONTROL ROOM
TURBO GENERATOR BUILDING
ELECTR. BUILDING
GAS CLEANING PLANT
COOLING TOWER
H_2SO_4 PLANT
51 720
11000
9000
27500
129520

SECTION 1



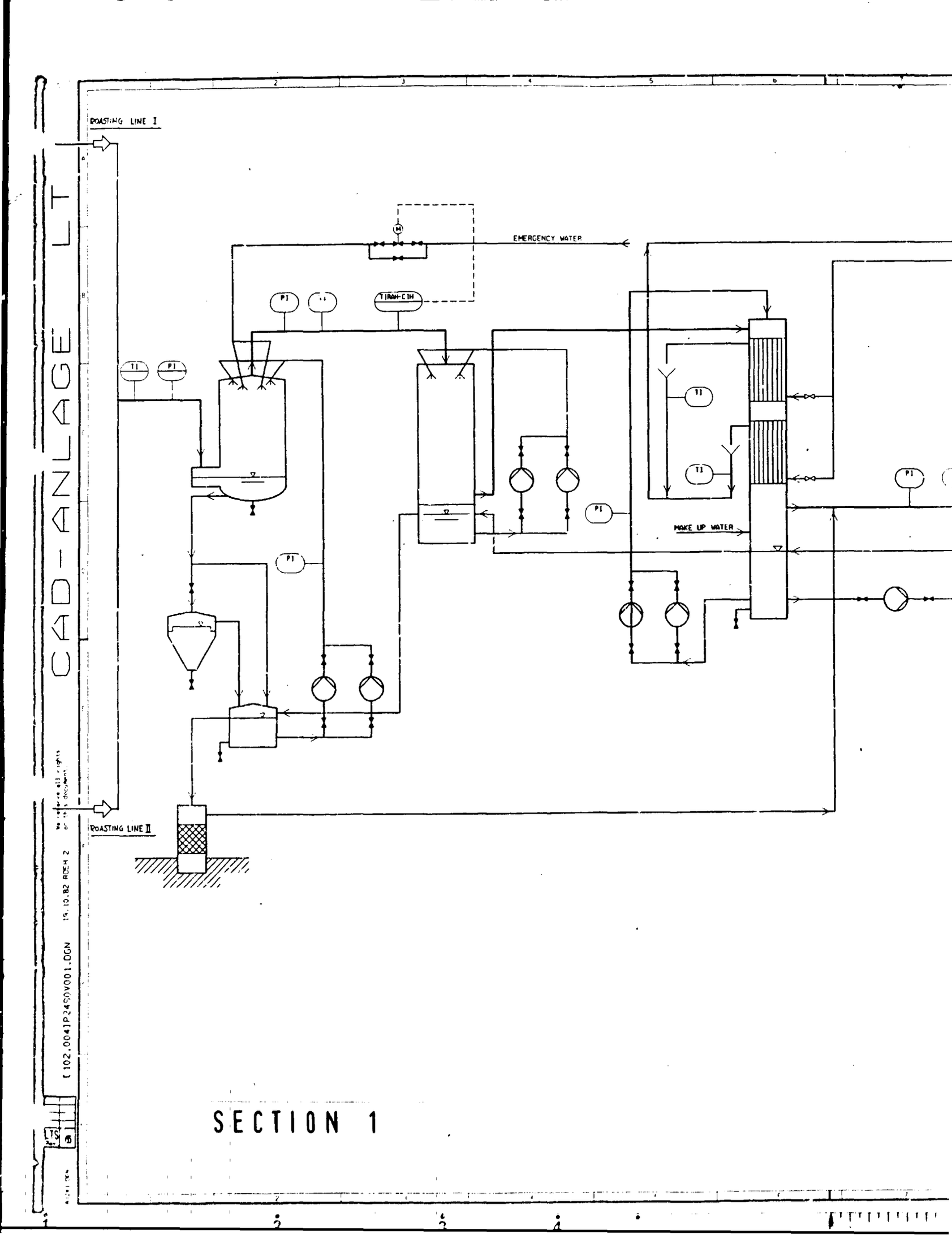
SECTION 2

GENERAL ARRANGEMENT
FOR PYRITE PLANT
217/240 t/D

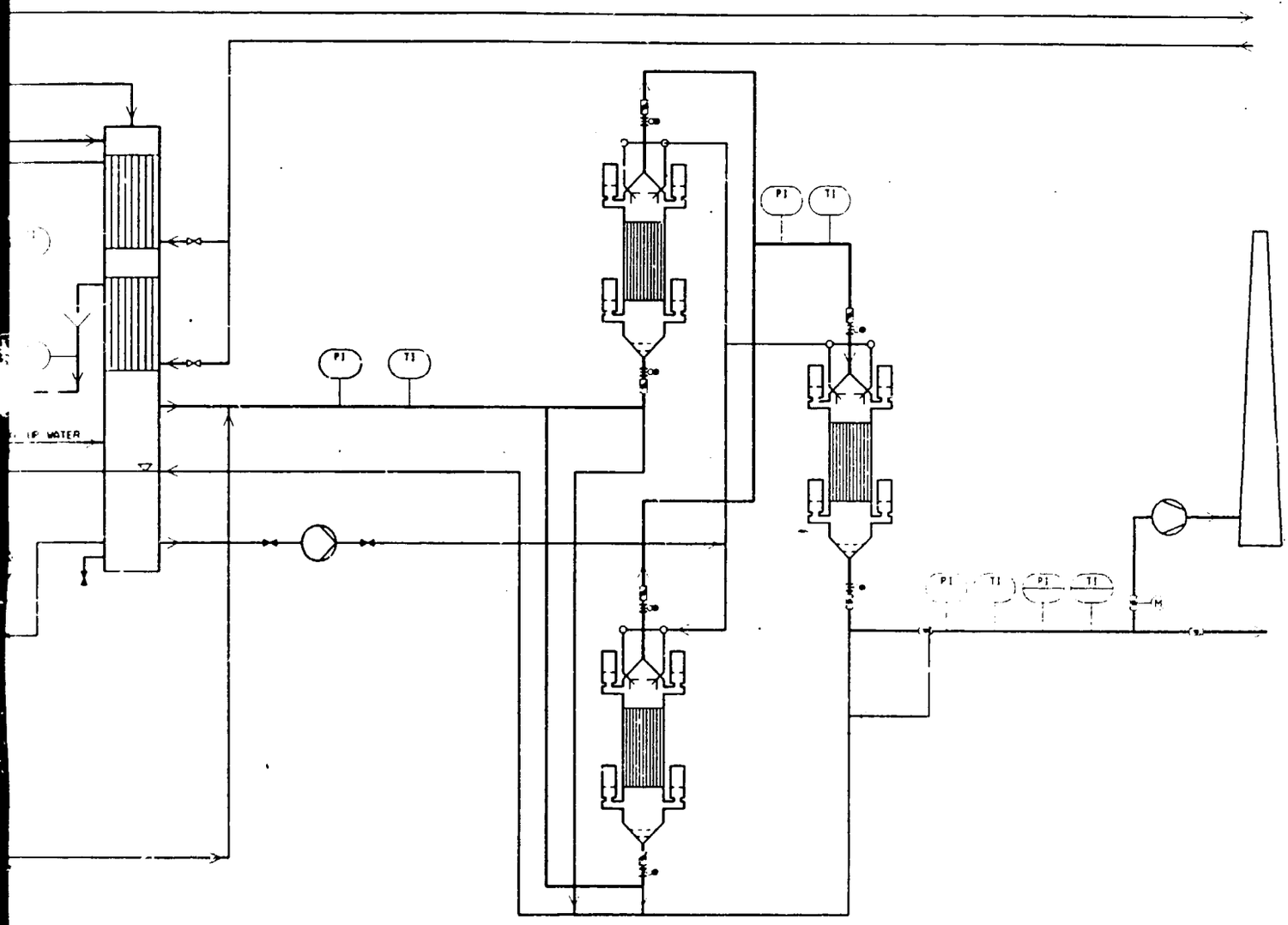
1 250

AM JHORE

L0A01 2250 000 05

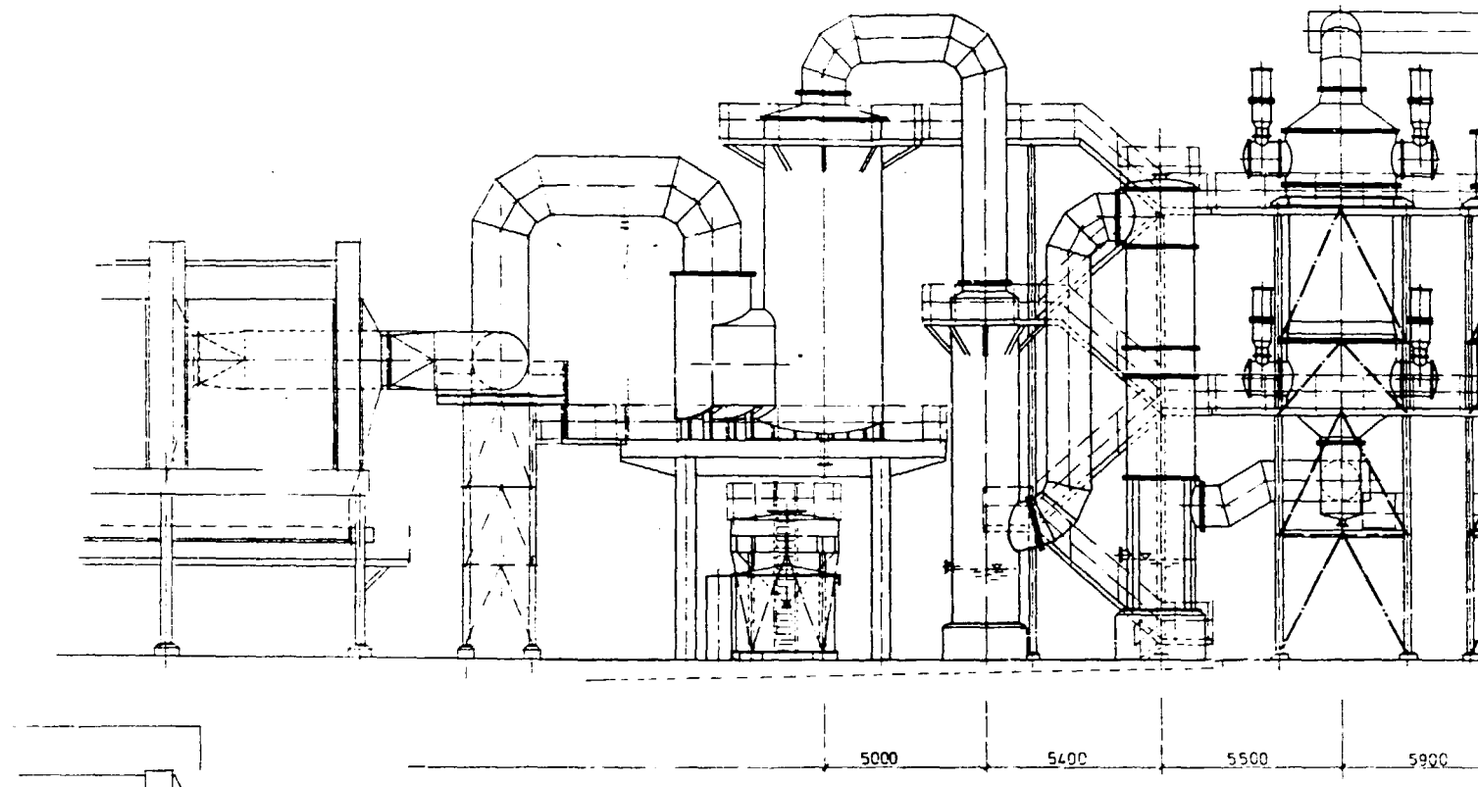

CAD-ANLAGE LT
ROASTING LINE I
ROASTING LINE II
EMERGENCY WATER
MAKE UP WATER
TI
PI
TIRAH-CIH
[102,0041P2450V001.DGN 19.10.82 ROSH 2

