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Contract № 90 204/205
UNIDO Project № US/IRA/90/251

PROJECT OPPORTUNITY STUDY ON INTEGRATED USE OF THE RAZGAH NEPHELINE ORES, IRAN BY METALLURGICAL PROCESSING INTO ALUMINA, CEMENT, SODIUM CARBONATE AND POTASH

Final Report

Volume I
GENERAL EXPLANATORY NOTE

NPO "VAMI"

VVO "TECHNOEXPORT"

ST.-PETERSBURG
1992

COMPOSITION
OF THE FINAL REPORT

Volume I. General Explanatory note.

Volume II. Drawings.

Volume III. Specifications of equipment.

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1. EXECUTIVE SUMMARY

1.1. General assumption criteria

At present the aluminium industry of Iran (the aluminium smelter "Iralco") uses imported alumina as raw material.

Iran has large proven deposits of aluminous ores (alunite, bauxite, nepheline) which may be used as the domestic raw material resources for development of the aluminium industry.

The promoter of this project under the UNIDO Contract No.90/204/205 is an Iranian state company ARMP formed in 1982/83 with the purpose of surveying, development and mining the deposits of aluminium ores in the country and processing them into alumina.

Executor of the project is the All-Union Foreign Trade Association "Technoexport", Moscow and All-Union Research and Design Institute of Aluminium, Magnesium and Electrode Industry, "NPO VAMI", St.Petersburg.

One of the aims of the above contract is the project opportunity study of the integrated conversion of Iranian nephelines to produce alumina, cement, sodium carbonate and potash.

1.2. Plant capacity

The alumina capacity of the plant is 200,000 tpy.

Output of co-products (carbonates and cement) is determined by calculations on the basis of quality of original ore:

carbonates	- 153,100 tpy
incl. sodium carbonate	- 35,400 tpy
potash	- 115,100 tpy
potassium sulfate	- 2,600 tpy
cement (based on 100% use of bellite mud and of local clay as corrective admixture	- 5,585,000 tpy

1.3. Raw material resources

As raw material the use will be made of nepheline ore from Razgah deposit. Reserves of the quality ore are estimated at about 120 million t.

According to the process flowsheet the use will be made of limestone from deposit Shiramin, whose reserves are estimated at 160 million t.

To secure 20 year operation of the plant it would be required to provide about 26 million t of nephelines and about 120 million t of limestone (in case of the use of local clay for cement production and 100% use of bellite mud).

1.4. Location

The plant is located in the region Shiramin, north-west section of Iran, in vicinity of the limestone mine.

The fenced area of the plant is 260 hectares, mud disposal area - 25 hectares.

1.5. Technology

Technology for processing nepheline ore and concentrates was developed and commercialised in Russia on the industrial scale, total output of alumina from nepheline being over 1 million tpy.

The basics of the technology for conversion of nepheline ores are sintering of ore with limestone in rotary kilns.

Resulting sinter is leached to generate bellite mud with moisture content of 40-45% which is used for cement production by the wet method in rotary kilns.

Pregnant liquor resulting from the sinter leaching is fed after desilication for production of alumina and carbonates.

1.6. Financial evaluation

Financial and economic evaluation of the integrated process for conversion of the Razgah nepheline ore has been prepared on basis of Customer (Iranian company ARMP) with use of the UNIDO developed computer model COMFAR.

Construction time of the complex is 5 years, design operation is 15 years.

Capacity of the alumina plant as per the contract is at a level of 200,000 tpy with output of corresponding quantities of co-products (calcined sodium carbonate, potash, potassium sulfate and cement).

Capacity of a cement plant when using local clay as a correcting aluminous admixture, with the full utilization of bellite mud, will be 5,585 mln.tpy.

1.6.1. Total investment costs

Total costs for construction of the production facilities and infrastructure are estimated at US $658.3 million and Rial 646838 million, with

	US $ mln	Rial mln
1. Production complex		
- imported equipment and materials	322.5	-
- Iranian equipment and materials	-	38645.0
- equipment installation	-	6379.0
- civil works	-	481898.4
- pre-production costs	98.3	15304.9
- contingency	42.1	-
Total of item 1	462.9	596450.0
2. Infrastructure	195.4	50388.0

Working capital requirements amount to US $8.9 million and Rial 2578 million.

1.6.2. Project financing

Provision of the project with funds is to be 100% at expense of governmental financing.

1.6.3. Production costs

Total costs for production of products is estimated at US $81.3 million and Rial 55641 million with:

	US $ mln	Rial mln
- raw material	1.45	2462.2
- various materials	28.41	1223.4
- process fuel	-	3116.4
- process utilities	1.85	1611.0

- direct labour	-	1347.2
- maintenance materials	8.06	3535.1
- general plant costs	2.14	1789.7
- administrative costs	1.48	1238.8
Total of operating costs	43.39	16328.8
- depreciation (average for 15 years of operation)	37.90	39312.0

1.6.4. Financial analysis

The tentative consolidated calculations proved non-viability of the project when estimated on basis of total costs (hard currency plus local costs) due to high costs of civil works and installation under conditions of Iran and inconsistency of the exchange rate between Rial and US dollar with prevailing market prices.

Since in the design criteria of ARMP it was suggested that the viability of the complex construction should be estimated only on basis of hard currency costs and revenues, the factor for conversion of local costs into hard currency was taken as zero.

The calculations made indicated the following basic financial and economic indicators of the project for the alternative selected (taking into account only hard currency income and expenditure):

- total investment costs - \$667.2 million
  with fixed capital - \$658.3 million
- average annual cash in hand - \$73.5 million
  with depreciation - \$37.9 million
- internal rate of return on investment - 5.8%
- payback period - 9.6 years
- breakeven point (in 5th year of operation) - 61%

1.6.5. Sensitivity analysis

A performed sensitivity analysis of the project in relation to variation of the major factors determining its feasibility (prices of products, operating costs and capital investments) has shown, that for their variation in the range of ±25% there is no appreciable improvement of the financial-economic parameters.

1.7. Conclusions

The results of the prepared study of project opportunity allow the following conclusions to be made:

1.7.1. Nepheline ores from the deposit Razgah may be processed into alumina, cement, sodium carbonate and potash according to the Supplier's proprietary industrial technology.

Implementation of the considered project allows establishment in Iran of domestic source of supply of the existing and future aluminium production capacities, eliminate imports of this product and reduce import of calcined sodium carbonate, eliminate imports of potash and establish its exports, and to satisfy demand of the country in cement.

1.7.2. The results of the financial and economic evaluation indicate the possibility of implementation of the proposed concepts (hard currency for construction and operation of the complex at expense of hard currency savings for import purchase of alumina, sodium carbonate and potash, as well as additional revenue from exports of potash will be paid back in 9.6 years at internal rate of return on investment at a rate of 5.8%. The savings and increase in hard currency revenues will amount to about US $35 million in average for 15 years of operation.

A final decision to be taken by the Government of the Islamic Republic of Iran taking into account the political, socio-economic, national and other priorities.

1.7.3. This study has been prepared in full scope as provided for by the Contract and corresponds to the "Guidelines for preparation of industrial feasibility studies".

2. GENERAL ECONOMIC DATA

2.1. General information

In 1990 consumption of aluminium in Iran amounted to 75,000 t. It is planned to increase consumption to 120,000 tpy in the near future and then to 300,-400,000 tpy.

Aluminium is mostly used in the construction industry, household appliances, electrical engineering, kitchen utensiles, equipment, etc.

At present Iran has no domestic production of alumina - raw material for production of aluminium metal.

The only aluminium smelter Iralco with capacity 65,700 tpy operates on imported alumina (135,000 tpy). Demand for alumina in the near future will increase to 200, - 250,000 tpy, then to 600, - 800,000 tpy. In case of import of alumina, Iran's costs in hard currency will be US $150-200 million/year.

Thus establishment of alumina production out of domestic raw material is one of the tasks of the Iranian Government.

Iran has three sources of aluminium ores: alunites, bauxites and nephelines. All types of raw materials have low contents of alumina containing components.

Alunite reserves amount to approximately 250 million tonnes, bauxites - 54 million tonnes, and nephelines - at least 1 billion tonnes.

Geological survey, study and amenability tests for production of alumina from local ores were initiated by the Iranian Government in 1981 with establishment of the Aluminium Raw Material Programme (ARMP) under auspices of the Ministry of Metals and Mining.

Under the project DP/IRA/85/003 "Development of alumina industry" (completed in 1990) the large scale project opportunity study (POS) was implemented and the feasibility study on the basis of proven reserves of alunites and bauxites. In this period (1985-1988) the nepheline study was not provided because of lack of geological and technological information, and because of absence of conclusions on the alunite and bauxite projects.

As a result of the study of possible conversion of alunites and bauxites it was determined that the alunite project cannot be implemented due to impossibility of sales of large quantities (400,000 tpy) of co-produced sulfuric acid, short supply of caustic potash and relatively high capital investment costs.

The bauxite technology (with tube digestors in the Bayer cycle) is economically viable, however, bauxite reserves are limited and cannot satisfy the growing demand for alumina. Thus, it became necessary to investigate the thrid source of local aluminous raw materials - nepheline ores.

2.2. Economic strategy

The development programme of Iran for the 20-year period within the framework of the general economic policy of the country provides for the priority implementation of the efforts aimed at satisfaction of needs of the industrial production at expense of domestic sources for hard currency saving reasons.

Given the aims and tasks of the above programme the establishment of the aluminium industry on the basis of domestic sources of raw materials within the framework of the national economic policy of Iran will ensure:

- development of independent economy by improving self-sufficiency in raw materials and industrial products;
- industrialisation of large sparsely populated areas;
- liquidation of alumina import purchases, decrease in import of other products and savings of hard currency.

Recently, base on extensive consultations with the USSR organisations under auspices of UNIDO the Iranian side expressed a desire for comprehensive geological and technological tests of significant potential reserves of nepheline ores for processing into alumina, cement, sodium carbonate and potash.

The Iranian government contacted UNIDO with official request to enter into the contract for the nepheline project. The contract was financed through the contribution provided by Iranian side and through a 6% contribution by the USSR to the permanent budget of UNIDO.

The results of the project will be taken into account in the future decisions by the Government regarding establishment of alumina production in the country.

2.3. Project promoter

The Project promoter from Iranian side is the state company ARMP established in 1982-1983.

ARMP engages in the study, development and mining of the aluminium ore deposits in the country, as well as tests for processing raw materials into alumina.

2.4. Project executor

The project opportunity study for construction in the Islamic Republic of Iran of the plant for integrated conversion of nepheline ores from Razgah deposit to produce cell-grade alumina, cement, calcined sodium carbonate and potash is implemented in accordance with the Contract No.90/204/205 between the United Nations Industrial Development Organisation (UNIDO) with headquarters in Vienna, Austria and the All-Union Foreign Trade Association "Technoexport", Moscow.

The POS is being prepared by the All-Union Research and Design Institute of Aluminium, Magnesium and Electrode Industry, "NPO VAMI", St.Petersburg, which has the knowledge and experience in the field of processing nepheline ores and designs of which were used for construction in the USSR of three alumina plants operating on nepheline raw materials.

2.5. Aims of Projects

The aim of this project No.90/204/205 is as follows:

- rendering technical and methodological assistance in sampling of representative samples of nepheline ores and limestone;
- running laboratory and bench-scale tests;
- implementation of the project opportunity study of the integrated conversion of Razgah nephelins ores to produce alumina, cement, sodium carbonate and potash.

2.6. Assumption criteria

To execute this project the Soviet experts developed and submitted to the Iranian party the methodology for additional geological investigation of the nepheline ore deposit Razgah. Also taken were typical samples of ores followed by amenability tests.

The geological report (Report 1) incorporating the methodology of geological investigation of reserves and quality of the ore was submitted to ARMP in April 1991. A brief description of the geological studies is given in Appendix 1.

The technological report (Report II) incorporating the methodology and results of laboratory and bench-scale analytical and amenability tests of four characteristic samples of Razgah nepheline ore (50 kg each) under sintering technology with limestone followed by hydrochemical treatment of sinter to produce alumina, cement, sodium carbonate and potash was submitted to ARMP in August 1991.

The investigation showed that reserves and quality of ores from the Razgah deposit allow construction of the alumina plant with capacity of 200,000 tpy of alumina and cement, sodium carbonate and potash as co-products.

By quality the Razgah ore (20% Al_2O_3, 54.9% SiO_2) is significantly inferior to nepheline ores processed in the USSR (27-28.5% Al_2O_3, 43-45% SiO_2), so consumption factors of materials and heat energy are expected to be much higher than in the USSR.

The results of the above reports were used for preparation of this report "Project opportunity study" (Report III).

As assumption criteria for implementation of POS the use was also made of the Memorandum on visit of VAMI specialists as UNIDO experts in the Islamic Republic of Iran from April 25 to May 16 1991 in Teheran, which contains assumption criteria prepared by specialists of Iranian and Soviet sides, including the required assumption criteria on infrastructure, mines for ore and limestone production, railway transport of ore, township, water supply, power supply and gas supply prepared by ARMP.

A final draft report was considered and discussed at UNIDO with ARMP representative from January 27, 1992 to

February 4, 1992.

In the course of discussions Subcontactor answered the points raised by Customer (Appendix 3). Additional answeres to Customer's questions are given in Appendix 4.

The Customer's comments were taken into account in the present final report.

3. MARKET AND DEMAND

3.1. Demand evaluation

3.1.1. Alumina

At present Iran imports 135,000 tpy of alumina from Australia, India, Turkey at cost of about US $34 million, which is mainly used for reduction to produce aluminium at the only country's aluminium smelter of Iralco company in Araq.

In the near future demand for alumina in Iran will increase to 450,000 tpy and then to 600, - 800,000 tpy. The existing alumina price is R 21000/t, i.e. $300/t at official exchange rate.

3.1.2. Cement

At present Iran experiences rapid development of the building industry, especially construction of houses and public buildings. In this connection demand for cement grows. Iran produced 15.1 million tpy of cement with capacity of the cement industry being 20 million tpy.

In the future demand for cement in Iran will increase to 30 million tpy. The existing cement price is R 10500/t.

3.1.3. Sodium carbonate

Calcined sodium carbonate is imported in quantity of 146,000 tpy at price of US $200/t. The main consumers of calcined sodium carbonate are chemical and textile industry, and production of glass. All produced sodium carbonate (35,400 tpy) will be consumed by the domestic market.

3.1.4. Potash

The present demand for potash in Iran is 10,000 tpy, including that of the chemical industry of 6,000 tpy, petrochemical industry of 1,000 tpy, photography, electro-plating, etc. of about 3,000 tpy. All of the above amount is imported. For potash marketing section see Appendix. 5.

3.2. Sales of finished products

The bulk quantity of products turned out by the complex aims at the domestic market of Iran (alumina, cement, calcined sodium carbonate, potassium sulfate and partially potash).

The quantity of potash to be exported annually according to data on the internal demand of Iran (10,000 tpy) is 105,000 tpy.

Retail price of the products according to ARMP design criteria are as follows (Rial per tonne):

- alumina US $200;
- cement - 10500;
- calcined sodium carbonate - 20000
- potassium sulfate - 24500.

Potash price according to data of Section 3.1.4 is assumed at a level of US $650/t for export and R 45500/t (based on official exchange rate of Rial).

3.3. Plant capacity

Capacity of the alumina plant based on nephelines of the Razgah deposit is defined by the contract to be 200,000 tpy.

According to the provided technological calculations based on 200,000 tpy of alumina from Razgah nephelines the plant produces as co-products:

sodium carbonate	- 35,400 tpy;
potash	- 115,100 tpy;
potassium sulfate	- 2,600 tpy;
cement (based on 100% use of bellite mud) and on local clay as corrective admixture	- 5,585,100 tpy

With above capacity of the alumina plant the explored reserves of nepheline ores would secure its operation for 90 years, and explored reserves of limestone (a second major raw material) - for 24 years.

3.4. Product quality

3.4.1. Cell-grade alumina from nephelines

Chemical composition, %

SiO_2	Fe_2O_3	Sum of R_2O in terms of Na_2O	LOI	Al_2O_3
0.03	0.01	0.3	0.46	99.2

Size distribution:

size, mm	content, %
+0.1	10
-0.1 +0.05	40
-0.05 +0.04	15
-0.04	35

Specific surface area - 55 to 70 m^2/g

Density - 3.5 to 3.6 t/m^3

Angle of repose - 39 to 42°

Bulk weight - 0.95 to 1.0 t/m^3

Content of α-Al_2O_3 - 27 to 30%

3.4.2. Calcined sodium carbonate

Na_2CO_3 - 98.5% min

K_2CO_3 - 1.5% max

K_2SO_4 - 0.25% max

3.4.3. Potash

K_2CO_3 - 98.5% min

Na_2CO_3 - 0.3% max

K_2SO_4 - 0.65% max

Al_2O_3 - 0.05%

3.4.4. Cement

Portland cement out of nepheline raw material is of grade 400 (40.0 MPa).

4. RAW MATERIALS AND OTHER PRODUCTION INPUTS

4.1. Nepheline ore and limestone

As raw materials for production of alumina, sodium carbonate, potash and cement the use is made of the Razgah nepheline ore and Shiramin limestone.

The Razgah deposit is situated at about 140 km NE of a proposed plant site and 85 km east of the town of Tabriz - a major industrial and administrative centre and a railway station. By now its exploration status corresponds to an exploratory-evaluation stage (according to the Russian classification of stages of geological-exploratory works). For preparation of this deposit for commercial mining it is necessary to carry out a preliminary and detailed exploration with transfer of the reserves into commercial categories B and C_1 (with a share of B reserves not less than 20%). For the total reserves and composition of the ores within the most promising blocks identified on an explored area see Table 4.1.

Table 4.1

Reserves and an average chemical composition of the ores*
in the blocks taken for calculation of reserves

Block	Reserves mln.t	Average content, %					
		Al_2O_3	Na_2O	K_2O	SiO_2	CaO	Fe_2O_3
Western	38.7	20.29	3.11	9.72	55.79	2.25	3.27
Eastern	62.2	19.59	3.35	9.82	54.83	2.64	4.01
Total	100.9	19.87	3.25	9.78	55.19	2.49	3.43

* Due to an incompleteness of the chemical-analytical works the data on ore composition is of a preliminary nature and has to be clarified. In their quality the Razgah ores are much inferior in comparison with a nepheline raw material used in Russia.

For an annual requirement of the plant in nepheline ore of about 1.3 mln.t the reserves from Western section will last 30 years, and that from Eastern section - 49 years. If required, a considerable increase of reserves is possible Taking into account the significant deviations in determining contents of K_2O, Al_2O_3, SiO_2 in the ARMP and VAMI laboratories, for technoeconomic calculations the following average composition of a nepheline ore was assumed:

Table 4.2

Chemical composition of nepheline ore, %

Name	Al_2O_3	Na_2O	K_2O	SO_3	SiO_2	Fe_2O_3	CaO	Other	LOI
Nepheline	20.0	3.2	10.2	0.075	54.9	3.7	2.0	2.725	3.2

Due to low content of alumina in nepheline ore of the Razgah deposit (20% against 27-28.5% in ore processed in the USSR) and high silica content (54.9% against 43-45% in the USSR) the Razgah nepheline may be classified as low-grade ores.

In the sintering technology of nepheline with limestone the main impurity in the ore is silica. Each molecule of silica shall be bonded into insoluble compound (in soda liquor) - dicalcium silicate, which with high content of silica results in high consumption of limestone and high heat consumption for sintering.

The Shiramin deposit is situated at about 60 km SW of Tabriz, at 3 km north of the Shiramin village, at about 4 km from Shiramin railway siding. This deposit was explored in the 80 s for limestones to be used in lime production, but the use of this data is limited due to a considerable difference in requirements on quality of a raw material to be used for production of alumina From the data based on sampling lumps of carbonate rocks carried out by ARMP together with GSI, in their section two layers of limestone are found, about 50 m thick, meeting the requirements of alumina production. Taking into account an areal extent of the carbonate rock mass, the limestone reserves are estimated to be 160 mln.t thus meeting nepheline complex requirement for 25 years. Due to a low degree of a deposit exploration status, meeting the requirements of a detailed prospecting stage, for preparation of the deposit for commercial development it is necessary to carry out its preliminary and detailed exploration.

According to the ARMP and GSI data, the Shiramin limestones by contents of silica and iron oxides in majority of cases meet the alumina production requirements, but a considerable portion of the limestones (about 25%) is represented by dolomitized varieties with MgO content exceeding a limiting value (over 1%). This calls for a detailed delineation of these varieties during exploration and their selective mining when operating the deposit. For an average estimated chemical composition of the limestone see Table 4.3.

Table 4.3

Name	Al_2O_3	Na_2O	K_2O	SO_3	SiO_2	Fe_2O_3	CaO	Other	LOI
Limestone	0.07	-	-	0.075	0.6	0.05	55.0	0.905	43.3

The nepheline and limestone quarries, and also crusher and classifier plants are designed by the Iranian side. Under agreement with ARMP at the stage of POS the limestone crusher and classifier plant and limestone storage are incorporated in the nepheline plant make-up and its costs will be estimated by Supplier.

4.2. Clay, iron ore, gypsum

In cement production from muds of the alumina plant in Russia the use is made of bauxite as aluminous admixture. Due to inavailability of bauxite in the region of the plant site in Iran, POS considers construction of the cement plant with use of local low-grade clay.

As the corrective admixture with iron oxide the use is made of local iron ore. Gypsum is added to clinker.

Chemical composition of corrective admixtures are shown in Table 4.4.

Table 4.4

Chemical composition of clay, iron ore, gypsum

Name	Al_2O_3	SiO_2	Fe_2O_3	CaO	Other	LOI
Clay	13.74	45.81	6.82	12.4	6.95	14.28
Iron ore	1.03	13.4	81.76	1.22	-	2.59
Gypsum	0.81	2.73	0.74	32.75.	45.25 (SO_3 31.2)	17.72

4.3. Fuel

As a process fuel for the sintering kilns, calcination and limestone roasting of the alumina plant, cement kilns and carbonates driers there is natural gas supplied over the pipeline by the Iranian natural gas company. Heat capacity of gas is 9200 kcal/Nm³.

As a standby fuel the use is made of high-sulfur oil with sulfur content of 3% supplied from Teheran by rail Heat capacity of oil is 9500 kcal/kg.

Given negative influence of sulfur in oil on production of carbonates the Customer suggested to consider a possible use of liquified gas or gasoline as a standby fuel. Heat capacity is 11000 kcal/Nm³.

4.4. Steam

For process needs (desilication of process liquors, evaporation of sodium carbonate liquors, etc.) the use is made of steam at 8 bar pressure as a heat carrier, which is supplied to the alumina plant from the steam and power plant to be designed by the Iranian side.

4.5. Electric power

The electric motors are powered with a.c. power at 10000 V, 6000 V, 380 V and 50 Hz.

For lighting use is made of a.c. at 220 V.

Power to the plant is supplied from the gas generator station to be designed by the Iranian side.

As a standby source the use is made of the Iranian power grid at 220 kV.

4.6. Water

Water for industrial needs, and service and potable water is supplied to the plant over the pipeline from three alternative sources:

A. Underground water 40 km north-east of Shiramin. There will be built 15 wells, pump station and pipelines.

B. Underground water 66 km south of Shiramin. There will be built 15 wells, pump station and pipelines.

C. Water from the river Zarrin 88 km from Shiramin. There will be built a channel and filtering station for feeding water to the plant

4.7. Auxiliary materials

4.7.1. Filter cloth, flocculant

For implementation of the process the use is made of capron filter cloth and synthetic flocculant of kind "Alclar 500" to be imported from western developed countries, USA or Japan.

4.7.2. Grinding bodies

For grinding the use is made of grinding bodies (ball, rods) of special steel to be imported from the USSR.

4.7.3. Refractories

For lining the kilns, driers the use is made of refractory bricks of fireclay and magnesite to be imported from the USSR.

4.7.4. Hydrochloric acid

For chemical cleaning the heating surfaces and filter cloth the use is made of hydrochloric acid available in Iran in Shiraze. Acid to the plant will be delivered in road tankers.

4.8. Consumption factors per tonne of finished alumina

Table 4.5

Item	Description	Unit	Qty	Remarks
1	Nepheline ore (natural W=2%)	t	6.4	
2	Limestone (natural W = 2%)	t	11.9	
3	Coagulant (Alclar 500)	kg	0.315	
4	Hydrochloric acid	kg	10	
5	Filter cloth	m^2	0.25	
6	Grinding bodies	kg	25	
7	Refractories	kg	15	
8	Fuel	t	2.33	
9	Electric power	kWh	2000	
10	Steam	Gcal	2.0	
11	Fresh water	m^3	25.0	
	Co-products			
1	Bellite mud	t	11.31	
2	Carbonate liquor (85.5 g/l Na_2O as Na_2CO_3)	m^3	4.33	

4.9. Consumption factors per tonne of carbonates

Table 4.6

Item	Description	Unit	Qty	Remarks
1	Carbonate liquor (85.5 g/l Na_2O as Na_2CO_3)	m^3	5.66	From alumina plant
2	Steam (6 ata)	Gcal	2.33	

Item	Description	Unit	Qty	Remarks
3	Electric power	kWh	200	
4	Fuel	t	0.054	

4.10. Consumption factors per tonne of cement

Table 4.7

Item	Description	Unit	w/clay	Remarks
1	Bellite mud to mix (dry basis)	t	0.255	from alumina plant
2	Bellite mud to cement (dry basis)	t	0.15	
3	Limestone (dry)	t	0.645	
4	Clay (dry)	t	0.207	
5	Iron ore (dry)	t	0.011	
6	Gypsum	t	0.05	
7	Fuel	t	0.161	
8	Electric power	kWh	125	
9	Refractries	kg	2.1	
10	Grinding bodies	kg	1.0	

4.11. Annual requirements for raw materials, materials and utilities

Table 4.8

S/N	Description	Unit	Annual requirements for production of			Total
			Alumina	Carbonates	Cement	
1	2	3	4	5	6	7
I	Raw materials					
1	Nepheline ore (2% H_2O)	000 t	1280	-	-	1280
2	Limestone (2% H_2O)	"	2380	-	3675	6055
II	Materials					
1	Synthetic flocculant (Alclar-500)	m^3	63	-	-	63
2	Filter cloth	000 m^2	50	-	-	50
3	Grinding bodies	t	5000	-	5585	10585
4	Refractory bricks	t	3000	-	11729	14729
5	Clay	000 t	-	-	1156	1156
6	Iron ore	000 t	-	-	61	61
7	Gypsum	"	-	-	279	279
8	Hydrochloric acid	t	2000	-	-	2000
III	Semiproducts of plant					
1	Carbonate liquor (natural - 85.5 g/l, carbonate Na_2O)	000 m^3	-	866	-	866
2	Dry bellite mud	000 t	-	-	2262	2262

1	2	3	4	5	6	7
IV	Process fuel	mln.Nm³	352.5	6.1	680	1038.6
V	Utilities					
1	Electric power	000 kWh	400000	30620	698125	1128745
2	Heat					
	- process	Gcal	400000	356720	-	756720
	- space heating, ventilation, hot water supply	Gcal	-	-	-	4000
	Total:	Gcal	400000	356720	-	796720
3	Recycle water	mln.m³	100.0	-	-	100.0
4	Fresh water	-"-	5.0	-	-	5.0

4.12. Supply programme of Plant

Supply programme of plant is adopted by ARMP data based on possible sources of supply of material resources and utilities, and the requirements of the alumina plant in the resources.

Table 4.9

Item	Resources	Source of supply	Delivery method	Minimum stock (days)
1	Nepheline ore	Razgah	railway	7
2	Limestone	Shiramin	conveyor	3
3	Oil	Tabriz		15
4	Natural gas		gas pipeline	-
5	Electric power	SPP	-	-
6	Steam	SPP	-	-
7	Water	40 km from Shiramin	-	-
8	Clay	50 km min	trucks	15
9	Gypsum	Shiramin	do	30
10	Iron ore			30

1	2	3	4	5
12	Filter cloth	Import		30
13	Synthetic floccu- lant	via	do	30
14	Grinding bodies	Dissolfu	railway	30
15	Refractory brick	do	3	30

5. PLANT LOCATION AND SITE

5.1. Selection of plant site

The proposed plant site is Shiramin region located in north-western part of Iran 100 km south of Tabris and 200 km west of town of Razgah.

The alumina plant is located in the vicinity of the limestone deposit.

On suggestion of the Iranian side 5 alternatives of jobsite for construction of the plant were considered which are located 2-10 km away south-west, north-west, north or north-east of the Shiramin limestone deposit on mostly level plots of land in the vicinity of the existing rail and motor ways.

Concerning sources of supply with fuel and nepheline ores all the above alternatives are approximately equal.

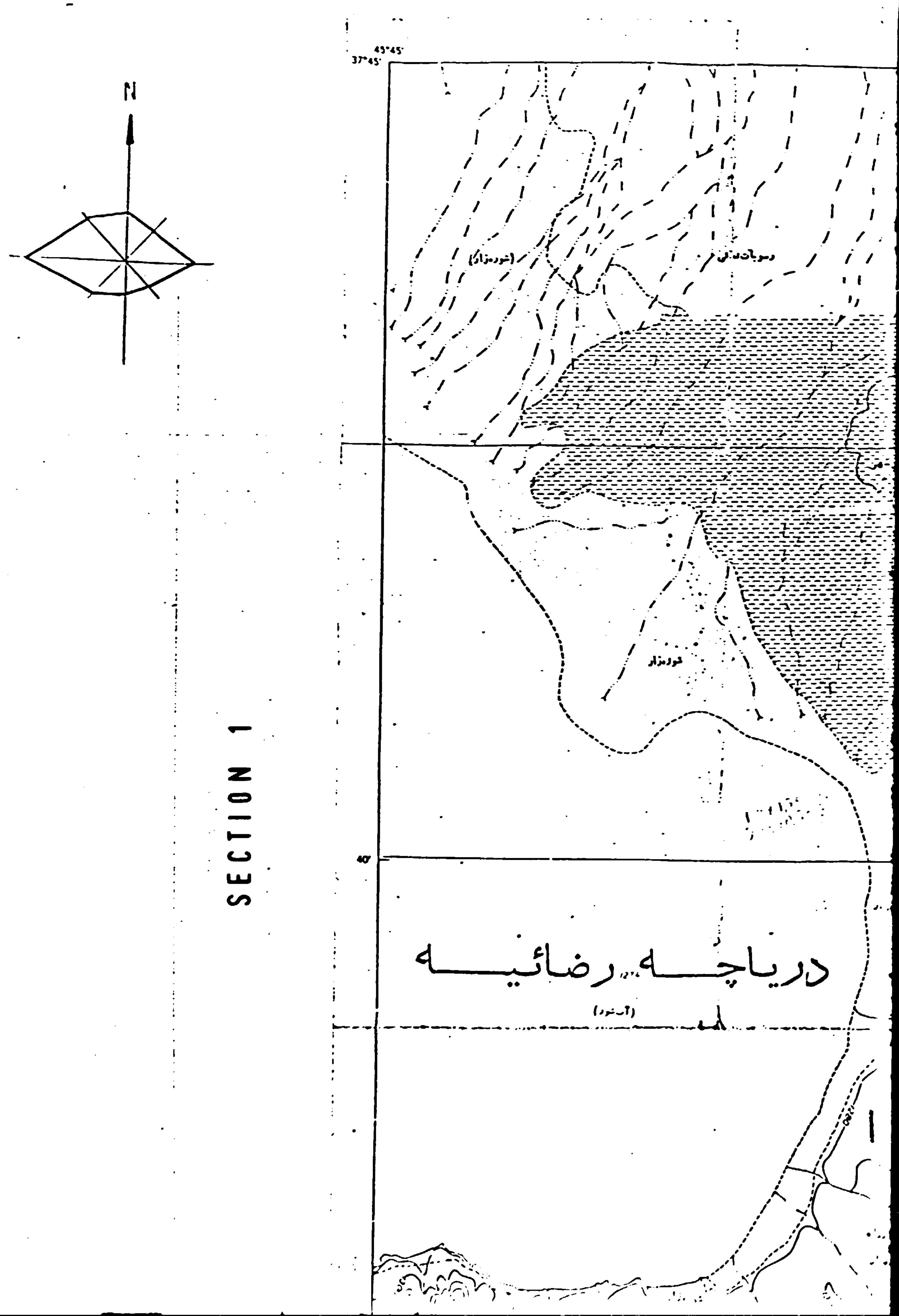
Data on physico-mechanical soil characteristics are not available for all sites, same relates to hydrological and hydro-hydrogeological characteristics of the region. Tentative selection of the site No.3 as recommended was made taking into account the general requirements for plant construction conditions.

In case of construction on this site:

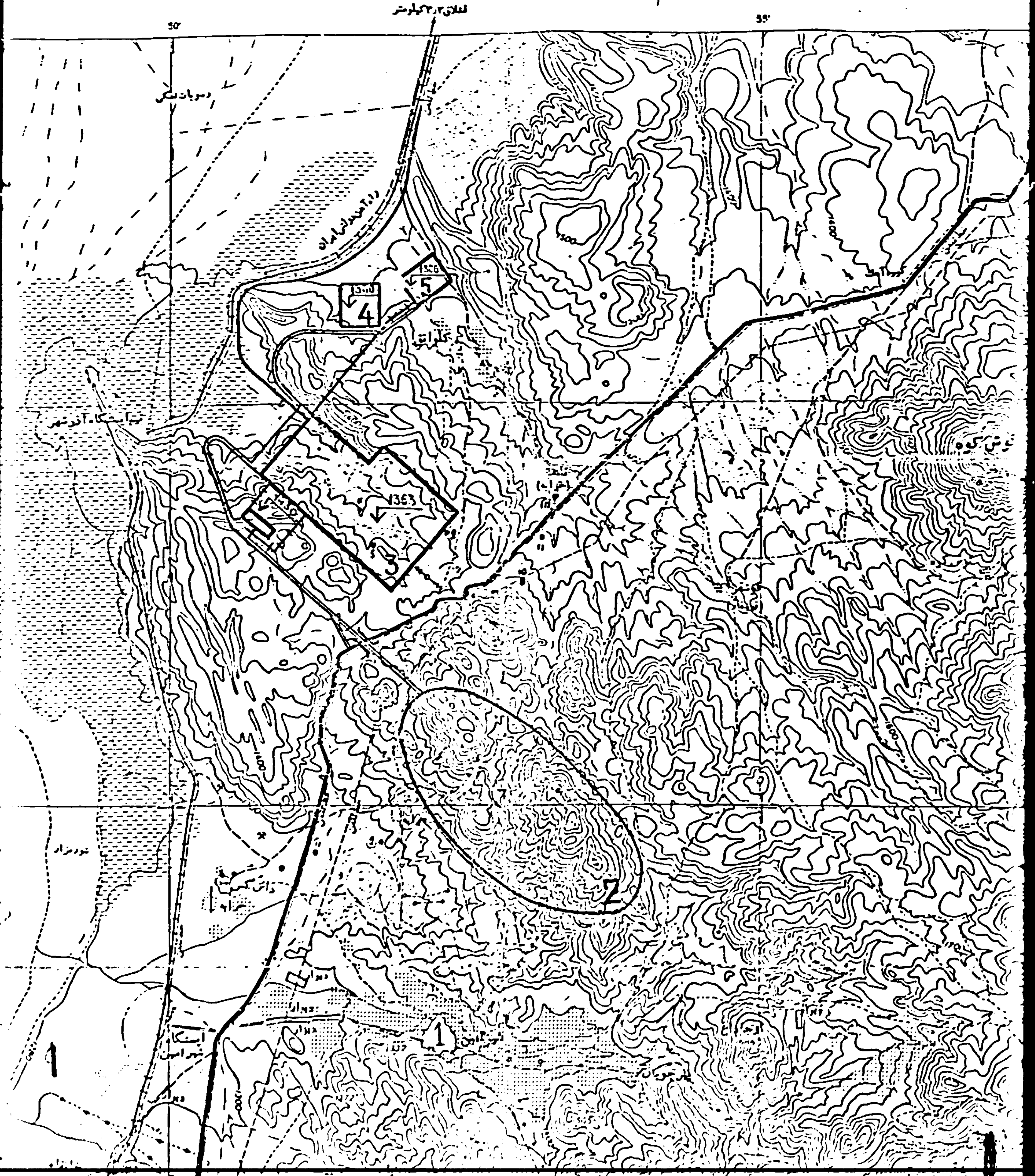
- no need to relocate any existing agricultural crops or structures;
- distance from supply sources of limestone and alluvium is minimal - 4.5 and 2 km, respectively;
- estimated lenght of the connection line to the existing railway of about 3 km may be extended practically on level land;
- risk of flooding with salt-laden water is eliminated;
- site is located in optimum conditions regarding power and water supply.

The site No.3 measuring 2.5 by 1.5 km is located 7 km west of the town of Shiramin extending from north-west to south-east. A railway runs 1.5 km north of the site along the shore of the salt lake, a motor road runs 1 km east of the site.

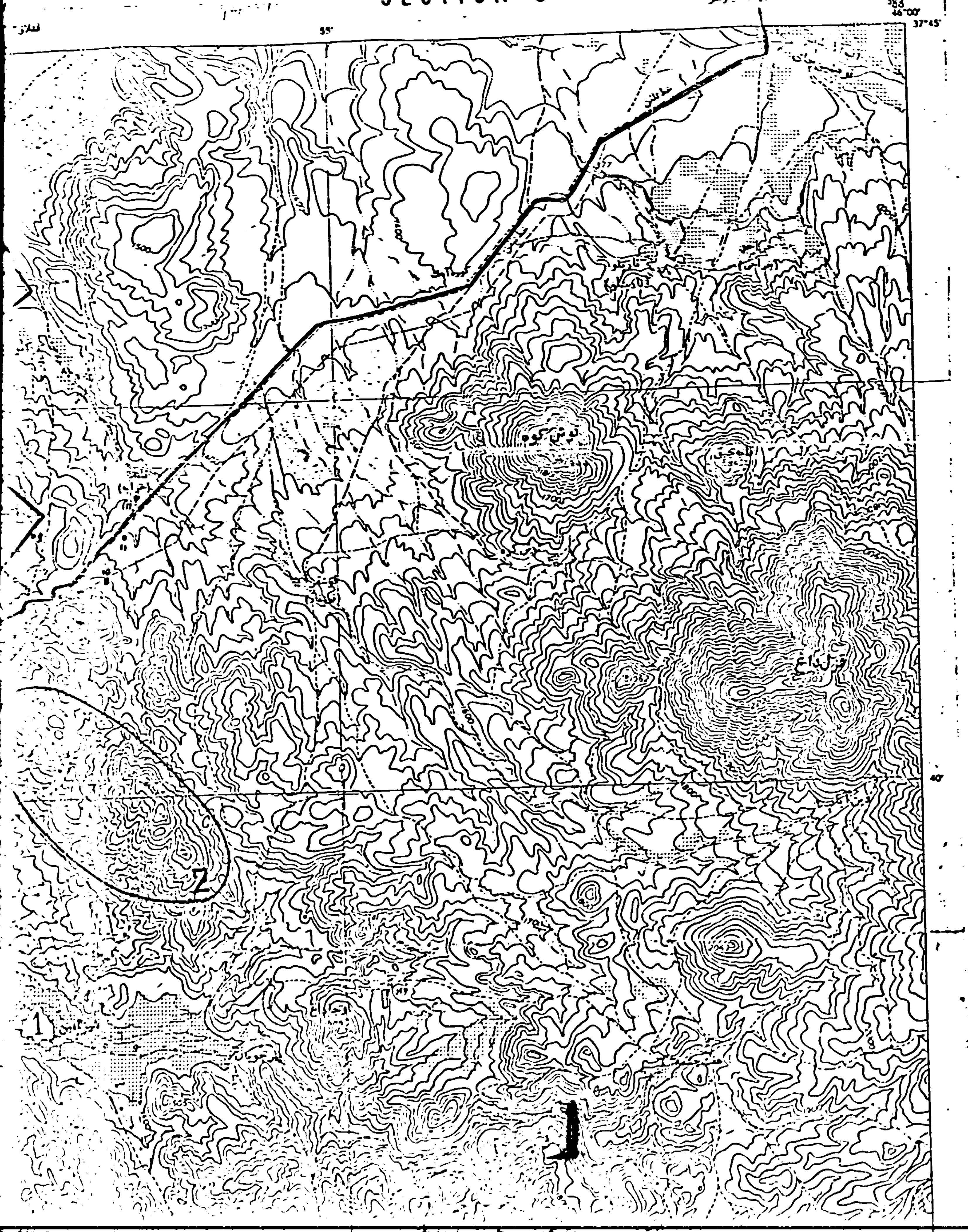
SECTION 1

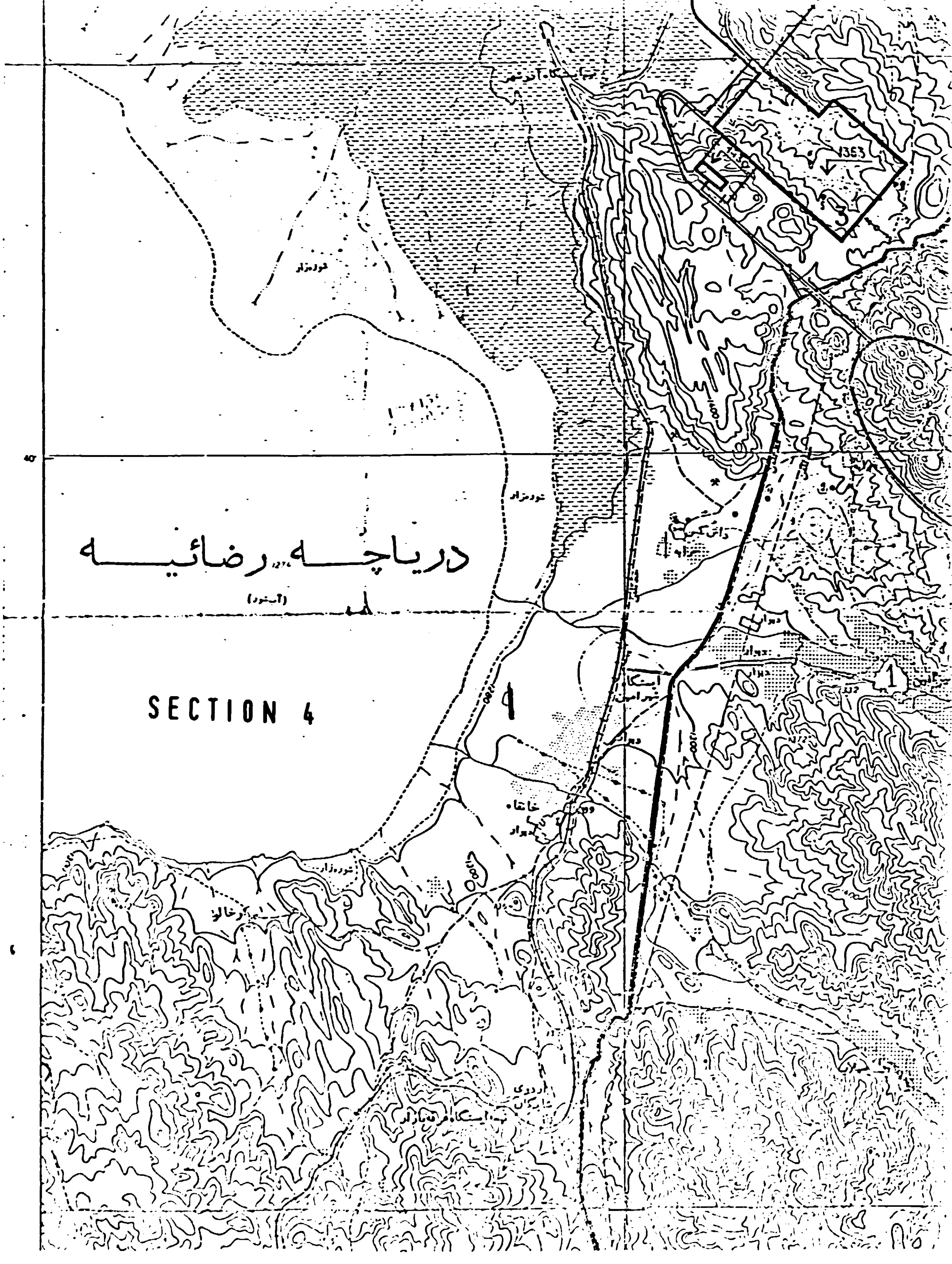


SECTION 2



SECTION 3





دریاچه رضائیه
(آستورد)
SECTION 4
شورهزار
دیزاو
خانقاه

EXPLICATION

1. SHIRAMIN
2. LIME STONE
3. NEPHELINES PROCESSING PLANT
4. MUD DISPOSAL WITH PUMP STATION FOR DECANT LIQUOR
5. SETTLING POND FOR RAIN WATER WITH PUMP STATION FOR PUMPING OF CLARIFIED WATER.

LEGEND

AREAS TO BE DESIGNED

EXISTING AREAS

MOTOR ROADS TO BE DESIGNED

EXISTING MOTOR ROADS

RAILROADS TO BE DESIGNED

EXISTING RAILROADS

SECTION 6

LEGEND

AREAS TO BE DESIGNED

EXISTING AREAS

MOTOR ROADS TO BE DESIGNED

EXISTING MOTOR ROADS

RAILROADS TO BE DESIGNED

EXISTING RAILROADS

SECTION 7

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RAZGAH NEPHELINES PROCESSING PLANT (IRAN)

	PHASE	SHEET	SHEETS
CONSTRUCTION SITE	POS	1	2

LAY-OUT SCALE 1:50000

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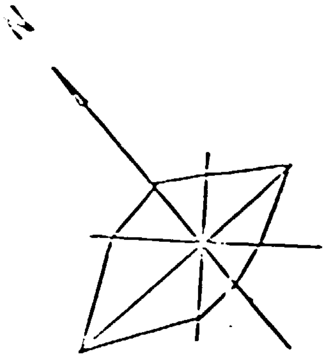

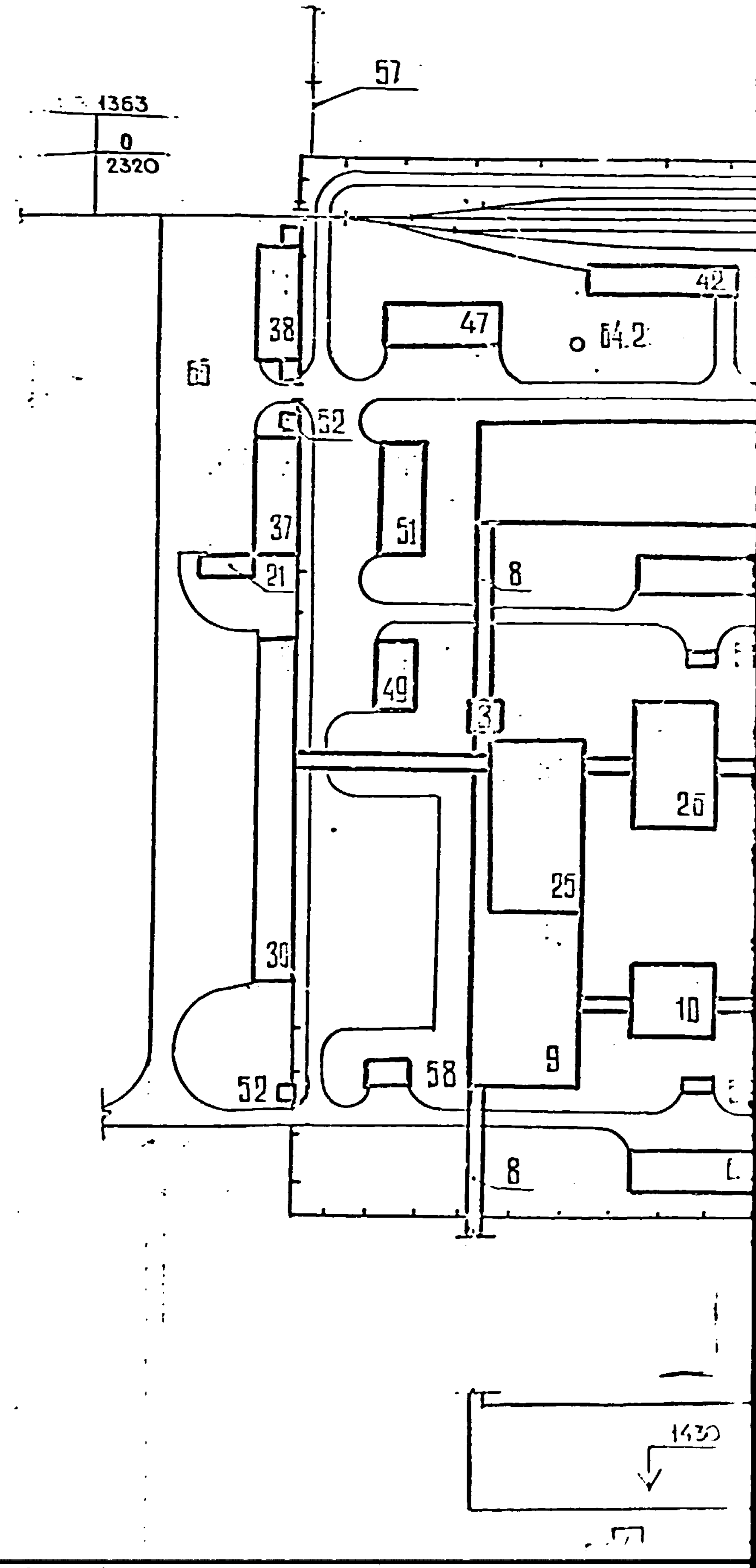
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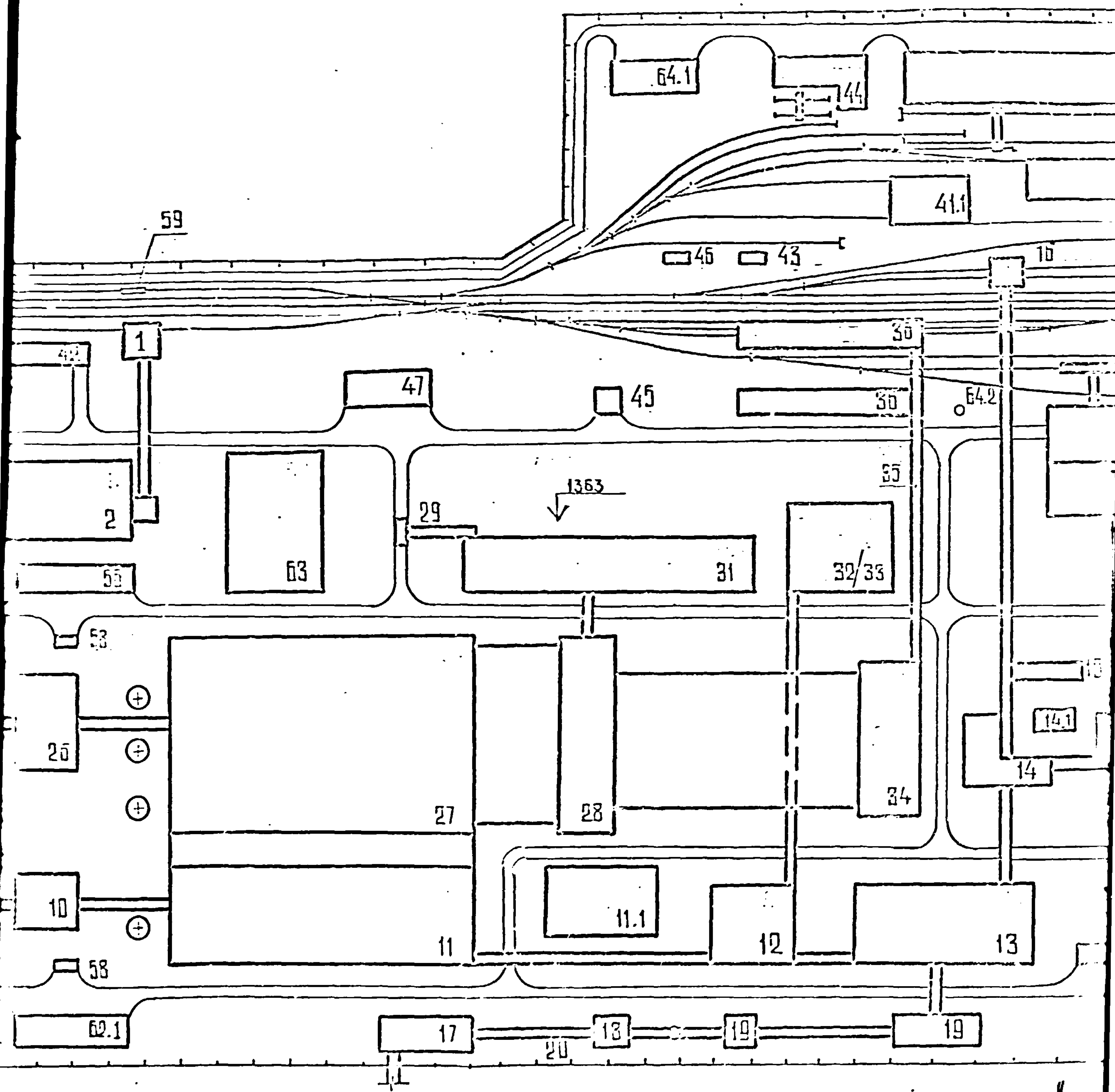
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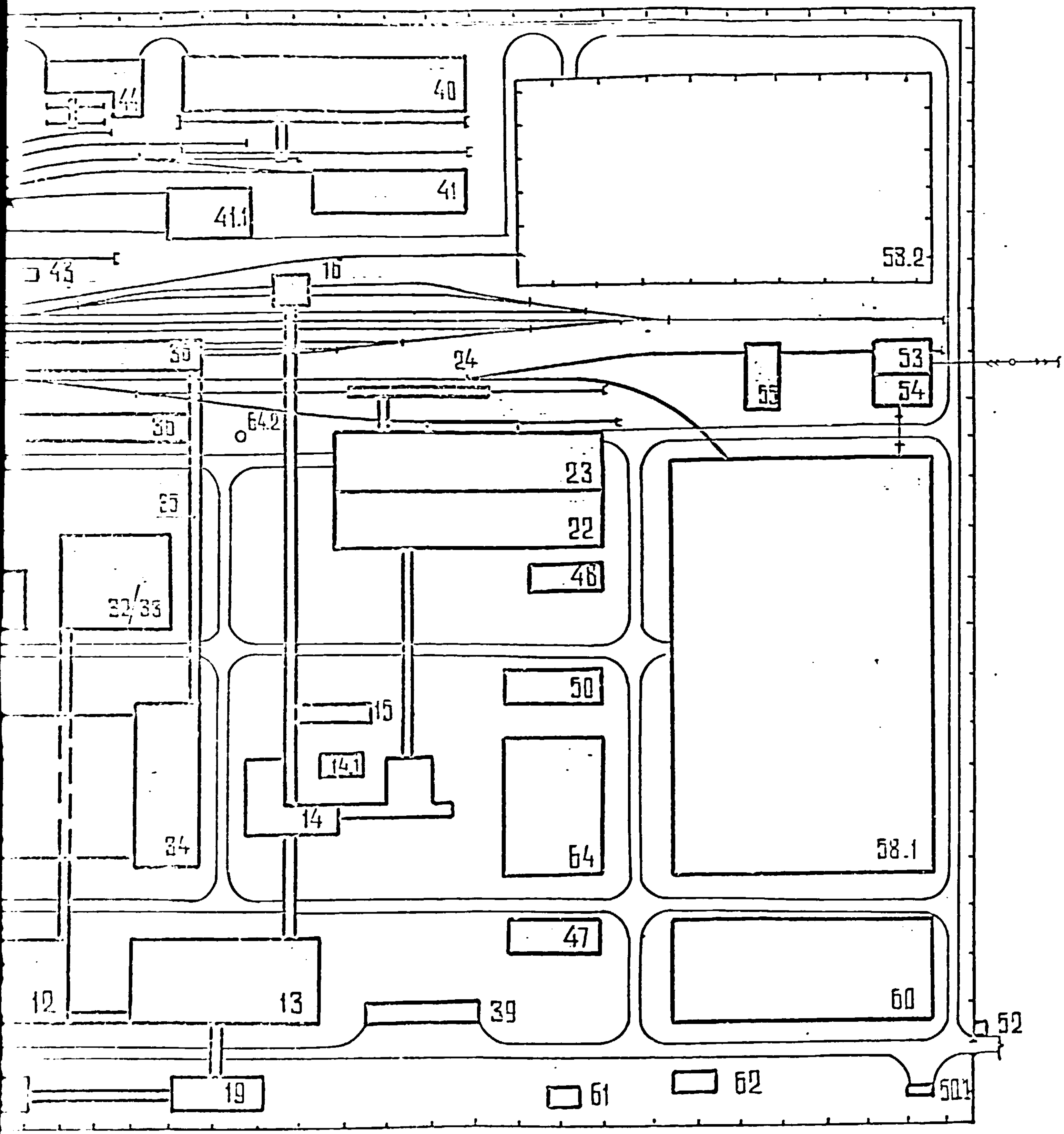
SECTION 2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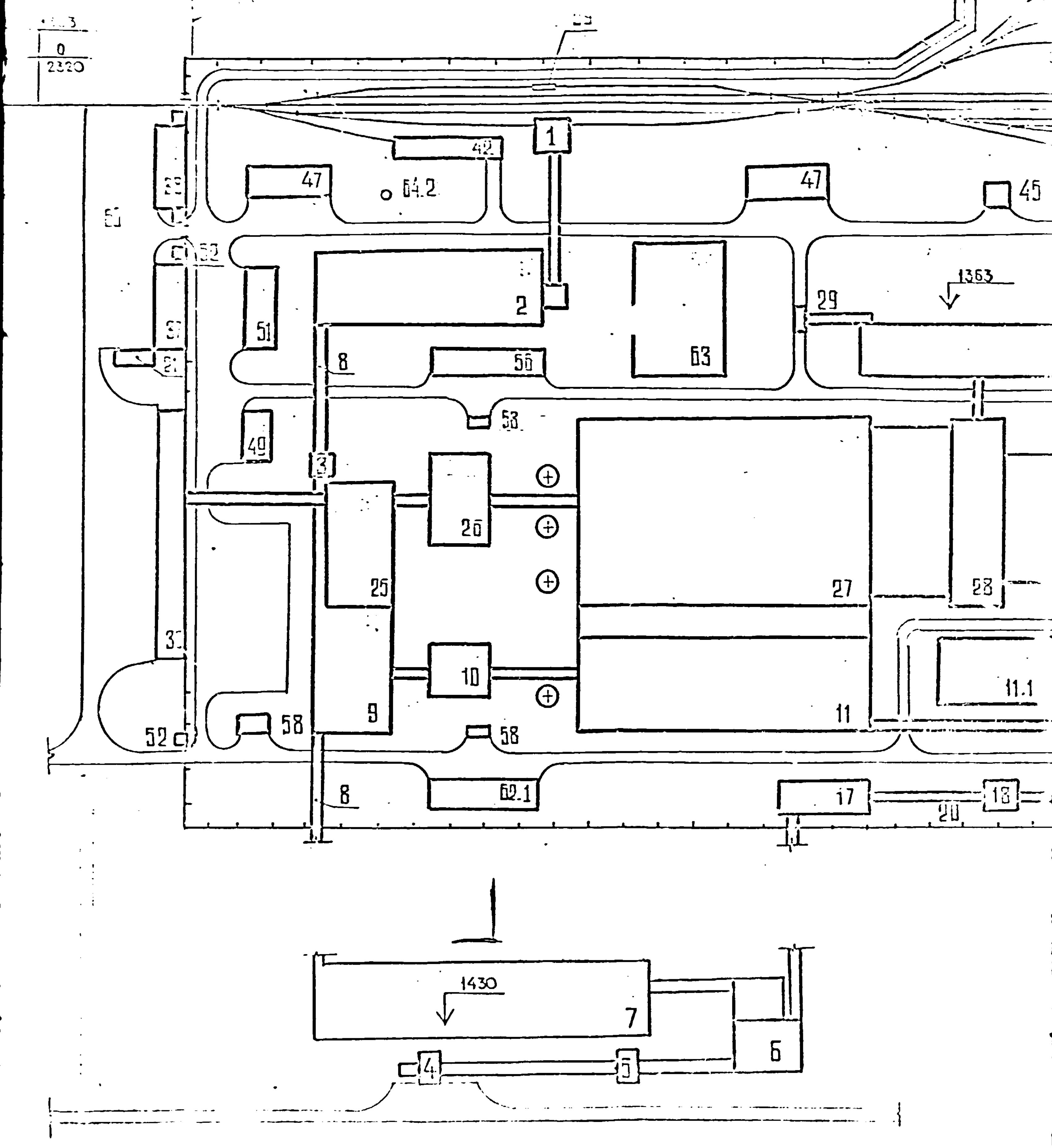
SECTION 3