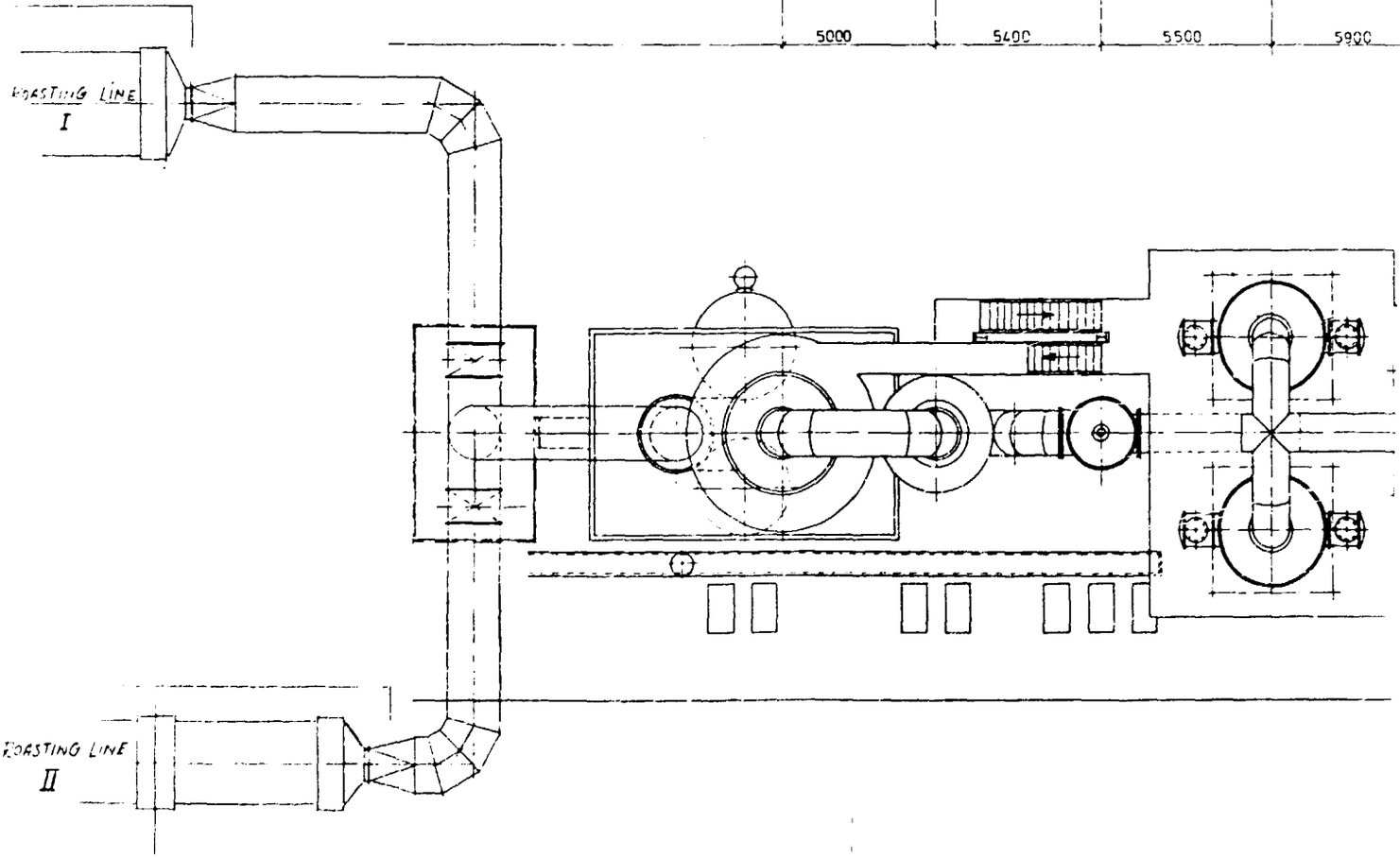
SECTION 1



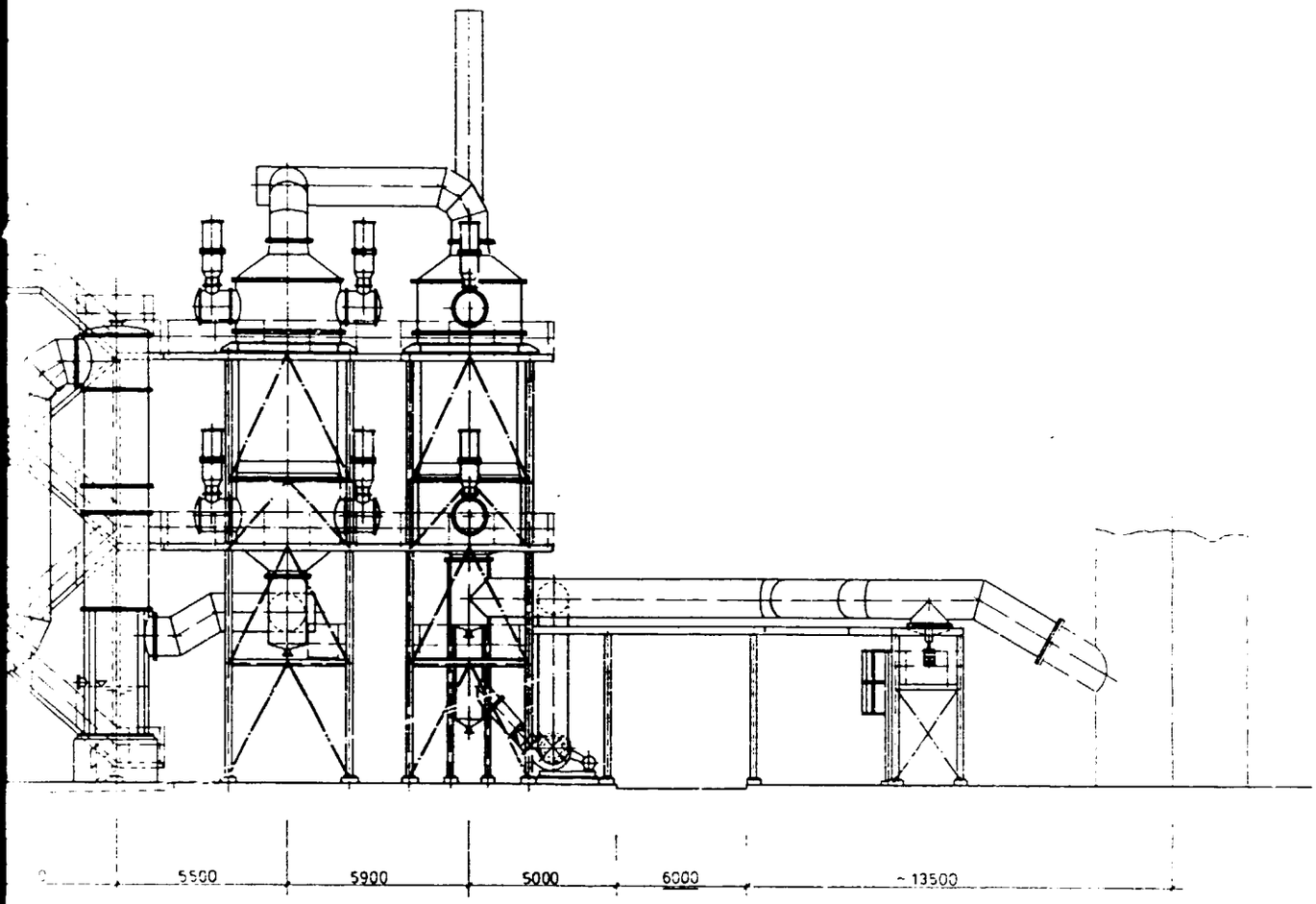
SECTION 2

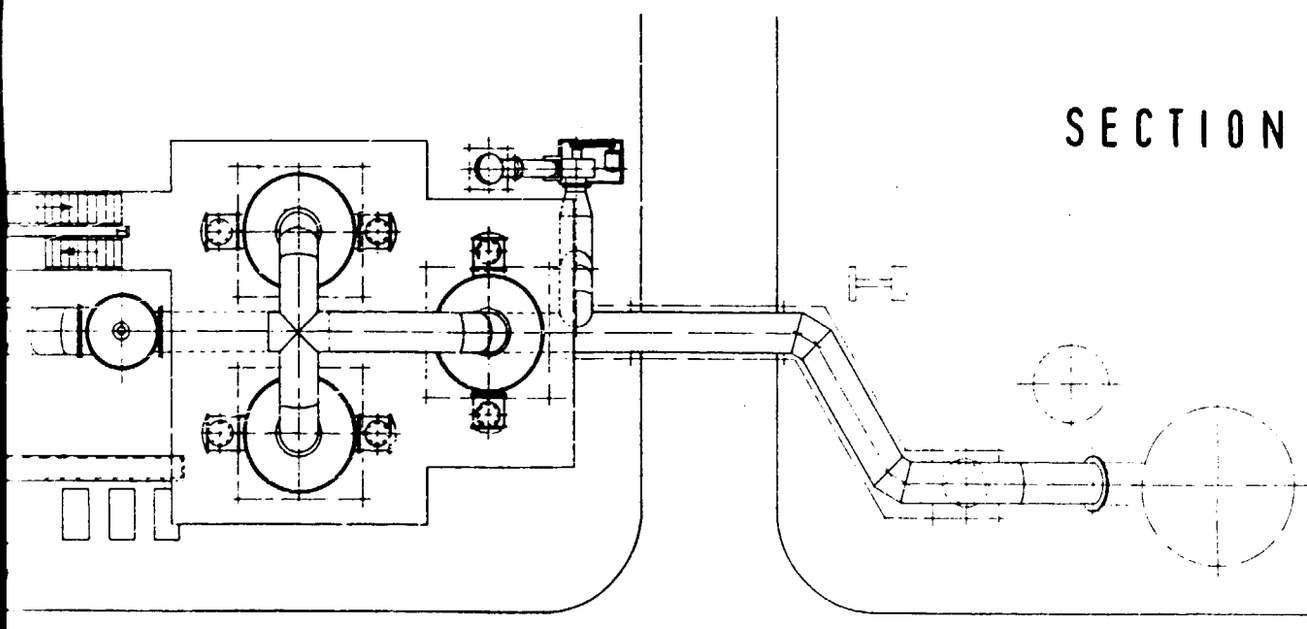
	9.5 85 KHZ	LURGI	Lurgi Umwelt und Chemotechnik GmbH
	GASCLEANING-PLANT		
	205 FLOW SHEET		
SRS	03 42250	PROL INDIEN	
L1A03225000001			





SECTION 1





SECTION 2

Prepared / checked	95 95 KHZ	Lurgi Umwelt und Chemotechnik GmbH	
Original Scale	1100	Title / Characteristic Features: GENERAL ARRANGEMENT GAS CLEANING PLANT	
Standard		Drawing Type 111	
Progress SRS	Job or Project No. 03 62250	Job PPCL ANUPHORE, INDIEN	
Drawing No.	L1A03225000002	Rev.	Reference Dwg.
			Original Size A1