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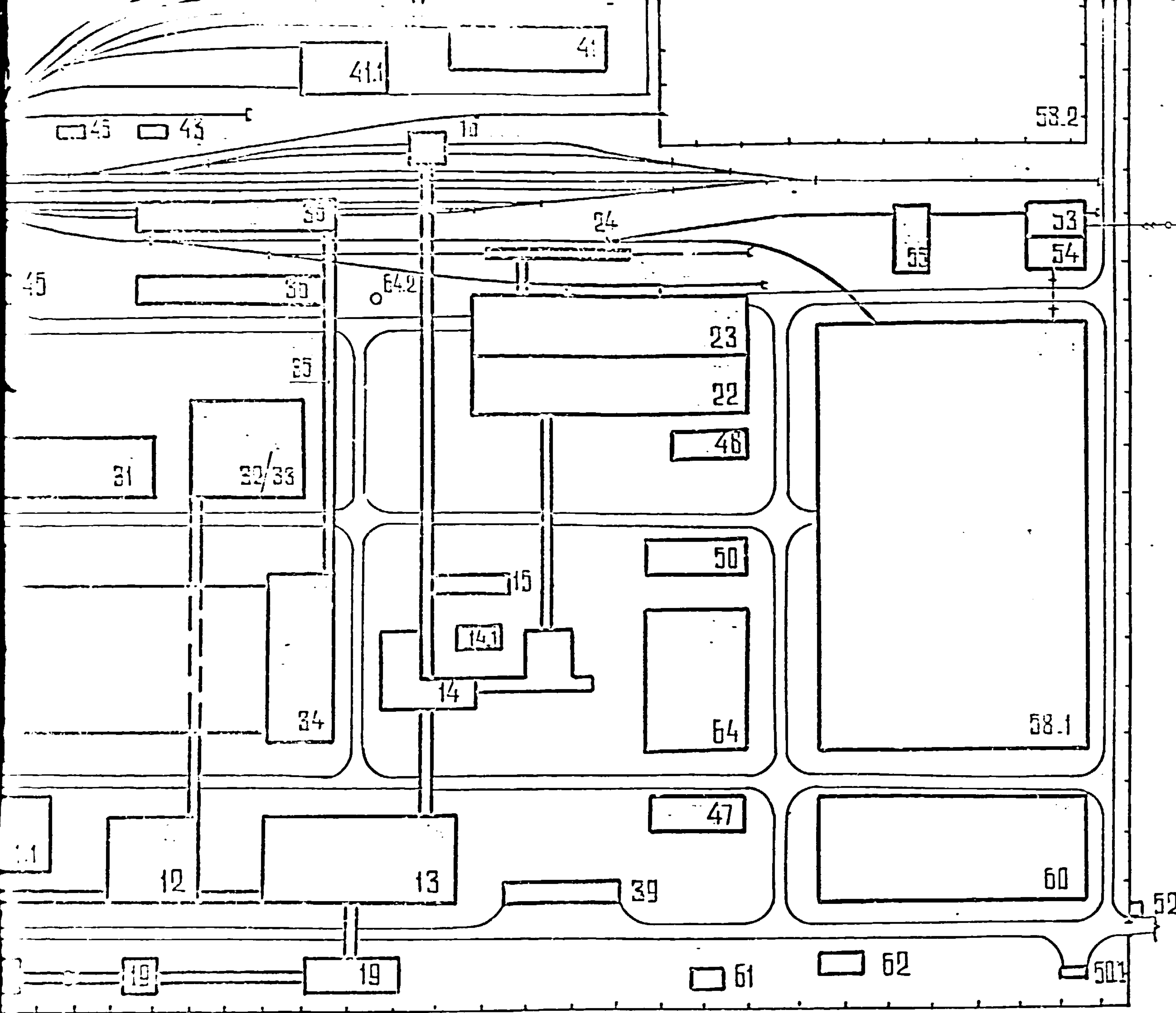
SECTION 4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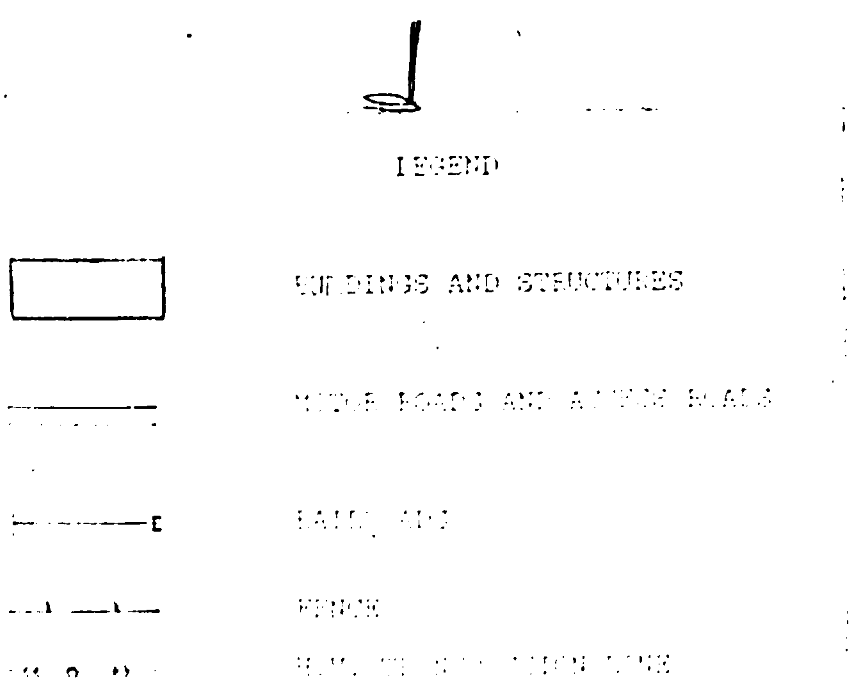
LEGEND
DINGS AND STRUCTURES

SECTION 5

EXPLICATION OF UNITS TO BE [illegible]

ALUMINA PRODUCTION

1.NEPHELINE TRANSFER UNIT
2.NEPHELINE STORAGE
3.NEPHELINE FINE CRUSHING
4.LIMESTONE TRANSFER STATION AND COARSE CRUSHING
5.LIMESTONE MEDIUM CRUSHING
6.LIMESTONE FINE CRUSHING WITH SCREENING
7.LIMESTONE STORAGE
8.LIMESTONE CONVEYOR GALLERY
9.GRINDING
10.CORRECTION AND RESERVE PONDS
11.SINTERING
11.1 BLOWER STATION
12.SINTER LEACHING
13.DESILICATION
14.HYDRATE CARBONIZATION AND PROCESSING
14.1 HYDRATE STORAGE
15.CALCINATION
16.PRODUCT ALUMINA STORAGE
17.LIMESTONE STORAGE FOR ROASTING
18.LIMESTONE ROASTING
19.LIME MILK PREPARATION AND CARBONIZATION
20.PROCESS PIPELINES GALLERIES AND PIPERACKS
21.AUTOMATIC PROCESS CONTROL

CARBONATE SODA AND POTASH PRODUCTION

22.EVAPORATION, CRYSTALLIZATION AND CENTRIFUGING
23.SODA PRODUCTS PRODUCTION
24.SILO STORAGE OF SODA PRODUCTS WITH PACKING

SECTION 6

37.ADMINI[illegible]
38.ENGINEER[illegible]
39.CENTRAL [illegible]
40.REPAIR SH[illegible]
41.MATERIAL
41.1. STEEL
42.REFRACTOR[illegible]
43.OILS, CHE[illegible]
44.REPAIR AN[illegible]
45.INDUSTRIA[illegible]
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51.CANTEEN
52.GUARD HOUS[illegible]

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9.GRINDING
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11.1 BLOWER STATION
12.SINTER LEACHING
13.DESILICATION
14.HYDRATE CARBONIZATION AND PROCESSING
14.1 HYDRATE STORAGE
15.CALCINATION
16.PRODUCT ALUMINA STORAGE
17.LIMESTONE STORAGE FOR ROASTING
18.LIMESTONE ROASTING
19.LIME MILK PREPARATION AND CARBONIZATION
20.PROCESS PIPELINES GALLERIES AND PIPERACKS
21.AUTOMATIC PROCESS CONTROL

CARBONATE SODA AND POTASH PRODUCTION

22.EVAPORATION, CRYSTALLIZATION AND CENTRIFUGING
23.SODA PRODUCTS PRODUCTION
24.SILO STORAGE OF SODA PRODUCTS WITH PACKING

CEMENT PRODUCTION

25.FEED GRINDING
26.MUD LAKES
27.CLINKER ROASTING
28.CLINKER STORAGE
29.GYPSUM TRANSFER UNIT
30.CLAY AND IRON ORE STORAGE
31.CLINKER AND ADDITIVES STORAGE
32.BELLITE MUD DRYING
33.DRY BELLITE STORAGE
34.CEMENT GRINDING
35.PROCESS PIPELINES GALLERIES AND PIPERACKS
36.CEMENT STORAGE WITH PACKING

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45.INDUSTRIAL [illegible]
46.HYDROCHLORIC [illegible]
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52.GUARD HOUSES

POWER [illegible]

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56. COMPRESSOR S[illegible]
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58.2.FUEL OIL FA[illegible]

TRANSP[illegible]

59.RAILWAY SCALE
60.GARAGE WITH ST[illegible]
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61.CLEAR PETROLE[illegible]
62.TRANSPORT DI[illegible]
62.1. FIRE FIGHTI[illegible]

WATER [illegible]

63. CLEAN WATER [illegible]
64. ALKALINE WA[illegible]
64.1.SERVICE PIP[illegible]
64.2.DOMESTIC [illegible]

SITE [illegible]

65. PRE-PLANT [illegible]

SECTION 7

[illegible]

[illegible] AND [illegible] FACILITIES

37. ADMINISTRATIVE BUILDING
38. ENGINEERING BUILDING
39. CENTRAL LABORATORY
40. REPAIR SHOPS
41. MATERIAL STORAGES
41.1. STEEL AND CAST IRON CASTINGS STORAGE
42. REFRACTORY STORAGE
43. OILS, CHEMICALS AND ACIDS STORAGE
44. REPAIR AND CONSTRUCTION SHOP
45. INDUSTRIAL GASES STORAGE
46. HYDROCHLORIC ACID STORAGE
47. LOCKER ROOMS NOS.1,2,3
48. LOCKER ROOMS OF SODA AND POTASH PRODUCTION
49. LOCKER ROOMS OF CEMENT PRODUCTION
50. TREATMENT AND REPAIR OF UNIFORMS
50.1. OXYGEN STATION
51. CANTEEN
52. GUARD HOUSES

SECTION 8

POWER AND UTILITY FACILITIES

53. 22 10 KV STEP-DOWN SUBSTATION
54. CENTRAL DISTRIBUTION SUBSTATION
55. TRANSFORMER AND OIL FACILITIES
56. COMPRESSOR STATION
57. CONDUCTORS RACK
58. GAS DISTRIBUTING STATIONS NOS.1,2,3.
58.1. HEAT AND POWER PLANT
58.2. FUEL OIL FACILITIES

TRANSPORT AND COMMUNICATION FACILITIES

59. RAILWAY SCALE
60. GARAGE WITH STOCK OF LARGE CAPACITY TRUCKS, OPEN PARKING AREA AND WASHING STATION
61. CLEAN PETROLEUM PRODUCTS STORAGE
62. TRANSPORT DISPATCHING STATION
62.1. FIRE FIGHTING STATION

WATER SUPPLY, SEWAGE AND MUD DISPOSAL FACILITIES

43. ... CHEMICALS AND ACIDS STORAGE
44. REPAIR AND CONSTRUCTION SHOP
45. INDUSTRIAL GASES STORAGE
46. HYDROCHLORIC ACID STORAGE
47. LOCKER ROOMS NOS.1,2,3
48. LOCKER ROOMS OF SODA AND POTASH PRODUCTION
49. LOCKER ROOMS OF CEMENT PRODUCTION
50. TREATMENT AND REPAIR OF UNIFORMS
50.1. OXYGEN STATION
51. CANTEEN
52. GUARD HOUSES

POWER AND UTILITY FACILITIES

53. 220/10 KV STEP-DOWN SUBSTATION
54. CENTRAL DISTRIBUTION SUBSTATION
55. TRANSFORMER AND OIL FACILITIES
56. COMPRESSOR STATION
57. CONDUCTORS RACK
58. GAS DISTRIBUTING STATIONS NOS.1,2,3.
58.1. HEAT AND POWER PLANT
58.2. FUEL OIL FACILITIES

TRANSPORT AND COMMUNICATION FACILITIES

59. RAILWAY SCALE
60. GARAGE WITH STOCK OF LARGE CAPACITY TRUCKS, OPEN PARKING AREA AND WASHING STATION
61. CLEAR PETROLEUM PRODUCTS STORAGE
62. TRANSPORT DISPATCHING STATION
62.1. FIRE FIGHTING STATION

WATER SUPPLY, SEWRAGE AND MUD DISPOSAL FACILITIES

63. CLEAN WATER RECIRCULATING UNIT NO.1
64. ALKALINE WATER SUPPLY SYSTEM
64.1. SERVICE PIPELINE REPAIR AND MAINTENANCE SHOP
64.2. DOMESTIC SEWERS PUMP STATION

SITE DEVELOPMENT

65. ... PLANT AREA

SECTION 9

FACILITIES

TRUCKS, OPEN

SECTION 10

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	1408105 – X			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	CONSTRUCTION SITE	PHASE	SHEET	SHEETS
		POS	2	2
	PLOT PLAN SCALE 1:5000	VAMI ST PETERSBURG		

5.2. Characteristics of site

Terrain of the site is mountainous, with hills and ridges, lowering in north-western direction from elevation of 1400 (region of motor road) to elevation 1300 (shoreline of the lake, region of railroad).

Climate is continental with dry arid summer and cool winter, average January temperature is -2°C, that of July +31°C, precipitation is mostly in winter and spring. River run-off is insignificant.

By geological structure the site is made up mainly by deluvium-proluvium loose deposits of clayey-carbonate composition with thickness from 3-5 to 30-50 m and more. On the south-eastern, western and north-western borders of the site there are outcrops of carbonate rocks of Jura-calcareous period, as well as carbonate travertines.

Level of ground water from the terrain surface is at depth of about 15 m. Given areas of watershed and terrain relief there would be required to build structures for controlled drainage of rain and flood water.

The prevailing wind direction is western. There is a possibility of salt dust blown from the lake. Maximum wind velocity is 50-70 m/sec.

Seismicity is 8 points on the Richter scale.

5.3. Plot-plan

The proposed plant incorporating the alumina, sodium carbonate and potash, and cement facilities will be located on the site measuring 2150 by 1200 m, ie. about 260 ha.

Height difference of the terrain is from 1400 m in south-east to 1300 m in north-west.

The plant plot-plan was prepared taking into account the following conditions:

- need for extension of rail spur to the plant with connection to the existing railway;

- securing minimal quantity of earthwork and minimal soil movement within the limits of the site;

- transport of limestone from the quarry located 2 km south of the complex plant site over the existing motor road;

- shipment of finished products by railway transport;

- process sequence of raw material conversion, cooperation between the main and support facilities;

- local conditions - prevailing wind direction, terrain relief and location of infrastructure.

The site of the crusher-classifier factory measuring about 600 by 300 m is located about 500 m south-east of the complex in vicinity of the existing motor road and limestone quarry with connections: 1) to the lower complex of conveyor gantries; 2) to limestone quarry by large mining dump trucks 40 t capacity over the projected road with overpass above the existing motor road.

A mud disposal area measuring 500 by 500 m will be provided on the site No.5 at a lower elevation 2 km north of the complex.

To avoid intersection of the main streams of pedestrian and motor traffic with railway traffic, the inplant rail spur with receiving units and storages is planned in the north-eastern part of the site.

Preplant area with administration building will be on the wind side of the plant in the north-western part of the site.

The power transmission lines and gas pipeline will run along the existing motor road Tabris-Shiramin. Normal power supply and steam for process needs and hot water for space heating will be from the steam and power plant.

The township will be located outside of the 3-km buffer zone of the plant in the area of township Shiramin located 7 km south of the plant.

5.4. Site preparation

Formed surface elevation of the proposed site is assumed to be 1363 m based on the following:

- coordination with the elevation of the existing railroad of the station Shiramin - 1300 m, which is attributed to necessity of running a rail spur to the plant;

- possibility of optimum quantities of earth moving work and movement of soil within the limits of the developed territory.

The leveling of the site (based on the terrain relief and the above conditions) will provide gradient of about 5% from south-east to north-west and excavation of soil in the eastern part of the site in quantity of 46,300,000 m^3 and moving it to the dump to 3 km away. Drilling and blasting operations will be employed.

The formed surface elevation of the mud disposal site is assumed to be 1300 m being elevation of the surrounding terrain. Possible expansion of the mud disposal site is to the north-west.

A rain water settling pond with area of 20 ha is planned 500 m west of the mud disposal site.

The formed surface elevation of the crusher-classifier unit is the same as that of the terrain and existing motor road, ie. 1400 m.

The proposed concepts on the plot-plan and its characteristics are shown in Table 5.1.

Table 5.1

Item	Characteristic	Unit	Quantity
1	Fenced area of site	ha	260
2	Build-up area of site	ha	88
3	Density of buildings	%	34
4	Length of in plant motor roads	km	40
5	Area of motor road pavement	ha	48
6	Length of in plant rail roads	km	12
7	Site preparation		
	excavation	m^3	46,300,000
	backfill	m^3	46,300,000
8	Greenery	ha	40

5.5. Logistics

5.5.1. Railway transport

According to Iranian side the weight limit of the existing railway is 2200 t, which corresponds to 26 rail cars in the train with total weight of loaded car of 80 t.

Estimated length of the rail spur from the existing railroad with rail top elevation of 1300 m to the plant with elevation of 1363 m and gradient of 2,0% is 3 km. Useful length of unloading dock tracks is to accommodate half of the train, ie. 13 cars.

The inplant rolling stock is provided by the Iranian side.

Total turnover of cargo shipped and received is 7,2 00,0 00 t per annum or 19,870 t/day.

To handle the above cargo it would be required to expand and reconstruct the existing railways at the station of Shiramin or construction of the new railway station.

5.5.2. Motor transport

To handle interplant cargo traffic provision is made for motor transport.

The major traffic is as follows:

- delivery of limestone from the quarry to the crusher and classifier unit in the amount of 6 million tpy or 16,700 tpd;

- delivery of mud from the mud disposal area to the storage, clay, iron ore and admixtures is 220,000 tpy or 800 tpd.

To transport limestone provision is made for 37 large dump trucks of type BelAZ 548A with capacity of 40 t.

A special motor road with overpass above the existing motor road between the quarry and the crusher and classifier unit is designed by the Iranian side.

To transport mud from the mud disposal area provision is made for 10 dump trucks of type KrAZ with capacity of 10 t and a road from north-eastern side about 5 km long following the relief of the terrain at elevations of 1400-1463 m with two-way traffic, paved road width of 7 m and road side of 1.5 m.

6. ENGINEERING STUDY

6.1. Production programme

Due to non-existant alumina industry in Iran and large potential demand for cell-grade alumina it is expected that 100% of capacity will be used, ie. alumina output will be 200,000 tpy.

As co-products the plant will produce:

sodium carbonate (Na_2CO_3 - 98.5%) - 35,400 tpy;

potash (K_2CO_3 - 98.5%) - 115,100 tpy;

potassium sulphate (K_2O - 50%) - 2,600 tpy;

Total of carbonates - 153,100 tpy

With 100% utilisation of bellite mud (solid waste of the alumina plant) the cement output will be (with local clay): - 5,585,100 tpy.

Achievement of the design capacity is expected in 2 years after startup of the plant, 50% of capacity is expected to be reached in one year of operation.

6.2. Technology

The nepheline ore and concentrate processing technology has been developed and commercialised on the industrial scale only in the USSR where over 1 million tpy of alumina is produced from nephelines.

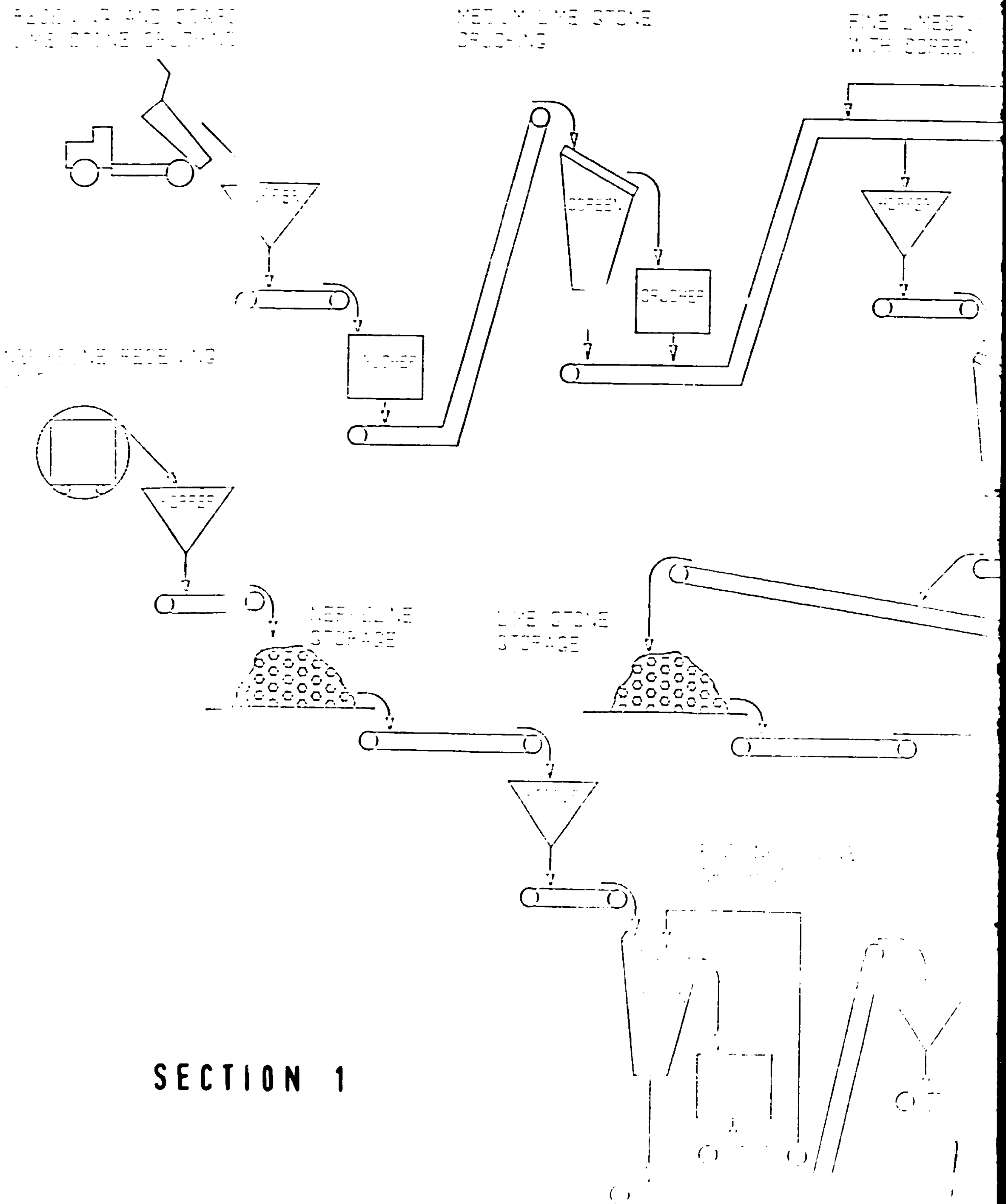
The basics of the technology is as follows:

6.2.1. Alumina plant (Fig. 6.1)

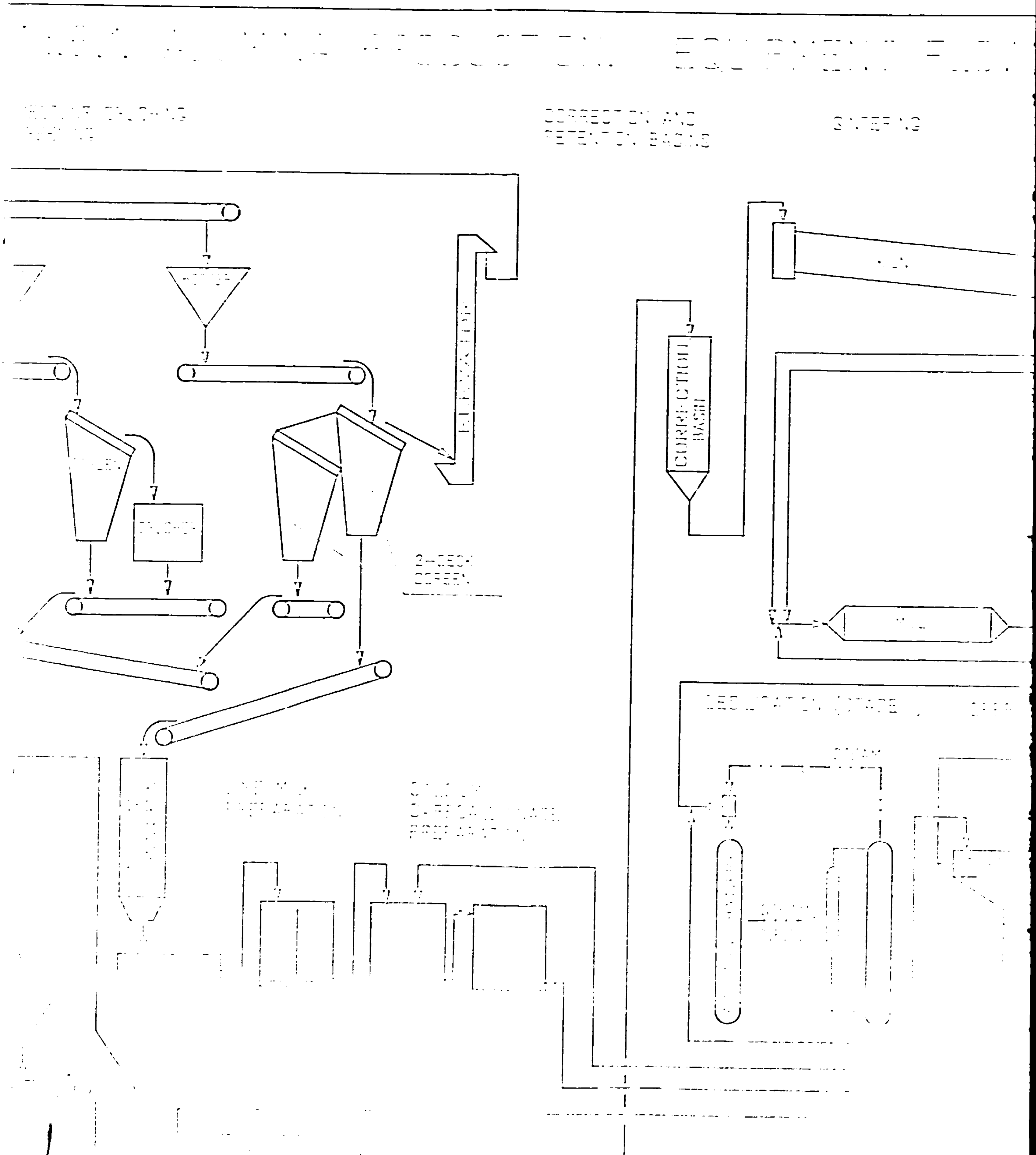
Limestone and nepheline ore after crushing are wet ground with use of recycle carbonate liquor and white mud slurry to 5% of size +0.08 mm in such proportions so that to secure the following molar ratios in the mix:

CaO to SiO_2 = 1.96; total Na_2O to Al_2O_3 = 1.08.

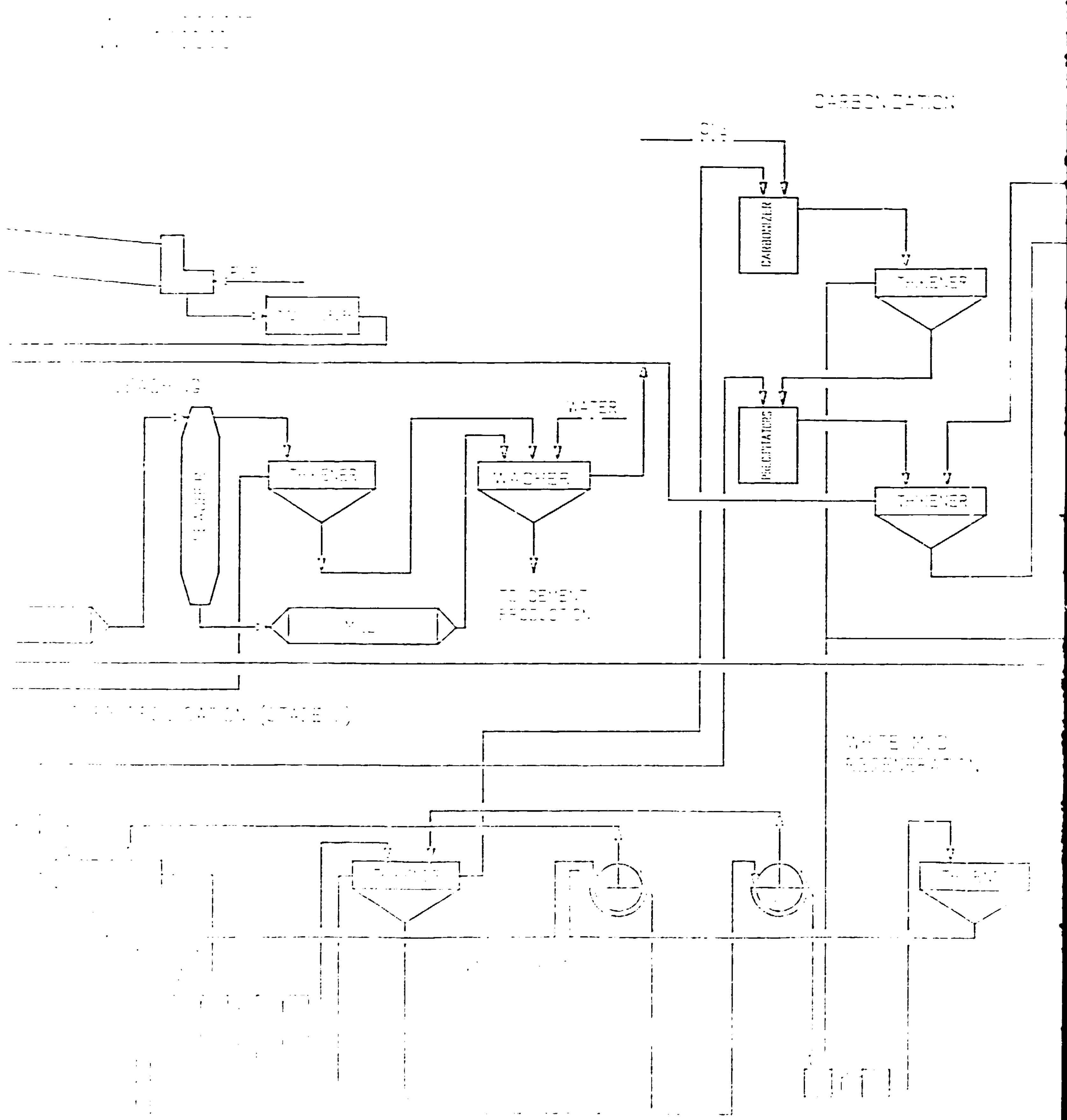
The mix after correction is sintered in the rotary kilns at temperatures of 1250-1300°C. After cooling the sinter is leached with recycle caustic soda and sodium [illegible]ate liquor, mud is washed and fed as slurry with [illegible]



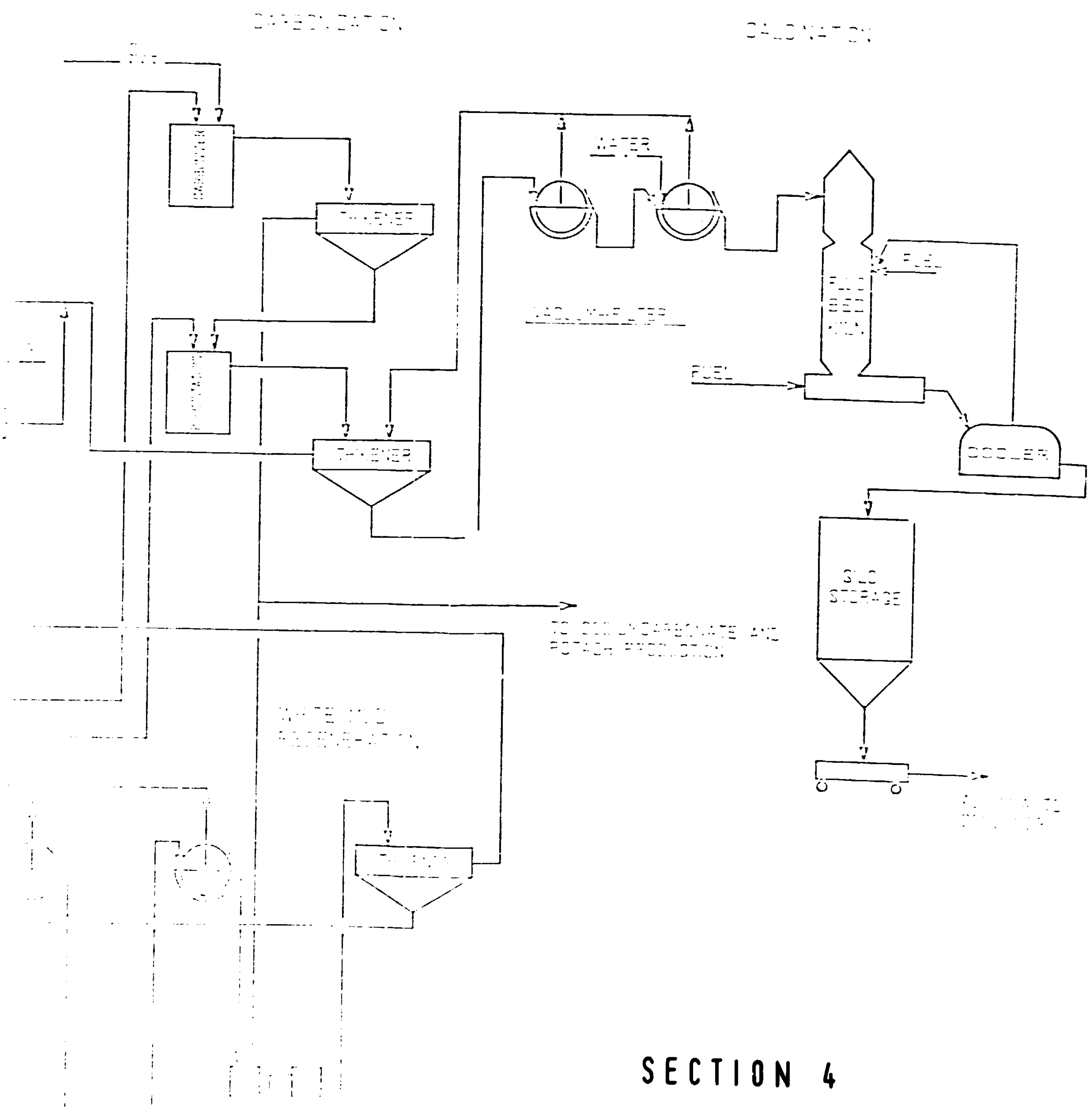
SECTION 1


CORRECTION AND
RETENTION BASINS
SINTERING
CORRECTION
BASIN
2-DECK
SCREEN

SECTION 2



SECTION 3



SECTION 4

of moisture content to the cement plant. During startups and shutdowns of the alumina plant sintering kilns or during disturbance of the process technology it is possible that off-grade mud is generated. This mud is dumped at the mud disposal area.

Pregnant liquor produced by sinter leaching is subjected to two-stage desilication.

Thermal desilication in autoclave to form white mud I (sodium and potassium hydroalumosilicate) is carried out at the first stage. Then after separation of white mud I the liquor is subjected to the second stage of desilication by addition of active lime-containing admixture to produce white mud II (tricalcium hydroalumosilicate) which after regeneration (treatment with sodium carbonate and potash liquor) is recycled along with white mud I for preparation of the sintering mix.

Highly desilicated pregnant liquor is carbonised with cleaned flue gases from the sintering kilns or lime roasting kilns.

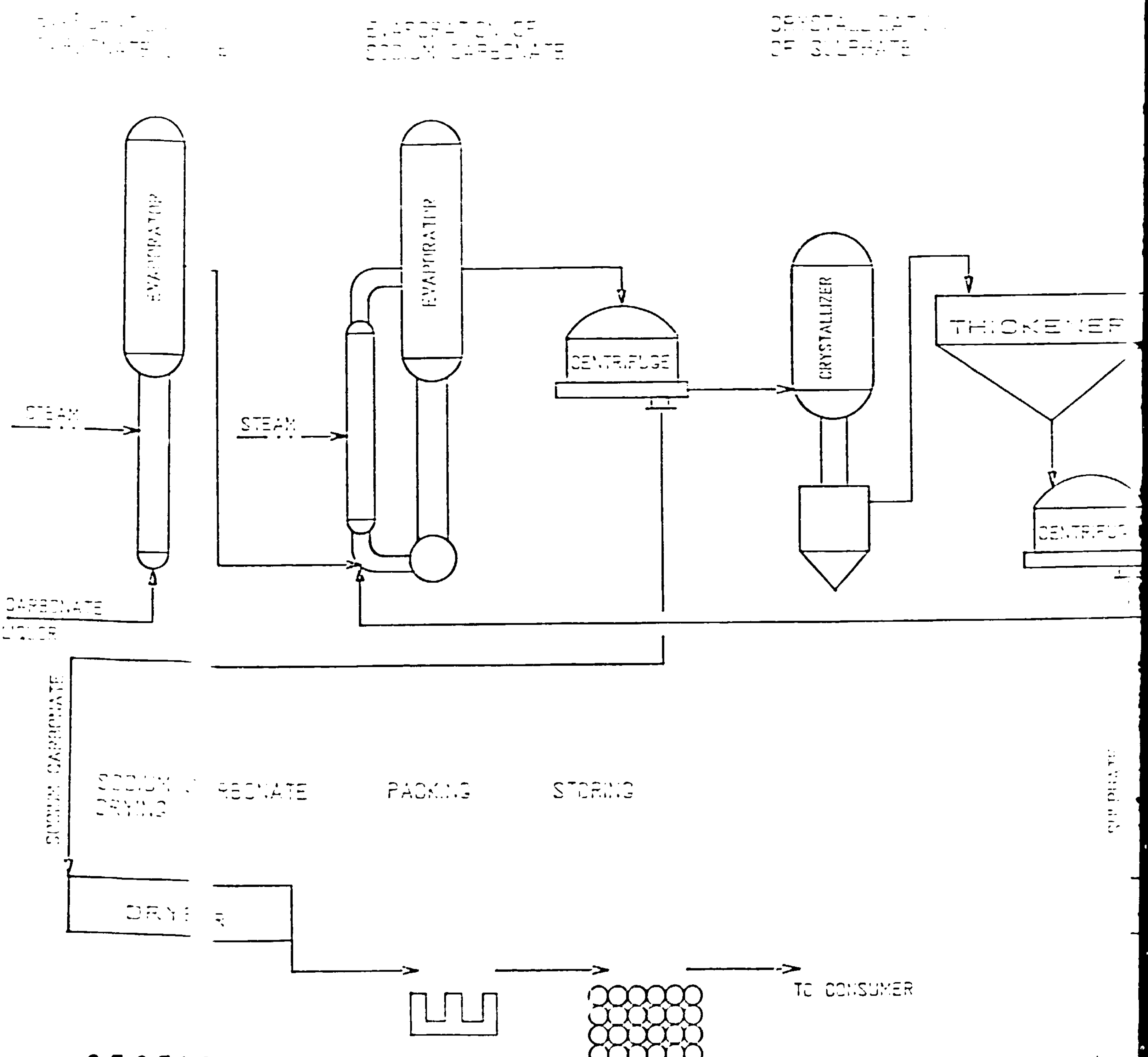
Carbonate liquor produced after separation of aluminium hydroxide is partially used for preparation of the sintering mix and partially for production of carbonates.

To produce caustic soda and sodium carbonate liquor for sinter leaching, part of pregnant liquor after the first stage of desilication is subjected to precipitation. As seed the use is made of aluminium hydroxide separated during carbonisation.

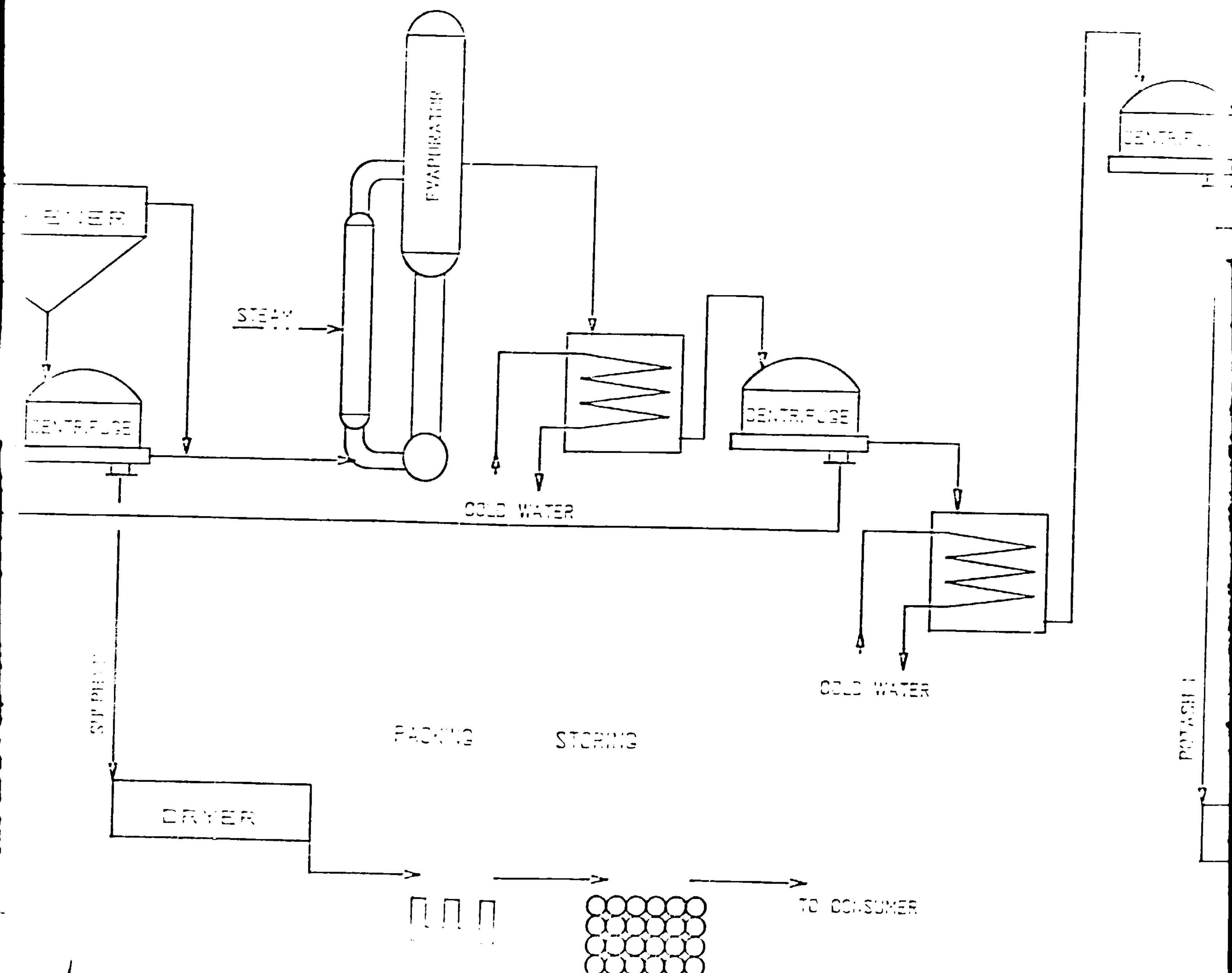
Resulting aluminium hydroxide is separated in settlers and washed in the vacuum drum filters. Washed hydrate is calcined to produce finished cell-grade alumina.

6.2.2. Sodium carbonate and potash plant (Fig.6.2)

Carbonate liquor from the alumina plant is concentrated by evaporation in the evaporator banks. Then double salts (sodium and potassium carbonates) are dissolved in concentrated liquor followed by further evaporation and separation of sodium carbonate. Sodium carbonate is reslurried with condensate and filtered in centrifuges.

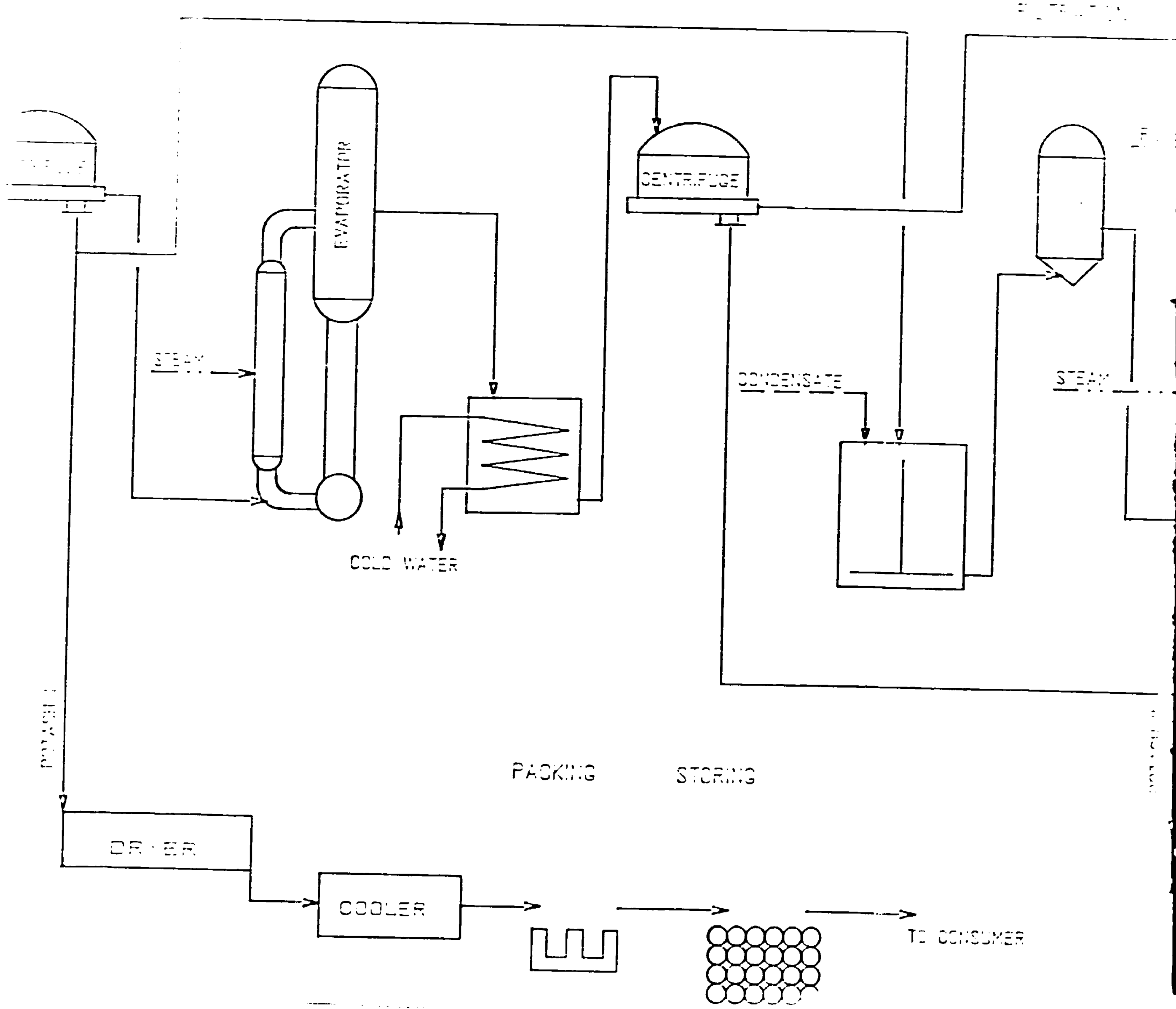

EVAPORATION OF
SODIUM CARBONATE
EVAPORATOR
EVAPORATOR
CENTRIFUGE
CRYSTALLIZER
THICKENER
STEAM
STEAM
CARBONATE
PACKING
STORING
DRYING
TO CONSUMER

SECTION 1


EVAPORATOR
STEAM
CENTRIFUGE
CENTRIFUGE
COLD WATER
COLD WATER
PACKING
STORING
DRYER
TO CONSUMER

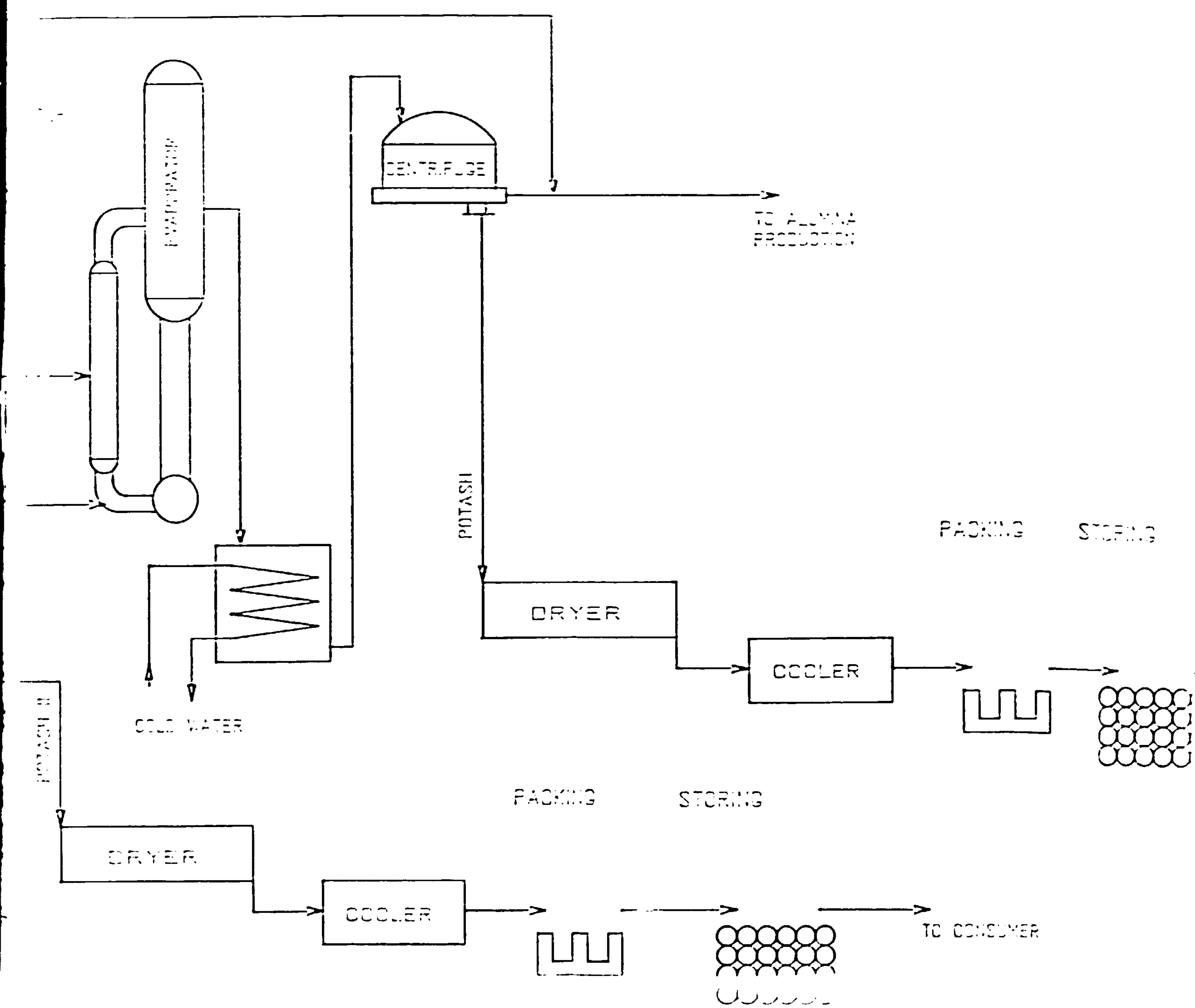
SECTION 2

EVAPORATION OF POTASH

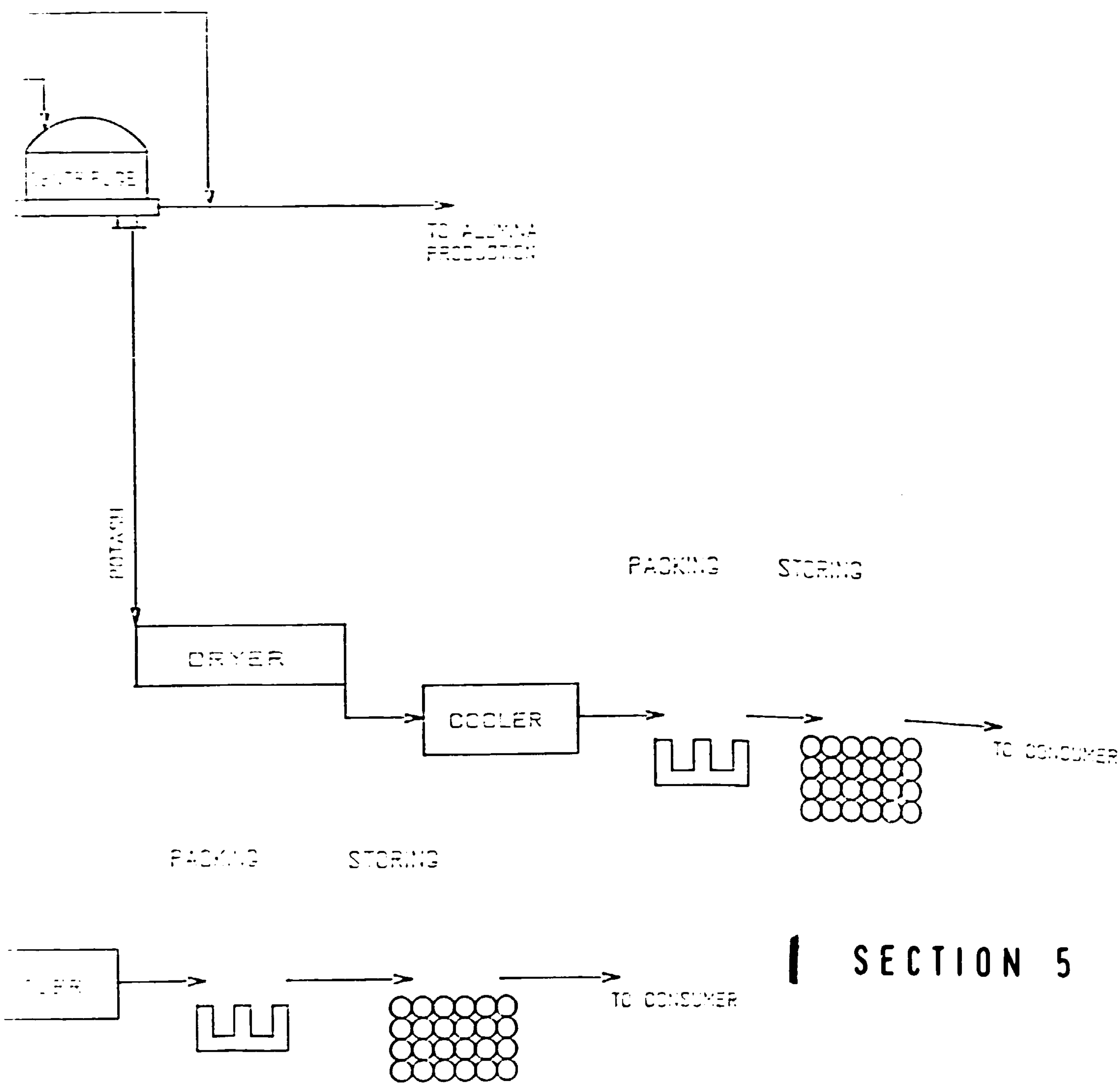


SECTION 3

EVAPORATION OF POTASH



SECTION 4


TO ALUMINA PRODUCTION
POTASH
DRYER
COOLER
PACKING
STORING
TO CONSUMER
PACKING
STORING
TO CONSUMER

SECTION 5

Washed sodium carbonate is dried and shipped as a finished product to consumers.