T1.101
AIR FILTER

T1.106
DRYING TOWER

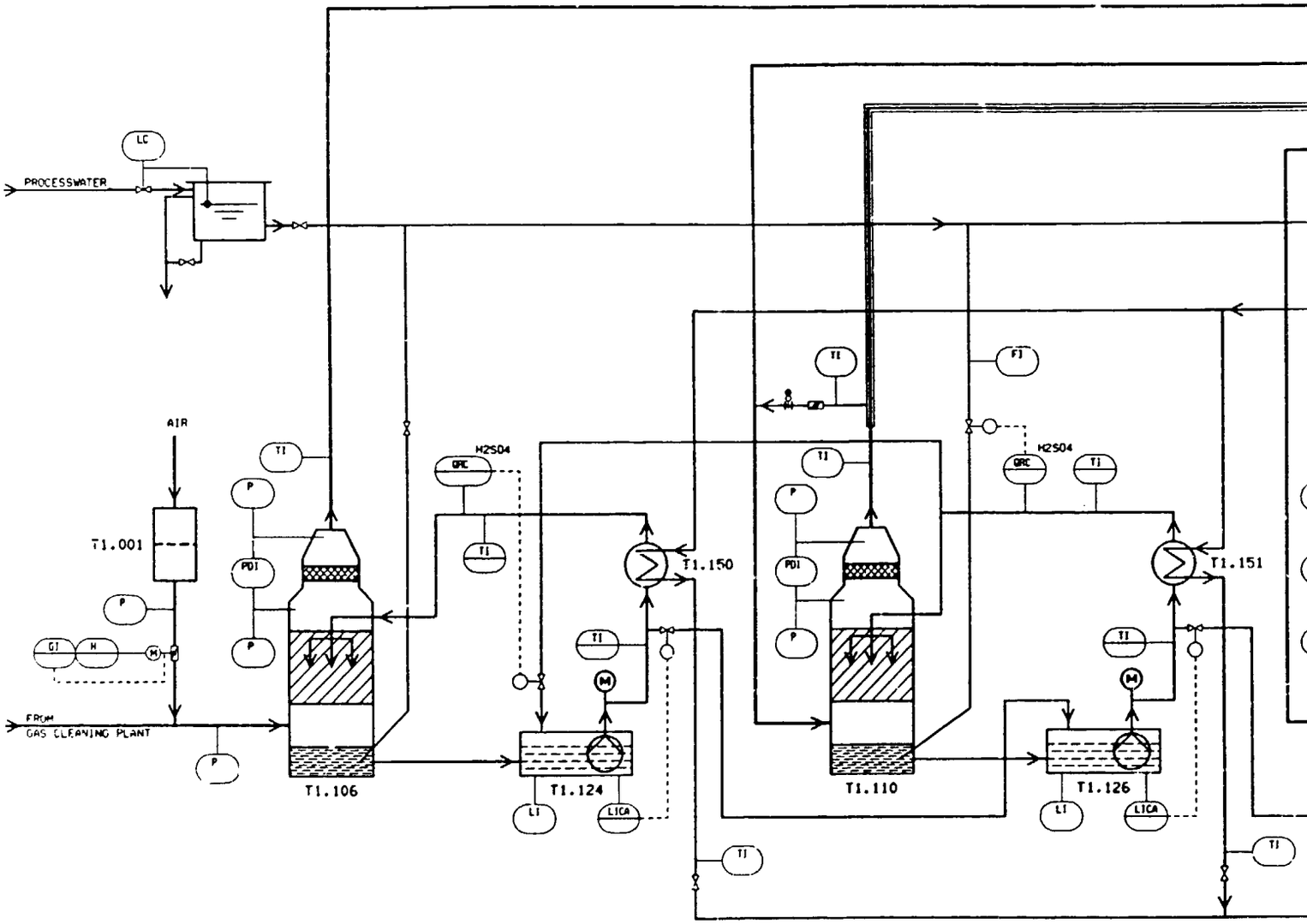
T1.124
ACID PUMP TANK

T1.150
ACID COOLER

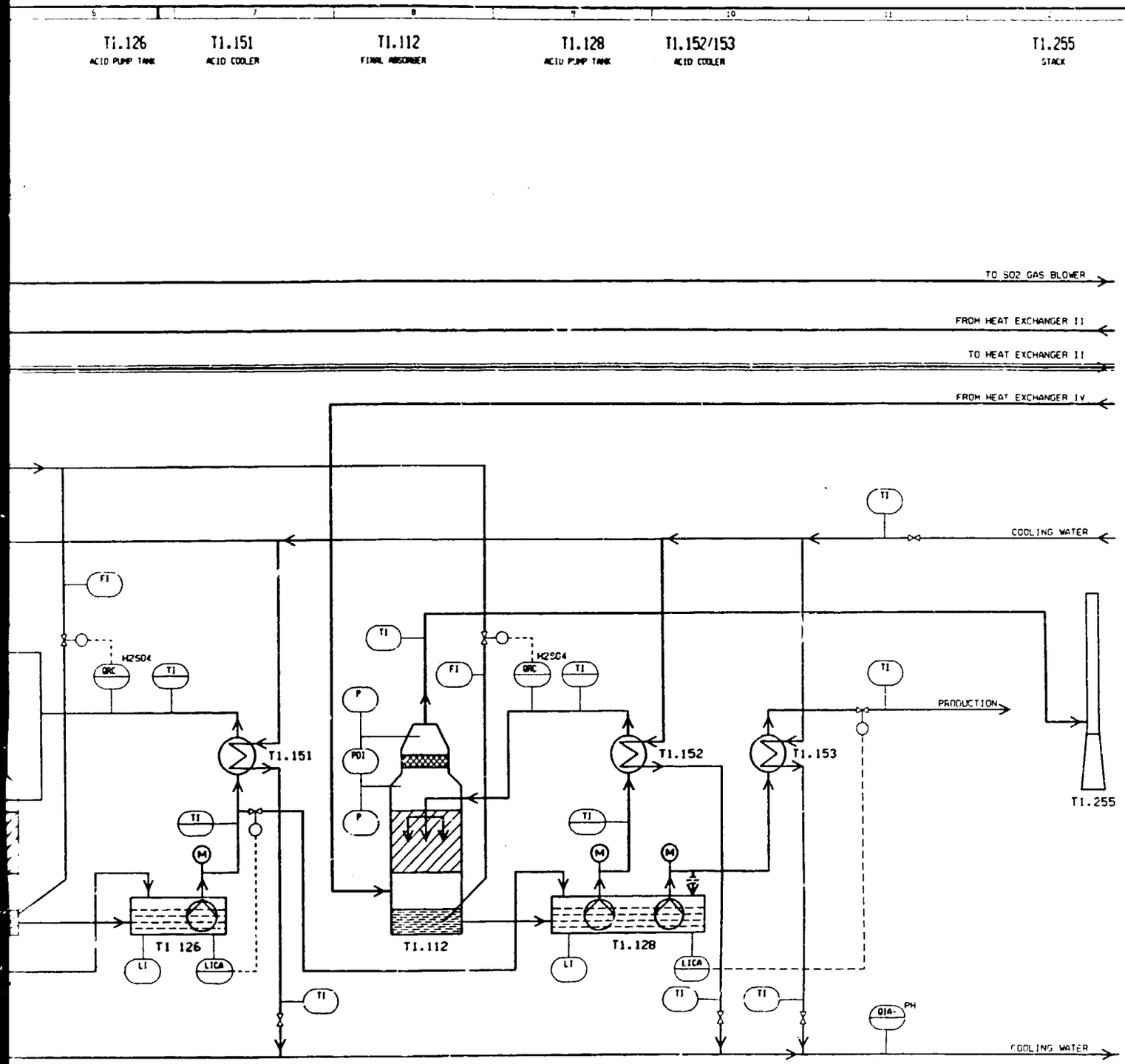
T1.110
INTERMEDIATE ABSORBER

T1.126
ACID PUMP TANK

T1.151
ACID COOLER



SECTION 1



SECTION 2

+ CROSSING LINES WITHOUT CONNECTION

+ CROSSING LINES WITH CONNECTION

Prepared	21.02.85	EPB/ENE	LURGI Lurgi Chemie und Hüttentechnik GmbH
Checked			
Sheet	Title/Characteristic Features		
	H2SO4-PLANT		
	DRYING AND ABSORPTION		
Standard	DIN	Drawing Type	205 PROCESS FLOW DIAGRAM
Process	CSK	Job or Project No.	022250
Job	AMJHORE		
Drawing No.	L1A0225000001	Rev.	C
Reference Dwg.			

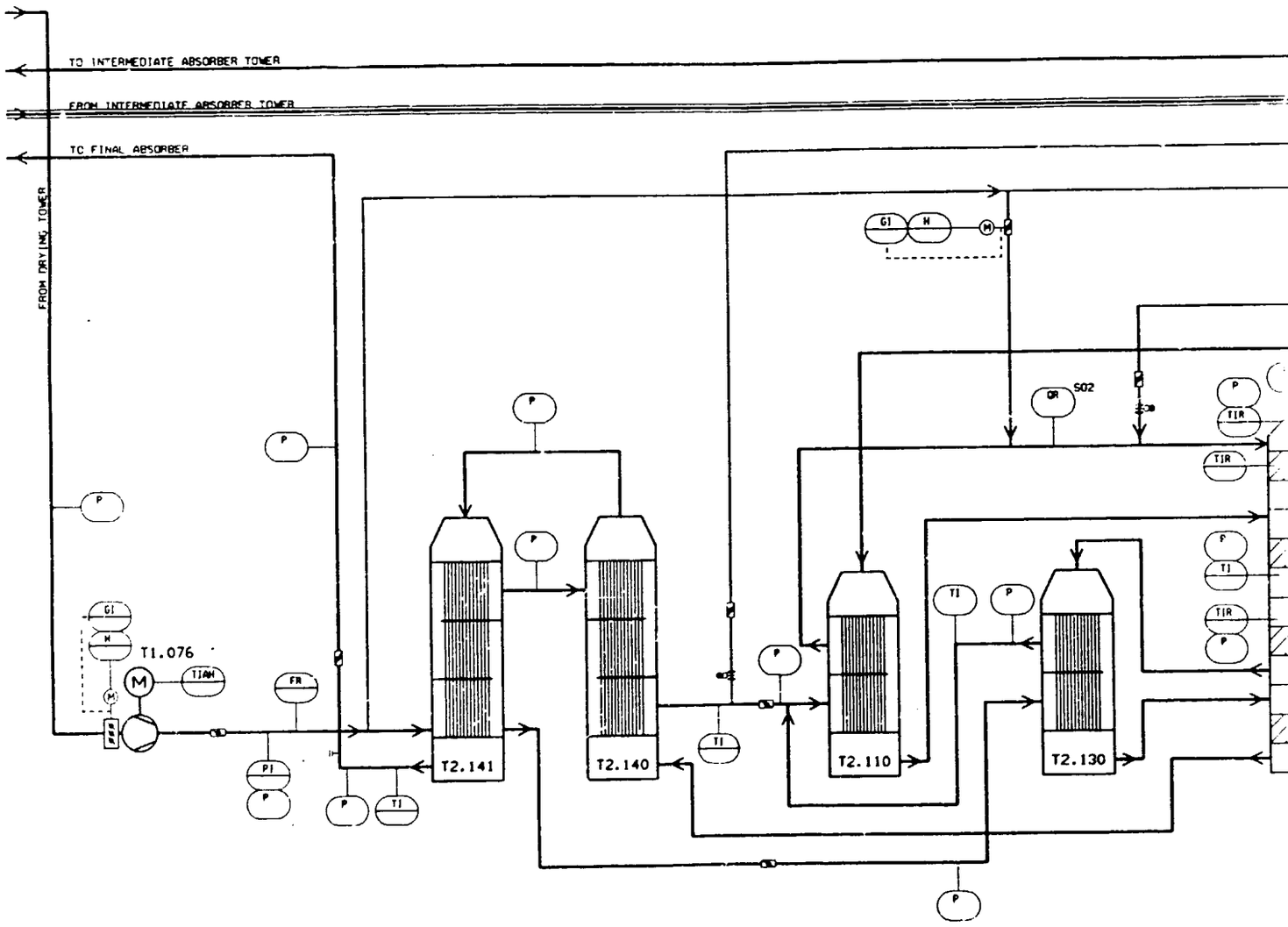
No.	Date	Changed	Checked	Kind of Revision
0	15.04.85	EPB		INITIAL RELEASE

T1.076
SO2-GAS BLOWER

T2.140/141
HEAT EXCHANGER
IVA IVB

T2.110
HEAT EXCHANGER
I

T2.130
HEAT EXCHANGER
III



SECTION 1

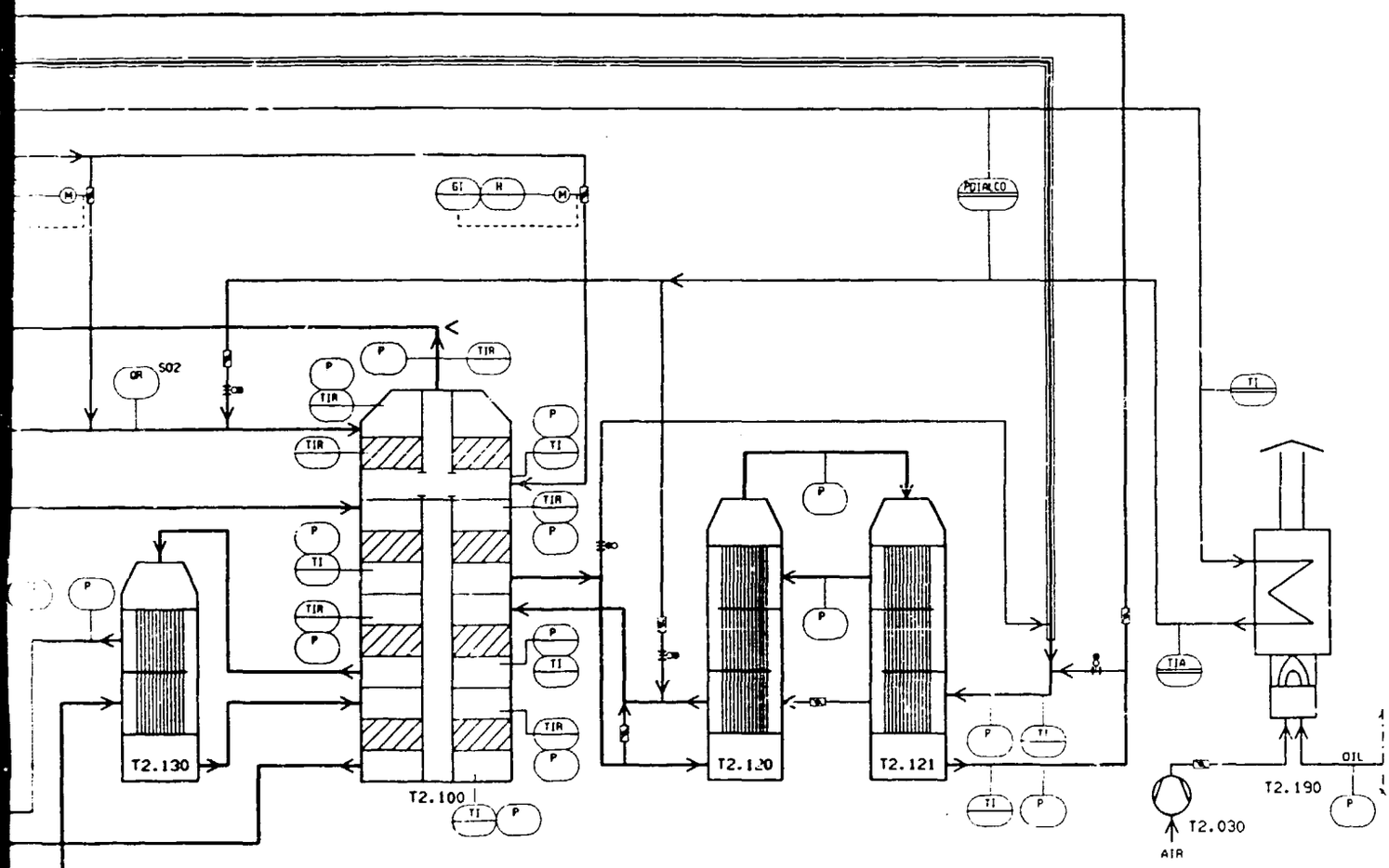
T2.130
HEAT EXCHANGER
III

T2.100
CONVERTER

T2.120/121
HEAT EXCHANGER
IIA / IIB

T2.030
BURNER AIR FAN

T2.190
PREHEATER



SECTION 2

+ CROSSING LINES WITHOUT CONNECTION

+ CROSSING LINES WITH CONNECTION

Prepared	Date 21.03.85	Name ERB/ENE	LURGI Lurgi Chemie und Hüttentechnik GmbH
Checked			
Sheet	Title/Characteristic Features: H2SO4-PLANT CONVERTER GROUP		
Standard DIN	Drawing type: 205 PROCESS FLOW DIAGRAM		
Design CSK	Job or Project No. 022250	Unit AMJHORE	
Drawing No. L1A0225000002	Rev.	Reference Dwg.:	