Spent liquor after separation of sodium carbonate is diluted with water and cooled in the vacuum crystalliser. Potassium sulphate is precipitated as solids to be separated in the centrifuge, dried and stored for shipment to consumers.

Spent liquor after separation of potassium sulphate is mixed with spent liquor after production of potash II and concentrated by evaporation to crystallise double salt. Double salt is sent to the head of the process for dissolution in concentrated carbonate liquor.

Spent liquor of double salt is cooled to separate potash I which is dried to produce product potash or, if necessary, is subjected to additional cleaning by recrystallisation method.

Part of spent liquor after separation of potash I is sent to sintering with spent liquor of potassium sulphate, and second part is concentrated and cooled to separate potash II. Spent liquor of potash II is recycled to the alumina plant for separation of aluminium salt impurities.

6.2.3. Cement production flowsheet (Fig. 6.3)

According to experience in operation of the cement plants in the USSR processing bellite mud from alumina plants, a wet method is proposed for cement production. Slurry of bellite mud from the alumina plant with moisture of 40% is ground in a mix with limestone, clay or bauxite and iron ore in proportion to secure the following weight ratios:

$n = SiO_2/Al_2O_3 + Fe_2O_3 = 2.8$ (silica module)

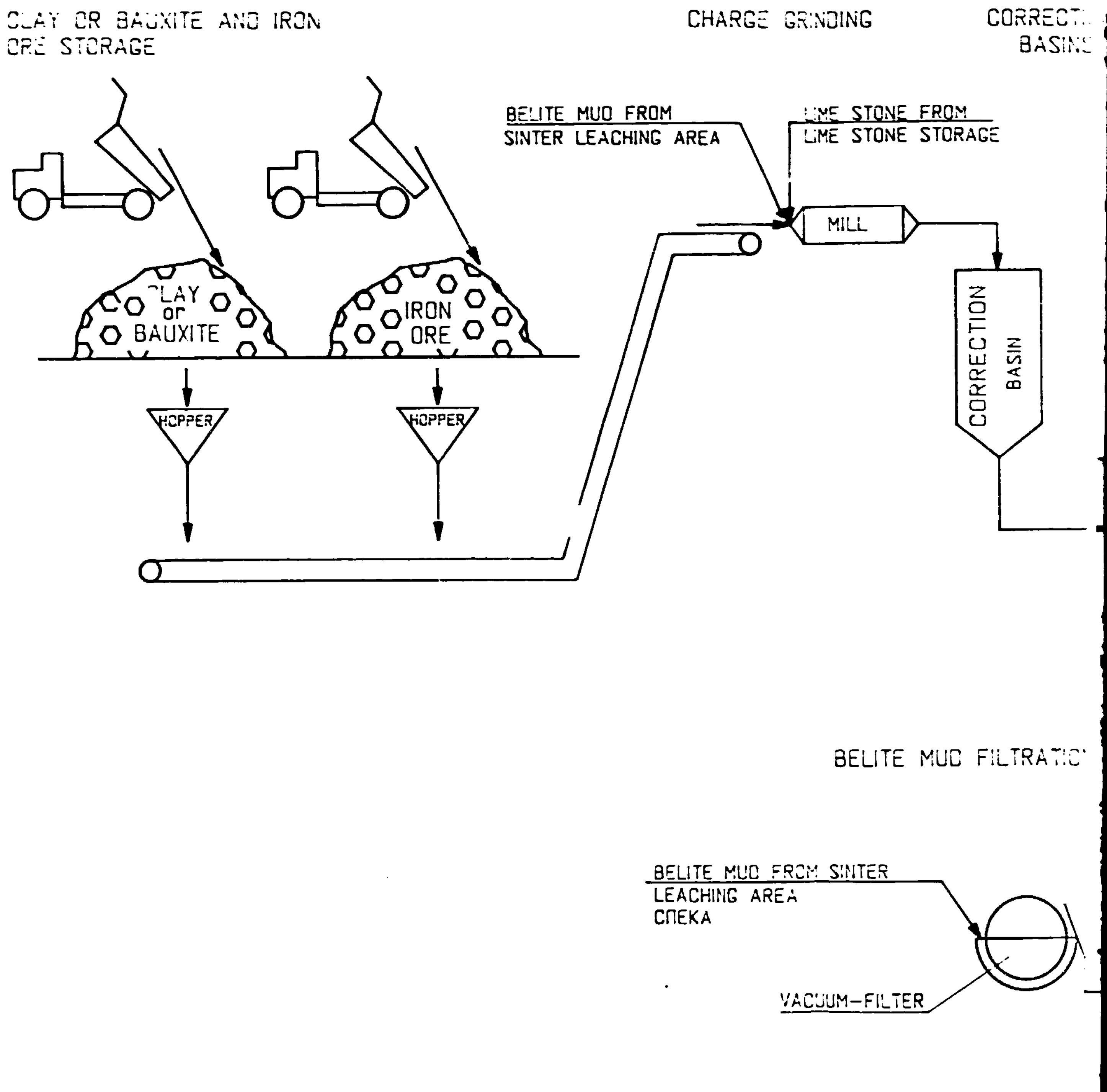
$p = Al_2O_3/Fe_2O_3 = 1.2$ (alumina module)

$kH = CaO - 1.65\ Al_2O_3 - 0.35\ Fe_2O_3/2.8\ SiO_2 = 0.9$[illegible] (saturation factor).

Mix is ground to 10% of size +0.08 mm, then corrected in the correction tanks and roasted in rotary kilns at temperatures of 1350-1400°C to produce clinker.

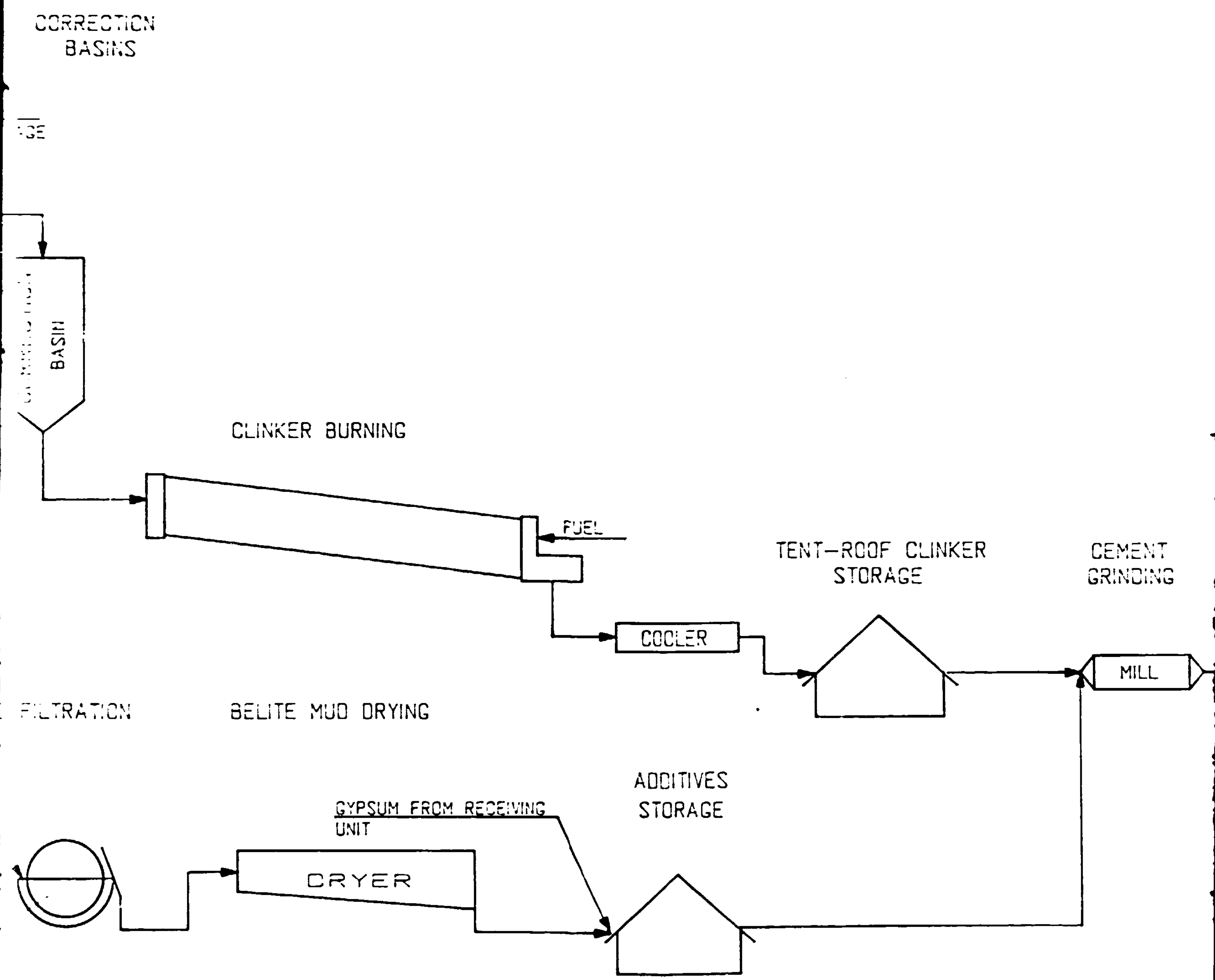
Clinker is cooled and dry ground to 6-7% of size +0.08mm.

Fig.6.3. CEMENT



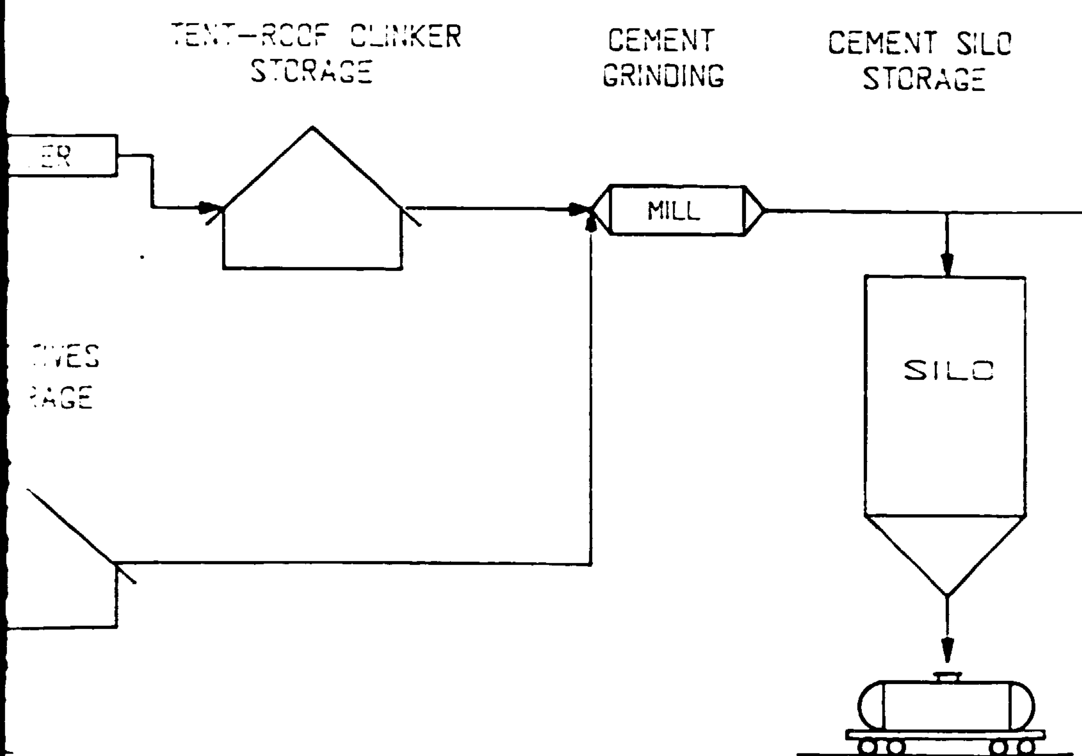
SECTION 1

ENT PRODUCTION.EQUIPMENT FLOWSHEET



SECTION 2

FLOWSHEET



SECTION 3

After joint grinding is 5 % of gypsum and 15 % of dry bellite mud. Finished cement is stored in silos and shipped to consumers.

To prepare dry bellite mud for addition to clinker provision is made for filtration and drying of part of original bellite mud.

Quality of produced cement corresponds to the current USSR standards with the characteristics recommended by the Iranian party not exceeding the limits (silicate and alumina modules, saturation factor).

6.3. Material balance of alumina plant.
Steam, water and condensate consumption diagram

6.3.1. External balance of input and output of components is prepared at the stage of project opportunity study (Table 6-1).

6.3.2. Steam, water and condensate consumption for process needs.

Calculations of steam consumption for needs of the alumina and carbonates plants are presented in the form of a diagram: "Steam, water and condensate consumption diagram" (Fig.6.4).

6.3.3. Material balance of carbonates plant (Table 6-2).

6.3.4. Material balance of cement plant (Table 6-3).

6.4. Selection of equipment for alumina plant

6.4.1. Nepheline receiving unit (drw.No.1339636)

Nepheline is delivered to the plant by rail in wagons 60 t capacity. Lump size of nepheline is 100 mm max. To cope with turnover of 1.3 million tpy provision is made for one wagon tippler for nepheline unloading, which is then delivered to the storage.

6.4.2. Nepheline storage (drwg No.1339636)

To store nepheline provision is made for an open stockpile storage with top charging by belt conveyors fitted

Variant CXEMA915

EXTERNAL MATERIAL BALANCE

I N

NUMBER	NAME OF FLOW	PHASE	MASS	AL2O3	NA2O	K2O	CO2	SO3
211	LIMESTONE	S.	11316.7	7.9	0.0	0.0	4900.1	8.
211	LIMESTONE	L.	230.9	0.0	0.0	0.0	0.0	0.
111	NEPHELINE ORE	S.	6268.1	1253.6	200.6	639.3	0.0	4.
111	NEPHELINE ORE	L.	127.9	0.0	0.0	0.0	0.0	0
143	WATER TO MUD WASHING	L.	16537.0	0.0	0.0	0.0	0.0	0.
114	CONDENSATE	L.	1132.7	0.0	0.0	0.0	0.0	0.
122	CARBON DIOXIDE	L.	587.3	0.0	0.0	0.0	587.3	0.
124	CARBON DIOXIDE	L.	48.2	0.0	0.0	0.0	48.2	0.
127	WATER FOR LIME MILK PREPAR.	L.	671.2	0.0	0.0	0.0	0.0	0.
133	WATER FOR SLURRY PREPAR.	L.	4892.7	0.0	0.0	0.0	0.0	0.
148	CARBON DIOXIDE	L.	18.4	0.0	0.0	0.0	18.4	0.
134	CARBON DIOXIDE FROM AIR	L.	1.0	0.0	0.0	0.0	1.0	0.
140	WATER TO HYDRATE WASHING	L.	1210.0	0.0	0.0	0.0	0.0	0.
146	LIMESTONE TO BURNING	S.	296.1	0.2	0.0	0.0	128.2	0.
146	LIMESTONE TO BURNING	L.	6.0	0.0	0.0	0.0	0.0	0
TOTAL		S.	17880.9	1261.8	200.6	639.3	5028.3	13
		L.	25463.3	0.0	0.0	0.0	655.0	0
		TOTAL	43344.2	1261.8	200.6	639.3	5683.3	13

O U T

NUMBER	NAME OF FLOW	PHASE	MASS	AL2O3	NA2O	K2O	CO2	SO3
1201	SINTERING LOSSES	S.	29.8	0.0	1.2	27.6	0.0	1
1201	SINTERING LOSSES	L.	13444.6	0.0	0.0	0.0	5191.6	0.
5001	SINTER GRINDING LOSSES	S.	132.1	13.6	2.6	9.1	0.0	0.
4301	MUD TO CEMENT PRODUCTION	S.	11313.6	251.8	53.7	162.3	71.5	3
4301	MUD TO CEMENT PRODUCTION	L.	7542.4	0.0	0.0	0.0	0.0	0
4301	FLUSH STEAM	L.	1956.4	0.0	0.0	0.0	0.0	
2201	CARBONIZATION LOSSES	L.	1915.8	0.5	3.7	14.6	9.2	
2601	LIQUER TO SODA PRODUCTION	L.	5017.3	1.2	105.3	411.0	279.1	
2701	UNDERBURNT LIMESTONE	S.	48.7	0.2	0.0	0.0	19.2	
2701	UNDERBURNT LIMESTONE	L.	18.2	0.0	0.0	0.0	0.0	
3401	PRECIPITATION LOSSES	S.	17.6	0.5	0.0	11.4	0.8	
4101	ALUMINA	S.	1000.0	990.0	0.8	3.2	0.0	
4102	CALCINATION LOSSES	S.	794.2	4.0	0.0	0.0	0.7	
4601	LIMESTONE BURNING LOSSES	L.	115.1	0.0	0.0	0.0	109.0	
TOTAL		S.	13336.0	1260.0	91.5	213.6	94.0	5.
		L.	30007.8	1.7	109.1	425.6	5588.9	8.
		TOTAL	43343.7	1261.7	200.6	639.1	5682.9	13

SINTER CONTENT

NUMBER	NAME OF FLOW	PHASE	MASS	AL2O3	NA2O	K2O	CO2	SO3
1250	SINTER	S.	13206.3	1357.2	283.1	913.8	1.3	17.

SECTION 1

EXTERNAL MATERIAL BALANCE

I N

TABLE 6-1

	PHASE	MASS	AL2O3	NA2O	K2O	CO2	SO3	SIO2	FE2O3	CAO	H2O	MISC
	S.	11316.7	7.9	0.0	0.0	4900.1	8.5	67.9	5.7	6224.2	0.0	102.4
	L.	230.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	230.9	0.0
	S.	6268.1	1253.6	200.6	639.3	0.0	4.7	3441.2	231.9	125.4	200.6	170.8
	L.	127.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	127.9	0.0
	L.	16537.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16537.0	0.0
	L.	1132.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1132.7	0.0
	L.	587.3	0.0	0.0	0.0	587.3	0.0	0.0	0.0	0.0	0.0	0.0
	L.	48.2	0.0	0.0	0.0	48.2	0.0	0.0	0.0	0.0	0.0	0.0
PAR.	L.	671.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	671.2	0.0
R.	L.	4892.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4892.7	0.0
	L.	18.4	0.0	0.0	0.0	18.4	0.0	0.0	0.0	0.0	0.0	0.0
S	L.	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
NG	L.	1210.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1210.0	0.0
	S.	296.1	0.2	0.0	0.0	128.2	0.2	1.8	0.1	162.9	0.0	2.7
	L.	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0
	S.	175[illegible].9	1261.5	200.6	639.3	5028.3	13.4	3510.9	237.7	6512.4	200.6	275.9
	L.	[illegible]483.3	0.0	0.0	0.0	655.0	0.0	0.0	0.0	0.0	24808.4	0.0
	TOTAL	43344.2	1261.8	200.6	639.3	5683.3	13.4	3510.9	237.7	6512.4	25008.9	275.9

O U T

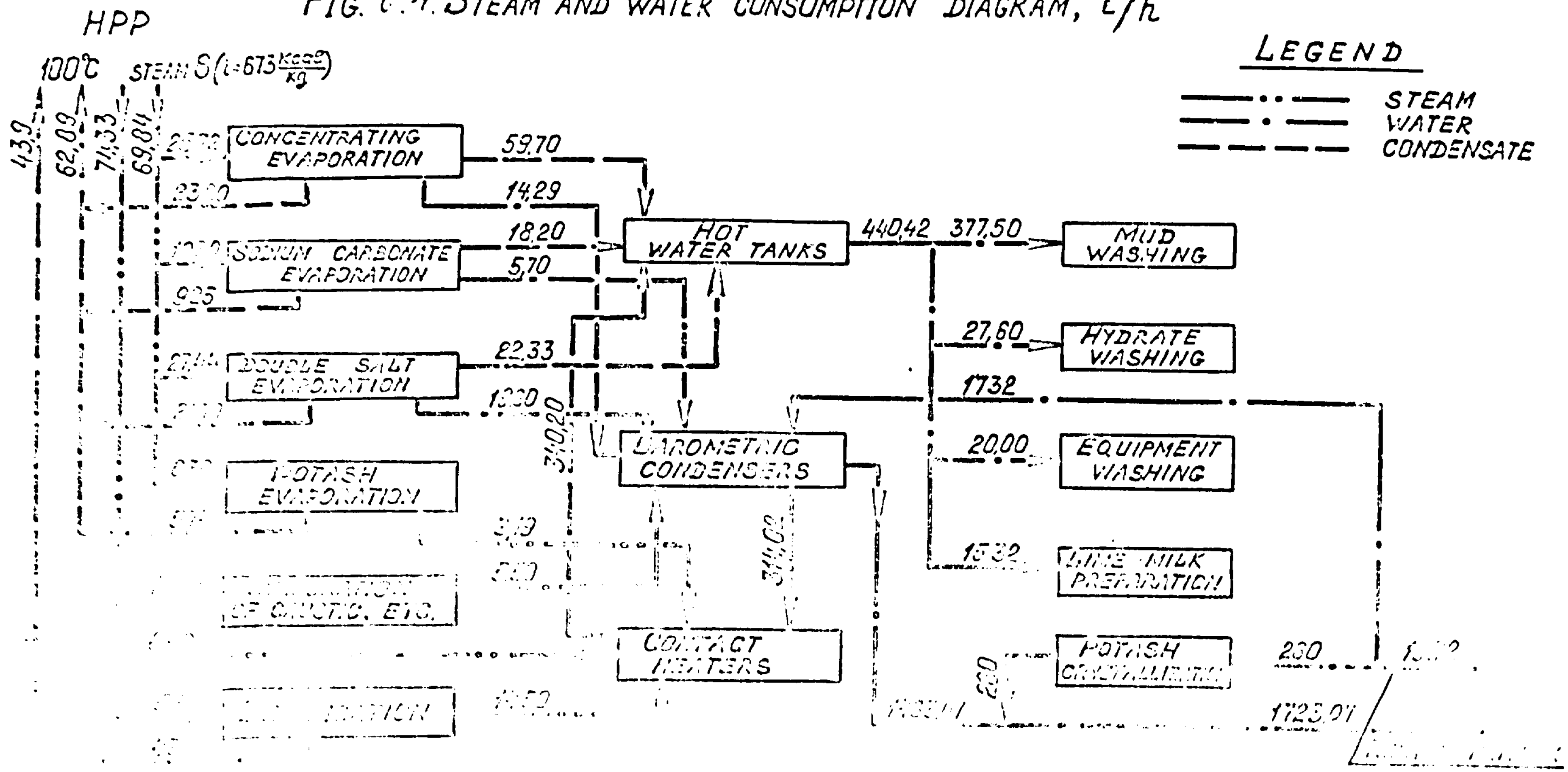
	PHASE	MASS	AL2O3	NA2O	K2O	CO2	SO3	SIO2	FE2O3	CAO	H2O	MISC
	S.	[illegible]	0.0	1.2	27.6	0.0	1.0	0.0	0.0	0.0	0.0	0.0
	L.	13444.6	0.0	0.0	0.0	5191.6	0.0	0.0	0.0	0.0	8253.0	0.0
	S.	132.1	13.6	2.6	9.1	0.0	0.2	35.7	2.4	65.4	0.0	2.8
N	S.	11313.6	251.5	52.7	162.3	71.5	3.4	3473.3	235.2	6422.5	339.4	270.5
N	L.	7542.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7542.4	0.0
	L.	1956.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1956.4	0.0
	L.	1915.8	0.5	3.7	14.6	9.2	0.3	0.0	0.0	0.0	1887.4	0.0
N	L.	5017.[illegible]	1.2	105.2	411.0	279.1	8.0	0.0	0.0	0.0	4212.8	0.0
	S.	48.7	0.2	0.0	0.0	19.2	0.2	1.8	0.1	24.4	0.0	2.7
	L.	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2	0.0
	S.	17.6	0.5	2.9	11.4	2.6	0.2	0.0	0.0	0.0	0.0	0.0
	S.	1000.0	990.0	0.8	3.2	0.0	0.0	0.0	0.0	0.0	6.0	0.0
	S.	794.2	4.0	0.0	0.0	0.7	0.1	0.0	0.0	0.0	789.4	0.0
	L.	115.1	0.0	0.0	0.0	109.0	0.0	0.0	0.0	0.0	6.0	0.0
	S.	13336.0	1260.0	91.5	213.6	94.0	5.1	3510.9	237.7	6512.4	1134.8	275.9
	L.	30007.8	1.7	109.1	425.6	5588.9	8.3	0.0	0.0	0.0	23874.3	0.0
	TOTAL	43343.7	1261.7	200.6	639.1	5682.9	13.4	3510.9	237.7	6512.4	25009.0	275.9

SINTER CONTENT

PHASE	MASS	AL2O3	NA2O	K2O	CO2	SO3	SIO2	FE2O3	CAO	H2O	MISC
S.	13206.3	1357.2	283.1	913.8	1.3	17.4	3574.6	239.6	6543.8	0.0	275.6

SECTION 2

FIG. 6.4. STEAM AND WATER CONSUMPTION DIAGRAM, t/h



[illegible] per 1t of alumina — [illegible] = 2,06 [illegible]

[illegible] per 1t of carbonate products — [illegible] = 2,350 [illegible]

TABLE 6-2

SODIUM CARBONATE AND POTASH PRODUCTION.
MATERIAL BALANCE IN kg PER 1 t OF SODIUM CARBONATE, POTASH AND POTASSIUM SULFATE.

No	NAME	IN	OUT
1.	CARBONATE LIQUOR FROM ALUMINA PRODUCTION	6554.3	-
2.	WATER TO REPULPING OF SODIUM CARBONATE	1650.1	-
3.	EVAPORATED WATER FROM CONCENTRATED LIQUOR	-	2942.2
4.	EVAPORATED WATER FROM SODIUM CARBONATE	-	1306.1
5.	EVAPORATED WATER FROM POTASSIUM SULPHATE	-	314.7
6.	EVAPORATED WATER FROM DOUBLE SALT	-	2242.0
7.	EVAPORATED WATER FROM SPENT LIQUOR OF POTASH	-	182.5
8.	WATER LOSS AT SODA DRYING	-	49.8
9.	WATER LOSS AT POTASH DRYING	-	167.1
10.	SODIUM CARBONATE	-	231.2
11.	POTASSIUM SULPHATE	-	17.
12.	POTASH	-	751.8
	TOTAL	8204.4	8204.4

MATERIAL BALANCE CEMENT PRODUCTION.

MATERIALS	CONSUMPTION					
	ALTERNATIVE WITH CLAY			ALTERNATIVE WITH BAUXAT		
	t/t CLINKER	t/t CEMENT	THOU.t PER YEAR	t/t CLINKER	t/t CEMENT	THOU.t PER YEA
BELITE MUD	0.319	0.255	1424.7	0.683	0.546	1776.3
LIMESTONE	0.806	0.645	3603.6	0.477	0.382	1240.6
CLAY	0.259	0.207	1156.5	-	-	-
BAUXITE	-	-	-	0.053	0.042	137.8
IRON ORE	0.014	0.011	61.4	0.025	0.020	65.0
CHARGE	1.398	1.118	6248.4	1.238	0.990	3219.8
CLINKER	1.000	0.800	4469.6	1.000	0.800	2600.8
GYPSUM	-	0.050	279.3	-	0.050	162.6
BELITE MUD	-	0.150	838.0	-	0.150	487.6
TOTAL BELITE MUD	-	0.405	2262.7	-	0.696	2262.7
FUEL (STAND t):						
DRYING MUD	0.006	0.005	27.9	0.006	0.005	16.3
BURNING OF CLINKER	0.195	0.156	871.6	0.157	0.126	409.6
CEMENT	-	1.000	5587.0	-	1.000	3251.0

with trip cars (two piles). One pile is being formed and the other pile is reclaimed. Capacity of one pile is assumed to be [illegible]-day stock of nepheline which allows for shutdown and repairs of the wagon tippler.

Reclamation of nepheline from the storage is by two bucket excavators (one operating, one standby).

6.4.3. Nepheline fine crushing (drwg No.1339636)

To crush nepheline from 100 mm in size down to 15-20 mm provision is made for short cone crushers 2200 mm diameter with screens operating in a closed circuit. Two crusher lines will be installed (one operating, one standby). Crushers are provided for crushing the ore delivered after the storage to the process.

6.4.4. Receiving and coarse crushing of limestone, medium crushing of limestone, fine crushing of limestone with screens (drwg No.1339637).

Equipment installed in the crushing section is provided for handling limestone required for alumina and cement plants.

Hourly flow of limestone:

- alumina plant	- 266 t
- incl. for roasting	- 8.0 t
- cement plant	- 420 t

On customer's request the limestone up to 1200 mm in size is to be delivered from the quarry to the plant by dump trucks. Limestone crushing from 1200 mm to 20 mm is provided for in three stages: coarse, medium and fine.

Operation is planned in two shifts (14 hrs), with total hourly flow being 1200 t.

To handle 1200 t/h of limestone provision is made for:

- coarse crushing - simultaneous operation of two jaw crushers 2100 by 1500, capacity 800 t/h each, product size up to 350 mm;

- medium crushing - two cone crushers 2200 mm diameter with pre-screening of minus 100 mm fraction. Capacity of each line "screen crusher" with reduction down to 120 mm corresponds to the capacity of the jaw crusher, ie. 800 t/h;

- fine crushing - eight hammer crushers 1600 mm diameter by 120 mm, with capacity up to 300 t/h. In addition to limestone crushing at the fine crushing section provision is made for screening limestone minus 80 plus 40 mm in size for roasting.

Two double-decker screens are provided for limestone screening.

6.4.5. Limestone storage (drwg No.1339637)

For storage of limestone after fine crushing provision is made for an open storage with top stacking by belt conveyors fitted with trip cars to form two stockpiles. Capacity of one pile is assumed to be 3-day stock of limestone which allows for shutdown and repairs of the coarse and medium crushers. Reclamation of limestone from the storage is by two bucket wheel excavators.

6.4.6. Grinding (drwg No.1339638)

Hourly flows:

- limestone - 258 t;
- nepheline - 143 t.

To produce the mix of required fineness (5% oversize on 0.08 mm sieve) provision is made for 4-stage grinding. Nepheline is ground in two stages, and combined grinding and re-grinding of nepheline with limestone is also in two stages.

To grind raw materials provision is made for tube mills 3.2 m diameter by 15 m. Number of mills is 12 pcs, including 2 pcs - 1 stage; 2 pcs (1 standby) - 2 stage; 4 pcs (1 standby) - 3 stage, 4 pcs (1 standby) - 4 stage.

Capacity of the mills:

- first stage nepheline grinding - 109 t/h;
- second stage nepheline grinding - 146 t/h;
- third stage nepheline grinding - 155 t/h;
- fourth stage nepheline grinding - 183 t/h.

The mills are located in same building with the cement mills.

6.4.7. Correction and surge tanks (No.1339639)

Hourly flow of the mix is 360 m³.

The tanks are provided for storage and correction (blending) of the mix. Provision is made for tanks 12 m diameter, capacity [illegible] m^3, number 12 pcs. Total stock of the mix is 3 day stock, corrected mix - 1.5-day stock.

6.4.8. Sintering (drwg No.1338861-T)

To sinter limestone-nepheline mix with moisture of 30% provision is made for sintering kilns 6.4/5.8 m diameter by 190 m fitted with combination coolers consisting of grating type coolers with area of grating 68 m^2 and water sprayed drum coolers 6.4/5.8 m diameter by 60 m.

Requirements for sinter are 2,640,000 tpy or about 301.4 t/h.

Number of kilns is 3. Capacity of 1 kiln is 118 t/h.

The finished sinter is conveyed to leaching.

Exit gases of the kiln are cleaned in the electrostatic precipitators and discharge to air via the chimney stack.

Dust entrapped in ESP is recycled to the kilns.

6.4.9. Sinter leaching (drwg No.1339640)

The following process operations are provided at the sinter leaching section:

- sinter storage and classification;
- sinter wet grinding;
- sinter leaching;
- re-grinding of coarse mud;
- mud filtration and washing;
- recycle liquor preparation.

The following equipment is installed upstream of the leaching section: two silos 18 m diameter, each with capacity 3600 t which secure sinter stock for 20 hrs of operation of the plant.

Sinter is fed from the sintering section by two belt conveyors. Before the silos the sinter is separated as 10 mm fraction on two inertial screens. Coarse sinter is fed to one silo, fine sinter - to another.

Wet sinter grinding with use of recycle liquor is in three rod mills 3.6 m diameter x 5.5 m. A vertical hydraulic classifier is fitted over each mill. Coarse sinter via weightometer is fed by a belt conveyor directly to the mill. Fine sinter from the silo is fed to the classifier, then coarse fraction (+2 mm) is directed to the mills, and fine fraction - to the mixers (bypassing the mills) where it is mixed with ground slurry.

Sinter leaching is in six vertical units 2.0 m diameter where mud is classified at the same time. Fine mud is gravity discharged with pregnant liquor to the settlers. Coarse washed mud is discharged from the lower section of the digesters and fed for re-grinding.

Mud re-grinding.

Re-grinding of coarse washed mud is in three ball mills 3.2 m diameter x 4.5 m. Mud slurry after grinding is pumped to the filter settlers of the last stage washing circuit.

Mud washing

Mud washing is counter-currently with hot water in one process line, which incorporates:

three parallel settlers 8 m diameter;

one washer 8 m diameter similar to settlers in each of the five stages of the washing circuit;

four parallel filter-settlers 5.75 m diameter at the last washing stage.

All settlers and washers are fed with coagulant. Preparation of coagulant solution is in two mixers 4.5 diameter by 4.5 m.

The unit is provided for hydrochloric acid washing of cartridges of the filter-settlers.

Recycle liquor is prepared by mixing cooled strong wash water (resulting from mud washing) with weak caustic soda-sodium carbonate solution.

The major equipment of the section:

6 mixers 6 m diameter by 9 m: two mixers each for caustic soda-sodium carbonate solution, hot wash water and recycle liquor, 2 mixers 6 m diameter by 6 m for cooled wash water and 2 cyclone film vacuum coolers 2.2 m diameter.

All leaching section equipment except 6 m diameter tanks is located in the building measuring 72x64 m in plan.

6.4.10. Desilication (drwg No.1339641)

The following sections are provided for desilication of pregnant liquor:

- autoclave desilication;

- calcium carboaluminate preparation;
- high desilication;
- mud recovery;
- thickening;
- filtration.

Fed to the desilication:

- pregnant liquor from the leaching section;
- lime slurry from lime milk preparation section.

All of the pregnant liquor at first stage is desilicated in autoclaves. The resulting liquor is divided into two portions. One portion is sent to the carbonization area into a soda-alkaline circuit for a precipitation operation. The second portion passes through the 2-nd desilication stage (deep desilication). An active additive is used at this operation-calcium carboaluminate. After a deep desilication the liquor comes into the carbonization area in a soda circuit for ca bonization.

Autoclave desilication of pregnant liquor is in three autoclave banks. Each bank consists of seven autoclaves 3.6m diameter and preheating chamber with surface area of 800 m^2.

For liquors and slurries the section is provided with 6 mixers 6 m diameter by 9 m: 3 mixers for starting liquor, one for recycle white mud slurry and two for desilicated slurry.

Besides, the section is provided with acid cleaning unit for autoclave chemical cleaning.

Calcium carboaluminate preparation which is used for high desilication of pregnant liquor is by mixing and simultaneous cooling of lime slurry and high desilicated liquor.

The major equipment of the section:

- vacuum cooler - 2 pcs;
- mixers: 7.5 m diameter by 6 m - 1 pc;
  4.5 m diameter by 3 m - 2 pc;
  3 m diameter by 6 m - 1 pc.

High desilication of part of pregnant liquor is by injection of carboaluminate slurry and by retention of slurry in mixers.

The major equipment of the section: 6 mixers 7.5 m diameter by 7.5 m combined into two process lines.

White mud-II recovery is by reslurrying and retention of white mud in carbonite liquor.

The major equipment of the section: 3 mixers 6 m diameter by 9 m combined into one process lines and 1 mixer 7.5 by 6 m.

Slurry thickening is in 8 siimple settlers 15 m diameter:

four are used for thickening slurry after autoclave desilication;

two are used for thickening slurry after high desilication;

two are used for thickening slurry after recovery.

Provided at the filtration section is filtration of thickened slurries and security filtration of liquors. Total number is 3 installed drum filters with filtering surface of 40m² and five leaf filters with filtering surface of 250 m².

Three drum filters are designed for filtration of slurry after autoclave desilication (white mud-I) and for slurry after high desilication (white mud-II) and recovery.

Three leaf filters are designed for filtration of liquor after autoclave desilication and two for liquor after high desilication (carbonate circuit).

The desilication section occupies area of 195x102 m. Four buildings will be built on this area: 18 by 100 m and three structures 12x12 m (autoclave banks), 12x100 m (centrifugal pumps), 12x90 m (thickened slurry and slurry pumps) and 18x100 m (filtration equipment).

Located outside of these buildings are settlers and tanks 9 m diameter and over.

6.4.11. Hydrate carbonisation and handling (drwg No.1334642)

Hydrate carbonisation and handling section includes the following process areas:

precipitation of hydrate slurry;

thickening of hydrate slurry;

hydrate filtration and washing;

security filtration of liquors of caustic soda-sodium carbonate circuit;

hydrate storage.

The starting pregnant liquor is fed from the desilication area, flue gases for carbonisation - from supercharger.

Washed hydrate is fed to the calcination, carbonate liquor - to the carbonates production, caustic soda-sodium carbonate liquor - to the leaching.

Carbonisation and precipitation at all sections is in the mechanically agitated units 7.5 m diameter by 12 m connected in series into banks in the number sufficient for required time of the process. Total 16 units are installed in the carbonate circuit and 6 units in caustic soda-sodium carbonate circuit.

Thickening of hydrate slurry is in simple settlers 15 m diameter. Total 5 settlers are installed.

Filtration of hydrate is in the drum filters with filtering surface of 40 m². For counter-current hydrate washing the filters are combined into one process line. Total 6 filters are installed.

Security filtration of liquors is in the leaf filters with filtering surface of 250 m². Total 6 filters are installed.

The process equipment of the hydrate carbonisation and handling is in the building and outdoors.

Carbonisers and precipitators are located on the site 38x60 m under cover.

Settlers and large tanks for liquors and slurries are located outside of the buildings without a cover.

The other process equipment is located in three buildings interconnected to each other.

Located in one building 12x78 m are centrifugal pumps and tanks for thickened slurry of the carbonisation, precipitation and thickening sections.

Located in a second building 30x54 m are drum and leaf filters and associated equipment.

Located in a third building 24x54 m is the hydrate [illegible] rage. Storage capacity of 1[illegible] t ensures 15-day stock of hydrate to allow for shutdown of the calcination kiln for repairs. The storage is equipped with a clamshell crane 1[illegible] t in capacity.

6.4.12. Calcination (drwg No.1338862-T)

To calcine alumina provision is made for calciners with circulating fluid bed. Number of calciners is one. Capacity of the calciners is 30 tph. Availability factor of calciner is 0.76.

Calcined material is fed by conveyors to the finished alumina storage. Calciner gases after cleaning in ESP are discharged into air from the chimney stack.

6.4.13. Finished alumina storage (drwg No.1338863-T)

The alumina storage consists of 4 silos 12 m diameter, 46 m high. Capacity of the storage is 12000 t of alumina to secure 18-day stock.

The silos are fitted with bag filters for cleaning air discharged during alumina loading.

Provision is made for rail car automatic alumina weighing and loading unit.

6.4.14. Limestone burning (drwg No.1338864-T)

Daily demand for lime is 138.3 t for three operating sintering kilns. To burn the lime provision is made for a shaft lime burning kiln 150 tpd capacity. Availability factor of the kiln is 0.92.

Burnt lime is conveyed to the lime silo. Exit gases are dedusted is cyclones and discharged to air via the chimney stack.

6.4.15. Lime milk preparation and causticisation (drwg No. 1338643-T)

The lime milk preparation and causticisation section includes the following areas:

- limestone store;
- lime milk preparation;
- causticisation.

Starting materials:

- lime from the limestone burning;
- carbonate liquor from the hydrate carbonisation and

Handling:

- hot water from the carbonates plant.

Finished products:

- lime milk is pumped to the desilication;
- caustic liquor is pumped to the carbonates plant;
- lime slurry is pumped to the grinding.

Lime store is a silo 12 m diameter, capacity 1400 t. Lime is fed to the silo by two plate conveyors. Lime from the silo is transported by two belt conveyors.

Lime slaking is in two process lines. Each line includes:

- lime slaker 2.2 m diameter by 10 m;
- single spiral classifier 1.5 diameter by 8.2 m;
- ball mill 0.9 m diameter by 1.8 m;
- tanks for liquors and slurries.

One line is used for slaking with hot water, and lime milk is used for desilication of pregnant liquor. The other line is used for lime slaking with carbonate liquor and causticisation.

For desilication lime milk is subjected to additional classification in hydrocyclones for separation of unburnt lime.

Causticisation of carbonate liquor is to produce caustic liquor. The starting carbonate liquor is first used for washing mud produced after thickening the causticisation slurry. Liquor after mud washing (washer overflow) is pre-heated in a spiral heat exchanger and used for lime slaking. Produced slurry is retained in the mixers-causticisers for causticisation. Then slurry is clarified in the settler. Overflow of the settler (caustic liquor) is pumped to the carbonates plant. Mud is washed with starting carbonate liquor and filtered in the drum filter. Lime cake from the filter is reslurried with water and is pumped along with unburnt lime to the grinding for preparation of sintering mix.

The major equipment of the section:

mixer-causticisers	3 pcs
settlers 15 m diameter	1 pc

washer 15 m diameter — 1 pc

drum filter 1[illegible] m² surface — 2 pcs

spiral heat exchanger 32 m² — 2 pcs

The process equipment is for lime milk preparation and causticisation is located in the building measuring 30x60 m in plan. Located outside of the building are a settler, washer and tanks 6 m diameter and more.

6.5. Selection of equipment for carbonates plant

6.5.1. Evaporation, crystallisation and centrifuging (drwg No.1339645)

The process technology for production of carbonates from carbonate liquor of the alumina plant includes the following stages:

- liquor concentration;
- dissolving of double salt in concentrated carbonate liquor;
- evaporation of mixed liquor with sodium carbonate crystallisation;
- crystallisation of potassium sulphate from spent sodium carbonate liquor;
- evaporation of spent sulphate liquor to produce double salt;
- Stage I of potash crystallisation from spent double salt liquor;
- Stage II of potash crystallisation from spent Stage I potash liquor.

For concentration of liquor the use is made of two 5-effect banks of mixed flow 5-1-2-3-4 based on ascending film evaporators with surface area of 300 m².

For evaporative concentration of the mixed liquor to separate non-product soda ash as solids provision is made for two 4-effect evaporator banks of mixed flow 4-1-2-3 based on forced circulation evaporators with surface area of [illegible] m².

For crystallisation of potassium sulphate provision is made for two vacuum crystallising unit of type "Crystal" based on crystalliser with evaporator diameter of 3.8 m.

For separation of double salt provision is made for one

...-effect counter-current forced circulation evaporators with surface area of 500 m².

Concentration of spent liquor of potash I is provided in a single-effect evaporator at atmospheric pressure with forced circulation, surface area of 500 m². Potash is crystallised in crystalliser tanks with agitators and water cooling. Two banks of 6 units each are installed.

To separate slurries of sodium carbonate, potash, double salt provision is made for an automatic centrifuge ФГН-2001К-02 with blade removal of cake. 16 centrifuges will be installed.

To separate slurries of potassium sulphate provision is made for a centrifuge ФГН-903К with pre-thickening of slurry in a simple settler 12 m diameter.

6.5.2. Carbonate drying (sodium carbonate, potash, potassium sulphate drwg No.1398365-T)

Quantity of sodium carbonate and potash is 150,500 tpy.

For drying sodium carbonate and potash provision is made for 5 driers 2.5 m diameter by 20 m. Capacity of the drier is 5 tph of dried product.

Availability factor of driers is 0.69.

Quantity of potassium sulphate is 2,600 tpy.

For drying potassium sulphate provision is made for one drier 1.2 m diameter by 6 m. Capacity of the dried is 500 kg/h of dried product.

Availability factor of a drier is 0.6.

Dried sodium carbonate is fed to the silo storage (2 silos 8 m diameter, capacity 1200 t each).

Potash and potassium sulphate is fed to the bagging station for packing. Exit gases from driers are cleaned in 2-stage cyclones, then wet scrubbed in Venturi tubes and after moisture separation are discharged to air.

6.6. Selection of equipment for cement plant

Given high humidity of belite mud (40%) provision is made for the wet cement production process.

As a correcting admixture in cement production use is normally made of bauxite or clay and iron ore.

In cement production from nephelines clinker is mixed with about 5% of gypsum and about 15% of dried bellite mud. This allows production of portland cement grade 400.

6.6.1. Storage of clay and iron ore (drwg No.1339646)

The storage is designed for receiving, storage and reclamation of clay, and iron ore (raw material admixtures) to the mix grinding.

Provision is made for clamshell-type storage. Delivery of raw materials is by dump trucks. Size of incoming clay is assumed 300-0 mm, that of iron ore 40-0 mm.

Clay, without crushing, is fed to mix grinding in the "Hydrofol" mill.

The stock at the storage is provided as follows:

iron ore - 30 days, clay - 15 days.

For stockpiling admixtures, and reclamation to the crushing or the process provision is made for 3 clamshell cranes with capacity 20 t.

6.6.2. Mix grinding (drwg No.1339647)

To produce raw material slurry of the required fineness (8% oversize on sieve (0.08 mm) provision is made for combined grinding of four-ingredient mix containing:

- limestone, clay, bellite mud, iron ore.

For grinding provision is made for:

2 mills "hydrofal" 7 m diameter by 2.3 m, capacity 220 tph for primary clay grinding;

1 tube mill 4 m diameter by 13.5 m, capacity 380 tph for re-grinding of clay and bellite mud to about 25% of oversize on the sieve 0.08 mm;

5 tube mills 4 m diameter by 13.5 m, capacity 185 tph for producing finished raw slurry.

The cement and alumina plant mills are located in one building.

6.6.3. Correction tanks (drwg No.1339648)

Tanks are provided for storing, correction (blending) of clay, bellite mud and raw mix.

There will be installed tanks 9 m diameter, capacity 1200 m³, in number of 28 pcs, including:

- 4 tanks for clay and bellite mud;
- 4 tanks for correction (blending) of raw mix;
- 20 tanks for storage of buffer stock of corrected raw mix

Total stock of raw mix is about 3 days.

6.6.4. Clinker roasting (drwg No.1398866-T)

With use of local clay as a correcting admixture in starting raw materials the capacity of the section by clinker will amount to 4.470.000 tpy.

For roasting provision is made for rotary kilns 6.4/5.8 dia by 190 m with combination cooling in grate cooler with area of grating 68 m² and drum cooler and drum coolers 6.4/5.8 dia by 60 m. Capacity of the kiln unit by clinker is 100 tph.

Number of units is 6 pcs.

Roasted clinker by conveyors is fed to 2 the shelter type storages with capacity 50,000 t each.

Exit gases are dedusted in ESP and discharged to air via chimney stacks.

Dust from ESP is recycled to the kiln.

6.6.5. Drying of bellite mud (drwg No.1398867-T)

Annual demand for dry mud is 838,000 t.

Number of installed driers is 4 pcs.

Exit gases are dedusted in cyclones and ESP and discharged to air via chimney stacks.

6.6.6. Clamshell storage of clinker and admixtures

For storage of admixtures to cement (gypsum and bellite mud), as well as clinker stock provision is made for clamshell storage of total capacity 300,000 t.

6.6.7. Cement grinding (drwg No.1339649)

For grinding clinker and admixtures provision is made for automated grinding units.

The unit incorporates proportioning feeders, ball tube mill 4 m diameter by 13.5 m, classifying an[illegible] equipment.

Capacity of the unit is 90 tph of cement at fineness of 6-7% of oversize on sieve +0.08 mm.

Number of units - 9 pcs.

6.6.8. Cement storage with bagging station

For storage and shipment of cement provision is made for silos 18 m diameter and capacity 10,000 m^3 each. The number of silos is 32 pcs. Provision is made for partial shipment of cement in 50-kg bags and also in small 3-5 kg packs with total output of up to 600,000 tpy.

Table 6-5

6.6.9. Weight of major process equipment

Item	Area	Weight of equipment, t			
		major	electrical	pipes	cable
1	Alumina plant	38600	1450	2600	1450
2	Carbonates plant	3600	200	920	150
3	Cement plant	50500	810	1350	950
4	Maintenance and auxiliary services	8300	1450	5500	2500
5	Inplant transport	1150	-	-	-
	Total	102150	3910	103700	5050

6.7. Maintenance and storage facility

6.7.1. Maintenance facility

The plant complex will incorporate the maintenance facility.

The maintenance facility provides for ensuring monthly preventive inspection and maintenance of the equipment, current and capital repairs.

The maintenance facility provides for fabrication of 50% of spare parts (of total requirements) for the equipment. The other 50% of spare parts more complicated in fabrication will be supplied from the equipment vendors.

The design provides for the following composition of the maintenance facility:

the repair department block with open store incorporated into the centralised equipment repair section, mechanical repair section and electrical repair section;

iron and steel casting section;

power system maintenance and repair workshops;

building maintenance section;

transformer oil facility.

6.7.2. Storage facility

It is designed for receiving, storing and release for production of operating materials, spare equipment and spare parts, etc.

The storage facility incorporates:

the main store;

equipment and material store;

refractory store;

oils, acids and chemicals store;

industrial gas store.

6.7.3. Garage

To secure repairs and parking of transport vehicles of the plant and mine the plant incorporates the garage for 100 trucks with a building for large trucks, open parking with washing station and storage of white oil products.

6.8. Architectural and civil-engineering concepts

The major architectural and civil-engineering concepts were developed on the basis of the proposed technology and selected major and auxiliary process equipment, as well as experience in the engineering of the alumina plants.

6.8.1. Hydrochemical sections

In the alumina and carbonates production the use is made of alkaline and carbonate liquors and slurries not being corrosive to steel elements. In this connection civil structures are made of carbon steel and concrete.

Foundations of all production buildings are to be in reinforced concrete of grade 150-200. Foundations are buried to 1.5-2.0 m. Foundations for lightweight equipment and spread footing for walls of electrical rooms are in concrete.

Columns, trusses, braces, intermediate floors are in steel The roof is of asbestos-cement sheets on steel purlins.

Given the climatic conditions of the jobsite the buildings are to be without wall panelling.

To reduce cost of construction, large tankage, settlers are mounted outdoors. Local covers will be provided over the settler drives.

Main floors in buildings are of alkali-proof concrete on sand and gravel bedding. To exclude seepage of alkaline liquors to ground provision is made for hydroinsulation of two layers of tar paper with bitumen impregnation. Elevation of finished floor is 150 mm higher than the formed surface elevation, and pavement around the building perimeter is 1 m wide.

6.8.2. Kiln section

According to the common practice the rotary kilns with grating type coolers and drum aftercooler are mounted outdoors.

The hot and cold ends of the kilns are indoors.

Electrostatic precipitators are located outdoors. ESP substations are indoors.

Surface in the vicinity of the kilns is concrete covered to allow for use of caterpillar cranes.

The shaft furnace for lime roasting is located outdoors on the R.C. foundation. The gas burner unit is covered. Lime silo 12 m in diameter is made of R.C. Covers are provided above the shaft furnace and silo. An elevator and stairs are provided for people.

6.9. Utilities

6.9.1. Fuel supply

Gas supply

The main fuel for process units of the plant is natural gas, standby fuel - oil.

To reduce pressure of gas at inlet to the plant provision is made for a central gas distribution unit.

Pressure of gas in intershop pipelines is 0.6 MPa. To reduce pressure of gas before supply to users (alumina plant and cement plant) provision is also made for central gas distribution units at each of the plants. Pipelines in the limits of the plant are laid on racks along with other pipelines.

Oil supply

Oil is used as standby fuel for kilns of the alumina and cement plants.

To receive, store and feed oil to the process the plant incorporates the fuel oil facility with four steel surface mounted tanks with capacity 10,000 m^3 each. Oil is delivered in rail tanks, feeding to users is over pipelines.

Liquified gas supply

On Customer s request an alternative based on use of liquified gas as a standby fuel was considered. Requirements in liquified gas with heat content of 11,000 kcal/kg for alumina production is about 300,000 tpy or 37 tph. Daily requirement in liquified gas is 890 t. To secure 10-day stock (according to USSR norms) of liquidied gas it would be necessary to provide for receiving and storage of about 9,000 t at the plant. To locate the liquified gas station required area will be about 200x200 m and safety spacing between the station and plant buildings and structures at least 150 m. The liquified gas station is a high explosion and fire hazardous unit.

The use of liquified gas would require laying the liquified gas pipelines over the plant territory, replacement of the burners of fuel users, change in process technology and higher consumption of fuel.

Technical concepts in case of use of gasoline as fuel are similar to those for the liquified gas alternative.

Based on the above considerations and given high cost of liquified gas or gasoline as contrasted to fuel oil, and their explosion and fire risk the use of liquified gas or gasoline in the alumina plant as fuel is not recommended.

6.9.2. Compressed air consumption

Compressed air will be supplied from the captive compressor station fitted with 6 centrifugal compressors with capacity of 500 Nm^3/min each. To dry part of compressed air the compressor station will incorporate driers of 100 Nm^3/min capacity each.

6.9.3. Oxygen supply

The oxygen supply source of the plant is a captive oxygen station with 2 air separators of 44 Nm^3/hr of gaseous oxygen each. Oxygen is used for maintenance needs of the plant.

6.9.4. Supercharger station

To feed carbon dioxide gas from the sintering kilns for carbonisation provision is made for a supercharger station with 6 superchargers of 700 Nm^3/min capacity each.

6.10. Power supply

Power supply of the plant is from the main switchgear 10 kV (MS-10 kV) of the steam and power plant. The steam and power plant will be designed by Customer. The steam and power plant will be provided with four generators with sectionalised busbar system.

A central switchgear (CS) will be provided on the plant territory in vicinity of the steam and power plant to feed the plant electric users with 10 kV power.

Regarding reliability of power supply the main part of electric users relate to Category I and II.

To supply with power the users of a special group of Category I provision is made for a main stepdown substation (MSDS) fitted with a 10 MVA. 220/10 kV transformer. The 220 kV transformer is connected to the power grid over the aerial transmission line.

Power supply of 0.4 kV users is from the low voltage cubicle of the packaged transformer substations located directly in the production rooms.

10 kV users and the packaged transformer substations are powered from the switchgear 10 kV (SG-10 kV) built into shops.

6.11. Water supply and mud diposal

6.11.1. Water supply and sewerage

Production water supply of the plant is based on a closed circuit principle.

Water supply of the plant to meet production needs is 100 million m^3/y. Water supply of the plant users with recirculating water is from two recirculating units of clean and alkaline water. Fresh process water from water supply sources in amount of 5 million m^3/y is used for compensation of water losses in the process and water recirculating units.

The plant site will be provided with a system of service and fire fighting water pipelines to supply drinking water for service, drinking and fire fighting needs.

Rain water from the plant site is used in the production water supply systems instead of fresh production water.

Rain water from the plant site is discharged to the sewage treatment plant to be designed by Customer. Discharge of household sewage of the plant is by sewage pump stations.

6.11.2. Mud disposal

Mud being waste of the alumina plant is discharged from the process in quantity of 2,260,000 tpy (on dry basis).

To stack off-grade mud provision is made for the mud disposal area. The quantity of off-grade mud is 220,000 tpy.

Mud removal from the plant is based on complete water recycle incorporating the following systems:

mud hydraulic transport system;

mud stacking (stacking site);

recycle of decant liquor.

The mud hydraulic transport system is designed to cope with complete mud flow at the rate of 1,000 m^3/h of slurry with maximum S:L ratio of 1:4 and consists of the mud pump station in the sinter leaching section, main and distributing mud pipelines. The mud disposal site is designed for stacking 220,000 tpy of mud followed by drying in air down to moisture of 20-25%, loading and delivery by motor trucks to the cement plant.

The mud disposal site is designed to have three plots with one being filled with mud, the second being dried and the third used for mud reclamation. Area of one plot is 5.5 ha. Total area of the mud disposal area including protection dykes and decant liquor pump unit is about 25 ha.

The bottom and top slopes of the protecting dykes will be provided with anti-seepage film screen with protection layer of local soil. Return of clarified decant liquor to the plant is by the pump station designed to capacity of 1,000 m³/h and consists of two liquor collection pits, gravity and main pipelines and the decant liquor pump station.

6.12. Environment protection

As a result of operation of the plant the following contaminating impact is expected on the environment.

1. Dusting during stacking, transport and handling of bulk materials.
2. Dusting and gas emissions from kiln sections.
3. Partial discharge of mud to the mud disposal area.
4. Service and domestic sewage discharge.
5. Rain water discharge from the plant site.

In the design of the plant provision is made for steps to secure minimal contamination of the environment.

There is no discharge of dust-laden air after the sinter cooler to the air owing to short length of the grate-type coolers and drum aftercoolers. All air is fed to the kiln.

There is no sinter crushing which could be the source of sinter dust emissions.

Provision is made for modern multi-stage gas cleaning system with high efficient cyclones and electrostatic precipitators.

Transfer stations of bulk materials are sealed and their number is minimised.

Provision is made for dedusting of aspiration air in the cyclones and bag filters.

For spreading residual dust, sulfur dioxide and nitrogen oxides forming during fuel burning, and as a result of sintering and clinker burning the discharge of exit gases after ESP is via the chimney stacks 120-150 m tall.

Annual emission to air, tpy

Plant	Particulate (dust)	SO_2	NO_2	NO	Na_2O	Remarks
Alumina	1150	200*	730	180	20	*with oil
Carbonates	40	-	15	5	5	with gas
Cement	1650	-	1185	295	-	
Total	2840	200	1930	480	25	

To secure environment protection and rational use of water resources the water supply of the plant is based on the closed circuit principle with complete use of industrial effluents and rain water from the plant site. Domestic sewage is pumped to the sewage treatment unit for complete biological cleaning.

To secure protection of surface water and underground water sources from contamination by mud disposal facility provision is made for the following:

- hydraulic insulation of bottom and sides of the mud disposal area and secondary settlement pond;

drainage of the mud disposal area;

buffer zone along the mud pipeline, decant liquor pipeline and motor road with drainage of surface and spilled water and liquors.

7. PERSONNEL AND MANAGEMENT

Requirement for labour for operation of the facilities of the nepheline complex designed by the Soviet side is determined in accordance with the proposed technical concepts, operating norms of the process equipment, production structure of the complex and on the basis of experience in operation of the similar plants of the Subcontractor.

To provide the plant with raw materials and utilities to secure maintenance of the equipment the complex will incorporate the support and auxiliary facilities.

To determine the number of personnel the following existing Iranian rules for accounting use of the working time are adopted:

- number of working days per year - 287;
- number of holidays and days-off - 79;
- number of working shifts per day
  main production - 3;
  others - 1;
- duration of working shift, hrs - 8.

The total number of employees of the complex is estimated at 2910 people with workers being 2522 clerical and certified technicians of 388 people.

Qualification structure of workers is as follows:

	men	%
- skilled workers	1377	55
- semi-skilled workers	793	31
- labourers	352	14
Total	2522	100

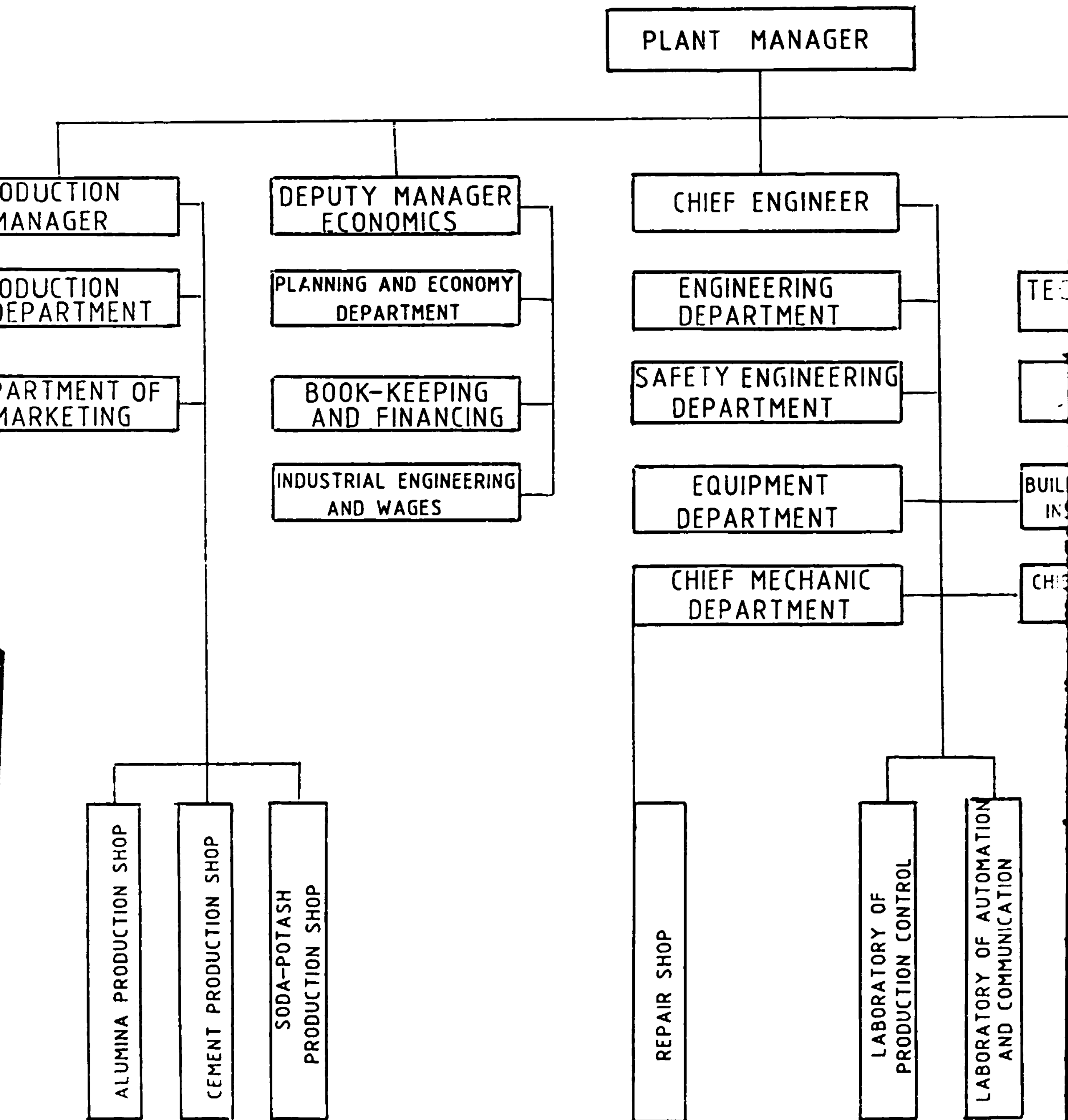
For the manning schedule of workers of the complex refer to Table 7-1.

For management of the production activity of the plant provision is made for formation of the functional administration of the plant.

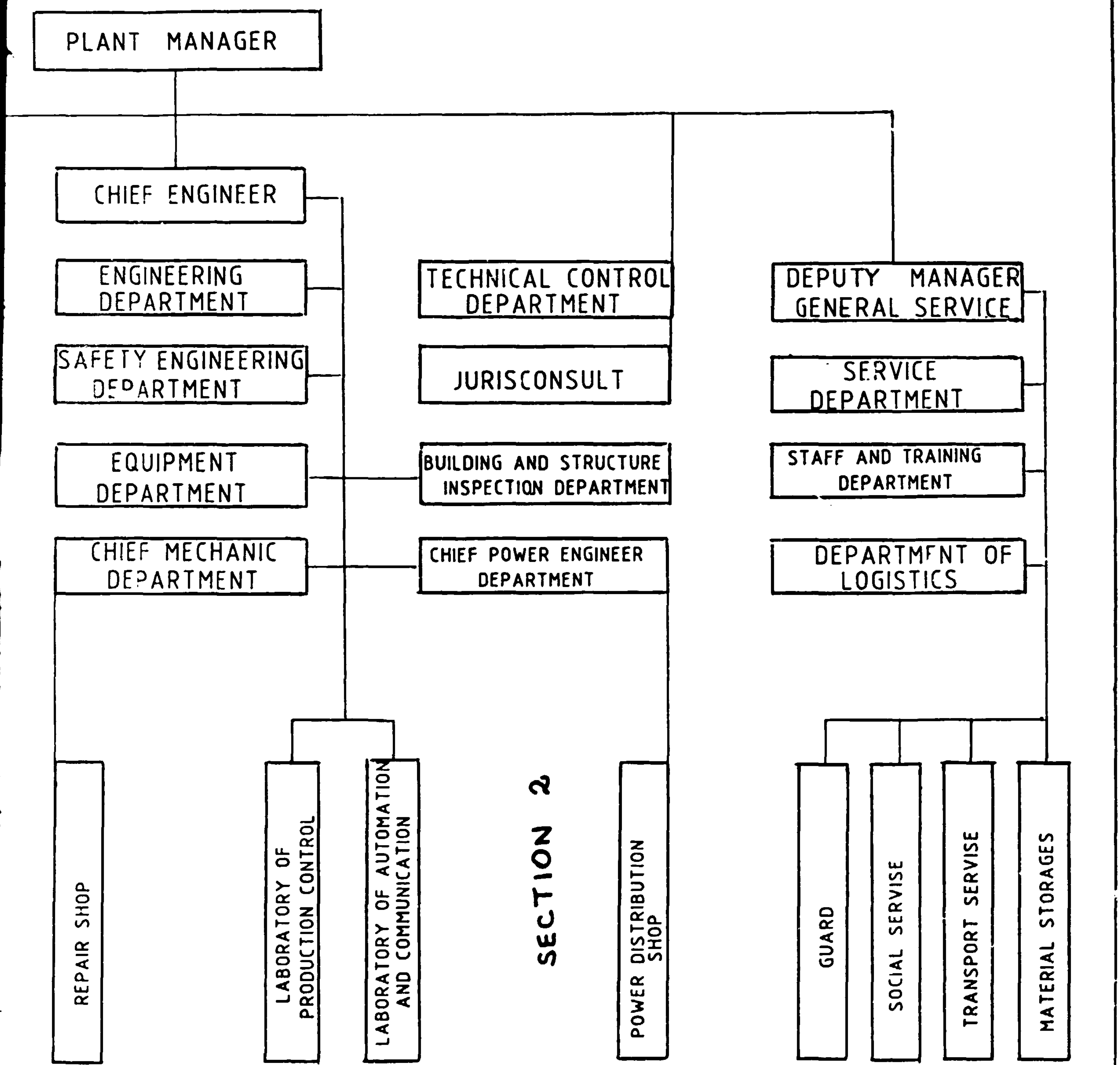
The main and auxiliary production section will be staffed with administration and certified engineer personnel.

Fig 7-1 ORGANISATION CHART OF ALUMINA P

SECTION 1



HART OF ALUMINA PLANT IN IRAN



Structure of managerial personnel and certified engineers is as follows:

- managerial personnel	33	9
- certified engineers	134	34
- foremen	103	27
- administrative personnel	84	22
- clerical	34	8
Total	388	100

Table 7-1

Summary manning table (number of people)

Item	Description	Qualification			Total
		High	Medium	Low	
	A. Main production				
1	Alumina plant	230	180	45	455
2	Carbonates plant	65	43	16	124
3	Cement plant	92	65	50	207
	Total of A	387	288	111	786
	B. Auxiliary and support facilities				
4	Maintenance and stores	560	325	95	980
5	Utilities	55	70	19	144
6	Transport	101	35	17	153
7	Production control	119	35	4	158
8	Automation, communication	133	10	4	147
9	Household services	2	5	84	91
10	Administration office	2	4	6	12
	Total of B	972	484	229	1685
11	Guards	-	-	12	12
12	Fire-fighting	18	21	-	39
	Total of complex	1377	793	358	2522

The manning table of employees by categories is given in Table 7-2.

In calculations of the annual labour costs of the nepheline complex the following levels of main average monthly salary was used (000 Rial per person):

- managerial personnel 350
- certified engineers 275
- foremen 150
- administrative personnel 110
- clerical 95
- skilled workers 80
- semi-skilled workers 50
- labourers 40

In addition to the above the following surcharges were accounted for:

- annual bonus in amount of two-monthly basic salary;
- insurance in amount of 20% of basic salary;
- compensation of expenses for social and household needs in amount of 8% of basic salary;
- add-on to workers and foremen of the main production facilities for operation in shifts in amount of 30% of basic salary.

For calculations of labour costs of workers refer to Table 7-3, those of certified engineers and staff - Table 7-4.

Table 7-2

Summary manning table by categories
(number of people)

Item	Description	Managerial	Eng.	Clerical	Foremen	Adm. staff	Total
	A. Main production						
1	Alumina plant	2	4	3	24	4	37
2	Carbonates plant	2	5	2	9	2	20
3	Cement plant	2	9	2	16	2	31
	Total of A	6	18	7	49	8	88
	B. Auxiliary and support facilities						
4	Maintenance and stores	7	12	8	28	15	70
5	Utilities	-	12	1	4	2	19
6	Transport	-	2	3	3	11	19
7	Production control	2	8	2	6	2	20
8	Automation and communication	2	32	2	3	4	43
9	Household services	-	1	2	2	1	6
10	Administration office	15	48	8	-	35	106
	Total of B	26	115	26	46	70	283
11	Guards	-	-	1	-	2	3
12	Fire-fighting	1	1	-	8	4	14
	Total of complex	33	174	34	103	84	388

Table 7-3

Calculations of production costs

Workers' salary

Item	Description	Unit	Skil-led	Category semi-skilled	labou-rer	Total
1	Main production	men	387	288	111	786
2	Maintenance and stores	men	560	325	95	980
3	Utilities	men	55	70	19	144
4	Transport	men	101	35	17	153
5	Adm. & services	men	207	75	110	459
	Total	men	1377	793	352	2522
6	Annual salary of one worker	000 Rial	960	600	480	-
7	Total annual salary	000 Rial	1321.9	475.8	169.0	1966.7
8	Bonus in amount of two-monthly salary	000 Rial	220.3	79.3	28.2	327.8
9	Social insurance	000 Rial	264.4	95.2	33.8	393.4
10	Expenses for social and household needs	000 Rial	105.8	38.1	13.5	157.4
11	Add-on to workers for working in shifts	000 Rial	111.5	51.8	16.0	179.3
	Total of salary (items 7 thru 11)	000 Rial	2023.9	740.2	260.5	3024.6
	With:					
	- production services	mln R	649.0	301.8	93.1	1043.9
	- general plant serv.	mln R	994.4	373.3	91.0	1458.7
	- Adm. services	mln R				

Table 7-4

Calculations of production costs

Certified engineers and personnel salary

Item	Description	Unit	Category: mana-ger.	E&T	Adm.	Fore-men	Cler-ical	Total
1	Main production	men	6	18	8	49	7	88
2	Maintenange & stores	men	7	12	15	28	8	70
3	Utilities	men	-	12	2	4	1	19
4	Transport	men	-	2	11	3	3	19
5	Adm. & services	men	20	90	48	19	15	192
	Total	men	33	134	84	103	34	388
6	Annual salary of one worker	000 Rial	4200	3300	1320	1800	1140	-
7	Total annual salary	000 Rial	138.6	442.2	110.9	185.4	38.8	915.9
8	Bonus in amount of two- monthly salary	000 Rial	23.1	73.7	18.5	30.9	6.5	152.7
9	Social insurance	000 Rial	27.2	88.4	22.2	37.1	7.8	182.7
10	Expenses for social and household needs	000 Rial	11.1	35.4	8.9	14.8	3.1	73.3
11	Add-on to workers for working in shifts	000 Rial	-	-	-	26.5	-	26.5
	Total of salary (items 7 thru 11)	000 Rial	200.0	639.7	160.5	294.7	56.2	1351.1
	With:							
	- production services	mln R	36.4	85.9	15.3	154.1	11.6	303.3
	- general plant serv.	mln R	42.4	124.2	53.5	91.1	19.8	331.0
	- Adm. services	mln R	121.2	429.6	91.7	49.5	24.8	716.8

See condensed production structure of the nepheline complex in Fig.7-1.

8. PROJECT IMPLEMENTATION SCHEDULE

Given experience of industrial construction companies in Iran construction of the complex may be completed within 5 years.

Breakdown of construction costs over the years of project implementation is shown tentatively below (%):

1st year - 10, 2nd year - 30, 3d year - 30, 4th year - 20. 5th year - 10.

The capacities will be commissioned at the end of the 5th year of construction. It is expected that in the 1st year 50% of the capacity will be attained, 100% - in 7th year from start of construction.

9. FINANCIAL AND ECONOMIC EVALUATION

9.1. General

This Section deals with the financial and economic evaluation of viability of establishment in the Islamic Republic of Iran of the facilities for integrated conversion of nepheline ores from Razgah deposit into alumina, carbonates and cement.

The calculations were prepared on the basis of assumption criteria submitted from Customer (ARMP) using the computer program COMFAR developed by UNIDO on the basis of the "Guidelines for preparation of industrial feasibility studies" (UNIDO, 1978).

The evaluation results incorporate:

- initial and working capital requirements;
- project financing sources;
- production expenses;
- cash flow tables;
- profit and loss account;

- balance sheets;
- assessment of benefits for national economy.

9.2. Production programme

Based on data from Section 8, given below is the production programme of the complex over the operating years. Value on the finished products is determined based on prices of Section 3.2.

Data on the production programme of the complex over the operating years is shown in Table 9.1. Capacity commissioning is assumed to be 25% in the 1st year, 75% in the 2nd year, and 100% starting from the 3d year.

Thus, value of the finished products of the complex with 100% capacity of the complex is US $121.9 million and R 58.7 billion.

9.3. Capital requirements

Investment costs for construction of the nepheline complex are determined based on the following:

- all equipment for the areas of the alumina and carbonates plants, auxiliary and support facilities, as well as 50% of the equipment for the cement plant is expected to be imported for hard currency, that is why its pricing is done on basis of the world market prices in US dollars;
- cost of 50% of the equipment for the cement plant, costs of civil works and equipment installation is calculated in Rials based on quantities of these works and supplies provided by Iranian companies at rates submitted by ARMP;
- pre-production costs were evaluated in Rials with separate indication of hard currency component;
- contingency to be assumed at 10% of the above costs;
- costs for infrastructure were assumed by ARMP data.

Total fixed capital requirements for the plant complex is as follows:

Hard currency spending, $ mln	406.9
Local costs, Rial mln	1187490.9

Construction costs of the main production facilities for each type of product will be as follows:
(excluding preproduction costs and contingency):

	US $ mln	R.mln
a) alumina production, total	132.6	138497.3
including:		
- construction	-	137527.3
- equipment	132.6	-

Production program of plant

S/N	Description of products	Price of tonne		6th				Output of product by	
		Rial	$	Export and import replacement		Internal market		Export and import replacement	
				000 t	mln $	000 t	mln Rial	000 t	mln $
1	2	3	4	5	6	7	8	9	10
1	Alumina	-	200	50.0	10.0	-	-	150.0	30.0
2	Carbonates								
2.1	Sodium carbonate	-	200	8.9	1.8	-	-	26.5	5.3
2.2	Potash	-	650	28.8	18.7	-	-	83.3	54.1
2.3	Potassium sulfate	24500	-	-	-	0.6	24.5	-	-
	Total of 2:	-	-	-	20.5	-	24.5	-	[illegible]
3	Cement	10500	-	-		1395	14647.5	-	-
	TOTAL:	-	-	-	30.5	-	14672.0	-	[illegible]

SECTION 1

Table 9.1

..oduction program of plant

Output of product by years									
				7th				8th, etc.	
Internal market		Export and import replacement		Internal market		Export and import replacement		Internal market	
000 t	mln Rial	000 t	mln $	000 t	mln Rial	000 t	mln $	000 t	mln Rial
7	8	9	10	11	12	13	14	15	16
-	-	150.0	30.0	-	-	200.0	40.0	-	-
-	-	26.5	5.3	-	-	35.4	7.1	-	-
-	-	83.3	54.1	-	-	115.1	74.8	-	-
[illegible].6	24.5	-	-	2.0	49.0	-	-	2.6	63.7
-	24.5	-	59.4	-	49.0	-	81.9	-	63.7
1395	14647.5	-	-	4190	43995.0	-	-	5585	58642.5
-	14672.0	-	89.4	-	44044.0	-	121.9	-	58706.2

SECTION 2

- erection	-	970.0
b) carbonates production, total, including:	22.0	35549.3
- construction	-	35393.3
- equipment	22.0	-
- erection	-	156.0
c) cement production, total, including:	96.4	185900.8
- construction	-	142522.8
- equipment	96.4	38645.0
- erection	-	4733.0

Costs of infrastructure are $195.4 million and R 50388 million.

Thus, summary initial investment requirements for construction of the plant complex facilities and infrastructure are as follows:

Hard currency spending, $ mln	602.3
Local costs, Rial billion	1237.9

Working capital requirement are determined by computation by the computer using the norms of stocks of resources in stores shown in Table 4.7, and also the following norms (days):

- accounts receivable - 30
- cash in hand - 15
- work in progress including finished products in store - 36
- accounts payable - 15

For structure of investment costs refer to Table 9.2.

9.4. Project financing

According to ARMP data the requirements for funds for construction of the plant complex and infrastructure will be 100% funded from the governmental resources of Iran, ie. no loans will required.

Breakdown of the investment costs shown in Section 9.3 over the years of construction is given in Table 9.3.

Table 9.2

Break-down of investment costs

S/N	Description	Costs, mln US $	Costs, mln Rials
1	Equipment and materials, total,	322.5	38645.0
	including spare parts	5.0	-
2	Erection	-	6379.0
3	Construction, including site preparation		481898.4
4	Preproduction costs		
4.1	Land for plant site	-	430
4.2	Customer's predesign costs	1.4	900.0
4.3	Customer's expenses during construction	14.3	4000.0
4.4	Equipment and material transportation costs in Iran	-	280.5
4.5	Customs duty on imported equipment and materials	-	2384.4
4.6	Commercial charges for imported equipment and materials	-	7153.2
4.7	Know-how, taxed	12.0	42.0
4.8	Iranian experts training costs, taxed	0.6	2.1
4.9	Subsistence of Russian experts in Iran (Contractor's supervision, erection supervision, start-up) taxed	3.0	112.7
4.10	Engineering and design, taxed	67.0	-
	Sub-total, item 4	98.3	15304.9

S/N	Description	Costs, mln	
		US $	Rials
5	Contingencies	42.1	54222.7
	Sub-total, for the complex within fence	462.9	596450.0
6	Infrastructure facilities	195.4	50388.0
	Total:	658.3	646838.0

Breakdown of investments by years of cons

S/N	Description of works and costs	Cost by years, \$ mln and					
		1		2		3	
		\$ mln	R mln	\$ mln	R mln	\$ mln	R mln
1	Equipment and installation	–	–	32,0	4500,0	95,0	I3500,0
2	Civil works	–	72282,0	–	I44584,8	–	[illegible]
3	Pre-production costs and contingencies	28,0	I39[illegible]4,0	42,0	[illegible]	42,0	[illegible]
	Total of 1-3:	28,0	[illegible]	74,0	[illegible]	I37,0	[illegible]
4	Infrastructure	8,0	[illegible]	[illegible]	[illegible]	65,0	[illegible]
	Overall	36,0	[illegible]	I01,0	[illegible]	202,0	[illegible]

SECTION 1

Table 9.3

of investments by years of construction

	Cost by years, $ mln and R.mln								
2		3		4		5		Total	
R mln	$ mln	R mln	$ mln	R mln	$ mln	R mln	$ mln	R mln	
4500,0	95,0	I3500,0	I60,0	22500,0	35,5	4524,0	322,5	45024,0	
I44584,8	–	I92769,0	–	48205,0	–	24078,4	–	48I898,[illegible]	
20846,0	42,0	20846,0	I5,0	8962,0	I3,4	6969,6	I40,4	69627,6	
[illegible]	[illegible]	227II8,0	I78,0	77867,0	48,9	33372,0	432,9	[illegible]	
[illegible]	66,0	I9I00,0	82,0	550[illegible],0	I3,4	3688,0	I95,4	50388,0	
I648I0,0	202,0	2422I5,0	257,0	83I87,0	62,3	39200,0	658,3	[illegible]	

SECTION 2

9.5. Production costs

The production costs include the following expenses:

a) raw materials and other materials;

b) fuel and utilities;

c) labour costs;

d) maintenance and repair materials;

e) depreciation;

f) plant overheads;

g) administration costs.

9.5.1. Cost of raw materials and other materials, and fuel and utilities.

The above expenses are determined on basis of annual requirements for the same as shown in Section 4.11 and prices based on ARMP data including freight costs (Table 9.4).

9.5.2. Labour costs

Annual fund of salary is assumed on the basis of calculations shown in Section 7 (see Tables 7.3 and 7.4) regarding production operations.

9.5.3. Maintenance materials

Costs of maintenance materials for the main equipment is assumed on the basis of ARMP at the following levels (% of the equipment cost):

- equipment (local and imported) - 2.5
- buildings and unit construction - 0.5

9.5.4. Plant overheads

Accounted for in these costs are the salary of personnel responsible for maintenance of the general plant facilities and other general plant costs.

9.5.5. Administration costs

Accounted for in these costs are the salary of administrative and managerial staff and other costs related to plant management.

According to ARMP assumption criteria data the total expenses under para 9.5.4 and 9.5.5 shall equal 5% of direct operating costs including depreciation.

Table 9.4

Calculations of prices for material and utility resources

S/N	Description	Unit	Unit price by ARMP data		Freight per unit		Unit cost of resources	
			Rial	$	Rial	$	Rial	$
1	Nepheline ore	t	598,0	0,700	6I6,0	0,336	I2I4,0	I,036
2	Limestone 1)	t	I50,0	0,02	–	–	I50,0	0,02
3	Natural gas	Nm^3	3,0	–	–	–	3,0	–
4	Electric power	kWh	I,322	0,00II	–	–	I,322	0,00II
5	Heat	Gcal	70,64	0,766	–	–	70,64	0,766
6	Fresh water	000 m^3	I2000,0	–	–	–	I2000,0	–
7	Flocculant	t	–	3000,0	I800,0	–	I800,0	3000,0
8	Hydrochloric acid	t	35000,0	–	4000,0	–	39000,0	–
9	Filter cloth	m^2	–	3,0	–	–	–	3,0
10	Grounding bodies	t	–	I400,0	6I6,0	–	6I6,0	I400,0
11	Refractory brick	t	–	900,0	6I6,0	–	6I6,0	900,0
12	Clay	t	200,0	–	540,0	–	740,0	–
13	Gypsum	t	300,0	–	540,0	–	840,0	–
14	Iron ore	t	–	–	–	–	2000,0	–

1) Freight cost of limestone delivery is included into general costs of the complex

9.5.6. Depreciation

In calculations of depreciation the fixed assets of the plant are broken down into categories according to ARMP assumption criteria data regarding depreciation rates (para 12.12, 12.13 and 13.4). Computation is done by using COMFAR program.

9.5.7. Annual production expenses

Cost estimate for production of products is shown in Table 9.5.

9.6. Financial and economic evaluation

9.6.1. Financial and economic calculations under the selected alternative of the nepheline complex

For the financial and economic evaluation of viability of construction of the industrial projects using the computer model COMFAR it is possible to secure a whole range of indicators, the most important of which are:

- profits accumulated by the project (gross, taxable, net);
- internal rate of return on investment;
- payback period on investment (by gross profit, cash of the plant);
- level of capacity utilised which secures repayment of all costs at expense of product sales revenue (breakeven point).

Since according to the "Guidelines for preparation of industrial feasibility studies" (UNIDO) it is necessary to provide evaluation of the project by summary costs (both local and foreign), and also taking into account a desire expressed by the Iranian party to provide the evaluation of hard currency expenses alone, this report gives four versions of calculations:

1) evaluation of hard currency expenses only (recalculation of local costs in Rials into dollars with zero exchange rate);

2) evaluation of total costs with conversion of local expenses at official exchange rate (US $1 = R 70).

In calculations a project life of 15 years was assumed

Annual operating costs

S/N	Description	Unit	Unit price		Annual consumption by years, 000		
			Rial	US $	6th	7th	8th
1	2	3	4	5	6	7	8
I	Raw materials						
1	Nepheline ore	t	I2I4,000	I,036	320	960	I280
2	Limestone	t	I50,000	0,020	I5I4	454I	6055
	Total of I:		-	-	-	-	-
II	Materials						
1	Flocculent	kg	I,800	3,000	I6	47	63
2	Hydrochloric acid	kg	38,000	-	0,5	I,5	2,0
3	Filter cloth	m^2	-	3,000	I2,5	37,5	50,0
4	Grinding bodies	kg	0,6I6	I,400	2646	7939	I0585
5	Refractory bricks	kg	0,6I6	0,900	3682	II047	I4729
6	Clay	t	740,000	-	289	867	II56
7	Iron ore	t	2000,0	-	I5	46	6I
8	Gypsum	t	840,000	-	70	209	279
	Total of II:		-	-	-	-	-
III	Process fuel Natural gas	000Nm^3	3000,000	-	259,7	779,0	I038,6
IV	Utilities						
1	Electric power	000 kWh	I322,000	I,I00	282,2	846,5	II28,7
2	Heat	Gcal	70,640	0,766	I99,2	597,5	796,7
3	Fresh water	000 m^3	I2000,000	-	I,3	3,8	5,0
	Total of III:		-	-	-	-	-

SECTION 1

Table 9.5

Annual operating costs

Annual consumption by years, 000			Costs by years					
6th	7th	8th	6th		7th		8th, etc	
			R mln	$ 000	R mln	$ 000	R mln	$ 000
6	7	8	9	10	11	12	13	14
320	960	I280	388,5	33I,5	II65,4	994,6	I553,9	I326,I
I5I4	454I	6055	227,I	30,3	68I,2	90,8	908,3	I2I,I
–	–	–	6I5,6	36I,8	I846,6	I085,4	2462,2	I447,2
I6	47	63	–	47,3	0,I	I4I,8	0,I	I89,0
0,5	I,5	2,0	–	–	0,I	–	0,I	–
I2,5	37,5	50,0	–	37,5	–	II2,5	–	I50,0
2646	7939	I0585	I,6	3704,8	4,9	IIII4,3	6,5	I48I9,0
3682	II047	I4729	2,3	33I4,0	6,8	9942,I	9,I	I3256,I
289	867	II56	2I3,9	–	64I,6	–	855,4	–
I5	46	6I	30,0	–	92,0		I22,0	
70	209	279	58,8	–	I76,4	–	235,2	–
–	–	–	306,6	7I03,6	92I,9	2I3I0,7	I228,4	284I4,I
259,7	779,0	I038,6	779,I	–	2337,3	–	3II6,4	–
282,2	846,5	II28,7	373,I	3I0,4	III9,2	93I,3	I492,3	I24I,7
I99,2	597,5	796,7	I4,I	I52,6	42,2	457,8	56,3	6I0,3
I,3	3,8	5,0	I5,6	–	46,8	–	62,4	–
–	–	–	402,8	463,0	I208,2	I389,I	I6II,0	I852,0

SECTION 2

1	2	3	4	5	6	7	8
V	Expenses for production labour salary	–	–	–	–	–	–
VI	Maintenance materials	–	–	–	–	–	–
	Total of I-VI		–	–	–	–	–
VII	Plant overheads		–	–	–	–	–
VIII	Administration expenses						
	Total of operating costs		–	–	–	–	–

SECTION 1

6	7	8	9	10	11	12	13	14
–	–	–	I347,2	–	I347,2	–	I347,2	–
–	–	–	3535,I	8062,0	3535,I	8062,0	3535,I	8062,0
–	–	–	6986,4	I5990,4	III96,3	3I847,2	I3300,3	39775,3
–	–	–	I789,7	2I35,0	I789,7	2I35,0	I789,7	2I35,0
			I238,8	I484,0	I238,8	I484,0	I238,8	I484,0
–	–	–	I00I4,9	I9609,4	I4224,8	35466,2	I6328,8	43394,3

SECTION 2

due to limitations of COMFAR programme.

The resulting figures indicate that with the Customer specified conditions the evaluation of viability of the project (hard currency costs alone and savings of hard currency by refusal of alumina, sodium carbonate and potash imports for internal needs, and also potential hard currency revenues through sales of potash at the international market) the selected alternative of construction of the industrial) complex for conversion of nepheline ores from Razgah deposit is noted for the following indicators (see Table 9.6):

- hard currency investment (fixed and working) $ mln - 667.2
- hard currency revenues and savings $ mln/year - 113.6
- hard currency operating cost $ mln/year - 40.1
- internal rate of return, on hard currency invested, % - 5.8
- investment payback period, years - 9.6

The total costs (including local) cannot be paid back because of high level of expenses for civil works and installation of equipment under Iranian conditions based on Customer specified unit rates.

Shown below are final Tables prepared by COMFAR program with calculation results for the alternative selected.

Table 9.6

Main financial and economic indicators

Item	Description	Unit	Indicators 1	Indicators 2
1	Fixed capital	$ mln	658.3	9908.1
2	Working capital	$ mln	8.9	45.7
3	Cost of products	$ mln	113.6	675.1
4	Operating cost	$ mln	40.1	281.6
5	Gross profit	$ mln	73.5	393.5

Item	Description	Unit	Indicators 1	2
6	Depreciation	$ mln	37.9	599.5
7	Net profit	$ mln	35.6	-206.0
8	Rate of return	%	5.83	-3.16
9	Payback period	years	9.6	22.7
10	Breakeven point	%	61	130

Note: Indicators under items 3 thru 7 are in average for 15 years of operation

9.6.2. Sensitivity analysis

For determining an effect on the main financial and economic indicators of the project of variations in capital investments, operating costs and prices of products a sensitivity analysis was performed.

Results of the analysis and graphical illustrations are given on figures below.

The given data show that the major effect on the project indicators is produced by variations of prices of the products. Thus, for their variation in the range of ±25%, an IRR varies for case 1 from 1.3 to 9.5% against 5.83% for the base case.

When the operating costs vary in the same range, an IRR varies from 4.3 to 7.2%.

If the capital investments increase by 20%, an IRR decreases down to 3.5%, and if they decrease by 20%, an IRR increases up to 9.05%.

A break-even point for this case when the prices of products vary in the range ±20%, changes from 46 to 85% against 61% in the base case.

As far as the second case is concerned, here even for the maximum reduction of the costs or increase of the prices, an IRR does not become positive, and a break-even point is outside 100%.

Results of calculations for Variant 1

Iranian Nepheline Complex.Final Report *
1992. March
Opportunity Study

5 year(s) of construction. 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 0.0000 units accounting currency
accounting currency: US $ mln

Total initial investment during construction phase

fixed assets:	658.31	99.999 % foreign
current assets:	0.00	0.000 % foreign
total assets:	658.31	99.999 % foreign

Source of funds during construction phase

equity & grants:	658.31	99.999 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	658.31	99.999 % foreign

Cashflow from operations

Year:	5	10	15
operating costs:	43.18	43.18	43.18
depreciation :	46.76	12.13	7.05
interest :	0.00	0.00	0.00
production costs	89.94	55.30	50.23
thereof foreign	100.00 %	100.00 %	100.00 %
total sales :	121.90	121.90	121.90
gross income :	31.96	66.59	71.67
net income :	31.96	66.59	71.67
cash balance :	78.72	78.72	78.72
net cashflow :	78.72	78.72	78.72

Net Present Value at: 10.00 % = -153.49
Internal Rate of Return: 5.83 %
Return on equity1:
Return on equity2:

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in US $ mln

Year	1	2	3	4	5
Fixed investment costs					
Land, site preparation, development	0.00	0.00	0.00	0.00	0.00
Buildings and civil works	8.00	27.00	65.00	82.00	13.40
Auxiliary and service facilities	0.00	0.00	0.00	0.00	0.00
Incorporated fixed assets	0.00	0.00	0.00	0.00	0.00
Plant machinery and equipment	0.00	32.00	95.00	160.00	35.50
Total fixed investment costs	8.00	59.00	160.00	242.00	48.90
Pre-production capital expenditures.	28.00	42.00	42.00	15.00	13.40
Net working capital	0.00	0.00	0.00	0.00	0.00
Total initial investment costs	36.00	101.00	202.00	257.00	62.30
Of it foreign, in %	100.00	100.00	100.00	100.00	100.00

Total Current Investment in US $ mln

Year	6	7	8
Fixed investment costs			
Land, site preparation, development	0.00	0.00	0.00
Buildings and civil works	0.00	0.00	0.00
Auxiliary and service facilities	0.00	0.00	0.00
Incorporated fixed assets	0.00	0.00	0.00
Plant, machinery and equipment	0.00	0.00	0.00
Total fixed investment costs	0.00	0.00	0.00
Preproduction capitals expenditures.	0.00	0.00	0.00
Working capital	2.79	4.08	2.04
Total current investment costs	2.79	4.08	2.04
Of it foreign, %	100.00	100.00	100.00

Total Production Costs in US $ mln

Year	6	7	8	9	10	11-12
% of nom. capacity (single product)	25.00	75.00	100.00	100.00	100.00	100.00
Raw material I	0.36	1.09	1.45	1.45	1.45	1.45
Other raw materials	7.10	21.31	28.41	28.41	28.41	28.41
Utilities	0.00	0.00	0.00	0.00	0.00	0.00
Energy	0.41	1.22	1.63	1.63	1.63	1.63
Labour, direct	0.00	0.00	0.00	0.00	0.00	0.00
Repair, maintenance	3.22	6.45	8.06	8.06	8.06	8.06
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	1.81	2.03	2.14	2.14	2.14	2.14
Factory costs	12.91	32.10	41.69	41.69	41.69	41.69
Administrative overheads	1.26	1.41	1.48	1.48	1.48	1.48
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	85.46	84.38	83.43	82.60	46.76	45.38
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	99.64	117.89	126.61	125.77	89.94	89.55
Costs per unit (single product)	1.99	0.79	0.63	0.63	0.45	0.45
Of it foreign, %	100.00	100.00	100.00	100.00	100.00	100.00
Of it variable,%	9.70	24.60	30.54	30.74	43.00	43.18
Total labour	1.26	1.41	1.48	1.48	1.48	1.48

Total Production Costs in US $ mln

Year	13	14-17	18	19-20
% of nom. capacity (single product)	100.00	100.00	100.00	100.00
Raw material I	1.45	1.45	1.45	1.45
Other raw materials	28.41	28.41	28.41	28.41
Utilities	0.00	0.00	0.00	0.00
Energy	1.63	1.63	1.63	1.63
Labour, direct	0.00	0.00	0.00	0.00
Repair, maintenance	8.06	8.06	8.06	8.06
Spares	0.00	0.00	0.00	0.00
Factory overheads	2.14	2.14	2.14	2.14
Factory costs	41.69	41.69	41.69	41.69
Administrative overheads	1.48	1.48	1.48	1.48
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00
Depreciation	18.78	12.13	11.93	7.05
Financial costs	0.00	0.00	0.00	0.00
Total production costs	61.95	55.30	55.11	50.23
Costs per unit (single product)	0.31	0.28	0.28	0.25
Of it foreign, %	100.00	100.00	100.00	100.00
Of it variable,%	62.42	69.32	70.17	76.98
Total labour	1.48	1.48	1.48	1.48

Net Working Capital in US $ mln

Year			6	7	8	9-20
Coverage	mdc	coto				
Current assets &						
Accounts receivable	30	12.0	1.18	2.79	3.60	3.60
Inventory and materials	29	12.5	0.60	1.79	2.39	2.39
Energy	0	---	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00
Work in progress	36	10.0	1.29	3.21	4.17	4.17
Finished products	0	---	0.00	0.00	0.00	0.00
Cash in hand	15	24.0	0.26	0.41	0.49	0.49
Total current assets			3.33	8.21	10.64	10.64
Current liabilities and						
Accounts payable	15	24.0	0.54	1.34	1.74	1.74
Net working capital			2.79	6.87	8.91	8.91
Increase in working capital			2.79	4.08	2.04	0.00
Net working capital, local			0.00	0.00	0.00	0.00
Net working capital, foreign			2.79	6.87	8.91	8.91

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in US $ mln

Year	1	2	3	4	5
Equity, ordinary ..	0.00	0.00	0.00	0.00	0.00
Equity, preference.	0.00	0.00	0.00	0.00	0.00
Subsidies, grants .	36.00	101.00	202.00	257.00	62.30
Loan A, foreign .	0.00	0.00	0.00	0.00	0.00
Loan B, foreign..	0.00	0.00	0.00	0.00	0.00
Loan C, foreign .	0.00	0.00	0.00	0.00	0.00
Loan A, local....	0.00	0.00	0.00	0.00	0.00
Loan B, local....	0.00	0.00	0.00	0.00	0.00
Loan C, local....	0.00	0.00	0.00	0.00	0.00
Total loan	0.00	0.00	0.00	0.00	0.00
Current liabilities	0.00	0.00	0.00	0.00	0.00
Bank overdraft	0.00	0.00	0.00	0.00	0.00
Total funds	36.00	101.00	202.00	257.00	62.30

Source of Finance, production in US $ mln

Year	6	7	8
Equity, ordinary ..	0.00	0.00	0.00
Equity, preference.	0.00	0.00	0.00
Subsidies, grants .	0.00	0.00	0.00
Loan A. foreign .	0.00	0.00	0.00
Loan B. foreign..	0.00	0.00	0.00
Loan C. foreign .	0.00	0.00	0.00
Loan A. local....	0.00	0.00	0.00
Loan B. local....	0.00	0.00	0.00
Loan C. local....	0.00	0.00	0.00
Total loan	0.00	0.00	0.00
Current liabilities	0.54	0.80	0.40
Bank overdraft	0.00	0.00	0.00
Total funds	0.54	0.80	0.40

Cashflow Tables, construction in US $ mln

Year	1	2	3	4	5
Total cash inflow	36.00	101.00	202.00	257.00	62.30
Financial resources	36.00	101.00	202.00	257.00	62.30
Sales, net of tax	0.00	0.00	0.00	0.00	0.00
Total cash outflow	36.00	101.00	202.00	257.00	62.30
Total assets	36.00	101.00	202.00	257.00	62.30
Operating costs	0.00	0.00	0.00	0.00	0.00
Cost of finance	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	0.00	0.00	0.00	0.00	0.00
Cumulated cash balance	0.00	0.00	0.00	0.00	0.00
Inflow, local	0.00	0.00	0.00	0.00	0.00
Outflow, local	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	0.00	0.00	0.00	0.00	0.00
Inflow, foreign	36.00	101.00	202.00	257.00	62.30
Outflow, foreign	36.00	101.00	202.00	257.00	62.30
Surplus (deficit)	0.00	0.00	0.00	0.00	0.00
Net cashflow	-36.00	-101.00	-202.00	-257.00	-62.30
Cumulated net cashflow	-36.00	-137.00	-339.01	-596.01	-658.31

Cashflow tables, production in US $ mln

Year	6	7	8	9	10	11
Total cash inflow	31.04	90.24	122.30	121.90	121.90	121.90
Financial resources	0.54	0.80	0.40	0.00	0.00	0.00
Sales, net of tax	30.50	89.45	121.90	121.90	121.90	121.90
Total cash outflow	17.51	38.38	45.61	43.18	43.18	43.18
Total assets	3.33	4.87	2.44	0.00	0.00	0.00
Operating costs	14.17	33.51	43.18	43.18	43.18	43.18
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	13.53	51.86	76.68	78.72	78.72	78.72
Cumulated cash balance	13.53	65.39	142.07	220.79	299.51	378.23
Inflow, local	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, local	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	0.00	0.00	0.00	0.00	0.00	0.00
Inflow, foreign	31.04	90.24	122.29	121.89	121.89	121.89
Outflow, foreign	17.51	38.38	45.61	43.18	43.18	43.18
Surplus (deficit)	13.53	51.86	76.68	78.72	78.72	78.72
Net cashflow	13.53	51.86	76.68	78.72	78.72	78.72
Cumulated net cashflow	-644.78	-592.91	-516.23	-437.51	-358.79	-280.07

Cashflow tables, production in US $ mln

Year	12	13	14	15	16	17
Total cash inflow	121.90	121.90	121.90	121.90	121.90	121.90
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	121.90	121.90	121.90	121.90	121.90	121.90
Total cash outflow	43.18	43.18	43.18	43.18	43.18	43.18
Total assets	0.00	0.00	0.00	0.00	0.00	0.00
Operating costs	43.18	43.18	43.18	43.18	43.18	43.18
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	78.72	78.72	78.72	78.72	78.72	78.72
Cumulated cash balance	456.95	535.67	614.39	693.11	771.83	850.55
Inflow, local	0.00	0.00	0.00	0.00	0.00	0.00
Outflow, local	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	0.00	0.00	0.00	0.00	0.00	0.00
Inflow, foreign	121.89	121.89	121.89	121.89	121.89	121.89
Outflow, foreign	43.18	43.18	43.18	43.18	43.18	43.18
Surplus (deficit)	78.72	78.72	78.72	78.72	78.72	78.72

Net cashflow	78.72	78.72	78.72	78.72	78.72	78.72
Cumulated net cashflow	-201.35	-122.63	-43.91	34.81	113.53	192.25

Cashflow tables, production in US $ mln

Year	18	19	20
Total cash inflow . .	121.90	121.90	121.90
Financial resources .	0.00	0.00	0.00
Sales, net of tax . .	121.90	121.90	121.90
Total cash outflow . .	43.18	43.18	43.18
Total assets	0.00	0.00	0.00
Operating costs . . .	43.18	43.18	43.18
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	78.72	78.72	78.72
Cumulated cash balance	929.27	1007.99	1086.71
Inflow, local	0.00	0.00	0.00
Outflow, local	0.00	0.00	0.00
Surplus (deficit) .	0.00	0.00	0.00
Inflow, foreign . . .	121.89	121.89	121.89
Outflow, foreign . . .	43.18	43.18	43.18
Surplus (deficit) .	78.72	78.72	78.72
Net cashflow	78.72	78.72	78.72
Cumulated net cashflow	270.97	349.69	428.41

Cashflow Discounting:

a) Equity paid versus Net income flow:
- Net present value .... 10.00 %
- Internal Rate of Return (IRRE1) ..

b) Net Worth versus Net cash return:
- Net present value .... 10.00 %
- Internal Rate of Return (IRRE2) ..

c) Internal Rate of Return on total investment:
- Net present value .... -163.49 at 10.00 %
- Internal Rate of Return (IRR) .. 5.83 %

Net Worth = Equity paid plus reserves

Net Income Statement in US $ mln

Year	6	7	8	9	10
Total sales, incl. sales tax	30.50	89.45	121.90	121.90	121.90
Less: variable costs, incl. sales tax.	9.67	29.00	38.67	38.67	38.67
Variable margin	20.83	60.44	83.23	83.23	83.23
As % of total sales	68.31	67.58	68.28	68.28	68.28
Non-variable costs, incl. depreciation	89.97	88.89	87.94	87.10	51.27
Operational margin	-69.14	-28.45	-4.71	-3.88	31.96
As % of total sales	-226.67	-31.80	-3.87	-3.18	26.22
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-69.14	-28.45	-4.71	-3.88	31.96
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-69.14	-28.45	-4.71	-3.88	31.96
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-69.14	-28.45	-4.71	-3.88	31.96
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-69.14	-28.45	-4.71	-3.88	31.96
Accumulated undistributed profit	-69.14	-97.58	-102.29	-106.17	-74.21
Gross profit, % of total sales	-226.67	-31.80	-3.87	-3.18	26.22
Net profit, % of total sales	-226.67	-31.80	-3.87	-3.18	26.22
ROE, Net profit, % of equity					
ROI, Net profit+interest, % of invest.	-10.46	-4.28	-0.71	-0.58	4.79

Net Income Statement in US $ mln

Year	11	12	13	14	15
Total sales, incl. sales tax	121.90	121.90	121.90	121.90	121.90
Less: variable costs, incl. sales tax.	38.67	38.67	38.67	38.67	38.67
Variable margin	83.23	83.23	83.23	83.23	83.23
As % of total sales	68.28	68.28	68.28	68.28	68.28
Non-variable costs, incl. depreciation	50.89	50.89	23.29	16.63	16.63
Operational margin	32.34	32.34	59.94	66.59	66.59
As % of total sales	26.53	26.53	49.18	54.63	54.63
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	32.34	32.34	59.94	66.59	66.59
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	32.34	32.34	59.94	66.59	66.59
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	32.34	32.34	59.94	66.59	66.59
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	32.34	32.34	59.94	66.59	66.59
Accumulated undistributed profit	-41.87	-9.53	50.41	117.01	183.60
Gross profit, % of total sales	26.53	26.53	49.18	54.63	54.63
Net profit, % of total sales	26.53	26.53	49.18	54.63	54.63
ROE, Net profit, % of equity					
ROI, Net profit+interest, % of invest.	4.85	4.85	8.98	9.98	9.98

Net Income Statement in [illegible]

Year	[illegible]	17	[illegible]	19	[illegible]
Total sales, incl. sales tax	121.90	121.90	121.90	121.90	121.90
Less: variable costs, incl. sales tax.	38.67	38.67	38.67	38.67	38.67
Variable margin	83.23	83.23	83.23	83.23	83.23
As % of total sales	68.28	68.28	68.28	68.28	68.28
Non-variable costs, incl. depreciation	16.63	16.63	16.44	11.56	11.56
Operational margin	66.59	66.59	66.79	71.67	71.67
As % of total sales	54.63	54.63	54.79	58.79	58.79
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	66.59	66.59	66.79	71.67	71.67
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	66.59	66.59	66.79	71.67	71.67
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	66.59	66.59	66.79	71.67	71.67
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	66.59	66.59	66.79	71.67	71.67
Accumulated undistributed profit	250.19	316.78	383.57	455.24	526.90
Gross profit, % of total sales	54.63	54.63	54.79	58.79	58.79
Net profit, % of total sales	54.63	54.63	54.79	58.79	58.79
ROE, Net profit, % of equity					
ROI, Net profit+interest, % of invest.	9.98	9.98	10.01	10.74	10.74

Projected Balance Sheets, construction in US $ mln

Year	1	2	3	4	5
Total assets	36.00	137.00	339.01	596.01	658.31
Fixed assets, net of depreciation	0.00	36.00	137.00	339.01	596.01
Construction in progress	36.00	101.00	202.00	257.00	62.30
Current assets	0.00	0.00	0.00	0.00	0.00
Cash, bank	0.00	0.00	0.00	0.00	0.00
Cash surplus, finance available	0.00	0.00	0.00	0.00	0.00
Loss carried forward	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00
Total liabilities	36.00	137.00	339.01	596.01	658.31
Equity capital	36.00	137.00	339.01	596.01	658.31
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00
Current liabilities	0.00	0.00	0.00	0.00	0.00
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00
Total debt	0.00	0.00	0.00	0.00	0.00
Eqrity, % of liabilities	100.00	100.00	100.00	100.00	100.00

Projected Balance Sheets, Production in US $ mln

Year	6	[illegible]	8	9	10	11
Total assets	658.84	659.64	660.04	660.04	692.00	[illegible]
Fixed assets, net of depreciation	[illegible]	495.46	[illegible]	[illegible]	275.67	[illegible]
Construction in progress	0.00	0.00	0.00	[illegible]	0.00	[illegible]
Current assets	3.07	7.60	10.16	10.16	10.16	[illegible]
Cash, bank	0.26	0.41	0.49	0.49	0.49	0.49
Cash surplus, finance available	13.53	65.39	142.07	220.79	299.51	[illegible]
Loss carried forward	0.00	59.14	87.59	[illegible]	106.17	[illegible]
Loss	59.14	28.45	4.71	3.66	0.00	[illegible]
Total liabilities	658.84	659.64	660.04	660.04	692.00	[illegible]
Equity capital	658.31	658.31	658.31	658.31	658.31	[illegible]
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	[illegible]
Profit	0.00	0.00	0.00	0.00	31.96	[illegible]
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	[illegible]
Current liabilities	0.54	1.34	1.74	1.74	1.74	1.74
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	[illegible]
Total debt	0.54	1.34	1.74	1.74	1.74	1.74
Equity, % of liabilities	99.92	99.80	99.74	99.74	95.13	95.08

Projected Balance Sheets, Production in US $ mln

Year	12	13	14	15	16	17
Total assets	692.39	719.99	777.05	843.64	910.24	[illegible]
Fixed assets, net of depreciation	182.92	164.14	152.01	139.89	127.76	115.63
Construction in progress	0.00	0.00	0.00	0.00	0.00	0.00
Current assets	10.16	10.16	10.16	10.16	10.16	[illegible]
Cash, bank	0.49	0.49	0.49	0.49	0.49	0.49
Cash surplus, finance available	455.95	535.67	614.39	693.11	771.83	[illegible]
Loss carried forward	41.57	9.53	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00	0.00
Total liabilities	692.39	719.99	777.05	843.64	910.24	[illegible]
Equity capital	658.31	658.31	658.31	658.31	658.31	658.31
Reserves, retained profit	0.00	0.00	50.41	117.01	183.60	250.19
Profit	32.24	59.94	66.59	66.59	66.59	66.59
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	1.74	1.74	1.74	1.74	1.74	1.74
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	1.74	1.74	1.74	1.74	1.74	1.74
Equity, % of liabilities	95.09	91.43	84.72	78.03	72.32	[illegible]

Projected Balance Sheets, Production in US $ mln

Year	18	19	20
Total assets	1043.62	1115.28	1186.95
Fixed assets, net of depreciation	103.70	96.64	89.59
Construction in progress	0.00	0.00	0.00
Current assets	10.16	10.16	10.16
Cash, bank	0.49	0.49	0.49
Cash surplus, finance available	929.27	1007.99	1086.71
Loss carried forward	0.00	0.00	0.00
Loss	0.00	0.00	0.00
Total liabilities	1043.62	1115.28	1186.95
Equity capital	658.31	658.31	658.31
Reserves, retained profit	316.78	383.57	455.24
Profit	66.79	71.67	71.67
Long and medium term debt	0.00	0.00	0.00
Current liabilities	1.74	1.74	1.74
Bank overdraft, finance required.	0.00	0.00	0.00
Total debt	1.74	1.74	1.74
Equity, % of liabilities	63.08	59.03	55.46

Results of calculations for Variant 2

Iranian Nepheline Complex, Final Report
1992, March
Opportunity Study

5 year s' of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 0.0143 units accounting currency
accounting currency: US $ mln

Total initial investment during construction phase

fixed assets:	9908.08	6.644 % foreign
current assets:	0.00	0.000 % foreign
total assets:	9908.08	6.644 % foreign

Source of funds during construction phase

equity & grants:	9908.08	6.644 % foreign
foreign loans :	0.00	
local loans :	0.00	
total funds :	9908.08	6.644 % foreign

Cashflow from operations

Year:	5	10	15
operating costs:	262.76	262.76	262.76
depreciation :	617.60	497.33	492.26
interest :	0.00	0.00	0.00
production costs	880.35	760.09	755.02
thereof foreign	10.22 %	7.28 %	6.65 %
total sales :	723.41	723.41	723.41
gross income :	-156.95	-36.68	-31.61
net income :	-156.95	-36.68	-31.61
cash balance :	460.65	460.65	460.65
net cashflow :	460.65	460.65	460.65

Net Present Value at: 10.[illegible] % = -6332.27
Internal Rate of Return: -[illegible] %
Return on equity1:
Return on equity2:

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in US $ mln

Year	1	2	3	4	5
Fixed investment costs					
Land, site preparation, development	0.00	0.00	0.00	0.00	0.00
Buildings and civil works	1148.88	2303.04	3094.73	849.98	410.46
Auxiliary and service facilities	0.00	0.00	0.00	0.00	0.00
Incorporated fixed assets	0.00	0.00	0.00	0.00	0.00
Plant machinery and equipment	0.00	96.35	288.05	481.75	100.19
Total fixed investment costs	1148.88	2399.40	3382.78	1331.73	510.65
Pre-production capital expenditures.	226.83	340.10	340.10	114.56	113.07
Net working capital	0.00	0.00	0.00	0.00	0.00
Total initial investment costs	1375.71	2739.49	3722.87	1446.29	623.72
Of it foreign, in %	2.62	3.69	5.43	17.77	9.99

Iranian Nepheline Complex, Final Report --- 1992, March

COMFAR 2.1 - VAMI, LENINGRAD, U.S.S.R.