Sach-Nr

Ind	Rev.	Geändert Revised Name	Geändert Revised Datum Date	Geprüft Checked Name	Blatt Sheet	Art der Änderung Kind of Revision
3.	0		23.5.85	Emn		FIRST EDITION

Kunde: Custom…
Elektr…
Hochsp… High vo…
Nieder… Low vo…
Steuer… Contro…
Signals… Signal…
Normen… Standa…
Positio…
Nr. -U…
B1
I R
II R
25

(3) Datum 1 79
Zeichen N

Rev

SECTION 1

Original-Größe A3

Sach-Nr N01 Formblatt F 10197.3 DE

Dieses Blatt ist das Deckblatt für die weiteren Blätter mit derselben Zeichnungsnummer. Auf dem Blatt ist die Revision und die Art der Änderung gekürzt anzugeben. Die jeweils letzte Revision ist der Zeichnungsnummer im Deckblatt hinzuzufügen; sie gilt für alle zu der Zeichnungsnummer gehörenden Blätter. Auf den inhaltlich nicht geänderten Blättern bleibt der bisherige Revisionsvermerk bestehen.

This sheet is the cover sheet for all subsequent sheets having the same drawing number. The revision index and a brief description of the revision shall be entered on the cover sheet. The last revision index shall be added to the drawing number on the cover sheet and equally applies to all sheets having that drawing number. On those sheets where no revisions have been made the previous revision index shall be retained.

Kunde: Customer: PYRITES PHOSPHATES CHEMICALS LTD NEW DELHI

Elektrische Daten - Electrical data			Aufstellungsort - Plant site			
Hochspannung High voltage	6 kV	50 Hz	Land Country	INDIA		
Niederspannung Low voltage	415 V	50 Hz	Höhe über NN Elevation above sea level	165 m		
Steuerspannung Control voltage	220 V	50 Hz	Umgebungstemperatur Ambient temperature	°C min.	40 °C mittel-mean	°C max.
Signalspannung Signal voltage	24 V	DC Hz	Klima Climate	TROPICAL		

Normen: Standards: VDE, DIN, IEC

Positionsaufteilung der Anlage - Number of plant units

Nr. - Unit No.	Teilanlage - Plant unit	Bemerkungen - Remarks	Blatt-Sheet
B1.	PYRITE ORE PREPARATION		1-3
I R ...	ROASTING LINE I		4-6
II R ...	ROASTING LINE II		7-10
R5...	WATER TREATMENT		11
	COOLING TOWER		12
	HOT GAS PRECIPITATOR		13
	WET GAS PRECIPITATOR		14
	H_2SO_4 PLANT		15
	TURBO ALTERNATOR		16

	Datum	Name
Gezeichnet	13.6.85	Emn
Geprüft		

Lurgi Chemie und Hüttentechnik GmbH

Maßstab

Benennung / Charakt. Merkmale.

SECTION 2

Verbraucherliste - List of consumers

Normart

Zeichnungsart 551

Verfahren	Auftrags-/Angebots-Nr	Kennwort
CRNS	00.2250	AMJHORE PYRIT

Zeichnungs-Nr / Drawing No. L3A 00 22 50 000 03 Rev 0

Entst. aus

Deckbl. / zu Blatt 1 bis 16

F 10197.3 DE

Sach-Nr

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Folgeblatt zur Verbraucherliste F 10 ... 30E, die ohne weiteren Angaben und den Änderungszustand enthält
Continuation sheet to list of consumers F 10 197.30E showing all further information and the revision indexes.

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions-Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min⁻¹	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Hers
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min⁻¹	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manuf
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
E1.002	RECIPROCATING FEEDER	1						2,2	1500	415	B3	B	IP54		
E1.003	BELT CONVEYOR	1		6,3				7,5	1500	415	B2	B	IP54		
E1.004	BELT WEIGHER	1						2		415					
E1.005	DOUBLE DECK VIBRATION SCREEN	1						2,2	1500	415	B2	B	IP54		
E1.006	BELT CONVEYOR	1		3,4				3	1500	415	B3	B	IP54		
E1.007	FEEDER	1													
E1.010	FEEDER	1						1,30		415					
E1.011	ORE CONTER	1						J							
E1.012	FEEDER	1						?							
E1.013	FEEDER	1						1,30		415					
E1.014	ORE CONTER	1													
Summe Total				Summe Total											

SECTION 1

③ Datum: 11.79 Zeichen: N

Original-Größe A3

of inertia

Purchaser . M = Mechanical Department

E = Electrical Department

Lieferungsbestimmungen / Design requirements					Fabrikat - Make										Sonstiges - Others	
Netzspannung / voltage	Baufórm / Mounting	Isolierstoff-klasse / Insulation class	Schutzart / Enclosure	Explosionsschutzart / Explosion protect. type	Hersteller / Manufacturer	DIN / IEC Baugröße / DIN / IEC Size	Typ / Type	Nennstrom A / Rated current A	cos φ / Power factor	Wirkungsgrad % / %Efficiency	M_a/M_n	I_a/I_n	t_e-Zeit s / t_e time s	Gewicht kg / Weight kg	Besteller / Purchaser	Bemerkungen / Remarks
1	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	B3	B	IP54												M	
	B3	B	IP54												E	
															M	
	B3	B	IP54												E	
	B3	B	IP54												E	
															M	
															M	
															J	
															M	
															J	

SECTION 2

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions - Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Her
Item No.	Designation	No. req. Active	Reserve	Power req. kW (at shaft)	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manu
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
B1 015	BELT CONVEYOR	1		2,1				3	1500	415	B3	B	IP54		
B1 016	BELT CONVEYOR	1		2,1				3	1500	415	B3	B	IP54		
B1 017	BELT CONVEYOR	1		4,3				5,5	1500	415	B3	B	IP54		
B1 018	BELT CONVEYOR	1		4,3				5,5	1500	415	B3	B	IP54		
B1 019	RECIPROCATING FEEDER	1						2,2	1500	415					
B1 020	RECIPROCATING FEEDER	1						2,2	1500	415					
B1 021	BELT CONVEYOR	1		5,7				7,5	1500	415	B3	B	IP54		
B1 022	BELT WEIGHER	1						2		415					
B1 023	IMPACT CRUSHER	1						55	1500	415	B3	B	IP54		
B1 024	BELT CONVEYOR	1		4,4				5,5	1500	415	B3	B	IP54		
Summe Total				Summe Total											

SECTION 1

Rev	

③ Datum 11.79 Zeichen N

PURITE DES PREPARATION

Original-Größe A3

of inertia

rungsbestimmungen gn requirements					Fabrikat - Make										Sonstiges - Others	
spannung	Baufform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Hersteller	DIN / IEC Baugröße	Typ	Nennstrom A	cos φ	Wirkungsgrad %	M_a/M_n	I_a/I_n	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
voltage	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	M_a/M_n	I_a/I_n	t_e time s	Weight kg	Purchaser	Remarks
1	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
15	33	B	IP54												E	
15	33	B	IP54												E	
15	33	B	IP54												E	
15	33	B	IP54												E	
15															M	
15															M	
15	33	B	IP54												E	
							SECTION 2									
15															M	
15	33	B	IP54												E	
15	33	B	IP54												E	

PREPARATION | LURGI Gesellschaft: | Zeichnungs-Nr. / Drawing No.: [illegible] | Entst aus | Blatt 2 | Geändert bei Rev.