Total Current Investment in US $ mln

Year	6	7	8
Fixed investment costs			
Land, site preparation, development	0.00	0.00	0.00
Buildings and civil works	0.00	0.00	0.00
Auxiliary and service facilities	0.00	0.00	0.00
Incorporated fixed assets	0.00	0.00	0.00
Plant, machinery and equipment	0.00	0.00	0.00
Total fixed investment costs	0.00	0.00	0.00
Preproduction capitals expenditures.	0.00	0.00	0.00
Working capital	16.13	18.40	9.20
Total current investment costs	16.13	18.40	9.20
Of it foreign, %	15.41	20.15	22.15

Iranian Nepheline Complex, Final Report --- 1992, March

Total Production Costs in US $ mln

Year	6	7	8	9	10	11-12
% of nom. capacity (single product)	25.00	75.00	100.00	100.00	100.00	100.00
Raw material 1	9.16	27.43	36.66	36.66	36.66	36.66
Other raw materials	11.50	34.49	45.98	45.98	45.98	45.98
Utilities	9.07	27.21	36.28	36.28	36.28	36.28
Energy	5.23	15.68	20.91	20.91	20.91	20.91
Labour, direct	7.61	14.13	17.39	17.39	17.39	17.39
Repair, maintenance	23.45	45.89	58.61	58.61	58.61	58.61
Spares	0.00	0.00	0.00	0.00	0.00	0.00
Factory overheads	23.57	26.34	27.73	27.73	27.73	27.73
Factory costs	89.58	192.23	243.56	243.56	243.56	243.56
Administrative overheads	16.32	18.24	19.20	19.20	19.20	19.20
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	904.86	903.78	902.83	901.99	617.60	617.21
Financial costs	0.00	0.00	0.00	0.00	0.00	0.00
Total production costs	1010.76	1114.25	1165.59	1164.75	880.35	879.57
Costs per unit (single product)	20.22	7.43	5.83	5.82	4.40	4.40
Of it foreign, %	9.36	10.53	[illegible]	[illegible]	[illegible]	[illegible]
Of it variable,%	5.17	14.08	17.94	17.96	23.76	23.77
Total labour	23.93	32.37	36.59	36.59	36.59	36.59

COMFAR 2.1 - VAMI, LENINGRAD, U.S.S.R.

Total Production Costs in US $ mln

Year	13	14-17	18	19-20
% of nom. capacity (single product)	100.00	100.00	100.00	100.00
Raw material 1	36.66	36.66	36.66	36.66
Other raw materials	45.98	45.98	45.98	45.98
Utilities	36.28	36.28	36.28	36.28
Energy	20.91	20.91	20.91	20.91
Labour, direct	17.39	17.39	17.39	17.39
Repair, maintenance	58.61	58.61	58.61	58.61
Spares	0.00	0.00	0.00	0.00
Factory overheads	27.73	27.73	27.73	27.73
Factory costs	243.56	243.56	243.56	243.56
Administrative overheads	19.20	19.20	19.20	19.20
Indir. costs, sales and distribution	0.00	0.00	0.00	0.00
Direct costs, sales and distribution	0.00	0.00	0.00	0.00
Depreciation	548.41	497.33	497.14	492.26
Financial costs	0.00	0.00	0.00	0.00
Total production costs	811.17	760.09	759.90	755.02
Costs per unit (single product)	4.06	3.80	3.80	3.78
Of it foreign, %	7.64	7.28	7.25	6.65
Of it variable,%	25.78	27.52	27.52	27.70
Total labour	36.59	36.59	36.59	36.59

Net Working Capital in US $ mln

Year	mdc	coto	6	7	8	9-20
Coverage	mdc	coto				
Current assets &						
Accounts receivable	30	12.0	8.82	17.54	21.90	21.90
Inventory and materials	20	18.3	1.13	3.38	4.51	4.51
Energy	0	---	0.00	0.00	0.00	0.00
Spares	0	---	0.00	0.00	0.00	0.00
Work in progress	36	10.0	8.96	19.22	24.36	24.36
Finished products	0	---	0.00	0.00	0.00	0.00
Cash in hand	15	24.0	2.96	4.40	5.12	5.12
Total current assets			21.87	44.55	55.88	55.88
Current liabilities and						
Accounts payable	15	24.0	3.73	8.01	10.15	10.15
Net working capital			18.13	36.54	45.74	45.74
Increase in working capital			18.13	18.40	9.20	0.00
Net working capital, local			15.34	29.67	36.83	36.83
Net working capital, foreign			2.79	6.87	8.91	8.91

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in US $ mln

Year	1	2	3	4	5
Equity, ordinary ..	0.00	0.00	0.00	0.00	0.00
Equity, preference.	0.00	0.00	0.00	0.00	0.00
Subsidies, grants .	1375.71	2739.49	3722.87	1446.29	623.72
Loan A, foreign .	0.00	0.00	0.00	0.00	0.00
Loan B, foreign..	0.00	0.00	0.00	0.00	0.00
Loan C, foreign .	0.00	0.00	0.00	0.00	0.00
Loan A, local....	0.00	0.00	0.00	0.00	0.00
Loan B, local....	0.00	0.00	0.00	0.00	0.00
Loan C, local....	0.00	0.00	0.00	0.00	0.00
Total loan	0.00	0.00	0.00	0.00	0.00
Current liabilities	0.00	0.00	0.00	0.00	0.00
Bank overdraft	0.00	0.00	0.00	0.00	0.00
Total funds	1375.71	2739.49	3722.87	1446.29	623.72

Source of Finance, production in US $ mln

Year	6	7	8
Equity, ordinary ..	0.00	0.00	0.00
Equity, preference.	0.00	0.00	0.00
Subsidies, grants .	0.00	0.00	0.00
Loan A, foreign .	0.00	0.00	0.00
Loan B, foreign..	0.00	0.00	0.00
Loan C, foreign .	0.00	0.00	0.00
Loan A, local....	0.00	0.00	0.00
Loan B, local....	0.00	0.00	0.00
Loan C, local....	0.00	0.00	0.00
Total loan	0.00	0.00	0.00
Current liabilities	3.73	4.28	2.14
Bank overdraft	0.00	0.00	0.00
Total funds	3.73	4.28	2.14

Cashflow Tables, construction in US $ mln

Year	1	2	3	4	5
Total cash inflow . .	1375.71	2739.49	3722.87	1446.29	623.72
Financial resources .	1375.71	2739.49	3722.87	1446.29	623.72
Sales, net of tax . .	0.00	0.00	0.00	0.00	0.00
Total cash outflow . .	1375.71	2739.49	3722.87	1446.29	623.72
Total assets	1375.71	2739.49	3722.87	1446.29	623.72
Operating costs . . .	0.00	0.00	0.00	0.00	0.00
Cost of finance . . .	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00
Corporate tax . . .	0.00	0.00	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00	0.00	0.00
Surplus (deficit) .	0.00	0.00	-0.00	0.00	0.00
Cumulated cash balance	0.00	0.00	0.00	0.00	0.00
Inflow, local	1339.71	2638.49	3520.87	1189.29	561.42
Outflow, local	1339.71	2638.49	3520.87	1189.29	561.42
Surplus (deficit) .	0.00	0.00	-0.00	0.00	0.00
Inflow, foreign . . .	36.00	101.00	202.00	257.00	62.30
Outflow, foreign . . .	36.00	101.00	202.00	257.00	62.30
Surplus (deficit) .	0.00	0.00	0.00	0.00	0.00
Net cashflow	-1375.71	-2739.49	-3722.87	-1446.29	-623.72
Cumulated net cashflow	-1375.71	-4115.20	-7838.08	-9284.37	-9908.08

Cashflow tables, production in US $ mln

Year	6	7	8	9	10	11
Total cash inflow	184.59	544.87	725.54	723.41	723.41	723.41
Financial resources	3.73	4.28	2.14	0.00	0.00	0.00
Sales, net of tax	180.86	540.60	723.41	723.41	723.41	723.41
Total cash outflow	127.76	233.15	274.10	262.76	262.76	262.76
Total assets	21.87	22.68	11.34	0.00	0.00	0.00
Operating costs	105.90	210.47	262.76	262.76	262.76	262.76
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	56.83	311.72	451.45	460.65	460.65	460.65
Cumulated cash balance	56.83	368.55	820.00	1280.65	1741.29	2201.94
Inflow, local	153.55	454.63	603.25	601.51	601.51	601.51
Outflow, local	110.26	194.77	228.48	219.58	219.58	219.58
Surplus (deficit)	43.30	259.86	374.77	381.93	381.93	381.93
Inflow, foreign	31.04	90.24	122.29	121.89	121.89	121.89
Outflow, foreign	17.52	38.38	45.61	43.18	43.18	43.18
Surplus (deficit)	13.53	51.86	76.68	78.72	78.72	78.72
Net cashflow	56.83	311.72	451.45	460.65	460.65	460.65
Cumulated net cashflow	-9851.25	-9539.53	-9088.08	-8627.44	-8166.79	-7706.14

Cashflow tables, production in US $ mln

Year	12	13	14	15	16	17
Total cash inflow	723.41	723.41	723.41	723.41	723.41	723.41
Financial resources	0.00	0.00	0.00	0.00	0.00	0.00
Sales, net of tax	723.41	723.41	723.41	723.41	723.41	723.41
Total cash outflow	262.76	262.76	262.76	262.76	262.76	262.76
Total assets	0.00	0.00	0.00	0.00	0.00	0.00
Operating costs	262.76	262.76	262.76	262.76	262.76	262.76
Cost of finance	0.00	0.00	0.00	0.00	0.00	0.00
Repayment	0.00	0.00	0.00	0.00	0.00	0.00
Corporate tax	0.00	0.00	0.00	0.00	0.00	0.00
Dividends paid	0.00	0.00	0.00	0.00	0.00	0.00
Surplus (deficit)	460.65	460.65	460.65	460.65	460.65	460.65
Cumulated cash balance	2662.59	3123.24	3583.89	4044.54	4505.18	4965.83
Inflow, local	601.51	601.51	601.51	601.51	601.51	601.51
Outflow, local	219.58	219.58	219.58	219.58	219.58	219.58
Surplus (deficit)	381.93	381.93	381.93	381.93	381.93	381.93
Inflow, foreign	121.89	121.89	121.89	121.89	121.89	121.89
Outflow, foreign	43.18	43.18	43.18	43.18	43.18	43.18
Surplus (deficit)	78.72	78.72	78.72	78.72	78.72	78.72

Net cashflow	460.65	460.65	460.65	460.65	460.65	460.65
Cumulated net cashflow	-7245.49	-6784.84	-6324.20	-5863.55	-5402.90	-4942.25

III

Cashflow tables, production in US $ mln

Year	18	19	20
Total cash inflow . .	723.41	723.41	723.41
Financial resources .	0.00	0.00	0.00
Sales, net of tax . .	723.41	723.41	723.41
Total cash outflow . .	262.76	262.76	262.76
Total assets	0.00	0.00	0.00
Operating costs . . .	262.76	262.76	262.76
Cost of finance . . .	0.00	0.00	0.00
Repayment	0.00	0.00	0.00
Corporate tax . .	0.00	0.00	0.00
Dividends paid . . .	0.00	0.00	0.00
Surplus (deficit) .	460.65	460.65	460.65
Cumulated cash balance	5426.48	5887.13	6347.78
Inflow, local	601.51	601.51	601.51
Outflow, local	219.58	219.58	219.58
Surplus (deficit) .	381.93	381.93	381.93
Inflow, foreign . . .	121.89	121.89	121.89
Outflow, foreign . . .	43.18	43.18	43.18
Surplus (deficit) .	78.72	78.72	78.72
Net cashflow	460.65	460.65	460.65
Cumulated net cashflow	-4481.60	-4020.96	-3560.31

Cashflow Discounting:

a) Equity paid versus Net income flow:
    Net present value .... 10.00 %
    Internal Rate of Return (IRRE1) ..

b) Net Worth versus Net cash return:
    Net present value .... 10.00 %
    Internal Rate of Return (IRRE2) ..

c) Internal Rate of Return on total investment:
    Net present value .... -6332.27 at 10.00 %
    Internal Rate of Return (IRR) .. -3.16 %

Net Worth = Equity paid plus reserves

Net Income Statement in US $ mln

Year	6	7	8	9	10
Total sales, incl. sales tax	180.86	540.60	723.41	723.41	723.41
Less: variable costs, incl. sales tax.	52.29	156.86	209.15	209.15	209.15
Variable margin	128.57	383.74	514.26	514.26	514.26
As % of total sales	71.09	70.98	71.09	71.09	71.09
Non-variable costs, incl. depreciation	958.47	957.39	956.44	955.61	671.21
Operational margin	-829.90	-573.66	-442.18	-441.35	-156.95
As % of total sales	-458.86	-106.12	-61.13	-61.01	-21.70
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-829.90	-573.66	-442.18	-441.35	-156.95
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-829.90	-573.66	-442.18	-441.35	-156.95
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-829.90	-573.66	-442.18	-441.35	-156.95
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-829.90	-573.66	-442.18	-441.35	-156.95
Accumulated undistributed profit	-829.90	-1403.55	-1845.73	-2287.08	-2444.03
Gross profit, % of total sales	-458.86	-106.12	-61.13	-61.01	-21.70
Net profit, % of total sales	-458.86	-106.12	-61.13	-61.01	-21.70
ROE, Net profit, % of equity					
ROI, Net profit+interest, % of invest.	-8.36	-5.77	-4.44	-4.43	-1.58

Net Income Statement in US $ mln

Year	11	12	13	14	15
Total sales, incl. sales tax	723.41	723.41	723.41	723.41	723.41
Less: variable costs, incl. sales tax.	209.15	209.15	209.15	209.15	209.15
Variable margin	514.26	514.26	514.26	514.26	514.26
As % of total sales	71.09	71.09	71.09	71.09	71.09
Non-variable costs, incl. depreciation	670.83	670.83	602.02	550.94	550.94
Operational margin	-156.57	-156.57	-87.76	-36.68	-36.68
As % of total sales	-21.64	-21.64	-12.13	-5.07	-5.07
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-156.57	-156.57	-87.76	-36.68	-36.68
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-156.57	-156.57	-87.76	-36.68	-36.68
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-156.57	-156.57	-87.76	-36.68	-36.68
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-156.57	-156.57	-87.76	-36.68	-36.68
Accumulated undistributed profit	-2600.59	-2757.16	-2844.92	-2881.60	-2918.29
Gross profit, % of total sales	-21.64	-21.64	-12.13	-5.07	-5.07
Net profit, % of total sales	-21.64	-21.64	-12.13	-5.07	-5.07
ROE, Net profit, % of equity					
ROI, Net profit+interest, % of invest.	-1.57	-1.57	-0.88	-0.37	-0.37

Net Income Statement in US $ mln

Year	16	17	18	19	20
Total sales, incl. sales tax	723.41	723.41	723.41	723.41	723.41
Less: variable costs, incl. sales tax.	209.15	209.15	209.15	209.15	209.15
Variable margin	514.26	514.26	514.26	514.26	514.26
As % of total sales	71.09	71.09	71.09	71.09	71.09
Non-variable costs, incl. depreciation	550.94	550.94	550.75	545.87	545.87
Operational margin	-36.68	-36.68	-36.49	-31.61	-31.61
As % of total sales	-5.07	-5.07	-5.04	-4.37	-4.37
Cost of finance	0.00	0.00	0.00	0.00	0.00
Gross profit	-36.68	-36.68	-36.49	-31.61	-31.61
Allowances	0.00	0.00	0.00	0.00	0.00
Taxable profit	-36.68	-36.68	-36.49	-31.61	-31.61
Tax	0.00	0.00	0.00	0.00	0.00
Net profit	-36.68	-36.68	-36.49	-31.61	-31.61
Dividends paid	0.00	0.00	0.00	0.00	0.00
Undistributed profit	-36.68	-36.68	-36.49	-31.61	-31.61
Accumulated undistributed profit	-2954.97	-2991.65	-3028.14	-3059.75	-3091.36
Gross profit, % of total sales	-5.07	-5.07	-5.04	-4.37	-4.37
Net profit, % of total sales	-5.07	-5.07	-5.04	-4.37	-4.37
ROE, Net profit, % of equity					
ROI, Net profit+interest, % of invest.	-0.37	-0.37	-0.37	-0.32	-0.32

Projected Balance Sheets, construction in US $ mln

Year	1	2	3	4	5
Total assets	1375.71	4115.20	7838.08	9284.37	9908.08
Fixed assets, net of depreciation	0.00	1375.71	4115.20	7838.08	9284.37
Construction in progress	1375.71	2739.49	3722.87	1446.29	623.72
Current assets	0.00	0.00	0.00	0.00	0.00
Cash, bank	0.00	0.00	0.00	0.00	0.00
Cash surplus, finance available	0.00	0.00	0.00	0.00	0.00
Loss carried forward	0.00	0.00	0.00	0.00	0.00
Loss	0.00	0.00	0.00	0.00	0.00
Total liabilities	1375.71	4115.20	7838.08	9284.37	9908.08
Equity capital	1375.71	4115.20	7838.08	9284.37	9908.08
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00
Current liabilities	0.00	0.00	0.00	0.00	0.00
Bank overdraft, finance required	0.00	0.00	0.00	0.00	0.00
Total debt	0.00	0.00	0.00	0.00	0.00
Equity, % of liabilities	100.00	100.00	100.00	100.00	100.00

Projected Balance Sheets, Production in US $ mln

Year	6	7	8	9	10	11
Total assets	9911.82	9916.09	9918.23	9918.23	9918.23	9918.23
Fixed assets, net of depreciation	9003.23	8099.45	7196.62	6294.62	5677.02	5059.81
Construction in progress	0.00	0.00	0.00	0.00	0.00	0.00
Current assets	18.91	40.14	50.76	50.76	50.76	50.76
Cash, bank	2.96	4.40	5.12	5.12	5.12	5.12
Cash surplus, finance available	56.83	368.55	820.00	1280.65	1741.29	2201.94
Loss carried forward	0.00	829.90	1403.55	1845.73	2287.08	2444.03
Loss	829.90	573.66	442.18	441.35	156.95	156.57
Total liabilities	9911.82	9916.09	9918.23	9918.23	9918.23	9918.23
Equity capital	9908.08	9908.08	9908.08	9908.08	9908.08	9908.08
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	3.73	8.01	10.15	10.15	10.15	10.15
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	3.73	8.01	10.15	10.15	10.15	10.15
Equity, % of liabilities	99.96	99.92	99.90	99.90	99.90	99.90

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Projected Balance Sheets, Production in US $ mln

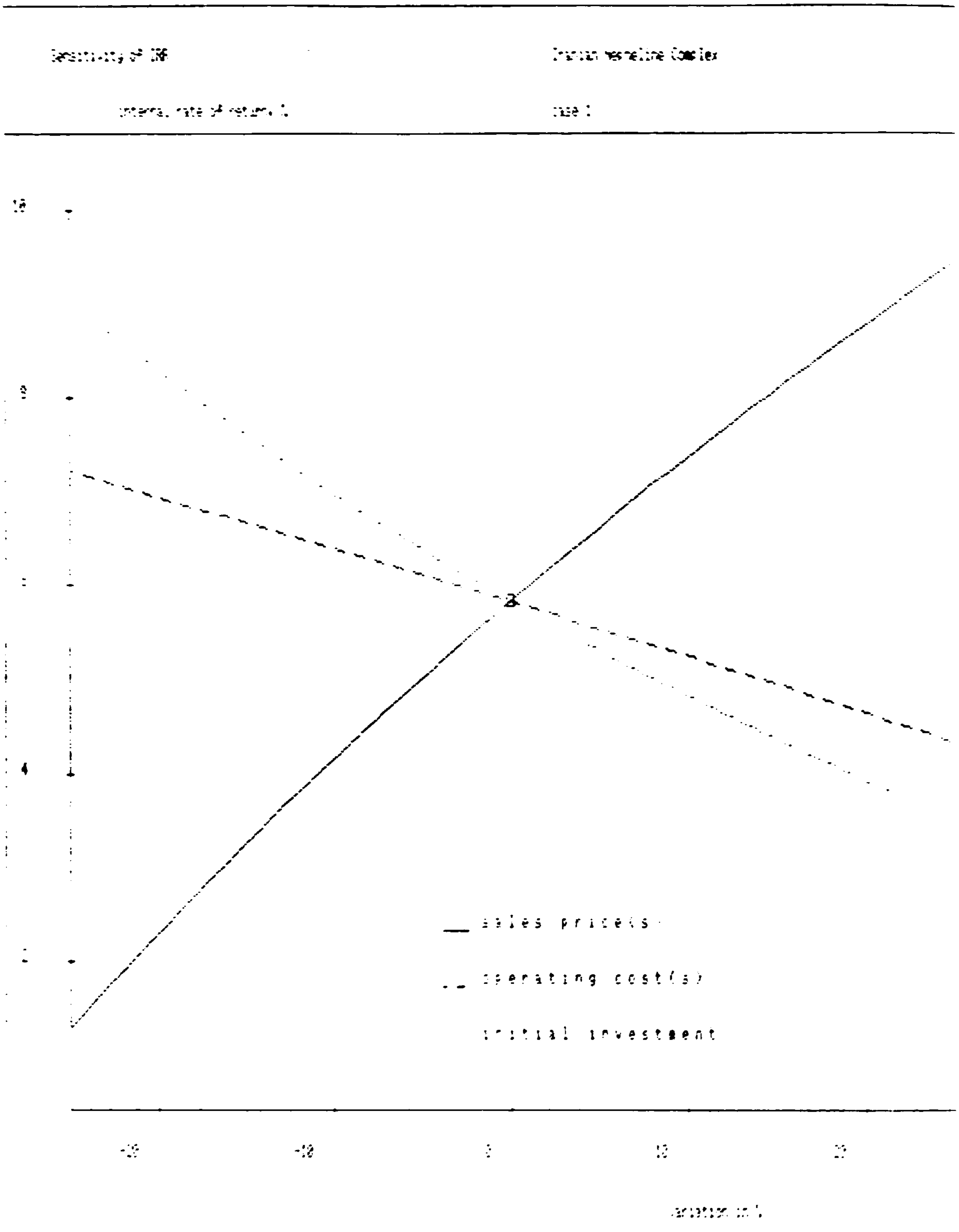
Year	12	13	14	15	16	17
Total assets	9918.23	9918.23	9918.23	9918.23	9918.23	9918.23
Fixed assets, net of depreciation	4442.60	3894.19	3396.86	2899.53	2402.19	1904.86
Construction in progress	0.00	0.00	0.00	0.00	0.00	0.00
Current assets	50.76	50.76	50.76	50.76	50.76	50.76
Cash, bank	5.12	5.12	5.12	5.12	5.12	5.12
Cash surplus, finance available	2662.59	3123.24	3583.89	4044.54	4505.18	4965.83
Loss carried forward	2600.59	2757.16	2844.92	2881.60	2918.29	2954.97
Loss	156.57	87.76	36.68	36.68	36.68	36.68
Total liabilities	9918.23	9918.23	9918.23	9918.23	9918.23	9918.23
Equity capital	9908.08	9908.08	9908.08	9908.08	9908.08	9908.08
Reserves, retained profit	0.00	0.00	0.00	0.00	0.00	0.00
Profit	0.00	0.00	0.00	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00	0.00	0.00	0.00
Current liabilities	10.15	10.15	10.15	10.15	10.15	10.15
Bank overdraft, finance required.	0.00	0.00	0.00	0.00	0.00	0.00
Total debt	10.15	10.15	10.15	10.15	10.15	10.15
Equity, % of liabilities	99.90	99.90	99.90	99.90	99.90	99.90

Iranian Nepheline Complex, Final Report --- 1992, March

Projected Balance Sheets, Production in US $ mln

Year	18	19	20
Total assets	9918.23	9918.23	9918.23
Fixed assets, net of depreciation	1407.72	915.46	423.21
Construction in progress	0.00	0.00	0.00
Current assets	50.76	50.76	50.76
Cash, bank	5.12	5.12	5.12
Cash surplus, finance available	5426.48	5887.13	6347.78
Loss carried forward	2991.65	3028.14	3059.75
Loss	36.49	31.61	31.61
Total liabilities	9918.23	9918.23	9918.23
Equity capital	9908.08	9908.08	9908.08
Reserves, retained profit	0.00	0.00	0.00
Profit	0.00	0.00	0.00
Long and medium term debt	0.00	0.00	0.00
Current liabilities	10.15	10.15	10.15
Bank overdraft, finance required.	0.00	0.00	0.00
Total debt	10.15	10.15	10.15
Equity, % of liabilities	99.90	99.90	99.90

Illustrations
to sensitivity analysis
for Variant 1


10
8
6
4
2
-20
-10
0
10
20
sales price(s)
operating cost(s)
initial investment

VALUES chart description [STANDARD]

Sensitivity of IRR — Iranian Nepheline Complex
internal rate of return, % — case 1

	sales price	operating c	initial inv	
-25.0	1.29	7.21	9.05	5.83
-23.9	1.51	7.15	8.88	
-22.8	1.74	7.10	8.71	
-21.7	1.96	7.04	8.55	
-20.6	2.18	6.98	8.39	
-19.5	2.40	6.92	8.23	
-18.4	2.61	6.86	8.08	
-17.3	2.82	6.80	7.93	
-16.2	3.03	6.74	7.78	
-15.1	3.23	6.68	7.63	
-14.0	3.44	6.62	7.48	
-12.9	3.64	6.56	7.34	
-11.8	3.84	6.50	7.20	
-10.7	4.03	6.44	7.07	
-9.6	4.23	6.38	6.93	
-7.4	4.61	6.25	6.67	
-6.3	4.80	6.19	6.54	
-5.2	4.98	6.13	6.41	
-4.1	5.17	6.07	6.28	
-3.0	5.35	6.00	6.16	
-1.9	5.53	5.94	6.04	
-0.8	5.70	5.88	5.92	
0.3	5.88	5.82	5.80	
1.4	6.06	5.75	5.68	
2.5	6.23	5.69	5.57	
3.6	6.40	5.63	5.46	
4.7	6.57	5.56	5.34	
5.8	6.74	5.50	5.23	
6.9	6.90	5.43	5.12	
8.0	7.07	5.37	5.02	
10.2	7.39	5.24	4.81	
11.3	7.55	5.17	4.70	
12.4	7.71	5.11	4.60	
13.5	7.87	5.04	4.50	
14.6	8.03	4.98	4.40	
15.7	8.18	4.91	4.30	
16.8	8.34	4.84	4.20	
17.9	8.49	4.78	4.11	
19.0	8.64	4.71	4.01	
20.1	8.79	4.64	3.92	
21.2	8.94	4.57	3.83	
22.3	9.09	4.51	3.73	
23.4	9.23	4.44	3.64	
24.5	9.38	4.37	3.55	
25.6	9.52	4.30	3.46	
27.8	9.81	4.16	3.29	
28.9	9.95	4.09	3.20	

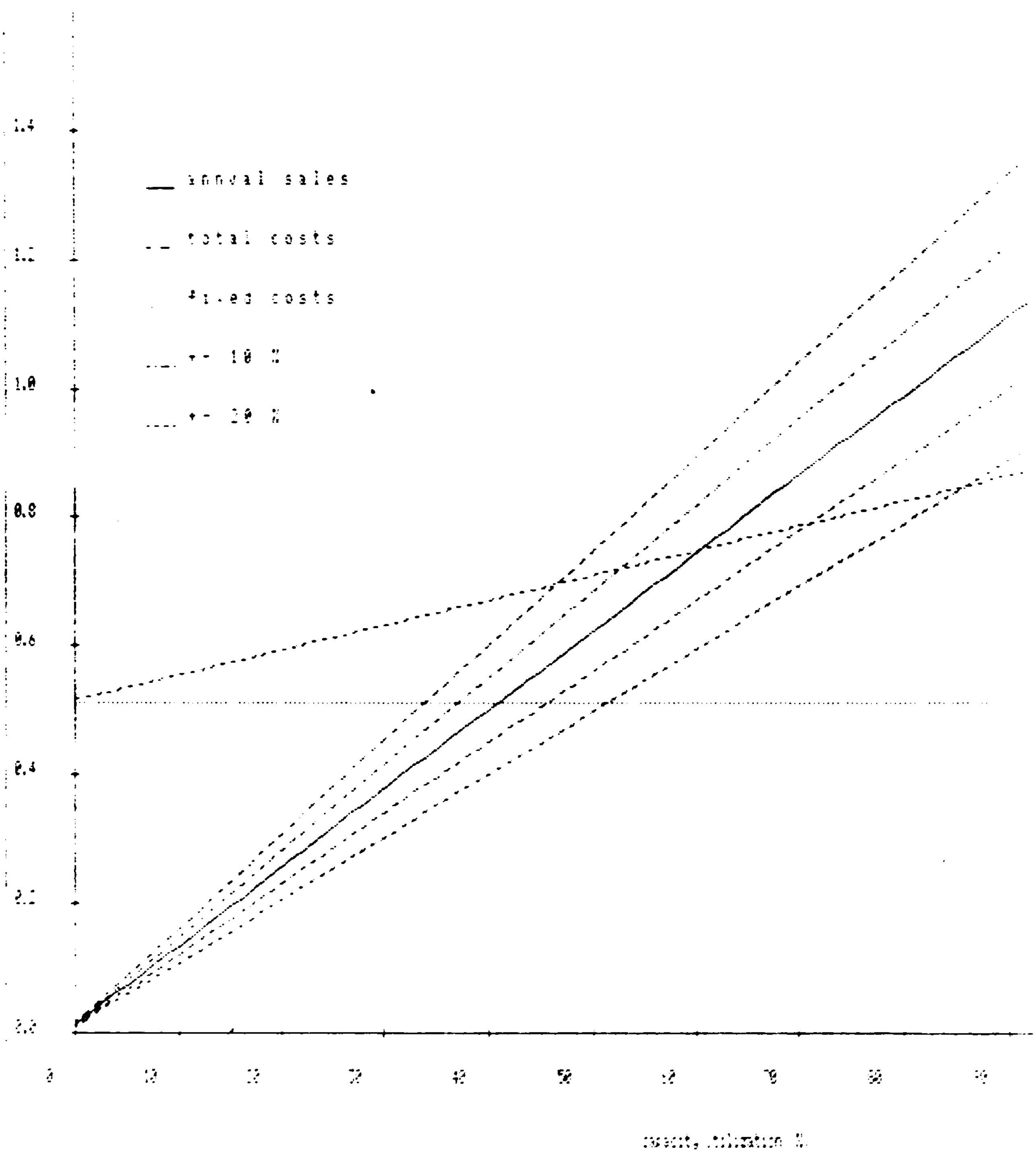
** variation in %

Break Even Chart * INC - 1 *

Variation of sales prices

US $ mln

for 5th production year

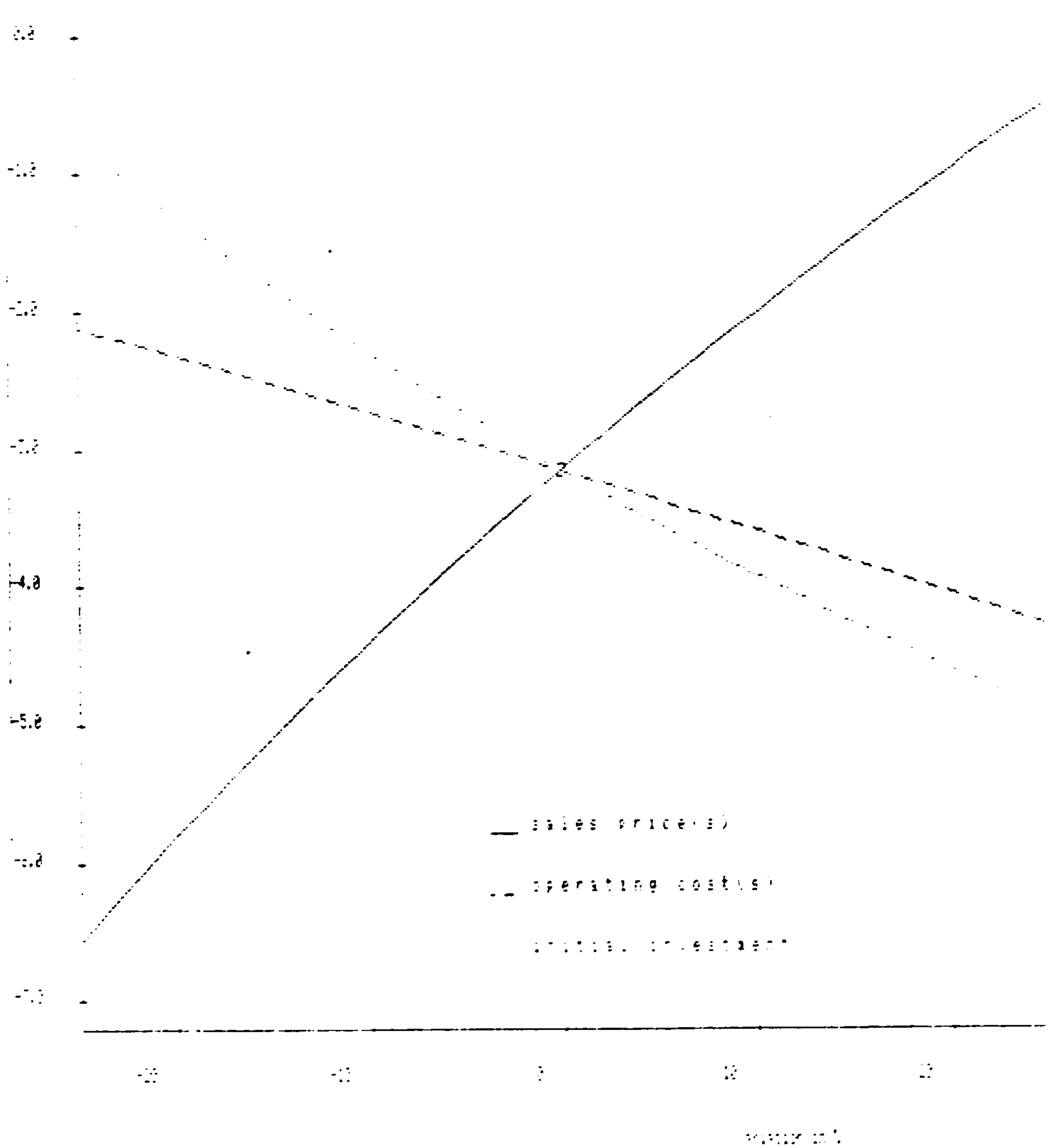


*Illustrations
to sensitivity analysis
for Variant 2*

Sensitivity of IRR

Internal rate of return, %

case 2



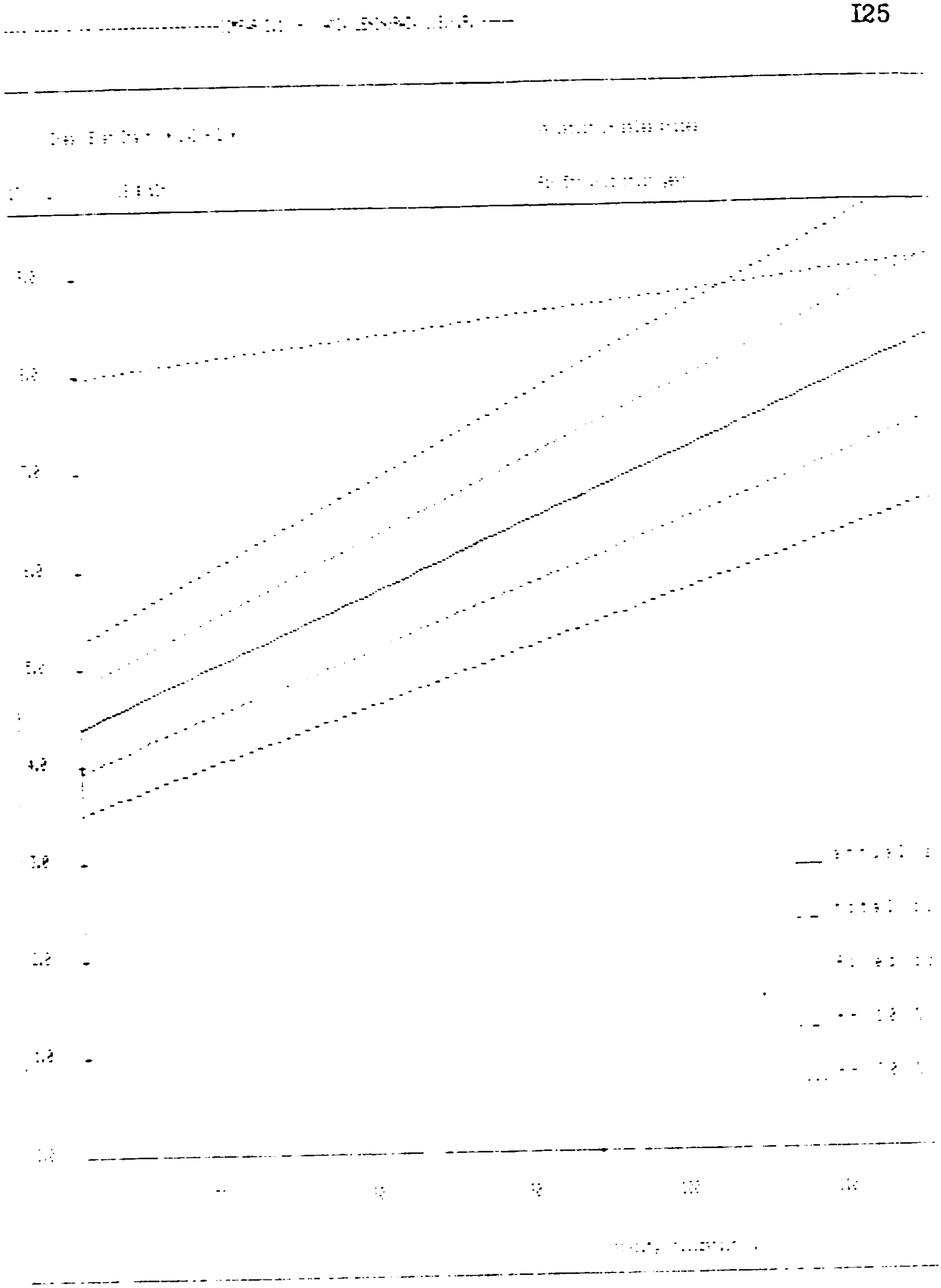
VALUES chart description [STANDARD]

Sensitivity of IRR — Iranian Nepheline Complex

internal rate of return, % — case 2

	sales price	operating c	initial inv	
-25.0	-6.56	-2.12	-0.75	-3.16
-23.9	-6.39	-2.16	-0.88	
-22.8	-6.22	-2.21	-1.00	
-21.7	-6.05	-2.25	-1.12	
-20.6	-5.88	-2.29	-1.24	
-19.5	-5.72	-2.34	-1.36	
-18.4	-5.56	-2.38	-1.47	
-17.3	-5.40	-2.43	-1.58	
-16.2	-5.24	-2.47	-1.70	
-15.1	-5.09	-2.52	-1.81	
-14.0	-4.94	-2.56	-1.91	
-12.9	-4.79	-2.61	-2.02	
-11.8	-4.64	-2.65	-2.12	
-10.7	-4.49	-2.70	-2.23	
-9.6	-4.35	-2.75	-2.33	
-7.4	-4.06	-2.84	-2.53	
-6.3	-3.92	-2.89	-2.62	
-5.2	-3.79	-2.93	-2.72	
-4.1	-3.65	-2.98	-2.82	
-3.0	-3.52	-3.03	-2.91	
-1.9	-3.38	-3.07	-3.00	
-0.8	-3.25	-3.12	-3.09	
0.3	-3.12	-3.17	-3.18	
1.4	-2.99	-3.22	-3.27	
2.5	-2.86	-3.27	-3.36	
3.6	-2.74	-3.31	-3.44	
4.7	-2.61	-3.36	-3.53	
5.8	-2.49	-3.41	-3.61	
6.9	-2.37	-3.46	-3.69	
8.0	-2.25	-3.51	-3.78	
10.2	-2.01	-3.61	-3.94	
11.3	-1.89	-3.66	-4.02	
12.4	-1.78	-3.71	-4.09	
13.5	-1.66	-3.76	-4.17	
14.6	-1.55	-3.81	-4.25	
15.7	-1.43	-3.86	-4.32	
16.8	-1.32	-3.91	-4.40	
17.9	-1.21	-3.96	-4.47	
19.0	-1.10	-4.01	-4.54	
20.1	-0.99	-4.06	-4.62	
21.2	-0.88	-4.11	-4.69	
22.3	-0.77	-4.16	-4.76	
23.4	-0.67	-4.22	-4.83	
24.5	-0.56	-4.27	-4.90	
25.6	-0.46	-4.32	-4.36	
27.8	-0.25	-4.43	-5.10	
28.9	-0.15	-4.48	-5.17	

** variation in %



10. VIABILITY OF CEMENT PRODUCTION FROM BELLITE MUD BY DRY AND SEMI-DRY PROCESS

In the world practice of cement production based on traditional raw materials (clay, limestone) the various methods for cement clinker production in common use are: the wet method - based on preparation of wet mix and its sintering in long rotary kilns, the dry method - based on preparation of dry mix and its sintering in short rotary kilns with various downstream preheaters; the semi-dry method - based on preparation of wet mix, its partial dehydration down to moisture securing handling and feeding to the kiln, and its sintering in short rotary kilns with various downstream preheaters or devices for drying.

Share of the dry method in the cement industry of the USA is 60%, Japan, FRG and Spain - 100%, other developed countries - 85-97%, France has no wet method, only the dry method and semi-dry method with mud filtration are used, USSR - 17%.

Production of cement from bellite mud in the USSR is done only by the the wet method in which raw materials are ground in water, blending and correction of the mix composition is in water suspensions. Mix sintering is in long rotary kilns with internal heat exchange devices.

Possible use of other methods for cement production from bellite mud is accounted for its physico-chemical and physico-mechanical properties which determine behaviour of mud in preparation of raw mix and its sintering in kiln units.

Bellite mud generated in production of alumina from nepheline raw material is reslurried after multiple washing and pumped to the cement plant with moisture of up to 40%.

By its physical properties bellite mud is water suspension. Size distribution: content of fraction +1 mm is 3-5%, fraction 200 micron is 50-60%, fraction +80 micron is 60-80%.

Density of solid phase of bellite mud is 3.0-3.1 g/cm^3, volume density 1.0-1.2 g/cm^3 (loose), 1.3-1.4 g/cm^3 (packed).

Use of the wet method in cement production from bellite mud ensured high degree of dispersion, stable chemical composition of raw mix before feeding to the kiln, low energy consumption for grinding, high quality of resulting clinker, normal sanitary conditions for operating personnel in mix preparation.

However, the wet method entails certain problems related to settlement and thickening of raw mix with extended storage in the slurry tanks of large capacity, necessity for continuous stirring of mix with compressed air, the wet method is noted for higher fuel consumption for evaporation of free moisture.

As compared with traditional mixes for cement production the mix based on bellite mud differs in lower reactivity, higher content of water soluble alkalis resulting in risk of formation of dust ledges in cold points of the kiln and high heat consumption due to presence of dicalcium silicate resulting in lower productivity of the kiln.

Besides, bellite mud based mix has low water retention capacity and low plasticity which predetermines low strenght of pellets formed in the kiln and high dust entrainment.

At the same time low water retaining ability of bellite mud and large size of particles as contracted to clay determines good filtering ability of bellite mud based raw mud.

Less content in raw mix of carbonate ingredient and relatively fine granulometry of bellite mud accounts for high grindability of raw mix.

In cement production from bellite mud one should bear in mind high content of alkalis in raw mix which create certain problems in processing bellite mud containing mixes in kilns with downstream cyclone preheaters. During sintering alkaline compounds partially dissociate, alkali become volatile and partially condense at the cold end of the kiln or in preheaters forming ledges which require regular cleaning.

The world practice has no industrial experience in processing bellite mud into cement by the dry or semi-dry method.

However, conducted tests and analysis of properties of bellite mud allows forecast to be made on possible utilisation of the dry or semi-dry method for cement production.

Given properties of bellite mud the principal process flowsheet of cement production by the dry method is as follows. Bellite mud with moisture up to 40% is dehydrated in mechanical filters (drum vacuum or pressure filters) down to moisture on 13-17% and resulting cake is fed for combined grinding with carbonate ingredient, correcting and special admixtures.

Grinding is in the units with simultaneous drying to moisture of 0.5-1.5% by heat of exit gases of the kiln.

Raw mix is corrected and blended in silos and roasted in short rotary kilns with the downstream preheaters.

With the semi-dry method of cement production from bellite mud the wet mix is prepared, which is then corrected and dehydrated in mechanical filters down to moisture of 13-17%.

The cake is dried (while ground) to moisture content of 0.5-1.5% by heat of exit gases of the clinker kiln and fed for roasting in short rotary kilns with the downstream preheaters.

Thus, difference in the dry and semi-dry method is in quantity of material to be filtered and equipment for its implementation. In processing Iranian nepheline ores the share of bellite mud in the mix is only 23% the number of items of equipment for the semi-dry method will be 3-4 times higher than with the dry method. Besides, in case of the semi-dry method there should be yet another process section (drying) for partially dehydrated mix with simultaneous grinding of resulting lumps and their disintegration into fines, although there is certain reduction in expenses for the mix correction tanks.

In Protocol of October 10, 1991 the Iranian side proposed to consider during preparation of the POS the semi-dry method for cement production incorporating wet grinding of bellite mud and dry grinding of individual mix components, pelletising of mix in feeding bellite mud slurry with moisture about 40% and dry ingredients (limestone, iron ore, aluminous ingredient and dust from the sintering kilns) to produce pellets with moisture about 15%, roasting of pelletised mix in short rotary kilns fitted with converter calciner of type "Lepol". The semi-dry method proposed by Iranian side has the following disadvantages:

1. Impossibility of obtaining homogenic mix druing preparation of pellets based on bellite mud slurry and dry mix ingredients. In pelletising the mix based on bellite mud slurry the core of pellets will consist mainly of bellite mud and periphery - of limestone, iron ore and aluminous ingredient. Besides, lack of homogeneity of production of clinker of required mineral composition and cement of required quality.

2. Given specific features of bellite mud it would be necessary to investigate possibility for producing pellets of required strength required for the system "Lepol".

3. With use of bellite mud with moisture content of about 40% it would be difficult to maintain the fixed moisture of raw mix about 15% required for normal pelletising process.

Due to this fact, the semi-dry method proposed by Iranian side is not used in the further calculations of economic viability.

Based on the available experience in utilisation of bellite mud, considered in the POS are the alternatives of the dry and semi-dry methods for cement production at the capacity and cost of equipment as determined on the basis of experience in operation of the cement industry in the USSR and abroad.

Table 10.1 shows certain indicators of cement production by different methods.

Table 10.1

Indicator	Method		
	wet	dry	semi-dry
Fuel consumption for roasting, t/t of cement	0.161	0.104	0.108
Power consumption kWh/t of cement	125.0	138.8	128.8
Fresh water consumption, m^3/t	0.489	0.250	0.340
Specific capital investment, %	100	92	99

Comparative analysis of performance figures of different methods for cement production taking into consideration properties of bellite mud shows that the use of the dry method is related to higher compressed air consumption for blending the mix and electric power for dry grinding.

With the semi-dry method necessity for dehydration of significant quantities of wet raw mix will result in higher capital investment for construction of the filtration section.

However, with the use of the semi-dry method the advantages of the wet method of mix preparation are utilised (uniform and stable composition, improved sanitary conditions) and possible reduction in fuel consumption while roasting dry mix in the modern kiln equipment.

Properties of bellite mud, absence of experience in cement production from bellite mud require the study for development of new equipment and its tests under industrial conditions.

To select the optimum method for processing bellite mud into cement it would be necessary to implement the following major efforts:

- study of bellite mud and bellite mud based mixes filtration process in the mechanical filters to determine the productivity, process parameters, residual moisture content;

- study of handling issues of partially dehydrated bellite mud and mix;
- study of bellite mud based mix drying and grinding process;
- determination of dry mix storing conditions;
- study of bellite mud based mix roasting process;
- study of mix pelletising process to determine pellet strength;
- development of the new kiln equipment taking into account properties of bellite mud;
- tests of new equipment under industrial conditions to determine the guaranteed figures.

The above study may be implemented at the existing plants in Iran or foreign plants, pilot plant and bench-scale units.

As starting raw material for the tests the use may be made of bellite mud supplied under a separate contract from one of the alumina plants in the USSR processing nepheline raw materials.

Due to the fact that at present there is no industrial experience for use of the dry and semi-dry method for sintering cement mix with bellite mud, the major performance and economic figures of such process may be secured only by forecast evaluation in comparison with the wet method.

The results of the calculations made in Sections 7 and 9 are used as the base version.

Table 10.2 shows data on expected indicators for production of cement under the dry and semi-dry method for production of cement clinker as compared with the wet method and Table 10.3 shows calculation of extra expenses for production of cement by different methods.

The cost of construction of the main cement plant facilities under the base version (wet method) is US $96.4 million and 185901 R million. Hence, investment costs for the dry method are US $88.7 million and R 171030 million, for the semi-dry method - US $95.4 million and R 184040 mln.

The obtained results indicate insignificant difference between total costs for cement production with different method for mix roasting, which will not practically affect the basic indicators of the complex of the whole.

Table 10.2

Item	Description	Unit	Consumption in production of clinker by method: wet	dry	semi-dry
1	Process fuel	Nm^3	121.8	78.7	81.7
2	Power	kWh	125.0	138.8	128.8
3	Additional number of personnel:				
3.1	Workers:				
	- high skilled	per.	-	5	10
	- medium skilled	per.	-	3	6
	- low skilled	per.	-	2	4
3.2	Foremen	per.	-	1	1
4	Cost of construction of cement plant facilities, % of wet method	%	100	92	99

Thus, selection of the mix roasting method in production of cement shall be based on possibility of the purchase of the equipment and also on difference in the ecological impact of establishment of the large scale cement operations.

Despite savings of fuel achieved under the dry and semi-dry methods of cement production as contrasted to the wet method recommended in this study, the decision may be positively taken on use of the dry or semi-dry method subject to clarification of the process and design concepts at the further stages of the engineering study and running the pilot tests.

At this stage, the only method which may be recommended is the wet method which underwent industrial testing in the Russian Federation.

Table 10-3

Cost estimate for production of cement by different methods (vy variable cost items)

S/N	Cost item	Unit	Unit price		Annual consumption								
					wet			dry			semi-dry		
					qty 000	Amount, mln		qty 000	Amount, mln		qty 000	Amount, mln	
			S	R		S	R		S	R		S	R
1	Fuel	Nm^3	-	3.0	487200	-	1461.6	314800	-	944.4	326800	-	980.4
2	Electric power	kWh	0.0011	1.322	500000	0.55	661.0	555200	0.61	734.0	515200	0.57	681.1
3	Labour cost	-	-	-	-	-	-	-	-	16.4	-	-	29.6
4	Maintenance materials	-	-	-	-	1.446	2788.5	-	1.331	2565.2	-	1.431	14.7
5	Depreciation	-	-	-	-	6.266	12083.6	-	5.766	11117.0	-	6.201	63.6
	Total	-	-	-	-	8.262	16994.7	-	7.707	15377.3	-	8.202	1769.4
6	Difference from wet method	-	-	-	-	-	-	-	-0.555	-1617.4	-	-0.06	-580.4
7	Same, %	-	-	-	-	-	-	-	-7.0	-9.5	-	-0.7	-3.4

11. NATIONAL ECONOMIC BENEFITS

In accordance with the Guidelines for preparation of industrial feasibility studies (UNIDO) this Section shows the calculations of the indicators reflecting economic benefits for Iran in case of implementation of the project under the selected alternative (for the stage of project possibility study) for the units of industrial complex (without infrastructure).

11.1. Number of created working places 2910

11.2. Capital investment per one created working place

$$\frac{\text{R 596450 million}}{2910} = \text{R 205 million/place plus}$$

$$\frac{462.9}{2910} = \text{US \$ 159.000/place}$$

11.3. Total savings of hard currency costs (US $ million):

a) export and import replacement of complex products	113.6
b) depreciation (foreign exchange component)	37.9
c) operating costs (foreign exchange component)	40.1
Total (item (a) - item (b) - item (c)	35.6

Appendixes

Appendix No 1

BRIEF DESCRIPTION OF ALUMINA COMPLEX RAW MATERIAL BASE

The Razgah deposit which is considered as an ore raw material base of the alumina complex is situated at about 140 km (along a straight line) to north-east from a proposed project site and at 85 km (along a straight line) east of the own of Tabriz, an administrative capital of Iranian Azerbaidjan, major industrial centre and railway station. The nearest residential areas are Razgah and Dechan villages situated at about 1.5 km south-west and about 3 km ESE of the deposit, respectively. The deposit is located in the readily accessible terrain about 15 km from an asphalt motorway connecting towns of Bostanabad and Ardabil. The unsurfaced roads are available from the motorway to the Razgah village and further to an exploration area.

The Razgah terrain is characterized by dissected middleheight topography with maximum divides up to 2098 m and relative elevations of 200 to 300 m. A significant part of the explored area features erosion remnants. Typical mountainous stream valleys mainly showing northeastern orientation are characterized by steep walls, sometimes - vertical or V-shaped. The major streams flow into the Aharchai and Adjichai rivers (Araks basin). Some of them have continuous water courses even in summer, whereas the Aharchai river flowing 5 km NW of the deposit if regulated, seems to be a source of the water supply of a mine. The use of underground water can be the second potential source of water supply.

The deposit area is characterized by pronouncedely continental climate with maximum temperature +32.5°C in summer and minimum -22.5°C (January). Annual precipitation is 137 mm, mainly falling at winter-spring period. Prospecting can be carried out in April through December.

A deposit area features considerable reserves of local building materials (stone, clay, sand and gravel mixes, gypsum, limestone), with some mining operations.

The residents of the region are mainly engaged in agriculture. Besides Tabriz, the largest residential areas in the vicinity are towns of Bostanabad (about 50 km SW), Miene (about 90 km SE), Ardabil (about 50 km ENE) and the Sarab village (about 35 km SE). There is a large oil refinery in Tabriz. There is an operating Sufian cement plant 35 km NW of Tabriz.

In the Mehraban area (about 20 km WSW of the deposit) there is a transformer substation from 230 kV power supply line passing south of the exploration area.

A state geological map scaled 1:250,000 (Ahar sheet) covering the site of Razgah deposit is available. An exposed by erosion area is represented by a schematic geological map with approximate scale of 1:20,000 produced on the basis of aerial photographs of the same scale.

A western portion of this area (outside the exploration area) has a 1:2,000 map.

A large-scale geological map for an area of the Razgah deposit under exploration is not available. By the present time only a topographic survey of this portion of the Razgah deposit, scale 1:5,000 and an instrumental tie of the cuttings made have been carried out.

By the present time a degree of exploration of the deposit corresponds to an exploratory-evaluation stage (according to the Russian classification for stages of geological-exploratory works). From the surface the deposit was explored with the aid of main trenches along profiles of NE direction at an interval of 400 m. Within a western portion of the explored area a network of trenches has an interval of 200 m. A point sampling method was used in these trenches, with a sampling step of 0.5 m and a section length of 5 m. Four boreholes about 200 m deep are bored in the western section of the deposit for studying a geological structure and quality of the ore.

The results of geological-exploratory works available at present made it possible to preliminary evaluate the Razgah deposit to a depth of an erosion downcutting (about

150 m). As a result, a geological structure of the explored area was established, with identification of the main types of ores, the areas of their development were deliniated. From analysis of the sampling results the limits of the blocks taken for reserve calculations were determined and the reserves were established in accordance with the classification developed in Russia. It should be noted that incompleteness of the chemical-analytical works at present does not allow to finalize a raw material quality in the blocks identified and requires a necessity of its finalizing at the following exploration stages.

An exposed by erosion portion of the Razgah alkaline massif, with which a deposit is connected having the same name, is elongated in NW direction and measures about 1.2 to 3 by 6 km. The exploration area is situated in its central and eastern portions. The area features mainly the altered to a various degree pseudoleucitic syenites overlapped in its southern submontane region and on flattened regions of the divide by Quaternary deposits.

These syenites, with a characteristic ocellar structure, are mainly formed by ovoidal individual pieces (measuring up to 15-20 mm across) which represent an aggregate of fine grains of predominantly leucocratic minerals (common potash feldspar, plagioclase, altered nepheline, spreustein aggregates, natrolite, analcite, liebenerite, etc.). The ovoids are cemented by a medium-grained material of a nepheline-syenite composition, noticeably rich in coloured and ore minerals. Because of this they feature a considerably higher content of alumina (by 1.5 to 2%$_{abs}$) and that of sodium oxide (by about 0.5 to 1%$_{abs}$) and by lower content of iron oxides (by 1.5 to 2%$_{abs}$), oxides of magnesium and titanium as compared with an average rock composition. Thus the change of content ratios between the ovoids and cementing material is likely to influence a chemical composition of the rocks and, correspondingly, their quality parameters as a complex alumina-bearing raw material.

At the same time the major factor determining a geological structure of the deposit and also considerably influencing a chemical composition and quality of the ores is the presence of faults controlling the location of the areas of development of the altered rocks and dykes, and, correspondingly, of lower quality ores. Within the boundaries of the explored area the following four major faults are distinguished, directionwise: 1) sublatitudinal; 2) submeridional; 3) north-western; and 4) north-èastern. Considerable in width and length zones (down to 100 m deep) of the zeolitized and kaolinized rocks are mainly connected with the north-western and sublatitudinal faults, while dykes are mainly controlled by NE and submeridional faults.

On the basis of the tests data and of an aerial photographs interpretation in the centre of the explored area a site was identified of development of pseudoleucitic syenites with a minimum development of faults and of rock alteration zones.

Analysis of the results of geological-exploration works and the data from field prospecting of the Razgah deposit allowed to identify three main types of nepheline-bearing ores - A, B and C and the most widespread type of impoverishing rocks - type D. The type A ores featuring the least degree of alteration, has a predominant occurence on the explored area (about 68%). The type B ores featuring a higher (on average, by $10\%_{rel}$) content of K_2O and SiO_2 (on average, by $1.5\%_{rel}$) and at the same time a sharply reduced content of Na_2O (by $70\%_{rel}$) are on average, about 8.7%. The type C ores featuring a lower (as compared with type A) content of Na_2O (by $56\%_{rel}$), K_2O (by about $6\%_{rel}$) and Al_2O_3 (by about $1.5\%_{rel}$) constitute about 15% of the explored area. The type D rocks featuring a sharply higher content of CaO and Fe_2O_3 and simultaneous considerably lower content of Al_2O_3 (by about $16\%_{rel}$), Na_2O (by about $65\%_{rel}$) K_2O (about $26\%_{rel}$), SiO_2 ($8.5\%_{rel}$) occupy on average about 7.5% of the total area.

While investigating the exploration area, along with the above types of ores and impoverishing rocks, considerable in scale silicization zones (up to 600 m long, 50 to 60 m wide) were identified, mainly controlled by submeridional and NW faults. To exclude a possible negative effect of these formations on quality of ores within an area earlier proposed for exploration, two new reserve calculation blocks were delineated - the Western and the Eastern ones. For these blocks the reserves were evaluated in accordance with the classification of reserves developed in Russia. Due to a wide occurence within the Razgah deposit of faults, connected with them zones of low-quality altered rocks, as well as a possible presence of a vertical zonality, it is classed as the second group of complexity of a geological structure. Calculation of reserves for deposits of this group make sense for categories B, C_1 and C_2, including commercial categories B and C_1. Due to lack at present of the exploration results using boreholes, an evaluation of an in-depth ore quality is possible within the erosion downcutting only based on the results of sampling of the main trenches. An evaluation of the reserves and of an average quality of the ores was carried out by the vertical parallel sections method along the lines of trenches No.4 and No.9 for the Western block and Nos.3, 10, 2 for the Eastern block.

The total reserves within the Western block are 38.7 mln.t, within the Eastern block - 62.2 min.t. The overall reserves of these tw blocks are 100.8 mln.t with an average content of Al_2O_3 - 19.87%; Na_2O - 3.25%; K_2O - 9.70%; SiO_2 - 55.19%; CaO - 2.49%; Fe_2O_3 - 3.73%. It should be noted that because of lack of the results of a chemical analysis for all the cuttings an average quality of ores was evaluated only for trenches Nos. 2, 3, 4 and is (in situ), as follows:

Average chemical composition of the ores
in the blocks identified

Table 1

Block	Average content, %					
	Al_2O_3	Na_2O	K_2O	CaO	SiO_2	Fe_2O_3
Western	20.29	3.11	9.72	2.25	55.79	3.27
Eastern	19.59	3.35	9.82	2.64	54.83	4.01
Total	19.87	3.25	9.78	2.49	55.19	3.73

The data on average composition of the ores to be clarified on the basis of the results of sampling in all the cuttings included into a block used for reserves calculation. It should be also noted that the results of comparison of the chemical analysis data of the common samples, carried out in the ARMP and VAMI laboratories, have shown the presence of significant deviations in determinations of SiO_2, Al_2O_3 (class 10.0-19.9%), K_2O (class 5.0-9.9%), with the ARMP determination results being higher in SiO_2 and lower in Al_2O_3 and K_2O with respect to the VAMI laboratory results. This testifies to the fact of necessity to clarify in the future the analysis procedures and their standardization. Taking into account an established deviation value in determining these components an average ore composition for carrying out techno-economic calculations was assumed as follows, %: Al_2O_3 - 20.0; K_2O - 10.2; Na_2O - 3.2; SiO_2 - 54.9; Fe_2O_3 - 3.7; LOI - 3.2; S - 0.03; Cl - 0.007.

The chemical and mineralogical composition and processing properties of the Razgah nepheline ore have been studied at VAMI using a material of the three characteristic bench-scale samples of the main types of ores and of one sample of impoverishing rocks. Along with this the chemical and mineralogical composition of 23 common samples of nepheline-bearing rocks of the main types has been studied.

The Shiramin limestone deposit being considered as a source of supplying the nepheline complex with a carbonate raw material for production of alumina and cement, is situated at about 60 km (along a straight line) south-west of Tabriz, at 2 to 3 km north of the Shiramin village. It is readily accessible, close to an asphalt motor road and at 4 km from Shiramin railway siding. There is an unsurfaced road between the motor road and the siding.

A deposit area features a dissected middle-height topography with absolute elevations of the divides up to 1,700 m and relative elevations of 200 to 300 m.

A state geological map, scale 1:250,000 is available for an area in vicinity of the deposit. In the early 60 s, when exploring the deposit for a carbonate raw material to be used in lime production a geological map, scale 1:20,000, was compiled for a deposit vicinity area and a map, scale 1:[illegible] for an explored area. Unfortunately, a usage of the results of previous works is limited by a considerable difference in requirements on quality of the carbonate raw material for alumina production.

Point sampling of limestones carried out by ARMP together with GSI along 3 exploratory profiles across the course of a carbonate rock formation makes it possible in a very preliminary way to evaluate their quality and potential resources, as sampling was carried out without cuttings and sampling points were not instrumentally sited. The length of intervals made of limestones meeting the alumina production requirements is in the range from 300 to 1,000 m reaching the maximum in a western portion of the deposit. In the section two limestone layers are distinguished of this quality with an identified depth of 50 m each. At the same time, not in a single of these profiles these layers were sampled to a full depth, and their strike and dip were not determined.

From the test results the limestones within the limits of practically all the intersection in relation to silica content (0.24 to 1.3%) and iron oxides (up to 0.11%) fully meet the alumina production requirements. At the same time a magnesium oxide content in about 25% of the samples exeeds the threshold limits. Here one can see a random alternation of the rocks containing about 0.5% MgO and less and rocks containing from 1 to 2% MgO. Both of the sampled grade-quality limestone layers are underlined and covered with highly dolomitized varieties which will dictate a necessity of a rigid selection of off-grade varieties when mining the raw material and thorough blending to ensure its quality. From the results of a check chemical analysis of the technological sample composed of 135 common samples collected within the limits of a productive interval along 3 profiles, the limestones meet the alumina production requirements (SiO_2 - 0.56%; MgO - 0.7%; CaO - 55.2%; Fe_2O_3 - 0.04%). As far as a sulphur content is concerned, which is a process detrimental impurity, the limestones included into the samples feature a better quality in comparison with a raw material used at the Achinsk plant. Taking into account the limitations and a very preliminary nature of the geological materials available, as well as a possibility of a lower quality material due to dolomitized varieties contained in limestones, for carrying out the techno-economic calculations the following composition of limestones to be used in alumina production, %: CaO - 55.0; MgO - 0.7; SiO_2 - 0.6; Fe_2O_3 - 0.05; Al_2O_3 - 0.07; S - 0.03; LoI - 43.3.

Appendix 2

The Results of Technological Studies of Nepheline Ore Characteristic Samples and of Limestone Samples of Shiramin Deposit

The analytical investigations and bench-scale studies of the main types of Razgah ores have been carried out using characteristic samples.

Sampling was performed by ARMP in accordance with a procedure prepared by Russian experts on the basis of the results of geological exploration works carried out by ARMP. A final sample blend preparation was conducted by VAMI experts after a check chemical analysis of the common samples used in preparing the characteristic samples. Limestones from a promising Shiramin deposit were used as an auxiliary carbonate raw material, with the duplicate common samples submitted by ARMP.

While preparing the characteristic raw material samples and studying their chemical and mineralogical composition, the following was carried out:

1) check chemical analysis of 150 common samples of nepheline-bearing rocks and of 120 samples of limestone.

2) chemical and mineralogical study of the main types of nepheline ores and of impoverishing rocks using the characteristic samples;

3) mineralogical-petrographic study of 20 common samples of nepheline-bearing rocks of Razgah deposit;

4) study of a chemical composition of Shiramin deposit limestone using common samples with the aim of separating varieties which could be used as an auxiliary raw material for production of alumina and in preparation of a characteristic sample for technological study.

The geological studies performed made it possible:

- to establish a possibility of usage, when preparing a draft opportunity study, of the results of analyses obtained by an ARMP laboratory;

- to separate, on an explored area of Shiramin deposit, sections made up of limestones suitable for production of alumina and to obtain preliminary data on composition of a carbonate raw material for the nepheline complex;

- to determine a mineralogical and chemical composition of the main types of nepheline-bearing ores and of the most predominant at Razgah deposit impoverishing rocks, showing the main peculiarities of their change within each of the types and of a distribution balance of the main chemical components by the major groups of minerals. A predominant role was shown in composition of the rocks and ores studied of feldspars, constituting up to 60% of a total rock volume and containing a major portion of alumina (over 50%), sodium oxide (up to 60%), potassium oxide (about 81%) and silicon oxide (about 65%);

- to establish that it is not advisable to mechanically beneficiate the Razgah ore due to a small increase of alumina and alkalis content accompanied by a simultaneous considerable increase of a silica content;

- to show that a higher commercial ore quality is possible mainly through an increase of a content in balance reserves of type A ore, as well as through selective mining and piling of B and C types of ore, and especially of impoverishing rocks of D type;

- to determine an approximate average composition of the nepheline-bearing ore for techno-economic calculations.

When carrying out the technological studies, the use was made of characteristic samples of the nepheline ore prepared from the common samples of ore collected by ARMP from the surface of Razgah deposit, as well as an average sample of Shiramin limestone.

An average content of the main components in samples A,B,C,D was as follows: Al_2O_3 - 20.2; 19.4; 19.9; 16.8%; SiO_2 - 54.7; 55.1; 54.6; 52.1%; Na_2O - 3.6; 0.84; 1.5; 1.4%; K_2O - 10.3; 10.5; 10.2; 7.7%. From the data of geological study of the surface of Razgah deposit an area was identified with reserves adequate for mining operations, with an average content of characteristic types of ore A;B;C and D being 90.3; 7.9; 1.8 and 0%, respectively, and an average content of the components was as follows, %: 54.9 SiO_2; 20 Al_2O_3; 3.2 Na_2O; 10.2 K_2O; 3.7 Fe_2O_3; 2 CaO; 0.075 SO_3. A prepared characteristic sample of limestone from Shiramin deposit contained (%): 43.3 LOI; 0.68 SiO_2; 0.13 Al_2O_3; 0.29 Fe_2O_3; 55.4 SiO_2; 0.69 MgO. According to the contract terms and conditions the following bench-scale technological studies were carried out:

Sintering feed preparation

- grindability studies of the four characteristic samples of nepheline raw material and of limestone;

- analysis of the results of studies and of idustrial experience in operation of the Achinsk alumina plant was performed. On its basis a raw material grinding flowsheet was selected, with hourly rates of raw mills and a water content of raw feeds determined.

Sintering

- for each of the four characteristic ore samples an effect was studied of contents of the feed components, of the size of ground components, how a sintering temperature affects a degree of formation of alkaline aluminates and the porosity of sinter. Rational compositions of the feeds for sintering were determined. While analyzing the results of studies as well as of an industrial experience by calculation an expected chemical recovery of components from the sinter was determined when processing a nepheline raw material of average composition from Razgah deposit;

- on the basis of industrial experience a specific fuel consumption was determined in the process of feed sintering and an hourly output of rotary kilns.

Sinter leaching

- grindability of the sinter was studied for wet grinding as well as mud settling rate when using a flocculant. In this case the sinters were used which were produced on the basis of each of the four characterisitc nepheline ore samples at an average sintering temperature;

- on the basis of the results of studies and of an industrial experience the following was determined: a specific output of the sinter wet grinding mills and of slurry thickeners; a number of washing stages; a water consumption for mud washing; an aluminate liquor composition; a chemical recovery of aluminium oxide and of alkali from the sinter; a chemical composition of a belite mud when processing an average composition nepheline ore of Razgah deposit.

Autoclave desilication

- within a range of a possible varation of the alumina liquor composition obtained after sinter leaching the following was studied. an effect of temperature (90 to 180°C), duration (3 to 5 hours), seed content (0 to 50 g/l) on a desilication degree and on composition of an autoclave white mud. The rational conditions were selected of carrying out a process at about 160°C, duration 3 hrs with a content of recycled autoclave mud of 15 to 16 g/l, which ensures a silica modulus of the liquor of 350 to 380 units.

Deep desilication

- within a range of a possible varation of the aluminate liquor composition at 95°C an effect was studied of a lime content (6 to 10 g/l CaO_{act}) and of duration (2 to 6 hrs) on the degree of desilication. The rational process conditions were determined as follows: duration - 4 hrs, lime content - 8 g/l CaO_{act} which ensures an A/S ratio of a desilicated liquor at the level of 2400 units which is required for producing alumina containing less than 0.03% SiO_2.

The studies on carbonization and precipitation of an aluminate liquor for recovery of aluminium hydroxide as well as on calcination of alumina were not carried out. The process parameters for these process stages were determined on the basis of an industrial experience.

As far as a cement production is concerned, the bench-scale studies were performed of sintering the feed produced from a belite mud (which was obtained when leaching the sinter prepared from an average composition nepheline ore of Razgah deposit), Shiramin limestone and clay. Sintering of the feed was carried out at 1350 to 1450°C to produce cement clinker of a normal chemical composition (66% C_3S, 16% C_2S, 5.4% C_3A, 11.2% C_4AF). By the results of studies a portland cement quality produced from a belite mud corresponds to the standards used. The process parameters of the cement production stages were determined by calculation with the use of an industrial experience.

Following an alkaline carbonate liquores processing technology having a possible average composition, a calculation analysis was carried out of solubility diagrams of a five-component system Na^+ - K^+ - CO^{2-} - SO^{2-} - Cl^- based on the literature data. The separation conditions were determined, as well as compositions of the solid phases and liquors, parameters of the process including a liquor concentration evaporation, dissolution of a double salt, sodium carbonate production evaporation, cooling the liquor down to 35°C for separation of potassium sulphate, further evaporation of the liquor for separating the double salt to be returned to the beginning of the process, evaporation and cooling down to 60 to 65°C of a spent liquor for separation of potash. When carrying out the studies the conditions were determined of repulping anhydrous sodium carbonate washing for reducing its potassium and sulphates content (t = 80°C, L/S about 1), a composition was determined of potassium sulphate and of potash separated from process liquors. Experimentally a possibility was shown of producing sodium carbonate, potash and potassium sulphate of the quality required. On the basis of the results of studies and on an industrial experience the parameters were determined of a polythermal decomposition process of the alkaline carbonate liquor which can be produced when processing a nepheline raw material of Razgah deposit, as well as composition of sodium carbonate, potash and potassium sulphate.

The carried out technological bench-scale studies of the four characteristic nepheline raw material samples of Razgah deposit and of limestone of Shiramin deposit made it possible:

- to determine the equipment flowsheets for processing a nepheline raw material by sintering for production of alumina, sodium carbonate, potash, potassium sulphate and portland cement;

- to determine the main parameters of the process and specific outputs of the main process equipment for all the integrated processing stages;

- to find out an effect of possible changes in composition of a nepheline ore of Razgah deposit on the process parameters;

- to obtain the parameters determining consumption of the raw materials, power, miscellaneous materials and an output of the products (alumina, sodium carbonate, potash, potassium sulphate and portland cement) through the usage of integrated processing of an average composition nepheline ore of Razgah deposit, required for a project opportunity study on integrated use of the Razgah nepheline ores, Iran.

The results of bench-scale technological studies are given in detail in Report No.2 and were used for selecting the equipment, determining the process parameters, consumption factors and other parameters when preparing a final report on studying an opportunity of the project in Iran processing the nepheline ore.

Appendix 3

Memorandum
on the results of consideration and discussion
of the Draft Final Opportunity Study Report (IIIa) of
UNIDO Project US/XP/IRA/92/022 - Contract 90/204/205

The discussion was held in UNIDO, Vienna, within the period 27 January 1991 - 4 February 1992.

Participants:

From ARMP, Teheran

Mr. M. Nadali, Representative of Deputy Minister of Non-ferrous Metals in ARMP, NPD and Team Leader
Mr. I.R. Kia, Financial and Administrative Consultant of the Deputy Minister for Non-ferrous Metals
Mr. A. Chekad, Technologist
Mr. M. Mussavi, Cost Estimator
Mr. F. Parviz Farzam, Economist
Mr. M. Madadi, Interpreter

From VAMI - St. Petersburg

Mr. G.A. Kaim, Team Leader
Mr. L.A. Klyuchanov, Process Engineer and Engineering Design
Mr. A.M. Nemchin, Economist
Mr. E.A. Voronov, Interpreter

From UNIDO

Mr. V. Iliev, BSO of the project, IO/T/MET

A. Issues discussed and Results

1. The parties have considered the Draft Final Opportunity Study Report (Report No. IIIa) which contains data showing technical feasibility of processing Iranian nepheline ore of Razgah deposit by the VAMI method to produce alumina, cement, sodium carbonate and potash. VAMI experts noted that the adopted project engineering concepts are the optimum ones for the nepheline ore of a specified composition and ensure a capacity of production of 200,000 tpy of alumina with corresponding tonnages of co-products.

2. The parties discussed the questions of the Iranian side raised in a telex dated 18 January 1992 as well as additional questions raised by the Iranian side in the course of discussions. For the Iranian side questions and answers by the Russian experts see Appendi: 1 to the Memorandum.

3. As requested by the Iranian side, the questions were considered also on Report No. 2 contained in Appendix No 2 to the Memorandum dated 10 October 1991 as well as additional questions submitted by the Iranian side. For all the answers see Appendix No. 2 to the present Memorandum.

4. The Iranian experts draw attention to the fact that in their opinion, construction costs of the plant are high. During the discussions the Iranian side gave explanations on the correctness of the rates for various types of civil works given in the Initial Data and submitted to the Soviet side in May 1991. Concerning the existing difference between Rials portion figures of the Draft Final Report and the preliminary estimated figures by the Iranian side, as well as the lack of justification for some of the costs such as pre-production costs, and if in the Final Report the same figures of recalculated ones are still contrary to those estimated by the Iranian side, the reason of this difference should be clarified and explained in any possible way so that neither the parties nor UNIDO are dissatisfied. The results obtained should be reflected in the Final Report.

B. AGREEMENT AND RECOMMENDATIONS

1. The Draft Final Report at the Project Opportunity Study stage was prepared in accordance with the requirements of UNIDO Contract No. 90/204/205.

The Final Report should take into account the answers given by the Subcontractor in Appendices No. 1 & 2.

2. The Final Report will consider only one variant of a cement production capacity for a full utilization of belite mud with the use of a local clay as an additive. An estimated cement production capacity is 5,585,000 tpy with a specified alumina production capacity of the project being 200,000 tpy.

3. In the Final Report the price of US$ 200 per ton of alumina to be assumed as reflecting the present situation on the world market.

4. The bench -scale studies carried out on separation of carbonate salts made it possible to develop an equipment flowsheet and to select equipment at the opportunity study stage. Taking into account a difference between the Iranian nepheline ore ((a high potassium content) and a nepheline ore processed on an industrial scale in Russia, for obtaining the guaranteed parameters on separation of carbonate salts when processing the Iranian nepheline ore some further testing is required which cannot prevent from taking a decision on constructing the plant at this stage.

5. The following timing for preparation of the final report was agreed:

- Submission of the results from the costs recalculation - within 10 days from the date of arrival of the Subcontractor's team to St. Petersburg.

- Submission of Iranian comments on the above results - within 3 days from receipt of the results.

- Submission of the Final Report one month later, but not beyond 20 March 1992.

Vienna, UNIDO, 4 February 1992

Signed:

For UNIDO	For ARMP	For VAMI
V. Iliev, IDO, IO/T/MET	M. Nadali, Team Leader	G. Kaim, Team Leader

Appendix Nr. 1 to
Memorandum of 4/2/92

Answers to Questions raised by the Iranian Delegation on the Draft Final Report

1. The Iranian delegation confirmed 30 January 1992 the correctness of unit costs for various kinds of civil works given in the initial data submitted to the Soviet side in May 1991.

In the final report an example will be given of calculations of the civil works costs in Rials based on unit costs and physical quantities for two production buildings.

2. The calculation of depreciation will be finalized on the basis of results obtained for the cost of civil works given above in Item 1.

3. In the Final Report the contribution of both the Iranian and Soviet sides for financing UNIDO contract Nr. 90/204/205 will be given.

4. In the Final Report the following will be given:

"An alumina production capacity of the plant is determined by the contract as 200,000 tpy."

5. The characteristics of alumina given on page 16, item 3.4.1 describe an actual alumina produced from the nepheline raw material. This alumina differs from a Bayer process alumina by a needle-like structure instead of a spherical structure characteristic for the Bayer alumina. It has a high specific surface area and dissolves well in bath (electrolyte) during the electrolysis of aluminium.

6. This comment is accepted. The Table, item 5.5, page 33, will be corrected.

7. A typing error. The slope is 2%.

8. The explanations are given confirming the correctness of the data in Table 6-3.

9,10,11,12. The questions are caused by an error on pg.48. The amount of limestone sent for burning is 8 T/hr. In this connexion in the Final Report the data on an hourly rate of limestone will be corrected.

An hourly rate of limestone sent to cement production is given for a variant using local clay with the complete utilization of belite mud.

13. A typing error in the translation. The third and fourth grinding stages operate on a mixture of nepheline and limestone. A different capacity of the mills at each stage is due to a fineness of grinding at each stage as well as grindability determined in the course of bench-scale studies which are given in Report II.

In the Final Report the explanations will be given on a quantity of mills at each raw mix grinding stage taking into account the reserve mills.

14 and 15: Additional explanations will be given in the Final Report on desilication operation, as well as on operations of carbonization and precipitation (item 6.4.11).

16. Page 55 - the last line but one should start "For dessilication.......", and not "After......)".

17. On page 66, item 6.10, the categories of the reliability of power supply are given and not the safety categories as it is given in the Draft Final Report. It will be corrected in the Final Report.

18. 100 mln. m3/year - a consumption of recirculating water.

19. On page 67 an explanation is given for disposal of an off-grade mud only. Usually for normal work and a stable production process all the mud is transferred to the cement plant as it is shown on the flowsheet. In this case a portion of the mud with a water content of 40% is used for preparing a mix in a clinker production. The remaining mud is filtered, dried and used as an additive to clinker in dry grinding for cement production.

20. See Item 1.

21. The Tables will be corrected in the final report. On figures in Rials - see item 1.

22. The figures for consumption were determined in accordance with the initial data supplied by ARMP which coincides with those normally used in the world engineering design practice.

23. In the Final Report the data will be given only for the variant of a complete usage of belite mud with an addition of local clay. For a plant producing 200,000 tpy of alumina an amount of co-produced cement will be 5,585,000 tpy.

24. In the Final Report additionally the capital investments will be given separately for the alumina, cement and carbonates production plants.

25. Depreciation was calculated on a computer and was printed as a total sum. At this stage a breakdown of depreciation by individual components is not required.

26. Number of non-production personnel for individual product plants can be distributed hypothetically, but it is not envisaged in the Terms of Reference. Division of a auxiliary personnel for individual production plants will result in an increase of its number for the complex as a whole by 40 -50%.

27. In the Final Report a rough preliminary structure of pre-production costs will be given.

28. It will be done in the Final Report for a recommended variant.

29. The calculations were performed for a capacity specified.

30. Sensitivity analysis will be carried out in the Final Report for a recommended variant with variable capital investments, operating costs and prices of the products.

31. The layout has been prepared for a plant where integrated processing of a nepheline raw material is carried out. Division of the nepheline complex into individual plants will result in an increase of area required, as well as in larger auxiliary facilities, in an increased number of service personnel and it will make the economic parameters worse. If requested by customer, the above facilities can be envisaged as individual plants at the next project implementation stage.

32. Table 55 will be corrected. The cost of mazut facilities is included into the capital investment costs, and the cost of a reserve amount - into the working capital. Page 64 states that mazut is a reserve fuel. An economic comparison for the reserve fuel is not required.

33. The Project Opportunity Study has been prepared in accordance with Sub-contractor's norms. An increase of the nepheline ore reserve is not required as it will result in a bigger working capital and in lower economic parameters.

34. For an answer see Appendix No. 1, item 24.

35. Pre-production costs will be finalized and divided into individual components. Contingency will be shown as a separate line.

36. At the Project Opportunity Study stage it is premature to compile a list of spare parts and it is not required by UNIDO methodology. The Final Report will give components of the total capital investments including the spare parts costs.

37. Taxation to be excluded.

Attached to Appendix Nr. 1
to Memo of 4/2/92

List of Questions raised by the Iranian Delegation on the Draft Opportunity Study Report IIIa

1. All figures in Rls. on page 7, para. 1.64 are incorrect (at least to times more).

2. The same on page 8, para. 1.6.3.

3. It has been stated on page 11 of the Draft that budget of the project has been provided from % Soviet contribution! ?

4. Regarding capacity of the plant, it has been stated on page 16, para. 3.3 that it is in accordance with the country's requirement which is not correct.

5. On page 17, physical specification of alumina is given, but incomplete. According to this specification, the produced alumina from the point of view of specific level is similar to that of sandy alumina and from the point of view of particle size similar to that of floury one. (This probably points to the fact that using your method what is produced is the small size particle alumina and then by lowering temperature of calcination increase the specific level of alumina; therefore, it is necessary, in addition to other specifications that will be supplied, to give the reason for priority of settling process in low temperature for small size particle.

6. On page 33, para. 5.5, mazut has been determined as required fuel and the quantity of produced cement as 4.5 M. tonne which neither is in conformity with original hypothesis and the changed materials.

7. On page 34, the slope of railway is said to be 20% and the quantity of load to be carried 72M. tonnes, which is not correct.

8. On page 46, Table 6-3, neither figures nor the title is correct.

9. On page 48, the amount of limestone to be used for production of cement is said to be 420 tonnes per hour, while, regarding special consumption of limestone for cement production, cement production would amount to 5.2M. tonnes. Besides, by giving few variants on page 47, 33, for different quantity of cement the whole thing is so mixed up and cannot be easily comprehended.

10. On page 46, the amount of required limestone for alumina plant is given as 350 T/H which is different from that on page 64 and also the figure is given on page 49.

11. On page 48, the amount of limestone to be used for calcination is given at 80 tonnes per hour, which is different from that of page 55, on which the figure is 3 x 138.8.

12. On page 48, the quantity of limestone to be consumed in the plant has been determined at 770 tonnes per hour, which is over and above the capacity of the mills which is only 1300 T/H at two shifts.

13. On page 49, para. 6.4.6 mills are for the 3rd and 4th stages of mixed materials which mistakenly is said to be used for nepheline ore. In the same para., we could see the reason for different capacity of the mills.

14. On page 52, para. which begins "Product of the..." (Line 7), is not clear and difficult to understnad.

15. On page 53, para. 6.4.11, it seems that the product of hydrate is extracted from carbonization section and there is nothing mentioned about hydrolysis section. While at Achinsk plant hydrate is a product which is extracted from hydrolysis section, in carbonization department only seed is produced.

16. On page 55 (the para.) the objective of the operation has not been specified.

17. On page 66, para. 6.10, you have mentioned something about catagory I and II which requires more explanation.

18. On page 66 the quantity of required water is said to be 100 M.[CM] which seems to be only circulating water, which is not very clear.

19. On page 67 there is some explanation about the waste mud which will be pumped out with ratio $\frac{S}{L} = \frac{1}{4}$ but as in flow sheet page 40 (main section) the whole belite would go directly from leaching section into cement production unit and on page 106, there are some very unclear statements about list of machineries and the way of drying the mud, filtering and so on. which are not in conformity with the original statement.

20. On pages 79 and 80 figures in RLS are not correct (probably ten times more!)

21. On pages 81, 82, 83, all Dollars and RLS. figures are displaced and the RLS. figures are all mistaken.

22. On page 87, para. 9.5.3 repair and maintenance is considered to be according to Iranian norms which should not be so because this depends on the kind of equipment and technology adopted and in this case it is preferred that your experiences be considered instead.

23. Nowhere in the Draft Final Report is there any mention of machineries for what capacity of cement production unit.

24. Costs of buildings and installations for alumina, carbonates and cement production units have not been given separately.

25. No table is given for complete depreciation for duration of plant operation.

26. Number of personnel for each non-producing units separately.

27. Various items of pre-production costs to be determined (including production costs).

28. The breaking point and internal date of return to be discussed through a rekated fig.

29. Determination of optimum capacity from economic point of view and the existing information.

30. Sensitivity analysis of the project in relation to a change in investment, capacity, etc. to be investigated.

31. The layout that you have delivered to us is for complex. Would you be kind enough to give us two layouts, one for the cement plant and one for the alumina and alkalies plant.

32. The Draft Final Report does not indicate that mazut is used as a reserve fuel (pg. 65). An economic comparison of variants should be given with the use of natural gas and mazut.

33. Table 4-7, page 25, shows that a minimum reserve of nepheline ore is assumed to be 7 days, which is not enough.

34. Construction costs should be given separately for the alumina, cement and carbonates plants.

35. Pre-production costs (US$ 84.4 mln and RLS. 118749.9) to be revised. Their structure to be given.

36. A list of spares to be given and their cost based on sub-contractor's experience.

37. Page 95 gives taxes calculated for a profit in hard currency. The payback period and investments shown there are not correct. There is no taxation for governmental projects.

Appendix Nr. 2
to Memo of 4/2/92

Answers to Questions contained in Appendix No. 2
to Memorandum of 10 October 1991

1. For a low alkali content in the ore required for the process ratio between alkali and alumina is ensured at the expense of recycled alkali. In this case the losses of alkali in sintering as well as in leaching the sinter should be compensated for with alkali which comes with the nepheline ore. Because of this if a recycle alkali flowrate increases, the recovery of alkali from the nepheline ore decreases.

2. In the Final Report on alumina density, an angle of repose, as well as short explanations on structure of alumina will be given.

3. The formula on page 170 of the Report No. 2 is an empirical one and applicable only to clay used at the Achinsk alumina plant.

4. The procedure developed at VAMI and an industrial experience allow to use the results of laboratory studies for design calculations of industrial kilns. In laboratory conditions the chemistry of the process is determined as well as sintering temperature and duration. The parameters for design calculation of rotary kilns: diameter, length, slope, number of revolutions per minute, etc. are determined according to the VAMI procedure. The material movement, kiln slope, and RPM are studied on a laboratory unit equipped with rotating drums.

5. According to the contract, all four samples were studied. The grindability, sintering, leaching, settling with the use of a flocculant were studied for all of them. In this way the quality of the ore was studied and how it affects the possibility of changing the process parameters. The most characteristic ore of Type A was studied in the full volume. The study in a full volume of other types of the ore is not required according to the VAMI procedure, as an ore quality does not affect the remaining production operations.

6. On the basis of technological testing the Razgak ore samples were determined the optimum process parameters adopted when developing the project design concepts of the POS. During the studies the obtained parameters were compared with the industrial data on processing nepheline ore at the Achinsk alumina complex. According to the Achinsk data the use of a coarser raw mix grinding reduces a recovery of alumina and alkali from the sinter, and a finer raw mix grinding increases a dust carry-over from the kiln and the losses of both alumina and alkali contained in this dust. On the basis of this an optimum size distribution of the ground Iranian ore was determined which is described in the text as "normal".

7. In the Final Report the data will be given on specific power consumption for grinding the Iranian ore.

8. When carbonizing an aluminate liquor all the alumina is extracted from the liquor as hydrate. In this case silica is extracted together with hydrate. Because of this on the basis of a industrial experience for producing a high-quality alumina a silica modulus of the aluminate liquor before carbonization should be 1,500 - 2,000 units. In a soda-alkali branch

(stream) where alumina is produced by precipitation (as hydrate) a silica modulus can be 300 - 400 units. A solubility curve will be given at a later date.

9. As it is mentioned in Item 8, during carbonization the silica from a liquor goes into the hydrate. In this case for ensuring a required quality it is necessary to carry out an operation of deep carbonization of the liquor. The size of particles also depends on carbonization conditions: rate of a gas supply, temperature, duration. The data on how the process parameters affect a carbonization operation will be given later.

10. VAMI has industrial experience in processing the nepheline ore with a high sodium alkali content. The studies carried out on separation of carbonate salts from liquors with a high potassium content made it possible to obtain the main parameters required for preparing the POS. More detailed studies are required for finalizing the data obtained. The performed tests on separation of carbonate salts on a bench scale allowed to prepare an equipment flowsheet and to select equipment at the POS stage. On the basis of the above tests a decision can be taken on possibility of processing the Iranian nepheline ore on an industrial scale. For obtaining the guaranteed parameters on separation of carbonate salts further tests are required, and the carrying out of these tests does not prevent from taking a decision on erection of the plant. These tests can be carried out at the project basic engineering design stage.

11. According to the VAMI procedure the determination of grindability of individual components makes it possible to determine grinding parameters of the mix. Because of this there is no necessity to conduct laboratory tests on grindability of the mix.

12. A composition of the liquor given on page 213 is the composition of an industrial liquor at the Achinsk alumina plant. When using the formula given it is necessary to take into account both caustic and carbonate alkalis.

13. The Final Report will include a separate chapter on evaluation of the reserves and quality of the nepheline ore on the basis of Appendix No. 1 to Memorandum dated 10 October 1991.

Appendix Nr. 2 to Memorandum
dated 10 October 1991 - also
attached to Memo of 4/2/92

Some points of view in relation to the Report No. 2

1- On page 155 of the report it is stated that in case of low alkali content of nepheline ore (causes the modulus of alkali to below) because of recycling process of alkali liquor at the plant, efficiency of alkali recovery decreases. Clarification is requird here to show where and to what degree the wast of alkali content is accured.

2- On page 158 there the chemical specification of attainable alumina from nepheline ore has been given and pointed that the physical characteristic of alumina would be between sandy and floury type. It is necessary to determine the physical characteristic of alumina and explain those elements affecting production of coarse crystal alumina.

3- On page 170 it is stated that using mixed raw material of lime-stone and clay to produce cement the quantity of product would be equal to q = 1.65 x 9 mud. Concerning the relation, in case of using whole belite mud the quantity of cement to be produced would be less than 4 million tons (1,770,000 tons). Here in order to get a result, the analysis of the used clay should be given and also determine the quantity of produced cement.

4- On page 213 it is stated that the heating system of the lab kiln is analogous to that of industrial kilns with dimention of

85 x 185m and it can be used for modeling. As the lab. kiln is of vertical type and fixed but the industrial kilns are of rotating type it is necessary to investigate the blending and behaviour of materials, their visidity and attrition and then infer the lab modeling industrial kilns.

5- Though it has been envisaged in the contract that all technological test for obtaining optimum technological parameters to be performed on all 4 technological characteristic sampels but tests were mainly concentrated on only one sample, that is, sample A For instance the grindability tests on nepheline ore tests pertainting to the production of carbonates, leaching and tests on production of cement from the belite mud etc. this has been specified in some pages of the report such as pages 178 and 259.

6- According to the contract the aim of technological testing was to obtain optimum technologica' parameters of processing nepheline ore of Razgah deposit but as it is shown on the report the performed tests were aiming mainly of reach technical parameters similar to those of Achinsk's plant regardles of they are being optimum or not. For exampel, investigating the effect of changes of particel size on other stages of the process out of each characteristic samples (3 samples) with distribution of particle size have been taken which only one is analogous to that ore which is used in Achinsk's plant and is given the name normal! and the other two (samples) one finer and the other coarser are being left aside and all syntering tests were concentrated on the sample which is called normal. (this has been specified on page 205 of the report.)

7- It has been stipulated in the contract that by grindability test the work index of Iranian nepheline ore must be determined and specified. This index is a determining factor for required energy for grinding each ton of ore and from this different manufacturers can farcast and dertermine the type of mill to be used for the purpose. In the report only grindability of Iranian lime stone and nepheline ore in comparison with Russian ore were specified. If the Soviet experience is not available, tnen the design work and/or selecting a sound grinding system would become difficult.

8- On page 290 of the report it is stated that the yield of aluminium hydrate is obtained from a liqure which has already been used for the initial desilication and the liqore is used for deep desilication will be processed in carbonization branch and hydrate seed is abtined from this process. To clarify this, it is necessary to give solubility curve of silica under the condition of hydrolysis and carbonization of aluminate liqures.

9- On page 158 it is mentioned that the carbonization technology is a determining factor for the particle size of alumina and also its impurity. To clarify this point additional detailed explanation is required to determine also the mechanism affecting the process.

10- On page 330 in the conclusion it is mentioned that for recovery of alkalines more tests should be carried out. Here we would like to have more explicit explanations to clarify these points in connection with the process.

11- Crashing tests for each stone was done individually, but in case of grinding mixture, only calculations were carried out. On page 199, para. B., description of tests, necessary tests should also be done for the mixture.

12- On page 213 equations R_2O_{12} = 30 gpl,
Na_2O - 13.3 gpl, K_2O = 51 gpl, are not corresponding to the formula
$R_2O = Na_2O + 0.66\ K_2O$.

13- Final recommendations on the quantity and quality of reserve should be stated somewhere in the Report.

Appendix 4

ADDITIONAL ANSWERS TO CUSTOMER'S COMMENTS ON THE DRAFT FINAL REPORT

Item 2

Alumina, commercially produced from nepheline raw material at Achinsk and Pikalevo refineries with continuous liquor carbonization and precipitation, contains 10-15% of fraction +100 microns, 45-57% of fraction minus 40 microns, density is 3.47-3.6 t/m^3, bulk weight is 0.95-1 t/m^3, angle of repose is 38-43°, alpha alumina content is 27-30%, specific surface is 50-90 m^2/g.

Difference between physical structure of Bayer alumina and that of nepheline alumina is explained by the fact that with Bayer precipitation process crystals of aluminium hydroxide grow slowly and have spherical - plate-like structure.

With sintering process of nepheline raw material aluminium hydroxide is precipitated by carbonization of major part (60-70 %) of liquor, with resulted product to be used as seed for precipitation process. Aluminium hydroxide structure is mainly determined by carbonization process with fast liquor supersaturation, intensive formation of nuclei and crystal growth. The resulted alumina has a radially fibrous structure.

The latter give better adhesiveness of alumina particles, larger angle of repose and less dusting in aluminium smelting process.

Item 8

Silica content in alumina is determined by its sedimentation during carbonization and precipitation of pregnant liquor, pollution of liquor with flue gases coming for carbonization, the presence of solid phase (white mud) after polishing filtration and also depends on methods of alumina carbonization and calcination.

According to commercial operation of Achinsk Alumina Complex autoclave desilication of liquor coming to precipitation up to alumina/silica ratio of 350-400 units alumina production with SiO_2 content of 0.03% is possible with alumina/silica ratio in pregnant liquor coming after deep desilication to carbonization of 2500 units.

During carbonization of major part of pregnant liquor practically all silica is removed from liquor together with aluminium hydroxide and sent with seed for precipitation of the rest part of the liquor.

During precipitation of liquor with alumina/silica ratio of 350-400 units silica is not precipitated into solid phase and resulted soda-alkali solution is sent for sinter leaching.

As it was mentioned before total silica balance during decomposition of aluminate liquor is determined not only by its sedimentation with aluminium hydroxide in its carbonization and precipitation, but also by mechanical pollution with flue gases, with solid phase of muds present in liquors, lining during alumina calcining, and therefore can be determined by actual practical data.

Values of silica solubility in aluminate liquors do not fully govern silica content in alumina produced from nepheline raw material.

Appendix No.5

POTASH MARKETING

The major trends in use of the potash in the world are:

- optic glass production;
- liquid soap production;
- pigment production;
- absorption of hydrogen sulfide in gas cleaning systems;
- dehydration of various products;
- production of other potassium compounds (hydrocarbonate, oxide, sulfate, reagents, metallic potassium, bromide, chloride, borate, oxalate, silicates, etc) having wide application in the industry, medicine, agriculture, etc.;

According to available indirect data the consumption of potassium carbonate can at present be estimated at [illegible]000 tpy):

USA - about 100, FRG and Japan - approximately 50 each, major European countries 20 max each; overall markets of developing countries of Latin America and South-Eastern Asia are estimated to have consumption of 7-8 each.

Regarding production of potash, then for a number of reasons high degree of monopoly, specific nature of applications, high share of inside sales and supplies to their own affiliates, and as a rule, unavailability of information no data is published. However, a[illegible]ing to [illegible] of potash in [illegible] in USA, [illegible] FRG Netherland, Fra[illegible], Be[illegible], [illegible] Great Britain and Spain, Japan.

The largest European producer of potassium carbonate is FRG (4 companies with total capacities of 50,000 tpy). In USA in 19[illegible]2 total capacities for potash production amounted to 86,000 tpy. For other countries production of potash by end 80's did not exceed 10, to 20,000 tpy.

In the 80's world production and consumption of potash increased in average by 2-3% annually. It is expected that this tendency would be kept in the future with significant fluctuation by countries (with higher increase in developing countries, especially in South-Eastern Asia).

Available data on level of foreign trade prices of potash in the 80's indicate significant differentiation by years and countries. Prices of individual shipments are affected by a large number of factors, first of all, nature of the transaction and relationship between partners, quality of product and size of shipment. As a rule, new producer offer the product at significantly lower prices, while for individual spot purchases of small shipments the prices were significantly higher.

At present the average level of foreign trade prices for potash is about US $ 645/t. Given noticeable tendency for increase in prices for potassium carbonate in 80's, it is safe to suggest that for the period until the year of 2000 the prices will grow at a rate of 2-3% per annum and their level by 2000 may reach $ 780-860/t.

Based on above statement one can conclude that emergence at the world market of a new potash producer (Nepheline company in Iran) will be linked with significant difficulties.

ARMP should carefully investigate possible lines for use of maximum quantity of this product for internal needs of Iran, and first of all, as chloride-free potassium fertilizer or study in the future possibility of production of part of potassium salts as potassium sulfate enjoying high demand at the world market.

Contract № 90/204/205
UNIDO Project № US/IRA/90/251

PROJECT OPPORTUNITY STUDY ON INTEGRATED USE OF THE RAZGAH NEPHELINE ORES, IRAN BY METALLURGICAL PROCESSING INTO ALUMINA, CEMENT, SODIUM CARBONATE AND POTASH

Final Report

Volume II
DRAWINGS

NPO „VAMI"

VVO „TECHNOEXPORT"

ST.-PETERSBURG
1992

COMPOSITION
OF THE FINAL REPORT

Volume I. General Explanatory note.

Volume II. Drawings.

Volume III. Specifications of equipment.

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LIST OF TECHNOLOGICAL EQUIPMENT

ALUMINA PRODUCTION

NEPHELINE RECEIVING UNIT

NEPHELINE STORAGE

FINE NEPHELINE CRUSHING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
	NEPHELINE RECEIVING UNIT			
200	CAR DUMPER	Q=134 t	1	
201	APRON FEEDER	B=2400 mm	1	
202	BRIDGE ELECTRIC CRANE	Q=32/5 t	1	
	NEPHELINE STORAGE			
210	BELT CONVEYOR	B=1200 mm L=145 m	1	
211	REVERSIBLE BELT CONVEYOR	B=1200 mm L=50 m	1	
212	BELT CONVEYOR	B=1200 mm L=150 m	2	
213	DISCHARGE TROLLEY	FOR BELT B=1200 mm	2	
214	BELT CONVEYOR	B=1000 mm L=150 m	2	
215	MOVABLE APRON FEEDER	B=1000 mm	2	
216	BUCKET EXCAVATOR	$V=5\ m^3$	2	
	FINE NEPHELINE CRUSHING			
230	BELT CONVEYOR	B=1000 mm L=150 m	2	
231	DISCHARGE TROLLEY	FOR BELT B=1000 mm	2	
232	APRON FEEDER	B=1200 mm	2	
233	BELT CONVEYOR	B=1000 mm L=20 m	2	
234	AUTOMATIC BELT WEIGHER	FOR BELT B=1000 mm	2	
235	INERTIAL SCREEN	B=1750 mm L=4100 mm	2	
236	CONE CRUSHER	D=2200 mm	2	
237	BELT CONVEYOR	B=800 mm L=175 m	2	
238	BELT CONVEYOR	B=800 mm L=35 m	2	
239	BRIDGE ELECTRIC CRANE	Q=20/5 t	1	

RECEIVING AND COARSE LIME STONE CRUSHING
MEDIUM LIME STONE CRUSHING
FINE LIME STONE CRUSHING WITH SCREENING
LIME STONE STORAGE
LIME STONE CONVEYOR GALLERY

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
	RECEIVING AND COARSE LIME STONE CRUSHING			
1	APRON FEEDER	B=2400 mm	2	
2	JAW CRUSHER	B=2100 mm L=1500 mm	2	
3	BRIDGE ELECTRIC CRANE	Q=50/12.5 t	1	
	MEDIUM LIME STONE CRUSHING			
10	BELT CONVEYOR	B=1200 mm L=220 m	2	
11	INERTIAL SCREEN	B=2500 mm L=5000 mm	2	
12	CONE CRUSHER	D=2200 mm	2	
13	BRIDGE ELECTRIC CRANE	Q=20/5 t	1	
	FINE LIME STONE CRUSHING WITH SCREENING			
20	BELT CONVEYOR	B=1200 mm L=240 m	2	
21	DISCHARGE TROLLEY	FOR BELT B=1200 mm	2	
22	APRON FEEDER	B=1200 mm	10	
23	BELT CONVEYOR	B=1200 mm L=20 m	10	
24	AUTOMATIC BELT WEIGHER	FOR BELT B=1200 mm	10	
25	INERTIAL SCREEN	B=1750 mm L=4100 mm	8	
26	HUMMER CRUSHER	D=1600 mm L=1300 mm	8	
27	MOVABLE BELT CONVEYOR	B=800 mm L=25 m	10	
28	BRIDGE ELECTRIC CRANE	Q=10 t	1	
29	DOUBLE DECK INERTIAL SCREEN	B=1750 mm L=4000 mm	2	
30	VERTICAL CHAIN ELEVATOR	B=200 mm	2	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
	LIME STONE STORAGE			
50	BELT CONVEYOR	B=1200 mm L=155 m	2	
51	REVERSIBLE BELT CONVEYOR	B=1200 mm L=50 m	2	
52	BELT CONVEYOR	B=1200 mm L=400 m	2	
53	DISCHARGE TROLLEY	FOR BELT B=1200 mm	2	
54	WHEEL EXCAVATOR	Q=320 t/h	1	
55	BUCKET LOADER	V=7.65 m^3	2	
56	MOVABLE APRON FEEDER	B=1200 mm	2	
57	BELT CONVEYOR	B=1200 mm L=450 m	2	
58	MOVABLE BELT CONVEYOR	B=1200 mm L=15 m	2	

GRINDING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
100	BELT CONVEYOR	B=1000 mm L=240 m	2	
101	DISCHARGE TROLLEY	FOR BELT B=1000 mm	2	
102	AUTOMATIC BELT WEIGHER	FOR BELT B=1000 mm	2	
103	ELECTRICAL VIBRANT FEEDER	Q=160 m^3/h	3	
104	BELT CONVEYOR	B=650 mm L=30 m	3	
105	AUTOMATIC BELT WEIGHER	FOR BELT B=650 mm	3	
106	MILL	D=3.2 m L=15 m	3	
107	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	3	
108	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	6	
109	TANK WITH CHAIN AGITATOR	D=7.5 m H=9 m	2	
110	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	6	
111	MILL	D=3.2 m L=15 m	1	
112	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	1	
113	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	4	
114	TANK WITH CHAIN AGITATOR	D=7.5 m H=9 m	2	
115	CENTRIFUGAL PUMP	Q=70 m^3/h H=40 m	8	
116	BELT CONVEYOR	B=1200 mm L=470 m	3	
117	DISCHARGE TROLLEY	FOR BELT B=1200 mm	3	
118	AUTOMATIC BELT WEIGHER	FOR BELT B=1200 mm	3	
119	DISK FEEDER	D=2000 mm	4	
120	BELT CONVEYOR	B=650 mm L=20 m	4	
121	AUTOMATIC BELT WEIGHER	FOR BELT B=650 mm	4	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
122	MILL	D=3.2 m L=15 m	4	
123	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	4	
124	CENTRIFUGAL PUMP	Q=112 m^3/h H=40 m	8	
125	TANK WITH CHAIN AGITATOR	D=7.5 m H=9 m	2	
126	CENTRIFUGAL PUMP	Q=112 m^3/h H=40 m	8	
127	MILL	D=3.2 m L=15 m	4	
128	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	4	
129	CENTRIFUGAL PUMP	Q=112 m^3/h H=40 m	8	
130	TANK WITH CHAIN AGITATOR	D=7.5 m H=9 m	2	
131	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	2	
132	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	6	
133	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	6	
134	BRIDGE ELECTRIC CRANE	Q=20/5 t	2	
135	BRIDGE ELECTRIC CRANE	Q=50/12 t	1	
136	BRIDGE ELECTRIC CRANE	Q=5 t	1	

CORRECTION AND RETENTION BASINS

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
251	DISTRIBUTION BOX		3	
252	BASIN	D=12 m V=2000 m^3	12	
253	CENTRIFUGAL PUMP	Q=335 m^3/h H=37.5 m	4	
254	CENTRIFUGAL PUMP	Q=335 m^3/h H=37.5 m	6	
255	CENTRIFUGAL PUMP	Q=390 m^3/h H=50 m	2	
256	TANK WITH CHAIN AGITATOR	D=4.5 m H=4.5 m	2	
257	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	4	
258	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	6	
259	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	6	
260	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2.5 t	3	
261	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2.5 t	1	
262	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=5 t	1	
263	PASSENGER ELEVATOR	Q=320 kg	1	

SINTERING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
301	PNEUMATIC SCREW PUMP	Q=36 t/h D=200 mm	3	
302	FEEDER OF CHARGE	PISTON REGULATION	6	
303	ROTARY KILN	D=6.4/5.8 m L=190 m	3	
304	GRATE COOLER	S=68 m^2	3	
305	FEEDER	Q=30 t/h	6	
306	DRUM AFTER COOLER	D=6.4/5.8 m L=60 m	3	
307	BELT CONVEYOR	B=1200 mm L=250 m	2	
308	FAN	H=5.1 kPa Q=33000 m^3/h	3	
309	FAN	H=9.2 kPa Q=58000 m^3/h	9	
310	DISCHARGE CYCLONE	D=1200 mm	3	
311	SCREW FEEDER	Q=42 t/h	6	
312	SCREW FEEDER	Q=14 t/h	6	
313	ELECTROFILTER	S=129.8 m^2	6	
314	EXHAUSTER	H=6 kPa Q=420000 m^3/h	9	
315	SCREW FEEDER	Q=14 t/h	72	
316	RAKE CONVEYOR	B=320 mm L=21 m	6	
317	RAKE CONVEYOR	B=320 mm L=32 m	6	
318	CARGO ELEVATOR	Q=500 kg	1	
319	SLUICE FEEDER	Q=60 m^3/h	3	
320	TWO CHAMBER PUMP	D=1800 mm	3	
321	OIL.HUMIDITY SEPARATOR	Q=50 m^3/h	6	
322	GANTRY CRANE	Q=100 t	3	
323	BRIDGE ELECTRIC CRANE	Q=5 t	1	
324	ELECTRIC HOIST	Q=2 t	1	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
325	ELECTRIC HOIST	Q=3.2 t	1	
326	ELECTRIC HOIST	Q=3.2 t	3	
327	ELECTRIC HOIST	Q=5 t	1	
328	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=5 t	2	
329	DISK GATE	D=300 mm	24	
330	RAKE CONVEYOR	B=500 mm L=21 m	6	