F 10198.3 DE

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions-Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Her
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manu
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
B1.025	DOUBLE DECK VIBRATION SCREEN	1						15	1500	415	B3	B	IP54		
B1 026	BELT CONVEYOR	1		4,3				5,5	1500	415	B3	B	IP54		
B1 027	VIBRATION FEEDER							1,5	1500	415					
B1 028	ROLLER CRUSHER							7,5 7,5	1500 1500	415	B3 B3	B	IP54		
B1.029	BELT CONVEYOR	1		3,5				4	1500	415	B3	B	IP54		
B1 030	BELT CONVEYOR			6,4				7,5	1500	415	B3	B	IP54		
	SECTION 1														
	Summe Total			Summe Total				MYLITE DRY PREPARATION							

Rev | Änderung

③ Datum: 11.79 Zeichen: N

Original-Größe A3

inertia

gsbestimmungen requirements				Fabrikat - Make										Sonstiges - Others	
Bauform	Isolierstoff-klasse	Schutzart	Explosions-schutzart	Hersteller	DIN / IEC Baugröße	Typ	Nenn-strom A	cos φ	Wirkungs-grad %	$\frac{M_a}{M_n}$	$\frac{I_a}{I_n}$	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
Mounting	Insulation class	Enclosure	Explosion protect.type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	$\frac{M_a}{M_n}$	$\frac{I_a}{I_n}$	t_e time s	Weight kg	Purchaser	Remarks
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
B5	B	IP54												E	
B3	B	IP54												E	
														M	
B3 B5	B	IP54												E	
B3	B	IP54												E	
B3	B	IP54												E	

SECTION 2

	Gesellschaft: LÜRGI	Zeichnungs-Nr. / Drawing No.: L3A00320E0000	Entst aus:	
			Blatt: 3	Geändert bei Rev.:

F 10198.3 DE

Sach-Nr

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions-Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Herst
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufa
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1
IR2.002	REVERS. BELT CONVEYOR	1		1,1				1,5	1500	415	B3	B	IP54		
IR2 002.1	BELT CONVEYOR	1		2				2,2	1500	415	B3	B	IP54		
IR2 003	BIN DISCHARGE CONVEYOR	1						5,5	1500	415	B3	B	IP54		
IR2 003.1	SERVOMOTOR	1						0,37		415					
IR2.004	BIN DISCHARGE CONVEYOR	1						5,5	1500	415	B3	B	IP54		
IR2 004 1	SERVOMOTOR	1						0,37		415					
IR2.005	BELT CONVEYOR	1						3	1500	415	B3	B	IP54		
IR2 006	BELT CONVEYOR	1						3	1500	415	B3	B	IP54		
IR2 007	BELT CONVEYOR	1						3	1500	415	B3	B	IP54		
IR2 008	BELT CONVEYOR	1						3	1500	415	B3	B	IP54		
IR2 009	ROTARY VALVE	1						2,2	1500	415	B3	B	IP54		
IR2 010	ROTARY VALVE	1						2,2	1500	415	B3	B	IP54		
Summe Total				Summe Total				PORSTINA LINE I							LUR

SECTION 1

Rev. | Datum | Zeichen

3 Datum 11.79 Zeichen: N

Original-Größe A3

of inertia

ungsbestimmungen gn requirements					Fabrikat - Make										Sonstiges - Others	
V spannung	Bauform	Isolierstoff-klasse	Schutzart	Explosions-schutzart	Hersteller	DIN / IEC Baugröße	Typ	Nenn-strom A	cos φ	Wirkungs-grad %	M_a/M_n	I_a/I_n	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
V voltage	Mounting	Insulation class	Enclosure	Explosion protect.type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	M_a/M_n	I_a/I_n	t_e time s	Weight kg	Purchaser	Remarks
1	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
[illegible]	B3	B	IP54												E	
[illegible]	B3	B	IP54												E	
[illegible]	B3	B	IP54												E	
[illegible]															M	REVERSIBLE
[illegible]	B3	B	IP54												E	
[illegible]															M	REVERSIBLE
[illegible]	B3	B	IP54												E	
[illegible]	B3	B	IP54												E	
[illegible]	B3	B	IP54												E	
							SECTION 2									
[illegible]	B3	B	IP54												E	
[illegible]	B3	B	IP54												M	
[illegible]	B3	B	IP54												M	

[illegible]

Gesellschaft: LURGI

Zeichnungs-Nr. / Drawing No.: [illegible]

Entst aus

Blatt 2

Geändert bei Rev.

F 10198.3 DE

Sach-

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions - Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment $\%M_n$	J $kg\,m^2$		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Her
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque $\%M_n$	J $kg\,m^2$		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manu
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
IR3.010	OIL PUMP	1						3	3000	415	B3	3	IP54		
IR3 012	ROASTING AIR BLOWER	1		195				250	3000	6000	B3	F	IP54		
IR3 012.1	VANE CONTROL	1						0,37		415					
IR3 015	ROASTING AIR FLAP	1						1,1		415					
IR4	CIRCULATION PUMP	1		18				22	3000	415	B3	3	IP54		
IR4	MAGNETIC VALVES FOR CLEANING SYSTEM	5						0,5		220					
IR4	HYDRAULIC PUMP FOR QUICK START AUX. TURBINE	1						0,2		415					
IR4	LIGHTING LEVEL STEAM DRUM	1						0,04		220					
	SECTION 1														
	Summe Total			Summe Total				ROASTING LINE I							LU

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Fortsetzblatt zu Druckschrift Nr. F10[illegible]DE, die weiteren Angaben und den Änderungszustand enthält.
Continuation sheet to list of consumers F.10197.3DE showing all further information and the revision indexes.

Rev. | Änderung

(3) Datum: 11.79 Zeichen.: N

Original-Größe A3

nt of inertia

Führungsbestimmungen / Design requirements					Fabrikat - Make										Sonstiges - Others	
Nenn-spannung V / Rated voltage V	Bauform / Mounting	Isolierstoff-klasse / Insulation class	Schutzart / Enclosure	Explosions-schutzart / Explosion protect. type	Hersteller / Manufacturer	DIN / IEC Baugröße / DIN / IEC Size	Typ / Type	Nenn-strom / Rated current A	cos φ / Power factor	Wirkungs-grad / %Efficiency	M_a/M_n	I_a/I_n	t_e-Zeit / t_e time s	Gewicht / Weight kg	Besteller / Purchaser	Bemerkungen / Remarks
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
415	B3	B	IP54												E	
10000	B3	F	IP54												E	
415															M	REVERSIBLE
415															M	REVERSIBLE
415	B3	B	IP54												E	
220															M	
415															M	
220															M	

SECTION 2

	LURGI Gesellschaft:	Zeichnungs-Nr. / Drawing No.:	Entst aus	
			Blatt 5	Geandert bei Rev.

F 10 198.3 DE

Sach-Nr

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions-Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Baufórm	Isolierstoffklasse	Schutzart	Explosionsschutzart	Herst
Item No.	Designation	No. req. Active	Reserve	Power req. (at shaft) kW	Starting % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufa
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1
IR7.001	REDLER	1						2,2	1500	415	B3	B	IP54		
IR7.002	REDLER	1						3	1500	415	B3	B	IP54		
IR7.003	REDLER	1						3	1500	415	B3	B	IP54		
IR7.005	BLOWER	1						22	3000	415	B3	B	IP54		
IR7.007	ROTARY VALVE	1						1,5	1500/22	415	B3	B	IP54		
IR7.012.1	SERVOMOTOR	1						1,2		415					
IR7.014	COOLING AND WETTING DRUM	1						4	1500	415	B3	B	IP54		
IR7.014.1	FEED SCREW	1						2,2	1500/34	415	B3	B	IP54		
IR7.018	SERVOMOTOR	1						1		415					
	SECTION 1														
	Summe Total			Summe Total				ROASTING LINE I							LUR

Rev 13

③ Datum: 11.79
Zeichen: N

Original-Größe A3

of inertia

Lieferungsbestimmungen / Design requirements					Fabrikat - Make										Sonstiges - Others	
Netzspannung / voltage	Bauform / Mounting	Isolierstoffklasse / Insulation class	Schutzart / Enclosure	Explosionsschutzart / Explosion protect. type	Hersteller / Manufacturer	DIN / IEC Baugröße / DIN / IEC Size	Typ / Type	Nennstrom / Rated current A	cos φ / Power factor	Wirkungsgrad / Efficiency %	M_a/M_n	I_a/I_n	t_e-Zeit / t_e time s	Gewicht / Weight kg	Besteller / Purchaser	Bemerkungen / Remarks
1	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
5	B3	B	IP54												E	
5	B3	B	IP54												E	
5	B3	B	IP54												E	
5	B3	B	IP54												E	
5	B3	B	IP54												M	
5															M	REVERSIBLE
5	B3	B	IP54												E	
5	B3	B	IP54												M	
5															M	REVERSIBLE

SECTION 2

LINE 1	Gesellschaft: LURGI	Zeichnungs-Nr. / Drawing No.: L3A 00225000003	Entst. aus:	
			Blatt: 6	Geändert bei Rev.:

F 10198.3DE

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions-Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min⁻¹	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Her
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting % M_n torque	J kg m²		Rated power kW	Rated speed min⁻¹	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manu
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
II R2 002	REVERS. BELT CONVEYOR	1						2,2	1500	415	B3	B	IP54		
II R2 003	BIN DISCHARGE CONVEYOR	1						5,5	1500	415	B3	B	IP54		
II R2 003.1	SERVOMOTOR	1						0,37		415					
II R2 004	BIN DISCHARGE CONVEYOR	1						5,5	1500	415	B3	B	IP54		
II R2 004.1	SERVOMOTOR	1						0,37		415					
II R2 005	BELT CONVEYOR	1						3	1500	415	B3	B	IP54		
II R2 006	BELT CONVEYOR	1						3	1500	415	B3	B	IP54		
II R2 007	BELT CONVEYOR	1						3	1500	415	B3	B	IP54		
II R2 008	BELT CONVEYOR	1						3	1500	415	B3	B	IP54		
II R2 009	ROTARY VALVE	1						2,2	5-21,5	415	B3	B	IP54		
II R2 010	ROTARY VALVE	1						2,2	5-21,5	415	B3	B	IP54		
Summe Total				Summe Total				ROASTING LINE II							

SECTION 1

Rev | Datum: 11.79 | Zeichen: N

Original-Größe A3

Sach-Nr. N01 Formblatt: F 10193.3DE

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Bestimmungen / Requirements				Fabrikat - Make										Sonstiges - Others	
Baufórm / Mounting	Isolierstoff-klasse / Insulation class	Schutzart / Enclosure	Explosions-schutzart / Explosion protect. type	Hersteller / Manufacturer	DIN / IEC Baugröße / DIN / IEC Size	Typ / Type	Nenn-strom / Rated current A	cos φ / Power factor	Wirkungs-grad / %Efficiency	M_a/M_n	I_a/I_n	t_e-Zeit / t_e time s	Gewicht / Weight kg	Besteller / Purchaser	Bemerkungen / Remarks
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
B3	B	IP54												E	
B3	B	IP54												E	
														M	REVERSIBLE
B3	B	IP54												E	
														M	REVERSIBLE
B3	B	IP54												E	
B3	B	IP54												E	
B3	B	IP54												E	
B3	B	IP54												E	
						SECTION 2									
B3	B	IP54												M	
B3	B	IP54												M	