SINTER HANDLING
SINTER LEACHING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
398	BELT CONVEYOR	B=1200 mm L=260 m	2	
399	INERTIAL SCREEN	B=1750 mm L=3500 mm	2	
400	BELT CONVEYOR	B=1200 mm L=27 m	2	
401	CONTINUOUS WEIGH FEEDER	Q=200 t/h	6	
402	BELT CONVEYOR	B=800 mm L=46 m	3	
403	BELT CONVEYOR	B=800 mm L=68 m	3	
404	VERTICAL HYDRAULIC CLASSIFIER		3	
405	ROD MILL	D=3.6 m L=5.5 m	3	
406	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	3	
407	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	6	
409	TANK WITH CHAIN AGITATOR	D=4.5 m H=6 m	2	
410	CENTRIFUGAL PUMP	Q=300 m^3/h H=30 m	6	
411	DISTRIBUTION BOX		2	
412	VERTICAL LEACHER	D=2 m	6	
413	BALL MILL	D=3.2 m L=4.5 m	3	
414	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	3	
415	CENTRIFUGAL PUMP	Q=300 m^3/h H=30 m	6	
416	THICKENER	D=8 m	3	
417	MIXER TANK	D=800 mm	3	
418	CENTRIFUGAL PUMP	Q=265 m^3/h H=22.5 m	6	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
419	1-ST STAGE WASHER	D=8 m	1	
420	MIXER TANK	D=800 mm	1	
421	CENTRIFUGAL PUMP	$Q=520\ m^3/h$ H=22.5 m	2	
422	2-ND STAGE WASHER	D=8 m	1	
423	MIXER TANK	D=800 mm	1	
424	CENTRIFUGAL PUMP	$Q=520\ m^3/h$ H=22.5 m	2	
425	3-RD STAGE WASHER	D=8 m	1	
426	MIXER TANK	D=800 mm	1	
427	CENTRIFUGAL PUMP	$Q=520\ m^3/h$ H=22.5 m	2	
428	4-TH STAGE WASHER	D=8 m	1	
429	MIXER TANK	D=800 mm	1	
430	CENTRIFUGAL PUMP	$Q=520\ m^3/h$ H=22.5 m	2	
431	5-TH STAGE WASHER	D=8 m	1	
432	MIXER TANK	D=800 mm	1	
433	CENTRIFUGAL PUMP	$Q=520\ m^3/h$ H=22.5 m	2	
437	6-TH STAGE FILTER-THICKENER	D=5.75 m	4	
438	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	4	
439	CENTRIFUGAL PUMP	$Q=350\ m^3/h$ H=40 m	8	
440	RECIEVER	$V=2.5\ m^3$	3	
441	HYDROSEAL TANK	D=1 m H=2 m	3	
442	CENTRIFUGAL PUMP	$Q=265\ m^3/h$ H=22.5 m	3	
443	TRAP	$V=1\ m^3$	1	
444	BAROMETRIC CONDENSER	D=800 mm	1	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
445	HYDROSEAL TANK	D=1.5 m H=2 m	1	
446	VACUUM PUMP	Q=50 m³/min	2	
447	TANK WITH CHAIN AGITATOR	D=6 m H=9 m	2	
448	CENTRIFUGAL PUMP	Q=350 m³/h H=40 m	2	
449	TANK WITH CHAIN AGITATOR	D=6 m H=9 m	2	
450	CENTRIFUGAL PUMP	Q=265 m³/h H=22.5 m	3	
451	VACUUM-COOLER OF CYCLONE-FILM TYPE	D=2.2 m	2	
452	HYDROSEAL TANK	D=1 m H=6.5 m	2	
453	TANK WITH CHAIN AGITATOR	D=6 m H=6 m	2	
454	CENTRIFUGAL PUMP	Q=350 m³/h H=40 m	4	
455	TANK WITH CHAIN AGITATOR	D=6 m H=9 m	2	
456	CENTRIFUGAL PUMP	Q=265 m³/h H=22.5 m	4	
457	TRAP	V=1 m³	2	
458	BAROMETRIC CONDENSER	D=1600 mm	2	
459	HYDROSEAL TANK	D=1.2 m H=2 m	1	
460	VACUUM PUMP	Q=50 m³/min	2	
461	TANK WITH CHAIN AGITATOR	D=6 m H=9 m	2	
462	CENTRIFUGAL PUMP	Q=300 m³/h H=40 m	4	
463	FLOCCULANT PREPARATION UNIT	D=1.6 m H=2.5 m	2	
464	METERING PUMP		2	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
465	VESSEL FOR WASHING FILTER SECTIONS WITH ACID AND WATER		2	
466	RECIEVER	V=0.4 m^3	2	
467	TANK WITH CHAIN AGITATOR	D=4.5 m H=4.5 m	2	
468	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	6	
469	TANK	D=6 m H=9 m	2	
470	CENTRIFUGAL PUMP	Q=500 $м^3$/ч H=37.2 м	3	
471	SUMP CHAIN AGITATOR	D=2 м	5	
472	CENTRIFUGAL PUMP	Q=170 $м^3$/ч	5	
473	DISTRIBUTION BOX		2	
474	DISTRIBUTION BOX		1	
475	DISTRIBUTION BOX		1	
476	HYDROSEAL TANK	D=0.8 m H=2 m	1	
477	TURBO COMPRESSOR	Q=80 m^3/min	2	
478	FEEDER TANK	D=1.6 m H=2.5 m	2	
479	SCREW CONVEYOR	D=38 mm L=360 mm	2	
480	MIXER TANK	D=800 mm	2	
484	BRIDGE ELECTRIC CRANE	Q=32/5 t	1	
485	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=5 t	1	
486	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
487	ELECTRIC HOIST	Q=1 t	3	
488	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
489	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
490	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=3.2 t	1	
491	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=3.2 t	1	

DESILICATION (STAGE I)

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
500	CONTACT COLUMN	D=1200 mm	3	
502	TANK WITH CHAIN AGITATOR	D=9 m H=9 m	4	
503	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	6	
504	JET PREHEATER	D=530 mm H=2700 mm	6	
505	DESILICATOR	D=3.6 m H=18.64 m	3	
506	CENTRIFUGAL PUMP	Q=450 m^3/h H=67 m	6	
507	AUTOCLAVE	D=3.6 m H=18.64 m	15	
508	AUTOCLAVE	D=3.6 m H=18.64 m	3	
509	1-ST STAGE FLASH TANK	D=2600 mm H=14500 mm	3	
510	2-ND STAGE FLASH TANK	D=2600 mm H=14500 mm	3	
511	HEATING CHAMBER	S=800 m^2 D=1800 mm	3	
513	FLASH TANK	D=800 mm	9	
514	VACUUM PUMP	Q=3 m^3/min	1	
515	SHELF PREHEATER	D=1200 mm	3	
516	TANK	D=4.5 m H=6 m	1	
517	CENTRIFUGAL PUMP	Q=200 m^3/h H=32 m	2	
518	TANK	D=4.5 m H=6 m	1	
519	CENTRIFUGAL PUMP	Q=50 m^3/h H=50 m	2	
520	TANK WITH CHAIN AGITATOR	D=9 m H=9 m	2	
521	CENTRIFUGAL PUMP	Q=450 m^3/h H=67 m	2	
522	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	7	
523	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	7	

DESILICATION
(STADE II AND REGENERATION)

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
528	HYDROCYCLONE	Q=200-300 m^3/h D=710 mm	3	
529	TANK WITH CHAIN AGITATOR	D=7.5 m H=6 m	2	
530	CENTRIFUGAL PUMP	Q=300 m^3/h H=30 m	3	
531	THICKENER	D=15 m	4	
532	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
533	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	2	
534	TANK WITH CHAIN AGITATOR	D=7.5 m H=6 m	2	
535	CENTRIFUGAL PUMP	Q=300 m^3/h H=30 m	4	
536	LEAF FILTER	S=250 m^2	3	
537	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	2	
538	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	2	
539	TANK WITH CHAIN AGITATOR	D=7.5 m H=6 m	2	
540	CENTRIFUGAL PUMP	Q=300 m^3/h H=30 m	2	
540a	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	2	
541	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	2	
542	VACUUM DRUM FILTER	S=40 m^2	2	
543	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
544	CENTRIFUGAL PUMP	Q=185 m^3/h H=45 m	4	
545	TANK WITH CHAIN AGITATOR	D=7.5 m H=6 m	1	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
546	CENTRIFUGAL PUMP	Q=140 m^3/h H=27 m	2	
547	CENTRIFUGAL PUMP	Q=225 m^3/h H=67 m	2	
548	RECIEVER	V=4 m^3	2	
549	HYDROSEAL TANK	D=1.2 m H=3.5 m	2	
550	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
551	CENTRIFUGAL PUMP	Q=70 m^3/h H=27 m	2	
552	TANK WITH CHAIN AGITATOR	D=7.5 m H=7.5 m	8	
553	CENTRIFUGAL PUMP	Q=300 m^3/h H=30 m	4	
554	UNIT FOR SYNTHESIZING CALCIUM HYDROCARBOALUMINAT		2	
555	TANK WITH CHAIN AGITATOR	D=7.5 m H=6 m	1	
556	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	2	
557	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	1	
558	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	2	
559	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
560	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	4	
561	THICKENER	D=15 m	2	
562	TANK WITH CHAIN AGITATOR	D=7.5 m H=6 m	2	
563	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	4	
564	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	

ITEM No.	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
565	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	3	
566	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	2	
567	VACUUM DRUM FILTER	S=40 m^2	1	
568	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	1	
569	CENTRIFUGAL PUMP	Q=70 m^3/h H=27 m	2	
570	TANK WITH CHAIN AGITATOR	D=7.5 m H=6 m	1	
571	CENTRIFUGAL PUMP	Q=265 m^3/h H=22.5 m	2	
572	CENTRIFUGAL PUMP	Q=70 m^3/h. H=27 m	2	
573	RECIEVER	V=4 m^3	1	
574	HYDROSEAL TANK	D=1.2 m H=3.5 m	1	
575	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	1	
576	CENTRIFUGAL PUMP	Q=70 m^3/h H=27 m	2	
577	LEAF FILTER	S=250 m^2	2	
578	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
579	CENTRIFUGAL PUMP	Q=70 m^3/h H=27 m	2	
580	TANK WITH CHAIN AGITATOR	D=7.5 m H=7.5 m	2	
581	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	2	
582	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	2	
583	TANK WITH CHAIN AGITATOR	D=6 m H=9 m	3	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
584	CENTRIFUGAL PUMP	Q=140 m^3/h H=27 m	2	
585	THICKENER	D=15 m	2	
586	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
587	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	4	
588	TANK WITH CHAIN AGITATOR	D=7.5 m H=6 m	2	
589	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	3	
590	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
591	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	2	
592	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
593	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	2	
594	BAROMETRIC CONDENSER	D=1.6 m	2	
595	HYDROSEAL TANK	D=1.2 m H=2 m	2	
596	VACUUM PUMP	Q=50 m^3/min	4	
597	TURBO COMPRESSOR	Q=80 m^3/min	2	
598	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	11	
599	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	11	
2503	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=3.2 t	1	
2504	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
2505	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=1 t	1	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
2506	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
2507	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
2508	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
2509	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
2510	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
2511	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
2512	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	2	

CARBONIZATION AND HYDRATE TREATMENT.
SODIUM CARBONATE STREAM.

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
601	CARBONIZATOR	D=7.5 m H=12 m	12	
603	PRECIPITATOR	D=7.5 m H=12 m	2	
604	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	2	
605	THICKENER	D=15 m	2	
606	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	2	
607	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	2	
609	TANK WITH CHAIN AGITATOR	D=7.5 m H=7.5 m	2	
610	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	2	
611	CARBONIZATOR	D=7.5 m H=12 m	4	
612	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	2	
613	THICKENER	D=15 m	1	
614	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	1	
615	TANK WITH CHAIN AGITATOR	Q=85 m^3/h H=10 m	2	
617	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	2	
618	TANK WITH CHAIN AGITATOR	D=7.5 m H=7.5 m	1	
619	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	2	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
6001	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	4	
6002	CENTRIFUGAL PUMP	$Q=170\ m^3/h$ H=40 m	4	
6003	CENTRIFUGAL PUMP	$Q=170\ m^3/h$ H=40 m	2	
6004	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=5 t	1	
6005	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	2	

CARBONIZATION AND HYDRATE TREATMENT
SODIUM CARBONATE–ALKALINE STREAM

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
621	CARBONIZATOR	D=7.5 m H=12 m	2	
623	PRECIPITATOR	D=7.5 m H=12 m	4	
624	CENTRIFUGAL PUMP	Q=185 m^3/h H=45 m	2	
625	THICKENER	D=15 m	1	
626	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	1	
627	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	2	
629	TANK WITH CHAIN AGITATOR	D=7.5 m H=7.5 m	1	
630	CENTRIFUGAL PUMP	Q=225 m^3/h H=67 m	2	
658	CYCLONE SEPARATOR	D=2400 mm	2	
659	HYDROSEAL TANK	D=0.72 m H=15 m	2	
668	BAROMETRIC CONDENSER	D=1600 mm	2	
669	HYDROSEAL TANK	D=1 m H=2.5 m	2	
670	VACUUM PUMP	Q=50 m^3/min	2	

CARBONIZATION AND HYDRATE TREATMENT. FILTRATION.

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
602	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	1	
608	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	1	
616	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	2	
620	LEAF FILTER	S=250 m^2	1	
622	TANK WITH CHAIN AGITATOR	D=7.5 m H=7.5 m	1	
628	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	2	
631	LEAF FILTER	S=250 m^2	2	
632	TANK WITH CHAIN AGITATOR	D=7.5 m H=7.5 m	2	
633	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	3	
634	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	1	
635	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	2	
636	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	1	
637	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	2	
638	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=3.2 t	1	
639	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=5 t	1	
640	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	2	
641	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
651	VACUUM DRUM FILTER	S=40 m^2	2	
652	RECIEVER	V=4 m^3	2	
653	HYDROSEAL TANK.	D=0.5 m H=4 m	1	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
654	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
655	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	4	
656	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	1	
657	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	2	
661	VACUUM DRUM FILTER	S=40 m^2	2	
662	RECIEVER	V=4 m^3	2	
663	HYDROSEAL TANK	D=0.5 m H=4 m	1	
664	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
665	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	4	
666	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	1	
667	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	2	
671	VACUUM DRUM FILTER	S=40 m^2	2	
672	RECIEVER	V=4 m^3	2	
673	HYDROSEAL TANK	D=0.5 m H=4 m	1	
674	VACUUM PUMP	Q=56 m^3/h H=17 m	2	
676	TANK	D=4.5 m H=4.5 m	2	
677	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	3	
678	BELT CONVEYOR	B=800 mm L=24 m	1	
679	BELT CONVEYOR	B=800 mm L=31 m	1	
680	BELT CONVEYOR	B=800 mm L=100 m	2	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
681	TRAP	$V=2.5\ m^3$	1	
682	MIXING CONDENSER	D=1000 mm	1	
683	HYDROSEAL TANK	D=0.5 m H=1 m	1	
684	VACUUM PUMP	$Q=50\ m^3/min$	2	
685	TURBO COMPRESSOR	$Q=80\ m^3/min$	2	
686	ELECTRICALLY DRIVEN DIAGONAL PLOUGH	FOR BELT B=800 mm	4	
687	AUTOMATIC BELT WEIGHER	FOR BELT B=800 mm	3	
688	APRON FEEDER	B=800 mm	1	
689	CRAB CRANE	Q=10 t	1	
691	TRAP	$V=2.5\ m^3$	1	
692	MIXING CONDENSER	D=1000 mm	1	
693	HYDROSEAL TANK	D=0.5 m H=1 m	1	
694	VACUUM PUMP	$Q=50\ m^3/min$	2	
695	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	2	
696	CENTRIFUGAL PUMP	$Q=170\ m^3/h$ H=40 m	2	
699	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	

CALCINATION

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
701	CONTINUOUS WEIGH FEEDER	Q=100 t/h	1	
702	2 SCREW FEEDER	Q=100 t/h	1	
703	DRYING VENTURI	D=2500 mm	1	
704	ELECTROFILTER FOR HIGH DUST-LADEN GAS	Q=74000 m^3/h	1	
705	AIRSLIDE	B=200 mm	1	
706	CELL FEEDER	Q=50 t/h	1	
707	PNEUMATIC ELEVATOR	Q=50 t/h	1	
708	DEHYDRATATION VENTURI	D=3000 mm	1	
709	CYCLONE HEAT EXCHANGER	D=4000 mm	1	
710	SLUICE VALVE	-	2	
711	FLUID BED KILN	D=3600 mm	1	
712	RECYRCULATION CYCLONE	D=4200 mm	1	
713	OVERFLOW OF FLUID BED	-	1	
714	DISCHARGE DEVICE OF FLUID BED KILN	-	1	
715	HEAT EXCHANGE COLUMN	D=950 mm	1	
716	CYCLONE HEAT EXCHANGER	D=2800 mm	1	
717	FLUID BED COOLER	B=3 m L=14 m	1	
719	SCREW	Q=50 t/h	1	
720	HEAT EXCHANGER	Q=100 m^3/h	2	
721	EXPANSION TANK	-	1	
722	CENTRIFUGAL PUMP	Q=90 m^3/h H=35 m	2	
723	BLOWER	Q=60 m^3/min H=60 kPa	1	
725	VARIATOR	-	2	
726	AIR CLEANING FILTER	Q=40000 m^3/h	2	
727	BLOWER	Q=11 m^3/min H=50 kPa	2	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
728	BLOWER	$Q=167\ m^3/min$ $H=63\ kPa$	5	
729	BLOWER	$Q=4.5\ m^3/min$ $H=30\ kPa$	1	
730	BELT CONVEYOR	B=800 mm L=70 m	2	
731	BELT CONVEYOR	B=800 mm L=12 m	1	
732	CARGO ELEVATOR	Q=500 kg	1	
733	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=5 t	1	
734	ELECTRIC HOIST	Q=3.2 t	1	
735	ELECTRIC HOIST	Q=2 t	1	
736	ELECTRIC HOIST	Q=2 t	1	
737	MANUAL HOIST	Q=3.2 t	1	
738	MANUAL HOIST	Q=1 t	1	

ALUMINA PRODUCT STORAGE

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
751	AUTOMATIC WEIGHT LOADING UNIT FOR RAIL WAGONS	Q=450 t/h	4	
752	BOTTOM PNEUMATIC DISCHARGE UNIT	Q=120 t/h	8	
753	BAG FILTER	S=90 m^2	4	
754	FAN	H=1.5 kPa Q=4800 m^3/h	4	
755	SLUICE FEEDER	Q=2.28 m^3/h	12	
756	BELT CONVEYOR	B=800 mm L=12 m	2	
757	BELT CONVEYOR	B=800 mm L=300 m	2	
758	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=1 t	1	
759	CARGO ELEVATOR	Q=500 kg	1	

LIME STONE BURNING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
901	BELT CONVEYOR	B=800 mm	1	
902	LIME STONE BIN	FRACTION 40-80 mm	1	
903	SWING FEEDER	$Q=250\ m^3/h$	1	
904	SKIP ELEVATOR	$V_{SKIP}=0.75\ m^3$	1	
905	HOIST OF SKIP ELEVATOR	Q=4 t	1	
906	FAN	H=4.44 kPa $Q=28700\ m^3/h$	1	
907	FURNACE FOR LIME STONE BURNING	Q=150 t/h	1	
908	SWING FEEDER	$Q=250\ m^3/h$	1	
909	CONTINUOUS WEIGH FEEDER	Q=10 t/h	2	
910	8 CYCLONES UNIT	D=1200 mm	1	
911	EXHAUSTER	H=9.3 kPa $Q=95000\ m^3/h$	1	
912	RAKE CONVEYOR	B=320 mm L=10 m	1 1	
913	ELECTRIC HOIST	Q=2 t	1	
914	ELECTRIC HOIST	Q=2 t	1	
915	MANUAL HOIST	Q=2 t	2	
916	ELECTRIC HOIST	Q=2 t	1	
917	MANUAL HOIST	Q=3.2 t	4	
918	CARGO ELEVATOR	Q=500 kg	1	

LIME MILK PREPARATION AND
CAUSTICIZATION
LIME MILK PREPARATION

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
800	APRON CONVEYOR	B=400 mm L=55 m	2	
801	AUTOMATIC BELT WEIGHER	FOR BELT B=500 mm	2	
802	BELT CONVEYOR	B=500 mm L=42 m	2	
803	LIME SLAKING UNIT	D=2200 mm L=10 m	2	
804	SINGLE SPIRAL CLASSIFIER WITH UNSUBMERGED SPIRAL	D=1.5 m L=8.2 m	2	
805	TANK WITH CHAIN AGITATOR	D=4.5 m H=4.5 m	1	
806	CENTRIFUGAL PUMP	Q=57 m^3/h H=17 m	2	
807	TANK WITH CHAIN AGITATOR	D=7.5 m H=9 m	1	
808	CENTRIFUGAL PUMP	Q=225 m^3/h H=67 m	2	
809	BALL MILL	D=0.9 m L=1.8 m	2	
810	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
811	CENTRIFUGAL PUMP	Q=57 m^3/h H=17 m	4	
812	TANK	D=7.5 m H=9 m	1	
813	CENTRIFUGAL PUMP	Q=57 m^3/h H=17 m	2	
814	HYDROCYCLONE	D=250 mm	1	
815	TANK WITH CHAIN AGITATOR	D=4.5 m H=4.5 m	1	
816	CENTRIFUGAL PUMP	Q=57 m^3/h H=17 m	2	
817	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	1	
818	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	1	
820	BRIDGE ELECTRIC CRANE	Q=12.5 t	1	

LIME MILK PREPARATION AND CAUSTICIZATION.CAUSTICIZATION.

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
851	TANK WITH CHAIN AGITATOR	D=4.5 m H=4.5 m	3	
852	CENTRIFUGAL PUMP	Q=70 m^3/h H=27 m	2	
853	TANK	D=6 m H=6 m	2	
854	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	2	
855	THICKENER	D=15 m	1	
856	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	1	
857	CENTRIFUGAL PUMP	Q=70 m^3/h H=27 m	2	
858	THICKENER	D=15 m	1	
859	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	1	
860	CENTRIFUGAL PUMP	Q=70 m^3/h H=27 m	2	
861	TANK	D=6 m H=6 m	2	
862	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	2	
863	TANK	D=6 m H=6 m	1	
864	CENTRIFUGAL PUMP	Q=70 m^3/h H=27 m	2	
865	TANK WITH CHAIN AGITATOR	D=4.5 m H=3 m	2	
866	CENTRIFUGAL PUMP	Q=85 m^3/h H=40 m	2	
867	VACUUM DRUM FILTER	S=10 m^2	2	
868	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	2	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
869	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	4	
870	SPIRAL HEAT EXCHANGER	S=32 m^2	2	
871	RECIEVER	V=1 m^3	2	
872	TRAP	V=0.4 m^3	1	
873	BAROMETRIC CONDENSER	D=800 mm	1	
874	HYDROSEAL TANK	D=1.2 m H=2 m	2	
875	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	2	
876	VACUUM PUMP	Q=25 m^3/min	2	
877	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	1	
878	CENTRIFUGAL PUMP	Q=56 m^3/h H=17 m	1	

SODIUM CARBONATE AND POTASH PRODUCTION

EVAPORATION, CRYSTALLIZATION
AND CENTRIFUGING.
EVAPORATION OF CARBONATE LIQUOR

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1000	TANK WITH CHAIN AGITATOR	D=9 m H=9 m	2	
1001	CENTRIFUGAL PUMP	Q=140 m^3/h H=27 m	3	
1002	EVAPORATOR	S=800 m^2	10	
1003	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	2	
1004	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	4	
1005	SHELL-AND-TUBE HEAT EXCHANGER	S=370 m^2	6	
1006	TANK WITH CHAIN AGITATOR	D=6 m H=9 m	1	
1007	CENTRIFUGAL PUMP	Q=140 m^3/h H=27 m	2	
1008	FLASH TANK	D=800 mm	14	
1009	MIXING CONDENSER	D=2000 mm	2	
1010	HYDROSEAL TANK	D=2 m H=2.5 m	2	
1011	VACUUM PUMP	Q=25 m^3/min	3	
1012	CENTRIFUGAL PUMP	Q=20 m^3/h H=50 m	4	
1013	CENTRIFUGAL PUMP	Q=12 m^3/h H=50 m	4	

EVAPORATION, CRYSTALLIZATION AND CENTRIFUGING
EVAPORATION, NATRIUM CARBONATE
CENTRIFUGING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1014	TANK WITH CHAIN AGITATOR	D=6 m H=9 m	1	
1015	CENTRIFUGAL PUMP	Q=140 m^3/h H=27 m	3	
1016	EVAPORATOR WITH INFORCED CIRCULATION	S=500 m^2	6	
1017	CENTRIFUGAL PUMP	Q=140 m^3/h H=27 m	4	
1018	SHELL-AND-TUBE HEAT EXCHANGER	S=370 m^2	4	
1019	EVAPORATOR WITH INFORCED CIRCULATION	S=500 m^2	2	
1020	TANK WITH CHAIN AGITATOR	D=4.5 m H=4.5 m	2	
1021	CENTRIFUGAL PUMP	Q=100 m^3/h H=40 m	2	
1022	CENTRIFUGE	Q=6 t/h	3	
1023	TANK WITH CHAIN AGITATOR	D=4.5 m H=6 m	1	
1024	CENTRIFUGAL PUMP	Q=100 m^3/h H=40 m	2	
1025	MIXING CONDENSER	D=1600 mm	2	
1026	HYDROSEAL TANK	D=2 m H=2.5 m	2	
1027	VACUUM PUMP	Q=25 m^3/min	2	
1028	CENTRIFUGAL PUMP	Q=12 m^3/h H=50 m	4	
1029	FLASH TANK	D=800 mm	8	
1030	TANK WITH CHAIN AGITATOR	D=4.5 m H=4.5 m	2	
1031	CENTRIFUGAL PUMP	Q=12.5 m^3/h H=32 m	2	
1032	TANK WITH CHAIN AGITATOR	D=4.5 m H=4.5 m	1	
1033	CENTRIFUGAL PUMP	Q=25 m^3/h H=32 m	2	
1035	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	2	
1036	CENTRIFUGAL PUMP	Q=25 m^3/h H=32 m	2	

EVAPORATION, CRYSTALLIZATION AND CENTRIFUGING.
CRYSTALLIZATION AND SEPARATION OF
POTASSIUM SULPHATE SLURRY.

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1038	TANK WITH CHAIN AGITATOR	D=4.5 m H=6 m	1	
1039	CENTRIFUGAL PUMP	Q=100 m^3/h H=40 m	2	
1040	VACUUM CRYSTALLIZER	Dev=3800 mm Dcr=5000 mm	4	
1041	CENTRIFUGAL PUMP	Q=100 m^3/h H=40 m	2	
1042	MIXING CONDENSER	D=2000 mm	4	
1043	HYDROSEAL TANK	D=2 m H=2.5 m	4	
1044	EJECTOR		2	
1045	EJECTOR VACUUM PUMP	Q=250 kg/h	2	
1046	TANK WITH CHAIN AGITATOR	D=6 m H=7.5 m	2	
1047	CENTRIFUGAL PUMP	Q=100 m^3/h H=40 m	2	
1048	THICKENER	D=12 m	1	
1049	TANK WITH CHAIN AGITATOR	D=3 m H=3 m	1	
1050	CENTRIFUGAL PUMP	Q=12.5 m^3/h H=32 m	2	
1053	TANK WITH CHAIN AGITATOR	D=6 m H=4.5 m	1	
1054	CENTRIFUGAL PUMP	Q=100 m^3/h H=40 m	2	

EVAPORATION, CRYSTALLIZATION AND CENTRIFUGING
EVAPORATION AND CENTRIFUGING
OF DOUBLE SALT.

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1055	TANK WITH CHAIN AGITATOR	D=6 m H=4.5 m	1	
1056	CENTRIFUGAL PUMP	Q=25 m^3/h H=32.5 m	11	
1057	EVAPORATOR WITH INFORCED CIRCULATION	S=500 m^2	8	
1058	JET PREHEATER	D=530 mm	2	
1059	TANK WITH CHAIN AGITATOR	D=6 m H=4.5 m	2	
1060	CENTRIFUGAL PUMP	Q=100 m^3/h H=40 m	2	
1061	FLASH TANK	D=800 mm	4	
1062	MIXING CONDENSER	D=1600 mm	4	
1063	HYDROSEAL TANK	D=2 m H=2.5 m	4	
1064	VACUUM TANK	Q=25 m^3/min	3	
1065	CENTRIFUGE	Q=6 t/h	7	
1066	TANK WITH CHAIN AGITATOR	D=6 m H=4.5 m	2	
1067	CENTRIFUGAL PUMP	Q=25 m^3/h H=32.5 m	2	
1068	TANK WITH CHAIN AGITATOR	D=6 m H=4.5 m	2	
1069	CENTRIFUGAL PUMP	Q=50 m^3/h H=16 m	2	
1070	TANK	D=6 m H=4.5 m	1	
1071	CENTRIFUGAL PUMP	Q=90 m^3/h H=85 m	2	
1072	TANK	D=6 m H=4.5 m	2	
1073	CENTRIFUGAL PUMP	Q=320 m^3/h H=50 m	4	

EVAPORATION, CRYSTALLIZATION AND CENTRIFUGING.
CRYSTALLIZATION AND CENTRIFUGING
OF POTASH

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1074	CRYSTALLIZER	D=4.5 m H=4.5 m	8	
1075	CENTRIFUGAL PUMP	Q=50 m^3/h H=16 m	6	
1076	TANK WITH CHAIN AGITATOR	D=4.5 m H=6 m	2	
1077	CENTRIFUGAL PUMP	Q=100 m^3/h H=40 m	2	
1078	CENTRIFUGE	Q=6 t/h	3	
1080	TANK WITH CHAIN AGITATOR	D=4.5 m H=6 m	2	
1081	CENTRIFUGAL PUMP	Q=25 m^3/h H=32.5 m	3	
1082	EVAPORATOR	S=125 m^2	2	
1083	MIXING CONDENSER	D=1600 mm	3	
1085	FLASH TANK	D=300 mm	2	
1086	TANK WITH CHAIN AGITATOR	D=4.5 m H=4.5 m	1	
1087	CENTRIFUGAL PUMP	Q=25 m^3/h H=32.5 m	14	
1088	CRYSTALLIZER	D=4.5 m H=4.5 m	6	
1089	TANK WITH CHAIN AGITATOR	D=4.5 m H=4.5 m	3	
1090	CENTRIFUGE	Q=6 t/h	3	
1091	COOLER	Q=2428344 kJ/h	4	
1092	TANK WITH CHAIN AGITATOR	D=4.5 m H=6 m	1	
1093	CENTRIFUGAL PUMP	Q=100 m^3/h H=40 m	2	
1094	LEAF FILTER	S=125 m^2	2	
1095	TANK WITH CHAIN AGITATOR	D=4.5 m H=6 m	2	
1096	CENTRIFUGAL PUMP	Q=25 m^3/h H=32.5 m	10	
1097	EVAPORATOR WITH INFORCED CIRCULATION	S=315 m^2	1	
1098	TANK WITH CHAIN AGITATOR	D=4.5 m H=6 m	2	
1099	CRYSTALLIZER	D=4.5 m H=4.5 m	4	
1100	TANK WITH CHAIN AGITATOR	D=4.5 m H=6 m	1	

EVAPORATION, CRYSTALLIZATION AND CENTRIFUGING.
CAUSTIC LIQUOR EVAPORATION

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
2000	TANK	D=7.5 m H=9 m	1	
2001	CENTRIFUGAL PUMP	Q=25 m^3/h H=32.5 m	2	
2002	EVAPORATOR WITH INFORCED CIRCULATION	S=315 m^2	2	
2003	FLASH TANK	D=800 mm	1	
2004	MIXING CONDENSER	D=2000 mm	1	
2005	HYDROSEAL TANK	D=2 m H=2.5 m	1	
2006	VACUUM PUMP	Q=12 m^3/min	1	
2007	TANK	D=7.5 m H=9 m	2	
2008	CENTRIFUGAL PUMP	Q=100 m^3/h H=40 m	2	
2009	CENTRIFUGAL PUMP	Q=12 m^3/h H=50 m	2	
2010	TANK	D=6 m H=4.5 m	1	
2011	CENTRIFUGAL PUMP	Q=90 m^3/h H=33 m	2	
2012	TANK	D=6 m H=4.5 m	1	
2013	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	5	
2014	CENTRIFUGAL PUMP	Q=140 m^3/h H=27 m	5	
2015	BRIDGE ELECTRIC CRANE	Q=20/5 t	1	
2016	BRIDGE ELECTRIC CRANE	Q=5 t	1	
2017	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=3.2 t	1	
2018	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=3.2 t	1	

POTASH DRYING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1201	WEIGHER	-	2	
1202	BELT CONVEYOR	B=800 mm L=80 m	2	
1203	FAN	H=3.46 kPa $Q=19000\ m^3/h$	3	
1204	FAN	H=5.52 kPa $Q=39900\ m^3/h$	3	
1205	FURNACE	-	3	
1206	DRYER	D=2.5 mm L=20 m	3	
1207	BELT CONVEYOR	B=800 mm L=5 m	3	
1208	4 CYCLONES UNIT	D=900 mm	3	
1209	6 CYCLONES UNIT	D=700 mm	3	
1210	VENTURI	SIZES: 1350x812x4565mm	6	
1211	TRAP	$V=10.8\ m^3$	3	
1212	SLUICE FEEDER	$Q=5.46\ m^3/h$	15	
1213	RAKE CONVEYOR	B=200 mm L=10 m	3	
1214	DRUM COOLER	D=2.2 m L=9.5 m	3	
1215	SLUICE FEEDER	$Q=60\ m^3/h$	3	
1216	RAKE CONVEYOR	B=320 mm L=10 m	3	
1217	ELEVATOR	Q=10 t/h	3	
1218	TANK	D=2.8 m H=4.4 m	2	
1219	CENTRIFUGAL PUMP	$Q=100\ m^3/h$ H=40 m	2	
1220	FAN	H=12.9 kPa $Q=150000\ m^3/h$	3	
1221	BAG FILTER	$S=30\ m^2$	3	
1222	FAN	H=2.3 kPa $Q=3460\ m^3/h$	3	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1223	TANK WITH AGITATOR	$V=10\ m^3$	1	
1224	CENTRIFUGAL PUMP	$Q=50\ m^3/h$ $H=16\ m$	1	
1225	TANK	$D=2.8\ m$ $H=4.4\ m$	1	
1226	CENTRIFUGAL PUMP	$Q=160\ m^3/h$ $H=50\ m$	1	
1227	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	$Q=5\ t$	1	
1228	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	$Q=3.2\ t$	1	
1229	ELECTRIC HOIST	$Q=1\ t$	1	

SODA DRYING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1231	CENTRIFUGE	Q=6 t/h	2	
1232	WEIGHER	Q=25 t/h	2	
1233	FAN	H=6.60 kPa Q=16600 m^3/h	2	
1234	FAN	H=5.52 kPa Q=39900 m^3/h	2	
1235	FURNACE	V=10 m^3	2	
1236	DRUM DRYER	D=2.5 m L=20 m	2	
1237	SLUICE FEEDER	Q=60 m^3/h	2	
1238	PNEUMATIC PUMP	Q=60 t/h	2	
1239	4 CYCLONES UNIT	D=900 mm	4	
1240	SLUICE FEEDER	Q=5.46 m^3/h	6	
1241	6 CYCLONES UNIT	D=700 mm	4	
1242	RAKE CONVEYOR	B=200 mm L=10 m	2	
1243	VENTURI	SIZES: 1540x1005x5290	4	
1244	TRAP	V=34.3 m^3	4	
1245	TANK	V=50 m^3	1	
1246	CENTRIFUGAL PUMP	Q=160 m^3/h H=63 m	1	
1247	FAN	H=12.9 kPa Q=150000 m^3/h	1	
1248	TANK WITH AGITATOR	V=10 m^3	1	
1249	CENTRIFUGAL PUMP	Q=50 m^3/h H=18 m	1	
1250	TWIN BIN	V=14 m^3	2	
1251	BIN	-	2	
1252	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=5 t	2	
1253	ELECTRIC HOIST	Q=1 t	1	
1254	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=3.2 t	1	
1255	ELECTRIC HOIST	Q=1 t	1	

SULFATE DRYING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1261	CENTRIFUGE	Q=1 t/h	1	
1262	TUBE-AND-SHELL HEAT EXCHANGER	$S=40\ m^2$ D=0.6 m L=2 m	1	
1263	DRUM DRYER	D=1.2 m L=6 m	1	
1264	RAKE CONVEYOR	Q=200 mm L=10 m	1	
1265	CYCLONE	D=500 mm	1	
1266	2 CYCLONES UNIT	D=400 mm	1	
1268	VENTURI	SIZES: 560x445x1250 mm	1	
1269	TRAP	$V=0.54\ m^3$	1	
1270	FAN	H=0.85 kPa $Q=3200\ m^3/h$	1	
1271	ELEVATOR	$Q=8.4\ m^3/h$	1	
1272	TANK	D=2.8 m D=4.4 m	1	
1273	CENTRIFUGAL PUMP	$Q=12.5\ m^3/h$ H=50 m	1	
1274	SLUICE FEEDER	$Q=2.28\ m^3/h$	1	
1275	SLUICE FEEDER	$Q=2.28\ m^3/h$	2	
1276	BIN	$V=2\ m^3$	1	
1277	WEIGHER	Q=2 t/h	1	
1278	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=3.2 t	1	
1279	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=3.2 t	1	
1280	ELECTRIC HOIST	Q=1 t	1	

CEMENT PRODUCTION

CLAY AND IRON ORE STORAGE

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1400	CRAB CRANE	Q=20 t	3	
1401	APRON FEEDER	B=1500 mm L=12 m	1	
1402	APRON FEEDER	B=1200 mm L=12 m	1	
1403	BELT CONVEYOR	B=1000 mm L=140 m	2	

CHARGE GRINDING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
116	BELT CONVEYOR	B=1200 mm L=470 m	2	
150	BELT CONVEYOR	B=1000 mm L=80 m	2	
151	DISCHARGE TROLLEY	FOR BELT B=1000 mm	2	
152	CONTINUOUS WEIGH FEEDER	Q=100 t/h	2	
153	CLAY GRINDING MILL	D=7 m L=2.3 m	2	
154	VIBRANT SCREEN		8	
155	BELT CONVEYOR	B=650 mm L=14 m	2	
156	AUTOMATIC BELT WEIGHER	FOR BELT B=650 mm	2	
157	MEDIUM CLAY GRINDING MILL	D=4 m L=13.5 m	1	
158	TANK WITH CHAIN AGITATOR	D=7.5 m H=6 m	2	
159	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	2	
160	TANK WITH CHAIN AGITATOR	D=6 m H=4.5 m	2	
161	CENTRIFUGAL PUMP	Q=170 m^3/h H=40 m	4	
162	TANK WITH CHAIN AGITATOR	D=7.5 m H=9 m	1	
163	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	2	
164	TANK WITH CHAIN AGITATOR	D=6 m H=4.5 m	1	
165	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	2	
166	CONTINUOUS WEIGH FEEDER	Q=100 t/h	5	
167	CONTINUOUS WEIGH FEEDER	Q=16 t/h	5	
168	BELT CONVEYOR	B=1000 mm L=20 m	5	

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
169	AUTOMATIC BELT WEIGHER	FOR BELT B=1000 mm	5	
170	FINE CLAY GRINDING MILL	D=4 m L=13.5 m	5	
171	TANK WITH CHAIN AGITATOR	D=6 m H=4.5 m	5	
172	CENTRIFUGAL PUMP	Q=225 m^3/h H=67 m	10	
173	TANK WITH CHAIN AGITATOR	D=7.5 m H=9 m	2	
174	CENTRIFUGAL PUMP	Q=350 m^3/h H=40 m	2	
175	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	5	
176	CENTRIFUGAL PUMP	Q=170 m^3/h H=27 m	5	
177	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=5 t	1	
178	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	2	
179	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2 t	1	
1403	BELT CONVEYOR	B=1000 mm L=140 m	2	

CORRECTION BASINS

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1450	BASIN	D=9 m V=1200 m^3	28	
1451	CENTRIFUGAL PUMP	Q=225 m^3/h H=67 m	10	
1452	CENTRIFUGAL PUMP	Q=225 m^3/h H=67 m	8	
1453	CENTRIFUGAL PUMP	Q=225 m^3/h H=67 m	2	
1454	TANK WITH CHAIN AGITATOR	D=9 m H=9 m	2	
1455	CENTRIFUGAL PUMP	Q=225 m^3/h H=67 m	3	
1456	SUMP CHAIN AGITATOR	D=2 m H=2.5 m	5	
1457	CENTRIFUGAL PUMP	Q=140 m^3/h H=27 m	5	
1458	PASSENGER ELEVATOR	Q=320 kg	1	
1459	ELECTRIC HOIST	Q=3.2 t	1	
1460	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=5 t	1	

CLINKER BURNING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1501	PNEUMATIC SCREW PUMP	Q=36 t/h D=200 mm	6	
1502	FEEDER OF SLURRY	PISTON REGULATION	12	
1503	ROTARY KILN	D=6.4/5.8 m L=190 m	6	
1504	GRATE COOLER	S=68 m^2	6	
1505	FEEDER	Q=42 t/h	6	
1506	DRUM AFTER COOLER	D=6.4/5.8 m L=60 m	6	
1507	APRON CONVEYOR	B=800 mm L=100 m	12	
1508	FAN	H=5.1 kPa Q=33000 m^3/h	6	
1509	FAN	H=9.2 kPa Q=58000 m^3/h	18	
1510	DISCHARGE CYCLONE	D=1200 mm	6	
1511	SCREW FEEDER	Q=42 t/h	6	
1512	SCREW FEEDER	Q=12 t/h	12	
1513	ELECTROFILTER	S=129.8 m^2	12	
1514	EXHAUSTER	H=6 kPa Q=420000 m^3/h	12	
1515	BLINK VALVE	D=300 mm	180	
1516	RAKE CONVEYOR	B=320 mm L=21 m	12	
1517	RAKE CONVEYOR	L=320 mm L=32 m	24	
1518	CARGO ELEVATOR	Q=500 kg	1	
1519	SLUICE FEEDER	Q=60 m^3/h	6	
1520	TWO CHAMBER PUMP	D=1800 mm	6	
1521	GANTRY CRANE	Q=100 t	6	
1522	BRIDGE ELECTRIC CRANE	Q=5 t	1	
1523	ELECTRIC HOIST	Q=2 t	1	
1524	ELECTRIC HOIST	Q=3.2 t	1	

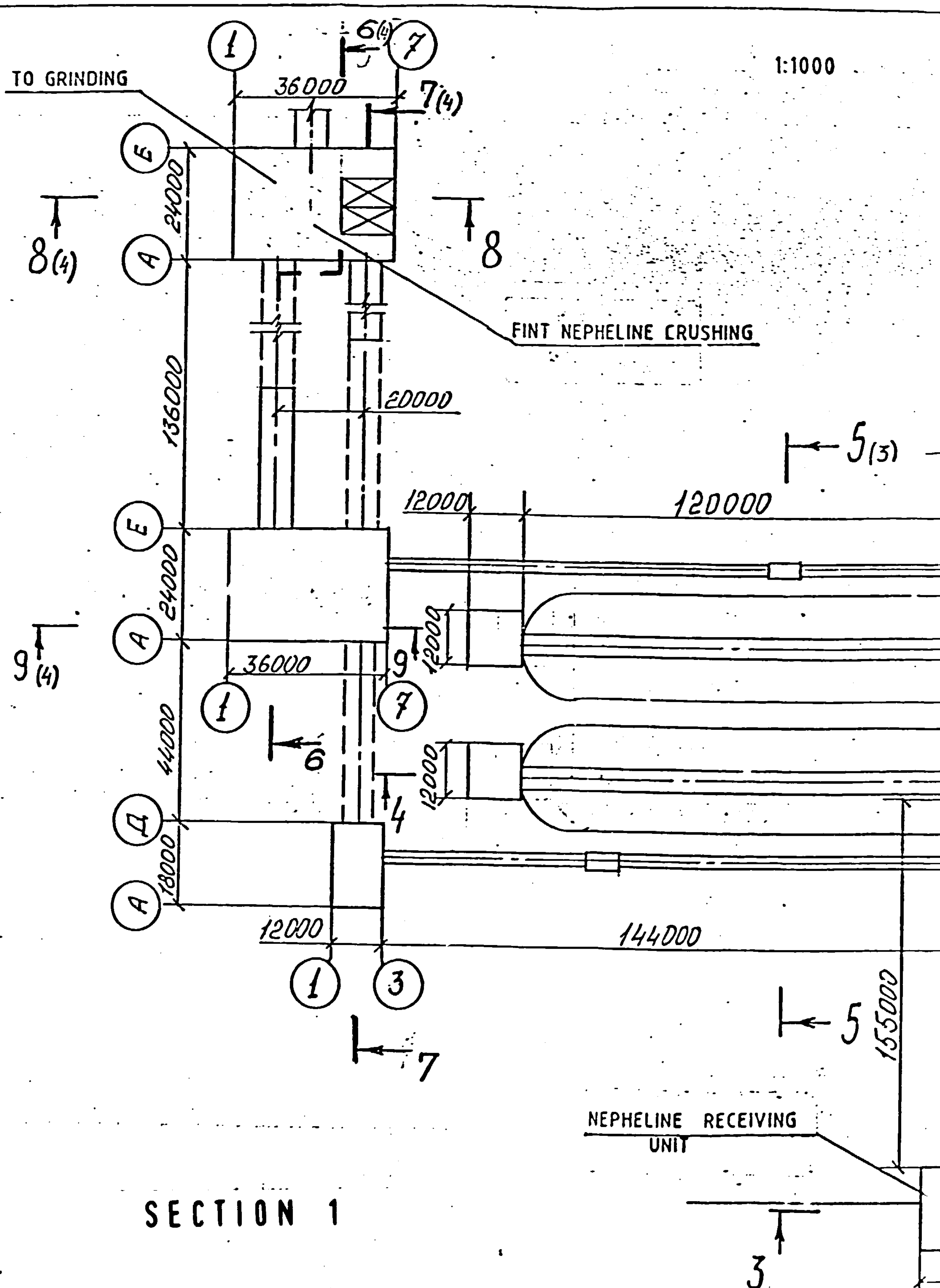
ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1525	ELECTRIC HOIST	Q=3.2 t	6	
1526	ELECTRIC HOIST	Q=5 t	3	
1527	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=5 t	2	
1528	RACK GATE	-	24	

DRYING OF BELLITE MUD

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1751	DRUM DRYER	D=3.2 m L=27 m	4	
1752	FAN	H=2.4 kPa Q=18000 m^3/h	4	
1753	FAN	H=2.5 kPa Q=30000 m^3/h	4	
1754	CYCLONE	D=2360 mm	8	
1755	ELECTROFILTER	S=41 m^2	4	
1756	EXHAUSTER	H=3 kPa Q=200000 m^3/h	4	
1757	BLINK VALVE	D=300 mm	16	
1758	SCREW CONVEYOR	D=320 mm L=6 m	4	
1759	SCREW CONVEYOR	D=320 mm L=30 m	4	
1760	BELT CONVEYOR	B=1000 mm L=82 m	2	
1761	BELT CONVEYOR	B=1000 mm L=70 m	2	
1762	ELECTRIC HOIST	Q=3.2 t	4	
1763	ELECTRIC HOIST	Q=1 t	8	
1764	MANUAL HOIST	Q=2 t	4	
1765	MANUAL HOIST	Q=1 t	16	

CEMENT GRINDING

ITEM No	DESCRIPTION	TECHNICAL CHARACTERISTICS	QUANTITY	REMARKS
1800	CEMENT MILL	D=4 m L=13.5 m	9	
1801	SEPARATOR WITH CYCLONES UNIT	D=5 m	9	
1802	SUCTION FAN	Q=160000 m^3/h	9	
1803	GATE FEEDER	D=300 mm.	72	
1804	PNEUMATIC TROUGH WITH FAN	B=400 mm	18	
1805	PNEUMATIC TROUGH WITH FAN	B=630 mm	9	
1806	PNEUMATIC TROUGH WITH FAN	B=630 mm	9	
1807	PNEUMATIC TROUGH WITH FAN	B=630 mm	9	
1808	PNEUMATIC TROUGH WITH FAN	B=630 mm	9	
1809	PNEUMATIC TROUGH WITH FAN	B=630 mm	9	
1810	BUCKET ELEVATOR	H=32.9 m	9	
1811	CHAMBER PNEUMATIC PUMP	Q=100 m^3/h	9	
1812	SUCTION FAN	Q=105000 m^3/h	9	
1814	2 CYCLONES UNIT	D=1400 mm	9	
1815	3 CHAMBERS 1 SECTION HORIZONTAL ELECTRICAL FILTER	S=28.7 m^2	9	
1816	SCREW CONVEYOR	D=320 mm L=22 m	9	
1817	BRIDGE ELECTRIC CRANE	Q=10 t	1	
1818	BRIDGE ELECTRIC CRANE	Q=32/5 t	1	
1819	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=10 t	1	
1820	SINGLE-SPAN OVERHEAD ELECTRIC CRANE	Q=2.5 t	1	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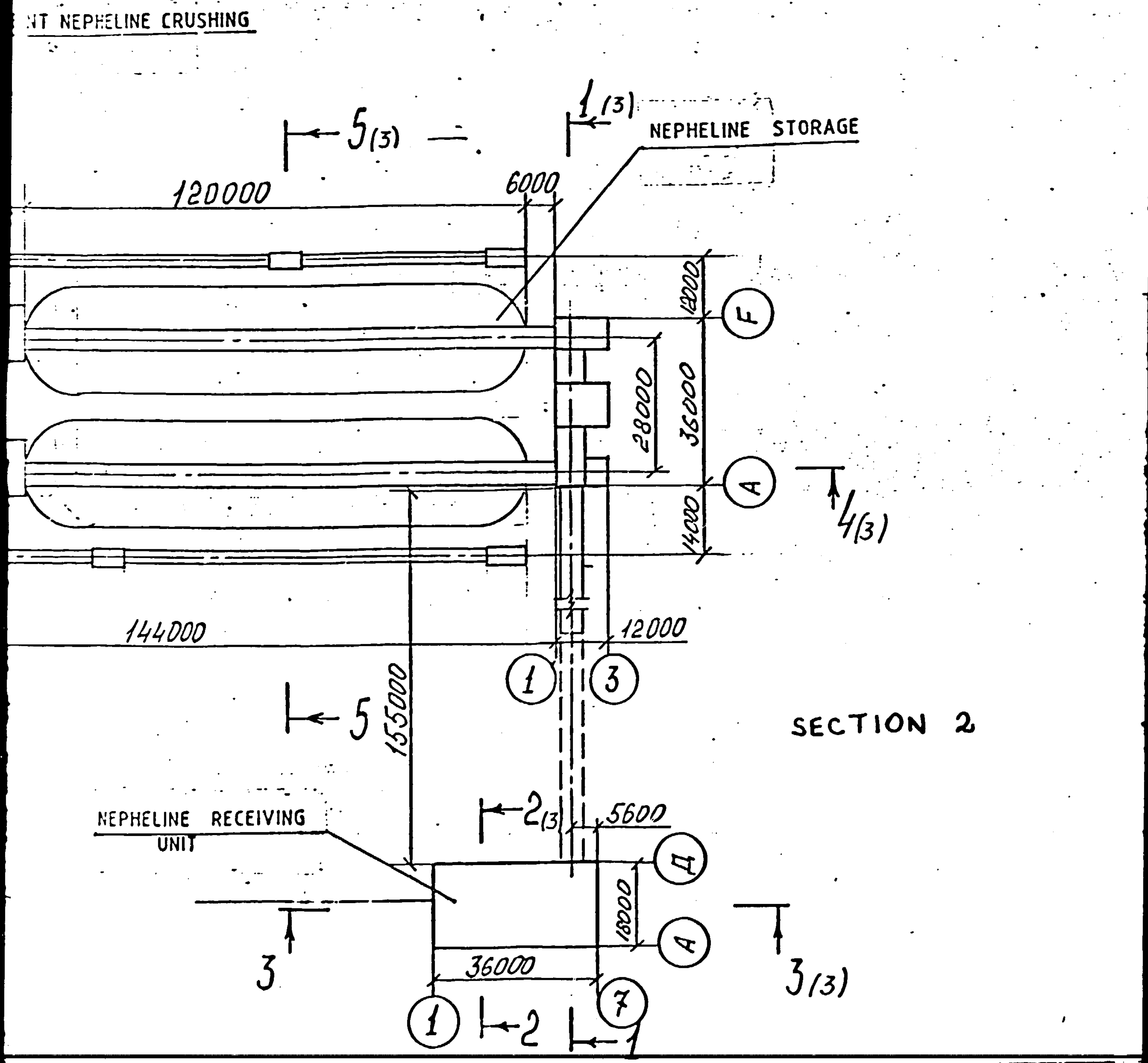
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SECTION 3

CONTRACT N 90/204/205

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	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	ALUMINA PRODUCTION. NEPHELINE RECEIVING UNIT. NEPHELINE STORAGE. FINE NEPHELINE CRUSHING.	PHASE	SHEET	SHEETS
		POS	2	
	LOCATION LAY-OUT	VAMI LENINGRAD		

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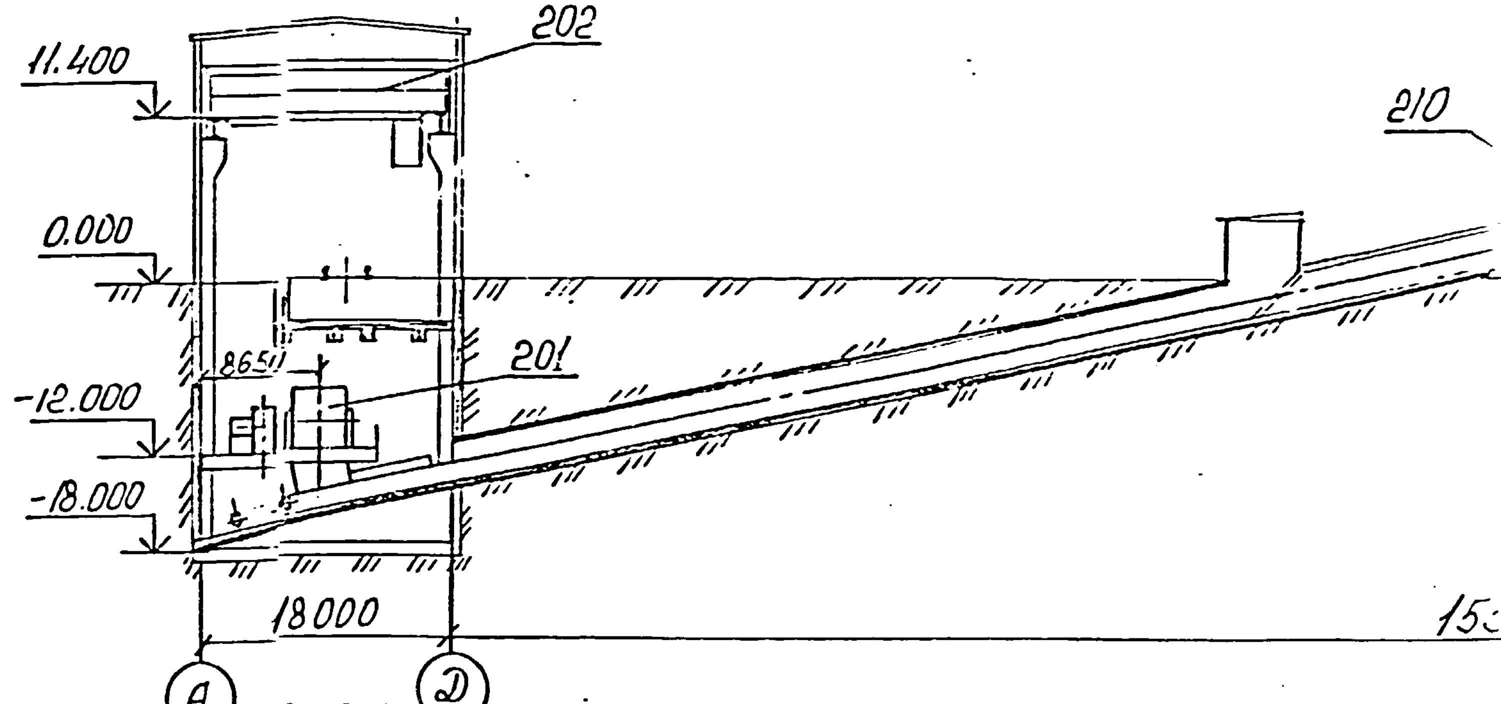
SECTION 1



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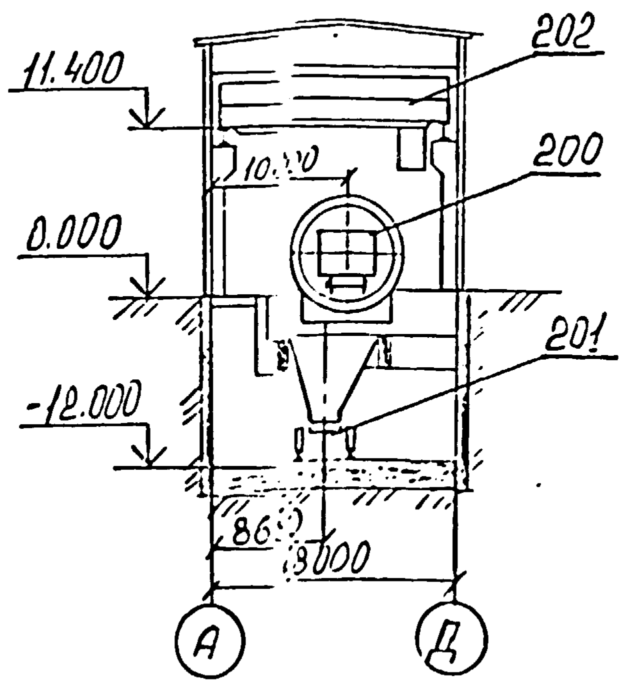