NE II

Gesellschaft: LURGI

Zeichnungs-Nr. / Drawing No.: L2P0000000000003

Entst aus

Blatt: 7 Geändert bei Rev.:

F10193.3DE

Sach-N

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom. - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions - Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min⁻¹	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Her
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min⁻¹	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manu
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
II R3.010	OIL PUMP	1						3	3000	415	B3	B	IP54		
II R3.012	ROASTING AIR BLOWER	1		125				160	3000	415	B3	B	IP54		
II R3.012.1	VANE CONTROL	1						0,37		415					
II R3.015	ROASTING AIR FLAP	1						1,1		415					
II R3.019	ROTARY VALVE	1						1,5	1500/15	415	B3	B	IP54		
II R4.	CIRCULATION PUMP	1		13				.	3000	415	B3	B	IP54		
II R4.	MAGNETIC VALVE FOR CLEANING SYSTEM	5						0,5		220					
II R4	HYDRAULIC PUMP FOR QUICK START AUX. TURBINE	1						0,2		415					
II R4	LIGHTING LEVEL STEAM DRUM	1						0,04		220					
SECTION 1															
Summe Total				Summe Total				ROASTING LINE II							

Rev | II

③ Datum: 11.79
Zeichen: N

Original-Größe A3

- of inertia

: ungsbestimmungen gn requirements					Fabrikat - Make										Sonstiges - Others	
✓ spannung	Bauform	Isolierstoff-klasse	Schutzart	Explosions-schutzart	Hersteller	DIN / IEC Baugröße	Typ	Nenn-strom A	cos φ	Wirkungs-grad %	M_a/M_n	I_a/I_n	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
V voltage	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	M_a/M_n	I_a/I_n	t_e time s	Weight kg	Purchaser	Remarks
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
5	B3	B	IP54												E	
5	B3	B	IP54												E	
5															M	REVERSIBLE
5															M	REVERSIBLE
5	B3	B	IP54												M	
5	B3	B	IP54												E	
0															M	
5															M	
0															M	
							SECTION 2									

LINE II

Gesellschaft: LURGI

Zeichnungs-Nr. / Drawing No.: L3A 00 22 50 00 00 03

Entst aus

Blatt 8 Geandert bei Rev.

F 10198.3 DE

Sach-Nr

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions - Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment $\%M_n$	J kg m²		Nenn-leistung kW	Nenn-drehzahl min^{-1}	Nenn-spannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Herst
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque $\%M_n$	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufa
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
II R7.001	REDLER	1						2,2	1500	415	B3	B	IP54		
II R7.002	ROTARY COOLER	1						22	1500	415	B3	B	IP54		
II R7.003	REDLER	1						2,2	1500	415	B3	B	IP54		
II R7 003.1	REDLER	1						2,2	1500	415	B3	B	IP54		
II R7 004	BUCKET ELEVATOR	1						7,5	1500	415	B3	B	IP54		
II R7.005.1	AIR DISTRIBUTOR	1						0,12		415					
II R7.005.2	ROTARY AIR FAN	1		5,2				7,5	3000	415	B3	B	IP54		
I R7.007	BLOWER	1						22	3000	415	B3	B	IP54		
II R7.009	ROTARY VALVE	1						1,5	22	415	B3	B	IP54		
I R7.010	FILTER	1						~1		415					
II R7.012.2	SERVO MOTOR	1						1,2		415					
	Summe Total			Summe Total				ROASTING LINE II							

SECTION 1

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Folgeblatt zur ... F10 weiteren Angaben und den Änderungszustand enthalt. Continuation sheet to list of consumers F10197.3DE showing all further information and the revision indexes.

Rev | Item

3 Datum: 11.79 Zeichen: N

Original-Größe A3

- of inertia

ungsbestimmungen on requirements					Fabrikat - Make										Sonstiges - Others	
spannung	Baufórm	Isolierstoff-klasse	Schutzart	Explosions-schutzart	Hersteller	DIN / IEC Baugröße	Typ	Nenn-strom A	cos φ	Wirkungs-grad %	M_a/M_n	I_a/I_n	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
voltage	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	M_a/M_n	I_a/I_n	t_e time s	Weight kg	Purchaser	Remarks
1	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	B3	B	IP54												E	
	B3	B	IP54												E	
	B3	B	IP54												E	
	B3	B	IP54												E	
	B3	B	IP54												E	
															M	
	B3	B	IP54												E	
	B3	B	IP54												E	
	B3	B	IP54												M	
							SECTION 2									
															M	
															M	REVERSIBLE

LINE II

Gesellschaft: LURGI

Zeichnungs-Nr. / Drawing No.: 13A0022500003

Entst aus

Blatt. 9 Geandert bei Rev.:

F10198.3DE

Sach-Nr.

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions-Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Herst
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufa
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1
II R7. 015	ROTARY VALVE							2,2	1500 /	415	B3	B	IP54		
II R7. 018	SERVO MOTOR	1						1		415					
	SECTION 1														
Summe Total				Summe Total				ROASTING LINE II							LUR

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Folgeblatt zur Verbraucherliste F 10 197 3 DE, die alle weiteren Angaben und den Änderungszustand enthält
Continuation sheet to list of consumers F 10 197 3 DE showing all further information and the revision indexes.

Rev. | Datum | Zeichen

③ Datum: 11.79 Zeichen: N

Original-Größe A3

* inertia

ngsbestimmungen n requirements					Fabrikat - Make										Sonstiges - Others	
Bauform	Isolierstoff-klasse	Schutzart	Explosions-schutzart	Hersteller	DIN / IEC Baugröße	Typ	Nenn-strom A	cos φ	Wirkungs-grad %	M_a/M_n	I_a/I_n	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
Mounting	Insulation class	Enclosure	Explosion protect. type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	M_a/M_n	I_a/I_n	t_e time s	Weight kg	Purchaser	Remarks
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
B3	B	IP54												M	
														M	REVERSIBLE

SECTION 2

LINE II	Gesellschaft: LURGI	Zeichnungs-Nr. / Drawing No.: L3A 0222500000	Entst aus	
			Blatt: 10	Geandert bei Rev.

FLUIDSIM

Sach-Nr

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Folgeblatt zur Verbraucherliste F 10 ... 30 DE, die ... weiteren Angaben und den Änderungszustand enthält.
Continuation sheet to list of consumers F 10 197 30 DE showing all further information and the revision indexes.

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions - Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Hers
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manuf
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
RS.	FEED WATER PUMP FEED WATER TANK	1		39				45	3000	415	B3	B	IP54		
RS.	DOSING PUMP	1						0,3		415					
RS	FEED WATER PUMP	1		0,6				1,5	3000	415	B3	B	IP54		
RS.	FEED WATER PUMP	1		3,9				5,5	3000	415	B3	B	IP54		
RS	CONTROL BOARD	1						3		415					
RS	DOSING PUMP	1						0,3		415					
RS	BLOWER FOR CO_2 SPRAYER	1						1,5	3000	415	B3	B	IP54		
RS	SERVICE PUMP	1		0,7				1,1	3000	415	B3	B	IP54		
RS	SERVICE PUMP		1	0,7				1,1	3000	415	B3	B	IP54		
Summe Total				Summe Total				WATER TREATMENT							

SECTION 1

Rev	

③ Datum: 1.79 Zeichen: N

Original-größe A3

...ent of inertia

Ausführungsbestimmungen / Design requirements					Fabrikat - Make										Sonstiges - Others	
Nenn-spannung V	Baufórm	Isolierstoff-klasse	Schutzart	Explosions-schutzart	Hersteller	DIN / IEC Baugröße	Typ	Nenn-strom A	cos φ	Wirkungs-grad %	$\frac{M_a}{M_n}$	$\frac{I_a}{I_n}$	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	% Efficiency	$\frac{M_a}{M_n}$	$\frac{I_a}{I_n}$	t_e time s	Weight kg	Purchaser	Remarks
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
415	B3	B	IP54												E	
415															M	
415	B3	B	IP54												E	
415	B3	B	IP54												E	
415															M	FUSE FEEDER
415															M	
							SECTION 2									
415	B3	B	IP54												E	
415	B3	B	IP54												E	
415	B3	B	IP54												E	

...TREATMENT

Gesellschaft: LURGI

Zeichnungs-Nr. / Drawing No.: L3A022250 0003

Entst. aus

Blatt 11

Geändert bei Rev.

Sach-Nr.

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions - Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Hers
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manuf
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	BLOWER	1						30	1500	415	B5	B	IP54		
	BLOWER	1						30	1500	415	B5	B	IP54		
	BLOWER	1						30	1500	415	B5	B	IP54		
	BLOWER	1						30	1500	415	B5	B	IP54		
	COOLING WATER PUMP	1		151				200	3000	6000	B3	B	IP54		
	COOLING WATER PUMP	1		151				200	3000	6000	B3	B	IP54		
	SECTION 1														
	Summe Total			Summe Total				COOLING TOWER							

Rev | Datum: 11.79 | Zeichen: N

Original-Größe A3

LU

- of inertia

ungsbestimmungen gn requirements					Fabrikat - Make										Sonstiges - Others	
V spannung	Baufórm	Isolierstoffklasse	Schutzart	Explosionsschutzart	Hersteller	DIN / IEC Baugröße	Typ	Nennstrom A	cos φ	Wirkungsgrad %	M_a/M_n	I_a/I_n	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
V voltage	Mounting	Insulation class	Enclosure	Explosion protect.type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	M_a/M_n	I_a/I_n	t_e time s	Weight kg	Purchaser	Remarks
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
5	B5	B	IP54												E	
5	B5	B	IP54												E	
5	35	B	IP54												E	
5	B5	B	IP54												E	
5	B3	B	IP54												E	
00	B3	B	IP54												E	

SECTION 2

POWER	Gesellschaft: LURGI	Zeichnungs-Nr. / Drawing No.: L3A 00225 0 0003	Entst. aus:	
			Blatt: 12	Geändert bei Rev.:

T 10198.3 DE

Sach-Nr

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions - Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Herst
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufa
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1
	ROTARY VALVE ZYCLON	1						0,75		415					
	ROTARY VALVE	2						0,75		415					
	RECTIFIER TRANSFORMER HOT GAS PRECIPITATOR	5						kVA 35		415					
	PERFORATED PLATE RAPPER	2						0,015		415					
	PLATE RAPPER	5						0,015		415					
	WIRE RAPPER	5						0,37		415					
	INSULATION HEATER	2						40		415					
	REDLER	2						3		415					
	SECTION 1														
	Summe Total			Summe Total				HOT GAS PRECIPITATOR							LU

Rev

3 Datum: 11.79 Zeichen.: N

Original-Größe A3

of inertia

...ungsbestimmungen ...n requirements					Fabrikat - Make										Sonstiges - Others	
...spannung	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Hersteller	DIN / IEC Baugröße	Typ	Nennstrom A	cos φ	Wirkungsgrad %	M_a/M_n	I_a/I_n	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
...voltage	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	M_a/M_n	I_a/I_n	t_e time s	Weight kg	Purchaser	Remarks
1	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
															M	
															M	
															M	
															M	
															M	
															M	
															M	

SECTION 2

PRECIPITATOR

LURGI Gesellschaft:

Zeichnungs-Nr. / Drawing No.: L3A00225000003

Entst. aus:

Blatt: 13 Geändert bei Rev.:

Sach-Nr.

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions - Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Hers
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manuf
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	SPRAYING TOWER PUMP	1	1	36				45	1500	415	B3	B	IP54		
	PUMP FOR STAND PIPE	1	1	5				7,5	1500	415	B3	B	IP54		
	COOLING PUMP	1	1	5				7,5	1500	415	B3	B	IP54		
	FILTER PUMP	1		16				18,5	1500	415	B3	B	IP54		
	RING COMPRESSOR	12		2,6				3		415					
	RECTIFIER TRANSFORMER WET GAS PRECIPITATOR	3						KVA 27		415					
	SECTION 1														
	Summe Total			Summe Total				WET GAS PRECIPITATOR							

Rev | Datum: 11.79 | Zeichen: N

Original-Größe A3

of inertia

ungsbestimmungen gn requirements					Fabrikat - Make										Sonstiges - Others	
spannung	Bauform	Isolierstoff-klasse	Schutzart	Explosions-schutzart	Hersteller	DIN / IEC Baugröße	Typ	Nenn-strom A	cos φ	Wirkungs-grad %	M_a/M_n	I_a/I_n	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
voltage	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	M_a/M_n	I_a/I_n	t_e time s	Weight kg	Purchaser	Remarks
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
5	B3	B	IP54												M	
5	B3	B	IP54												M	
5	B3	B	IP54												M	
5	B3	B	IP54												M	
5															M	
5															M	

SECTION 2

PRECIPITATOR

LURGI Gesellschaft:

Zeichnungs-Nr. / Drawing No.: L3A 00 22 5 0 00 0 03

Entst aus

Blatt. 14

Geandert bei Rev.:

TUV 198.3 DE

Sach-Nr

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Folgeblatt zur Verbraucherliste F 10 197 3DE, die alle weiteren Angaben und den Änderungszustand enthält.
Continuation sheet to list of consumers F 10 197 3DE showing all further information and the revision indexes.

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions - Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	% Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Baufom	Isolierstoffklasse	Schutzart	Explosionsschutzart	Hers
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manuf
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
T1. 045	SERVOMOTOR GAS FLAP	1						2,2		415					
T1 050	ACID PUMP DRYING	1						45	1500	415	V1	B	IP54		
T1 053	ACID PUMP INTER. ABSORPT.	1						55	1500	415	V1	B	IP54		
T1 056	ACID PUMP FINAL ABSORPT.	1						30	1500	415	V1	B	IP54		
T1 060	ACID PUMP PRODUCTION	1						11	1500	415	V1	3	IP54		
T1 062	ACID PUMP	1						2,2	1500	415	B3	3	IP54		
T1 076	SO_2 BLOWER	1		240				1000	1500	6000	B3	F	IP54		
T1 084	AUX. OIL PUMP	1						2,2	1500	415	B3	B	IP54		
T1 081	VANE CONTROL	1						1		415					
T1 096	AIR FAN NOISE HOOD	1						0,5		415					
T2 020	SERVOMOTOR GAS FLAP	1						2,5		415					
T2 021	SERVOMOTOR GAS FLAP	1						2,5		415					
T2. 030	BURNER AIR FAN	1						30	1500	415	B3	B	IP54		
T2 040	OIL PUMP FOR BURNER	1						1,5	1500	415	B3	B	IP54		
T2 041	OIL PUMP FOR BURNER	1						1,5	1500	415	B3	B	IP54		
T2 045	CONTROL BOARD	1						2		415					
Summe Total				Summe Total				H_2SO_4 PLANT							

SECTION 1

Rev	

③ Datum: 11.79
Zeichen: N

Original-Größe A3

t of inertia

Führungsbestimmungen / Design requirements					Fabrikat - Make										Sonstiges - Others	
Nenn-spannung V	Bauform	Isolierstoff-klasse	Schutzart	Explosions-schutzart	Hersteller	DIN / IEC Baugröße	Typ	Nenn-strom A	cos φ	Wirkungs-grad %	$\frac{M_a}{M_n}$	$\frac{I_a}{I_n}$	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	$\frac{M_a}{M_n}$	$\frac{I_a}{I_n}$	t_e time s	Weight kg	Purchaser	Remarks
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
415															M	REVERSIBLE
415	V1	B	IP54												E	
415	V1	B	IP54												E	
415	V1	B	IP54												E	
415	V1	B	IP54												E	
415	B3	B	IP54												E	
3000	B3	F	IP54												E	
415	B3	B	IP54												E	
415															M	REVERSIBLE
415															M	
415															M	REVERSIBLE
415															M	REVERSIBLE
415	B3	B	IP54				SECTION 2								E	
415	B3	B	IP54												E	
415	B3	B	IP54												E	
415															M	

PLANT

LURGI Gesellschaft:

Zeichnungs-Nr. / Drawing No.: L3A 00 22 50 00003

Entst aus.

Blatt 15 Geändert bei Rev.

F10198 3DE

M_a: Anlaufmoment - Starting torque
M_n: Nennmoment - Rated torque
I_a: Anlaufstrom - Starting current
I_n: Nennstrom - Rated current
J: Massenträgheitsmoment - Polar moment of inertia

Verbraucher - Consumers								Ausführungsbestimmungen Design requirements							
Positions - Nr.	Benennung	Anzahl Betrieb	Anzahl Reserve	Leistungsbedarf (Welle) kW	Anlaufmoment % M_n	J kg m²		Nennleistung kW	Nenndrehzahl min^{-1}	Nennspannung V	Bauform	Isolierstoffklasse	Schutzart	Explosionsschutzart	Her
Item No.	Designation	No. req. Active	No. req. Reserve	Power req. (at shaft) kW	Starting torque % M_n	J kg m²		Rated power kW	Rated speed min^{-1}	Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect. type	Manu
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	CONDENSATE PUMP MAIN CONDENSER	1	1					15	1500	415	B3	B	IP54		
	CONDENSATE PUMP AUX. CONDENSER	1	1					15	1500	415	B3	B	IP54		
	VACUUM PUMPS	1	1					7,5	1500	415	B3	B	IP54		
	SERVOMOTOR	1						0,75		415					
	REGULATING VALVE	1						0,5		415					
	AUX. OIL PUMP	1						15	1500	415	B3	B	IP54		
	SERVOMOTOR	3						0,37		415					
	SECTION 1														
	Summe Total			Summe Total				TURBO ALTERNATOR							

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Folgeblatt zur Verbraucherliste F 10 19... , die ... weiteren Angaben und den Änderungszustand enthält.
Continuation sheet to list of consumers F 10 197 3DE showing all further information and the revision indexes.

Rev | Datum | Zeichen

Original-Größe A3

ent of inertia

Führungsbestimmungen / Design requirements					Fabrikat - Make										Sonstiges - Others	
Nenn-spannung V	Bauform	Isolierstoff-klasse	Schutzart	Explosions-schutzart	Hersteller	DIN / IEC Baugröße	Typ	Nenn-strom A	cos φ	Wirkungs-grad %	M_a/M_n	I_a/I_n	t_e-Zeit s	Gewicht kg	Besteller	Bemerkungen
Rated voltage V	Mounting	Insulation class	Enclosure	Explosion protect.type	Manufacturer	DIN / IEC Size	Type	Rated current A	Power factor	%Efficiency	M_a/M_n	I_a/I_n	t_e time s	Weight kg	Purchaser	Remarks
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
415	B3	B	IP54												E	
415	B3	B	IP54												E	
415	B3	B	IP54												E	
415															E	REVERSIBLE
415															E	REVERSIBLE
415	B3	B	IP54												E	
415															E	REVERSIBLE
							SECTION 2									

ALTERNATOR

Gesellschaft: LURGI

Zeichnungs-Nr. / Drawing No.: L3A 00 22 50 00 03

Entst aus

Blatt 14 - Geandert bei Rev

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