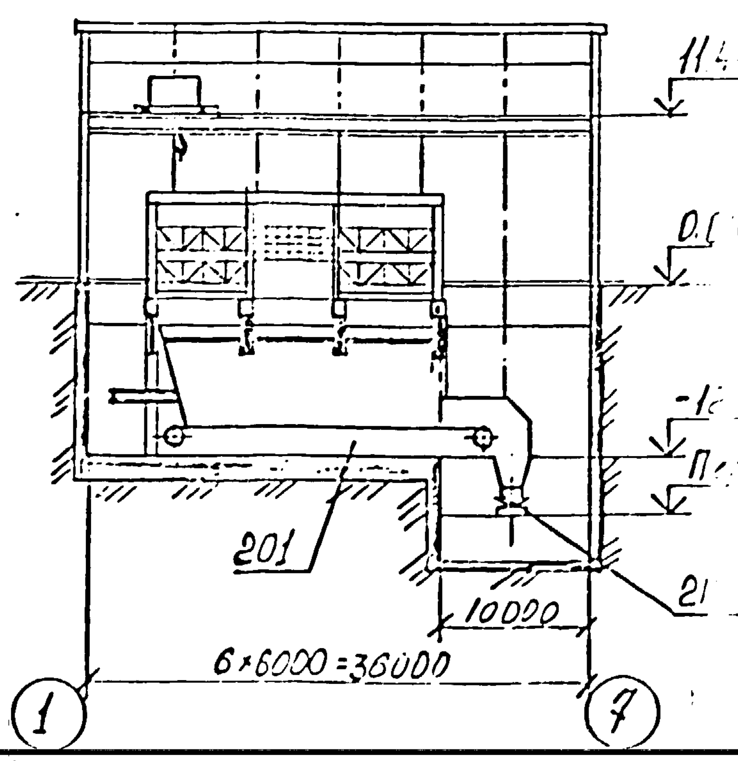

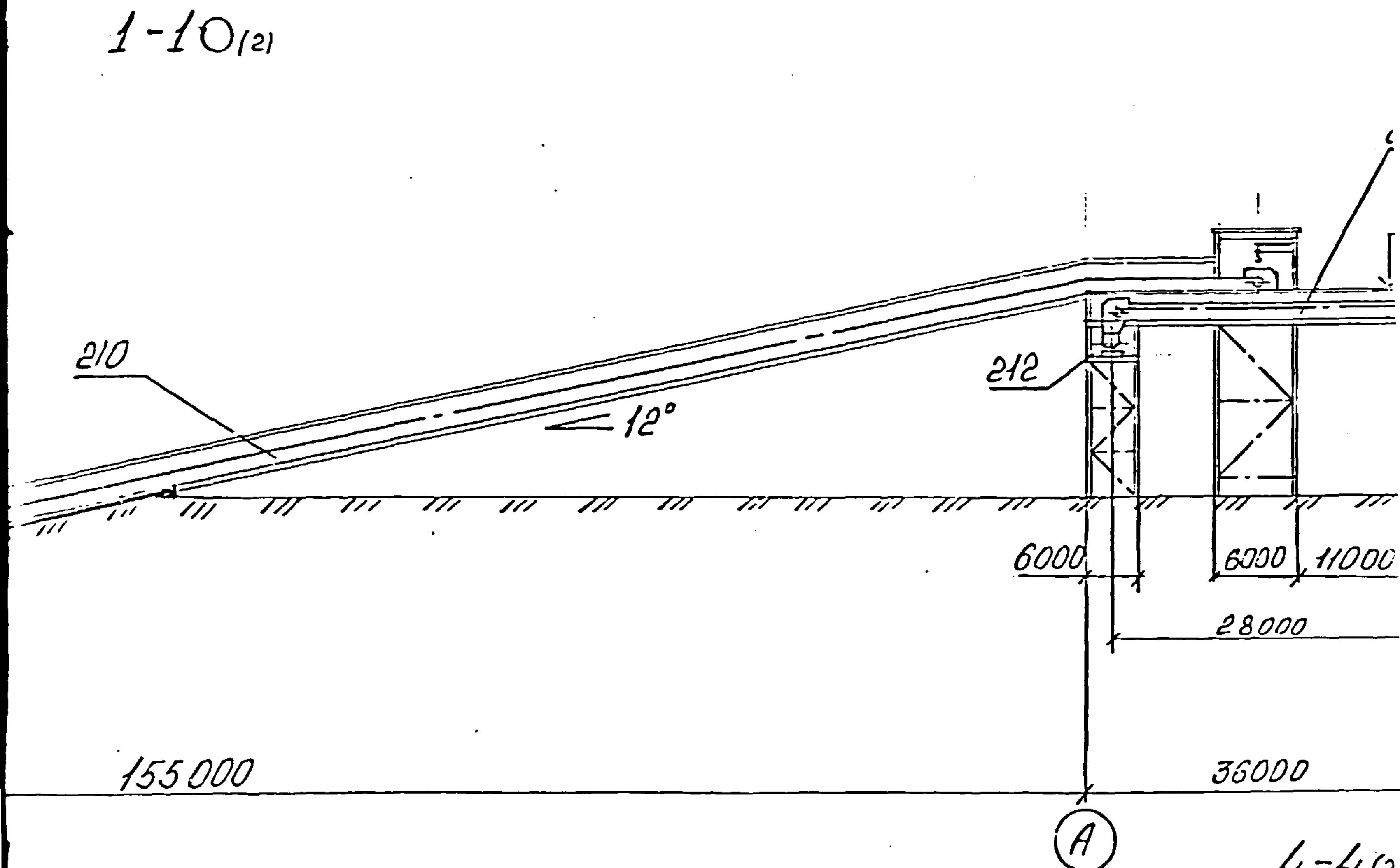
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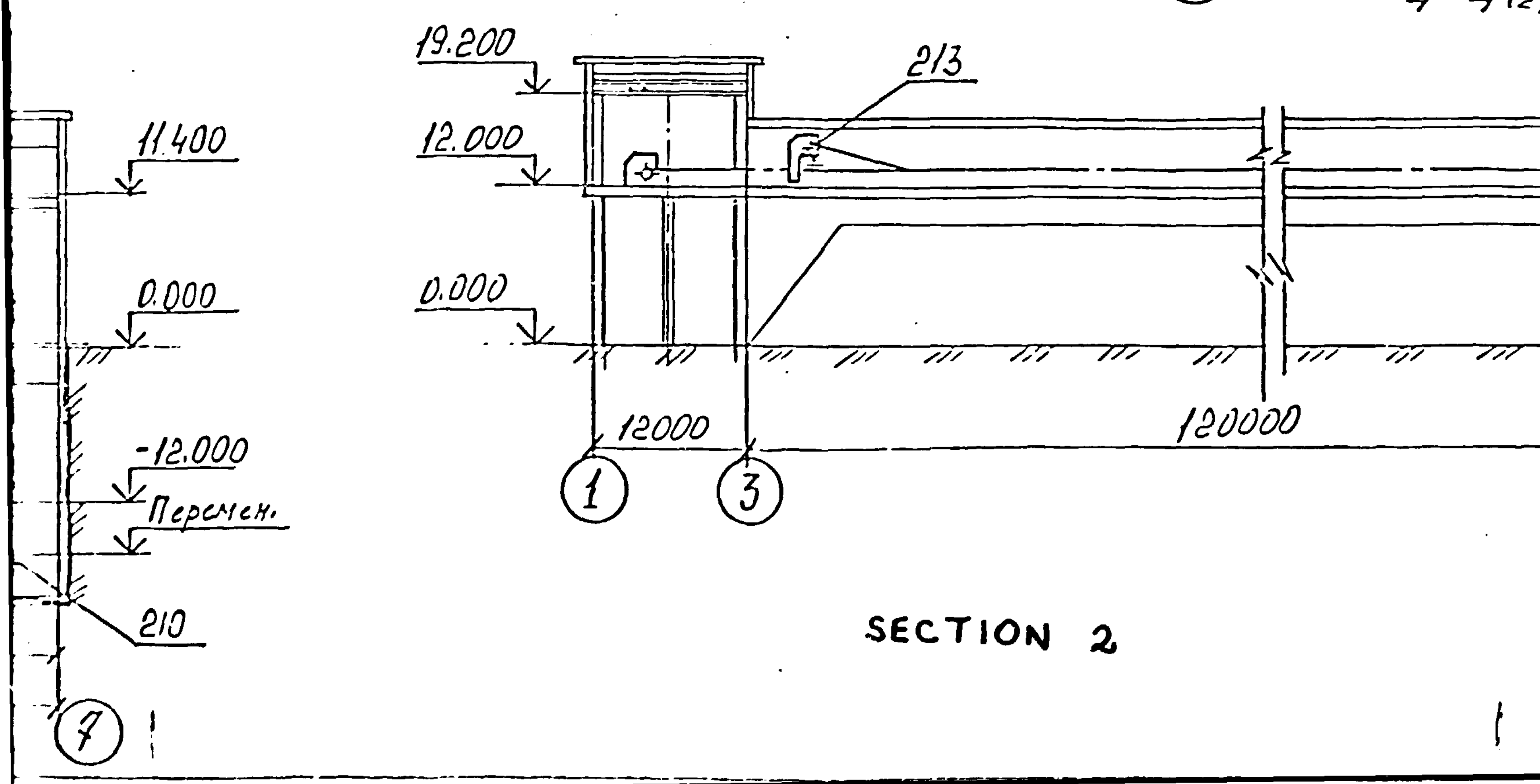
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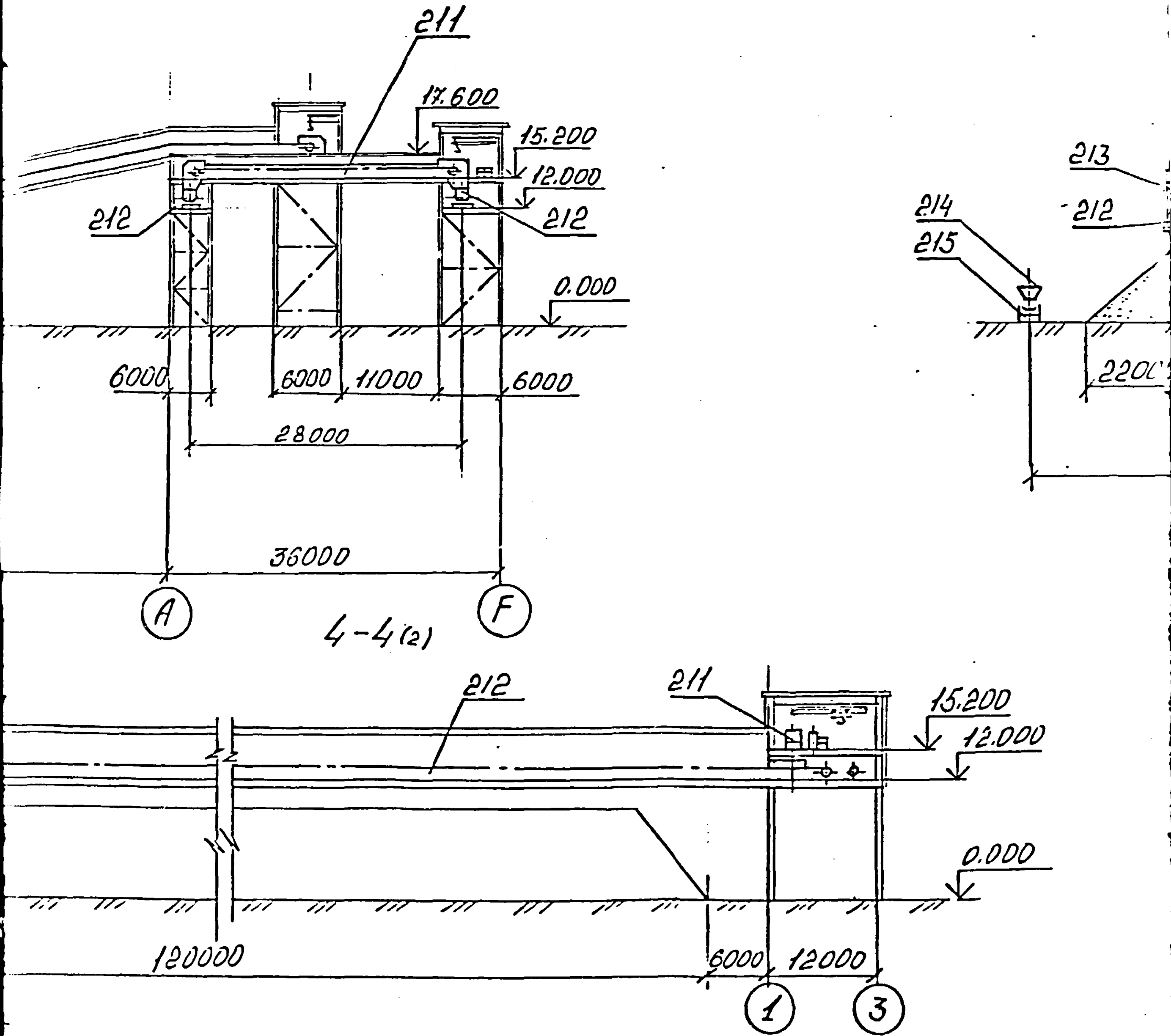
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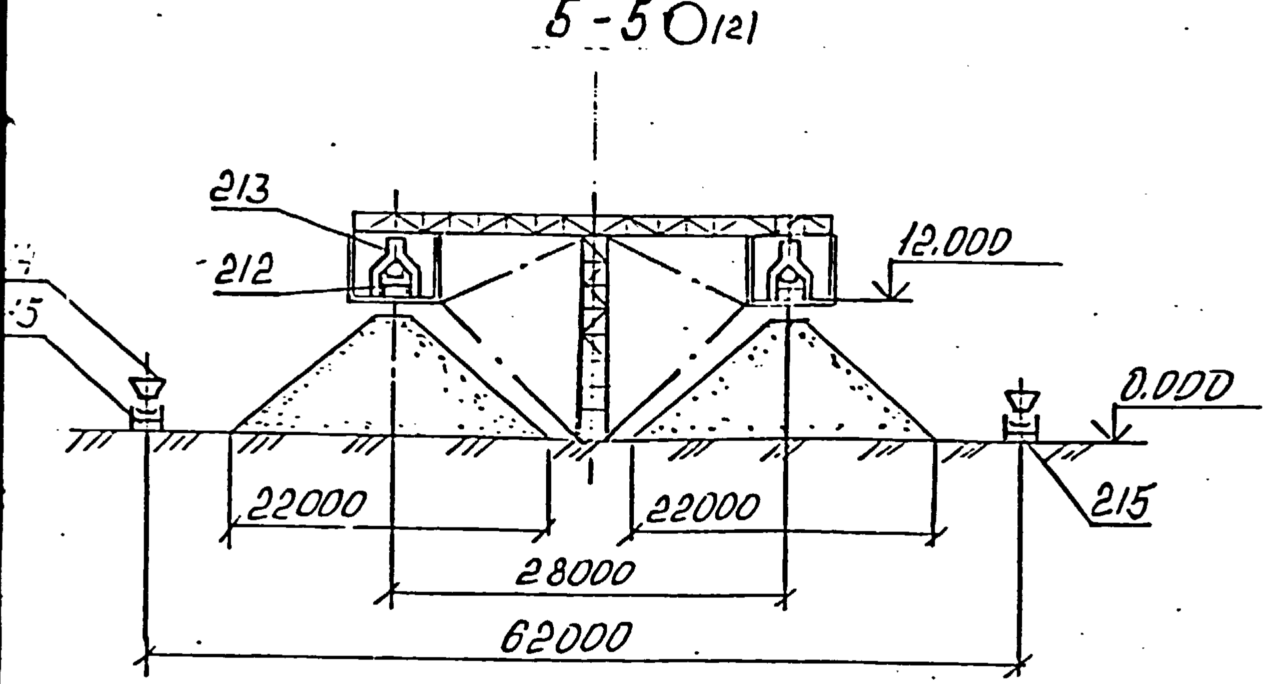

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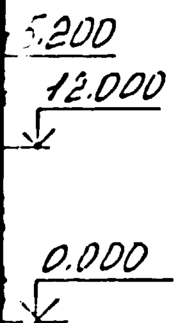

THE VIEWS ARE SHOWN IN SCALE 1:500

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	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	ALUMINA PRODUCTION. NEPHELINE RECEIVING UNIT. NEPHELINE STORAGE. FINE NEPHELINE CRUSHING	PHASE	SHEET	SHEETS
		POS	3	
	SECTIONS	VAMI LENINGRAD		

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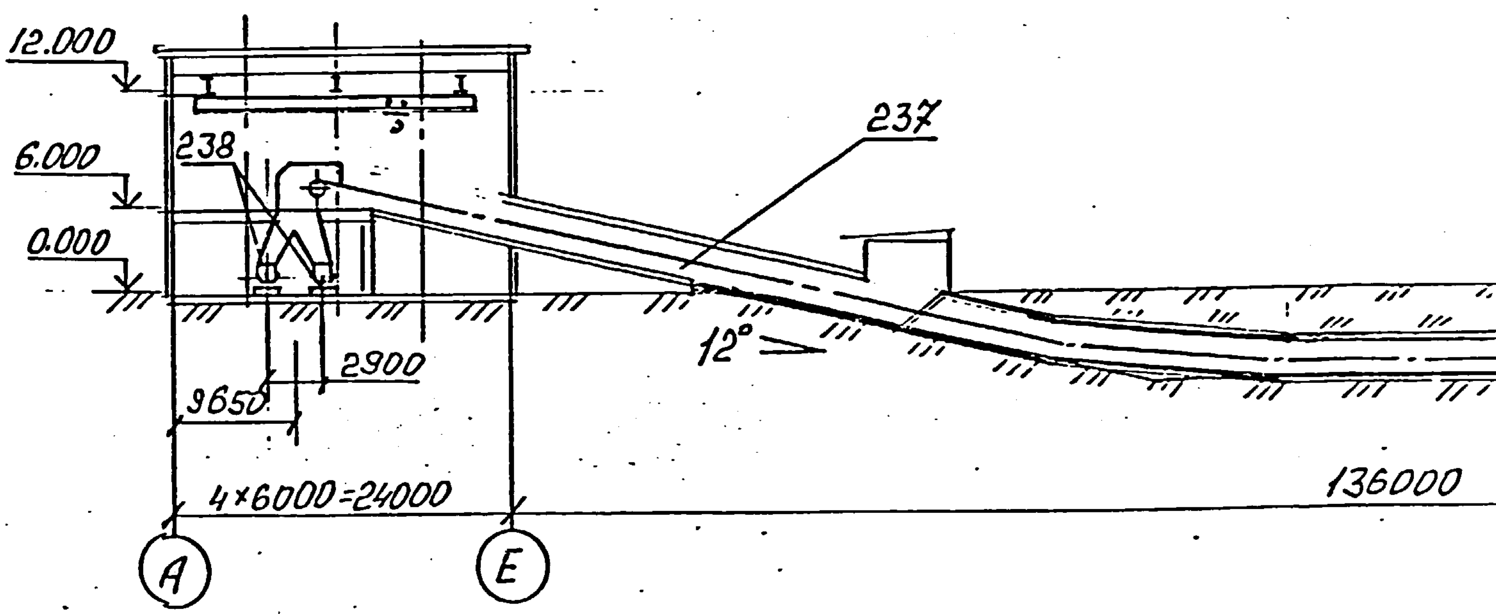
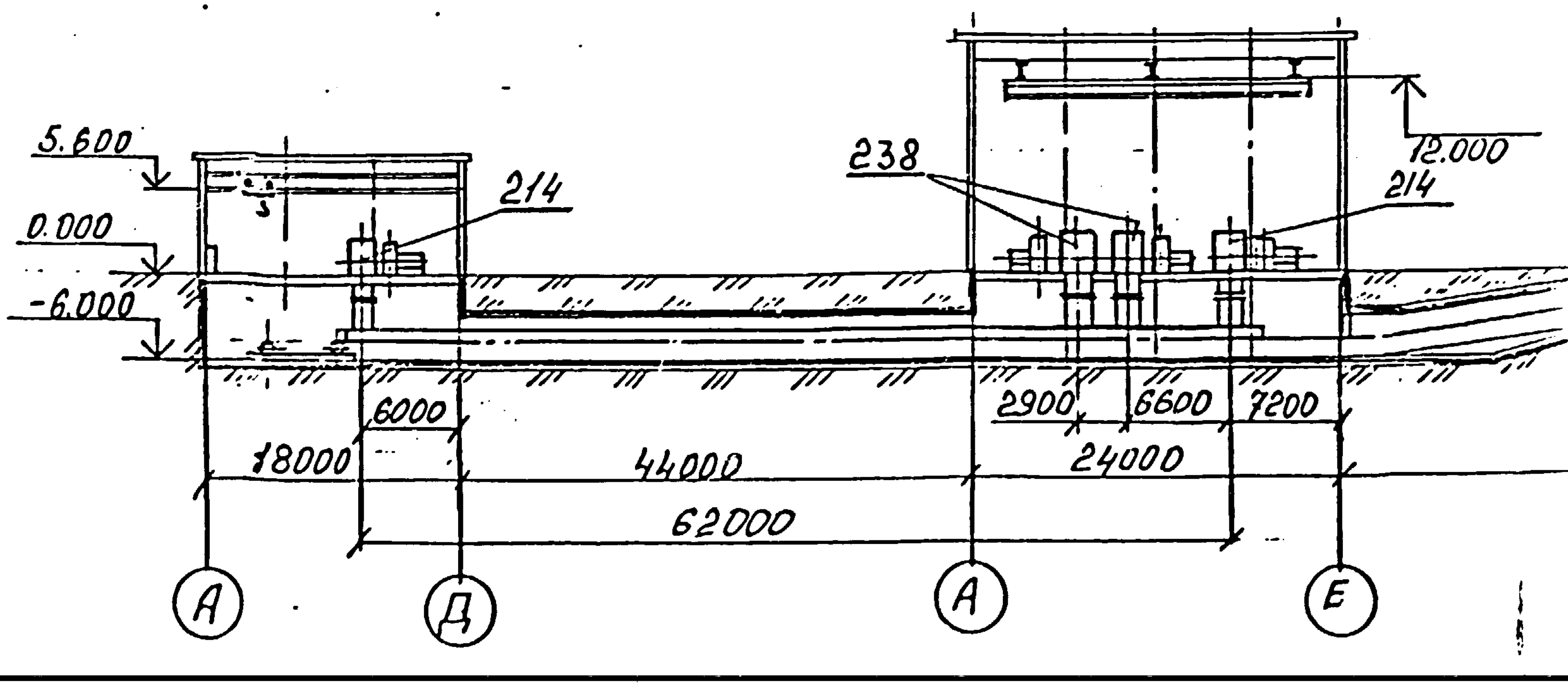
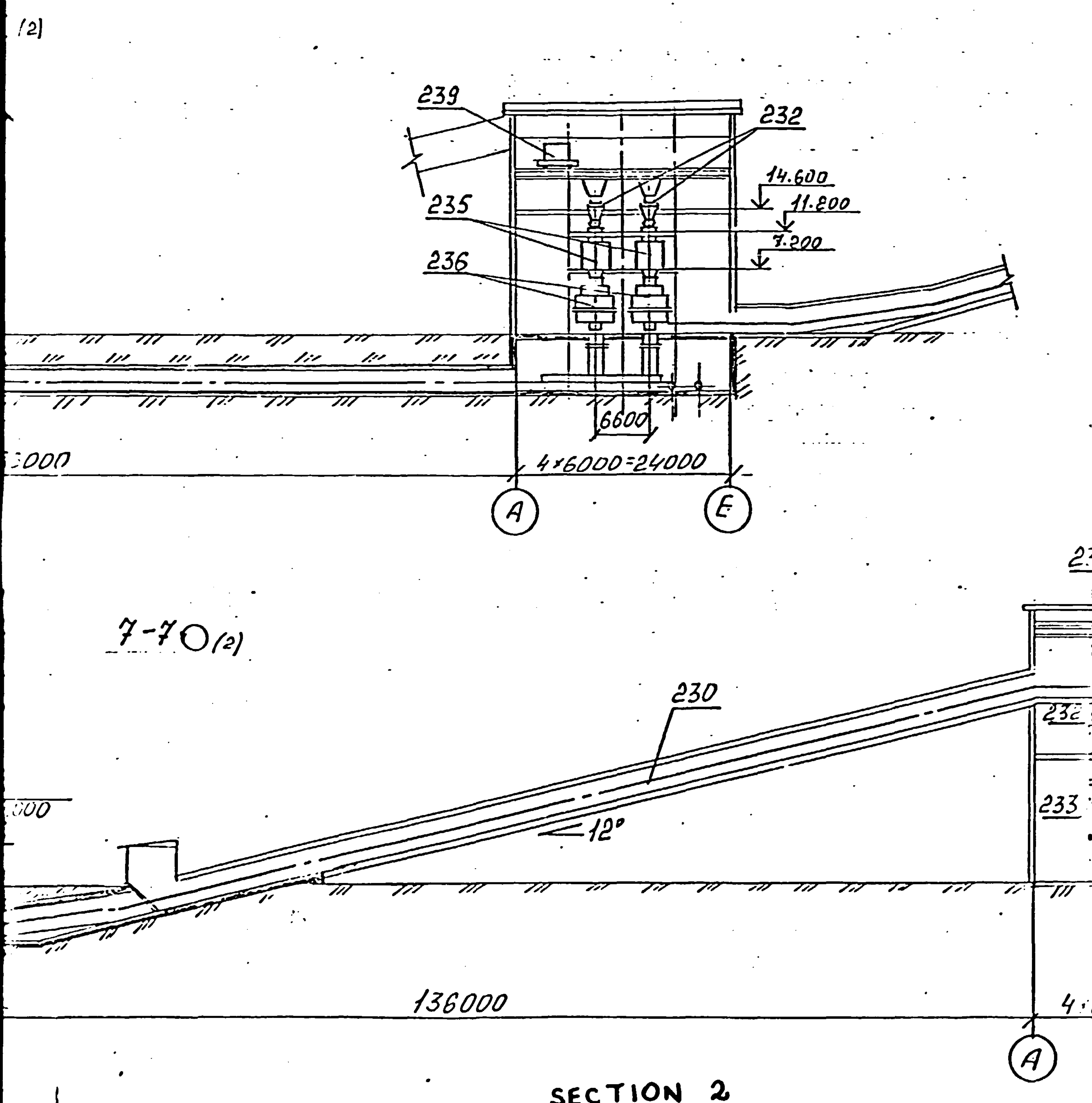


SECTION 1

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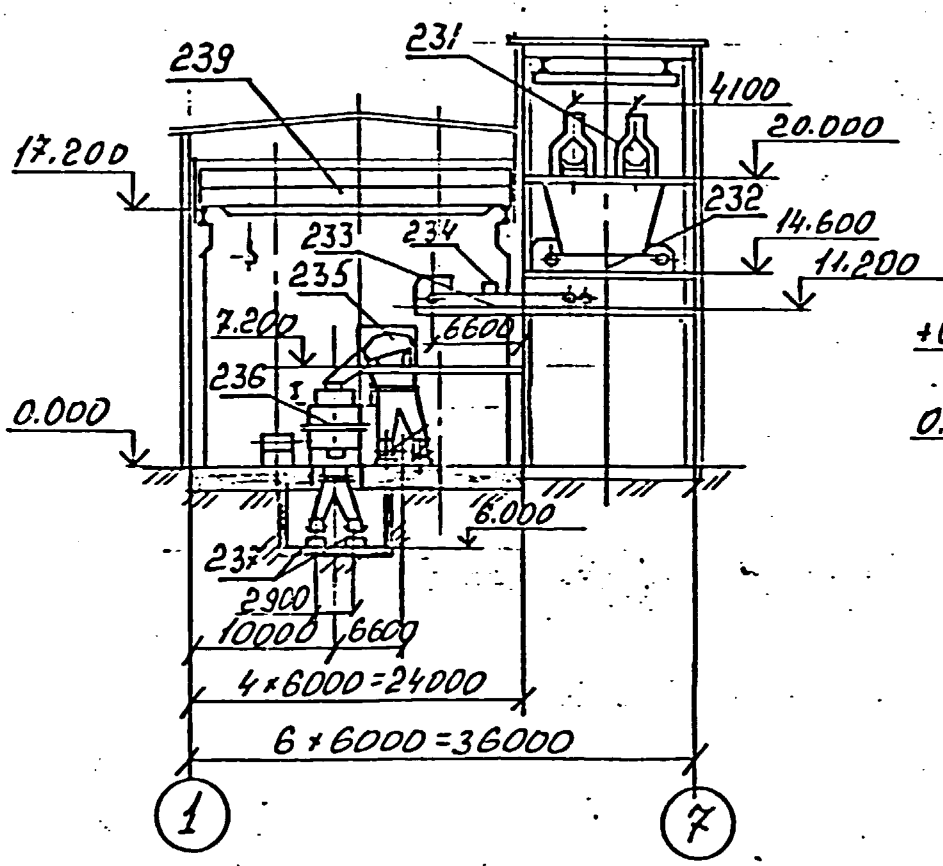

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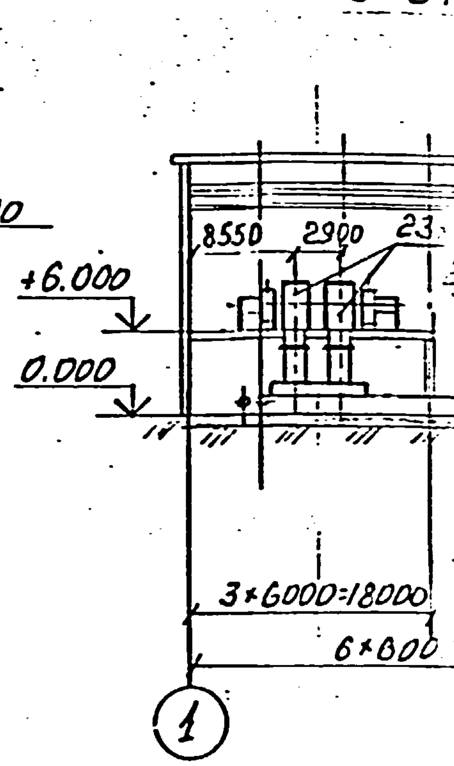

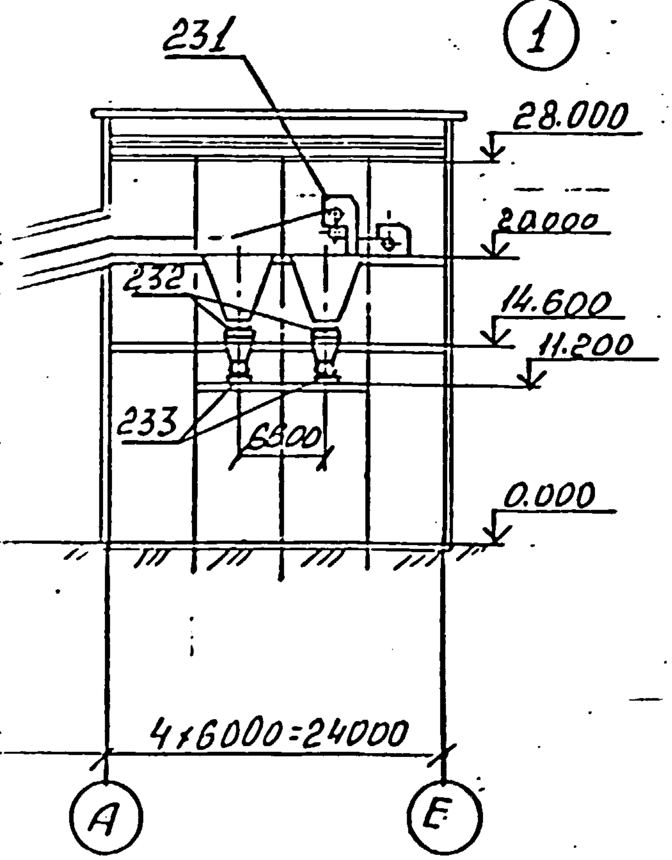

SECTION 3

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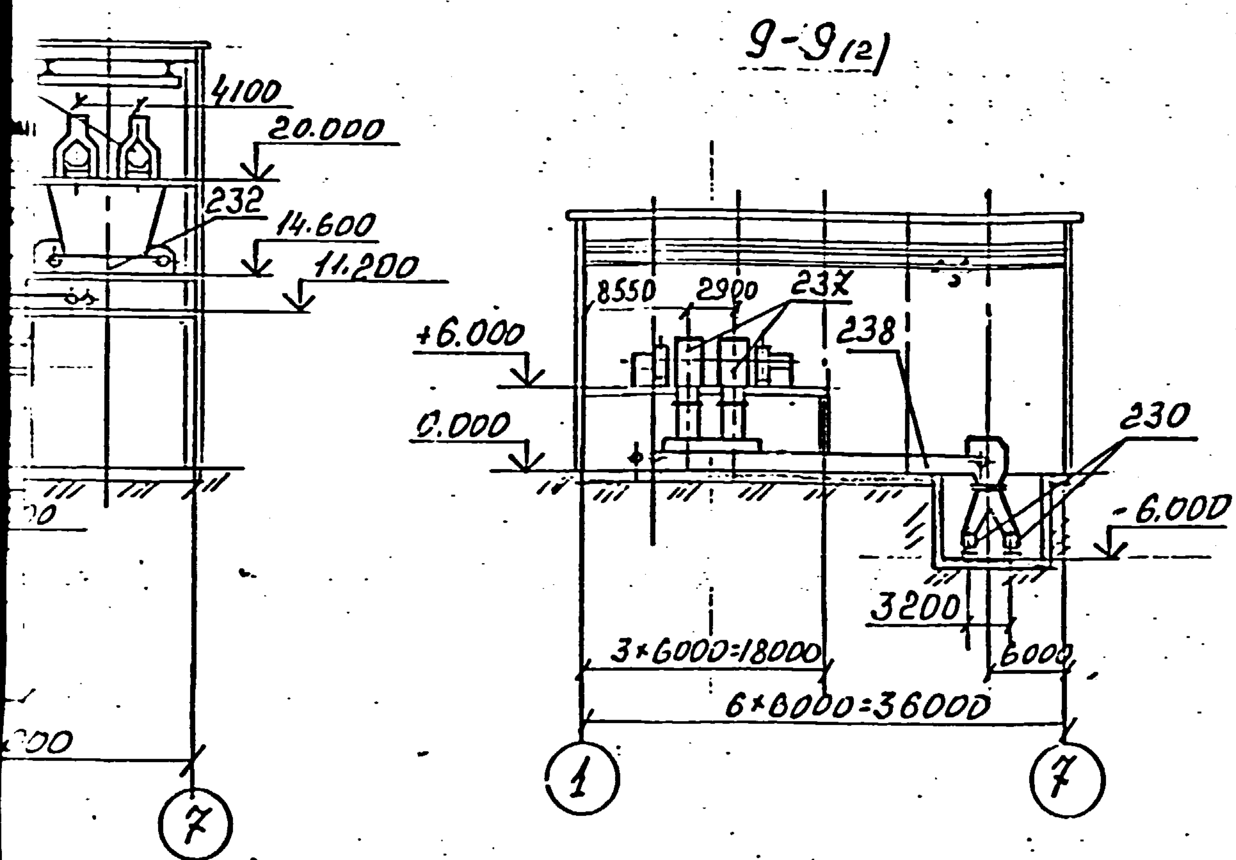

SECTION 4

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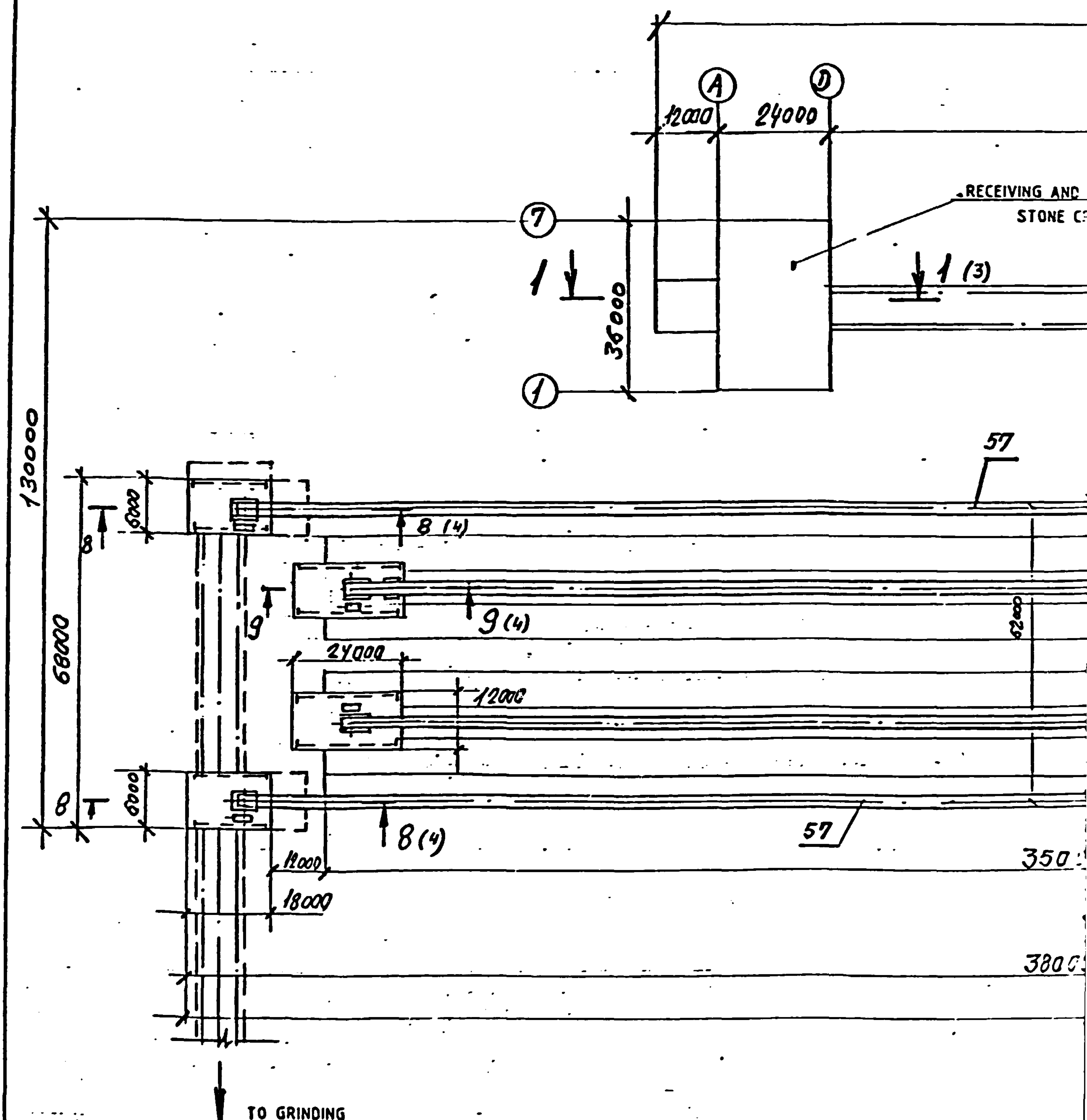
	ALUMINA PRODUCTION. NEPHELINE RECEIVING. UNIT. NEPHELINE STORAGE. FINE NEPHELINE CRUSHING.	PHASE	SHEET	SHEETS
		POS	4	
	SECTIONS	VAMI LENINGRAD		



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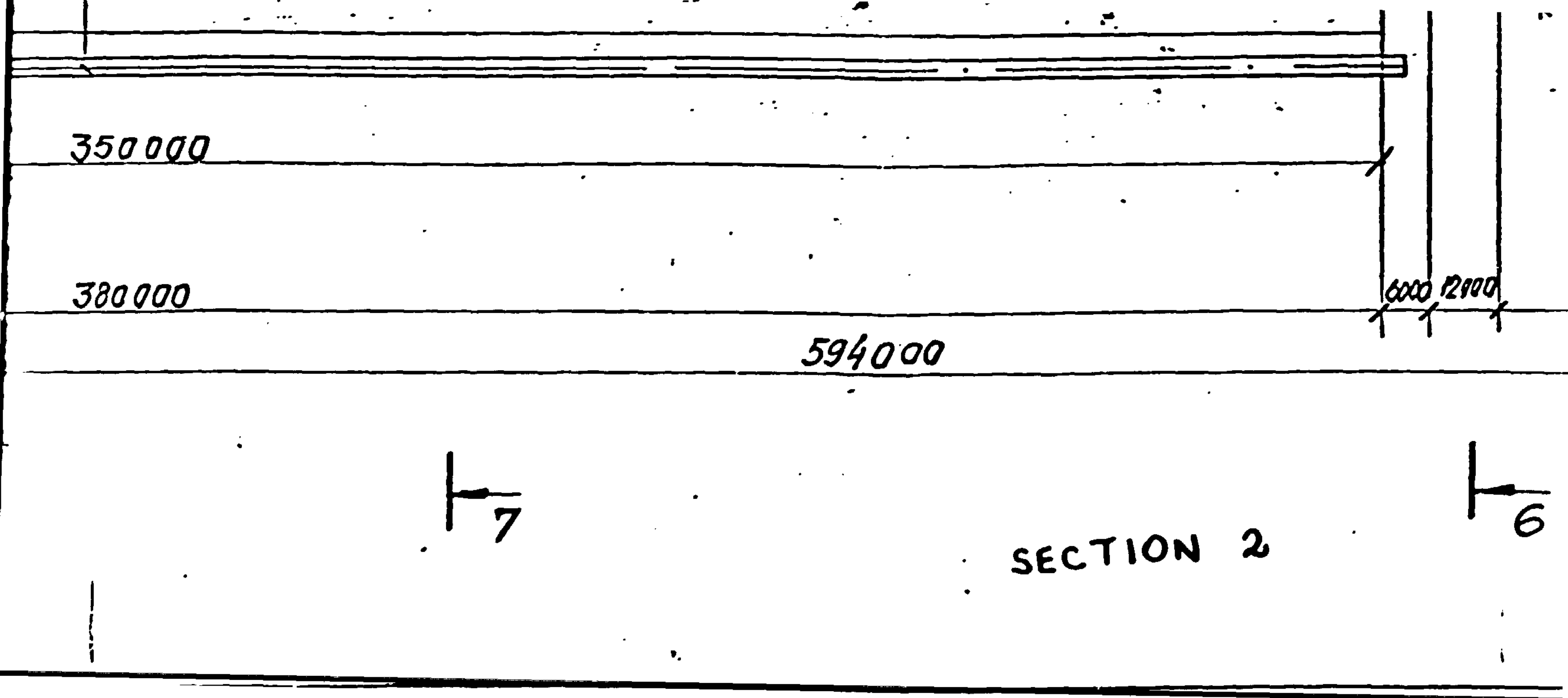
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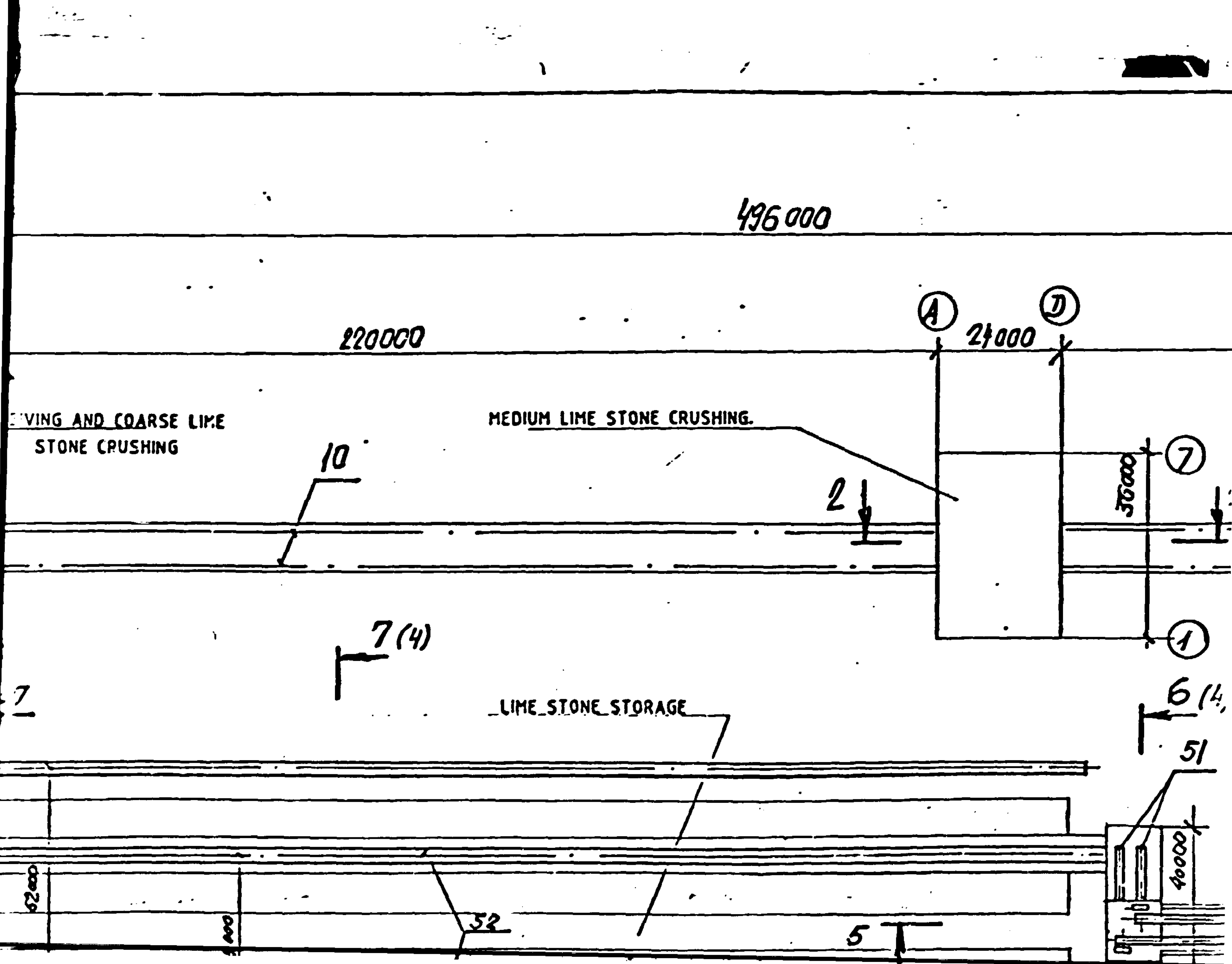
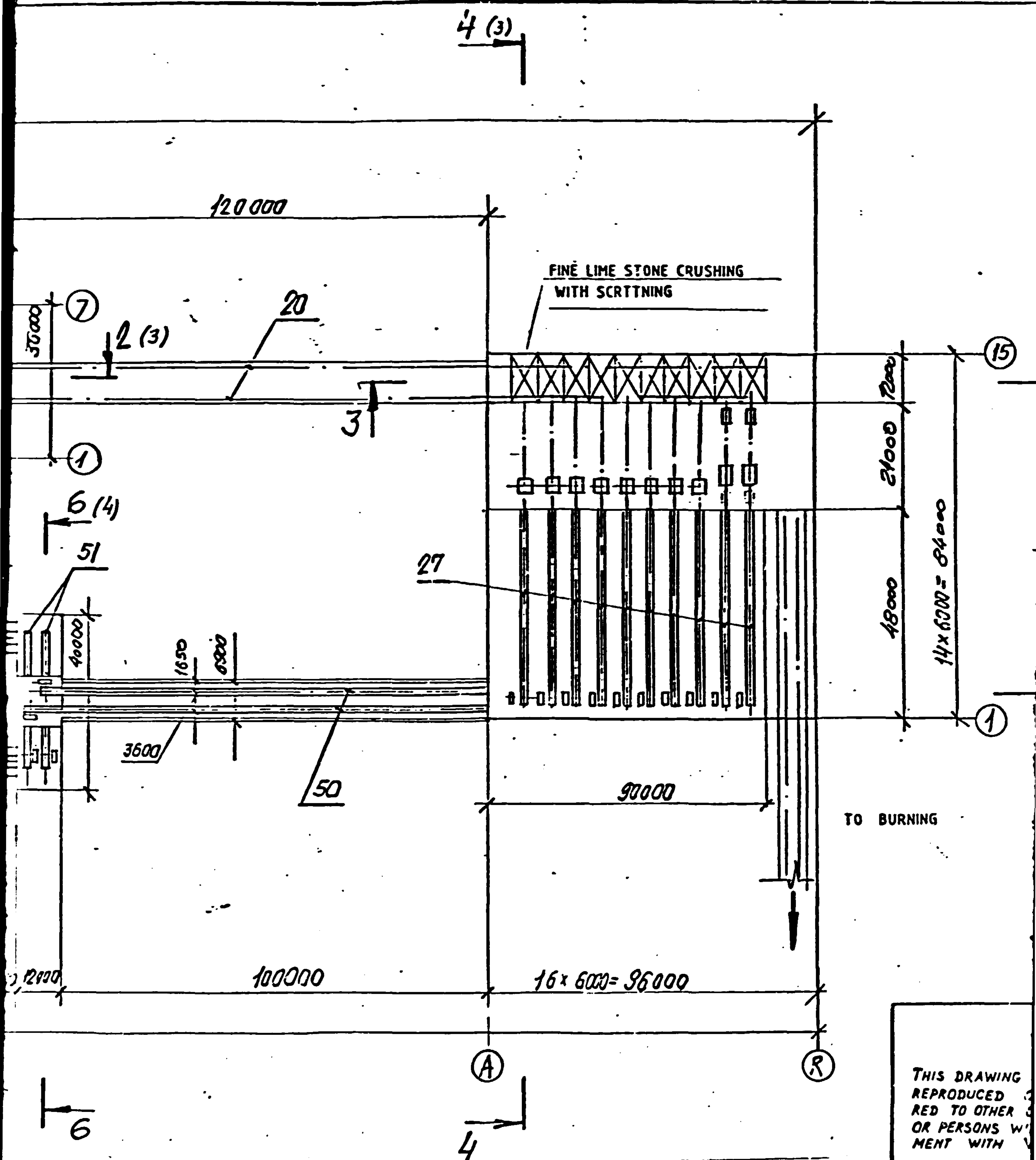
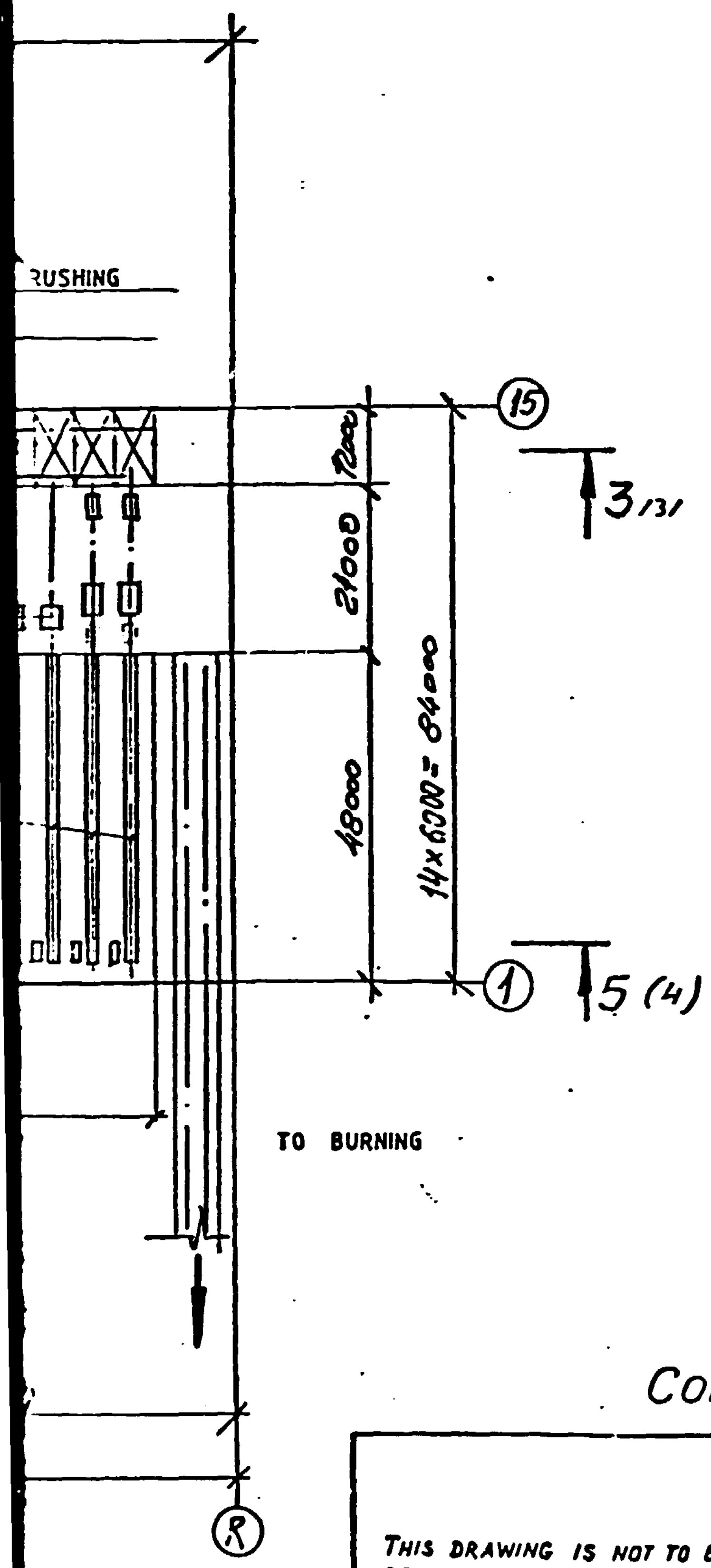
7
6
SECTION 2


496 000
220000
24000
36000
40000
62000
A
D
7
1
VING AND COARSE LIME
STONE CRUSHING
MEDIUM LIME STONE CRUSHING.
LIME STONE STORAGE
10
2
7 (4)
6 (4,
7
51
52
5


4 (3)
120 000
FINE LIME STONE CRUSHING
WITH SCRTTNING
20
7
2 (3)
3
15
1
6 (4)
51
27
40000
1650
3600
50
90000
TO BURNING
48000
24000
12000
14x6000= 84000
100000
16 x 6000= 96000
A
R
6
4

SECTION 3



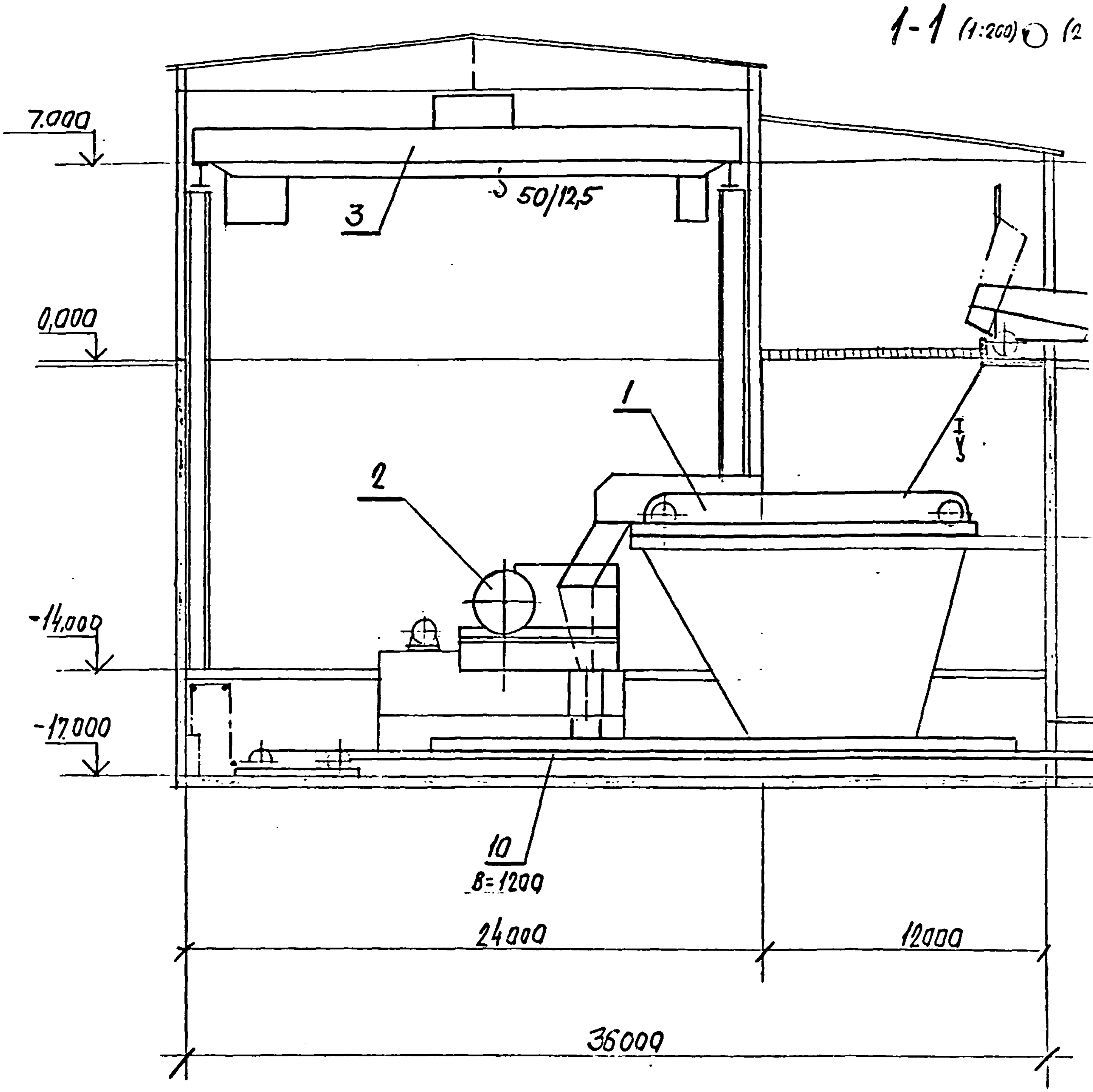
SECTION 4

THE VIENS ARE SHOWN IN SCALE 1:400

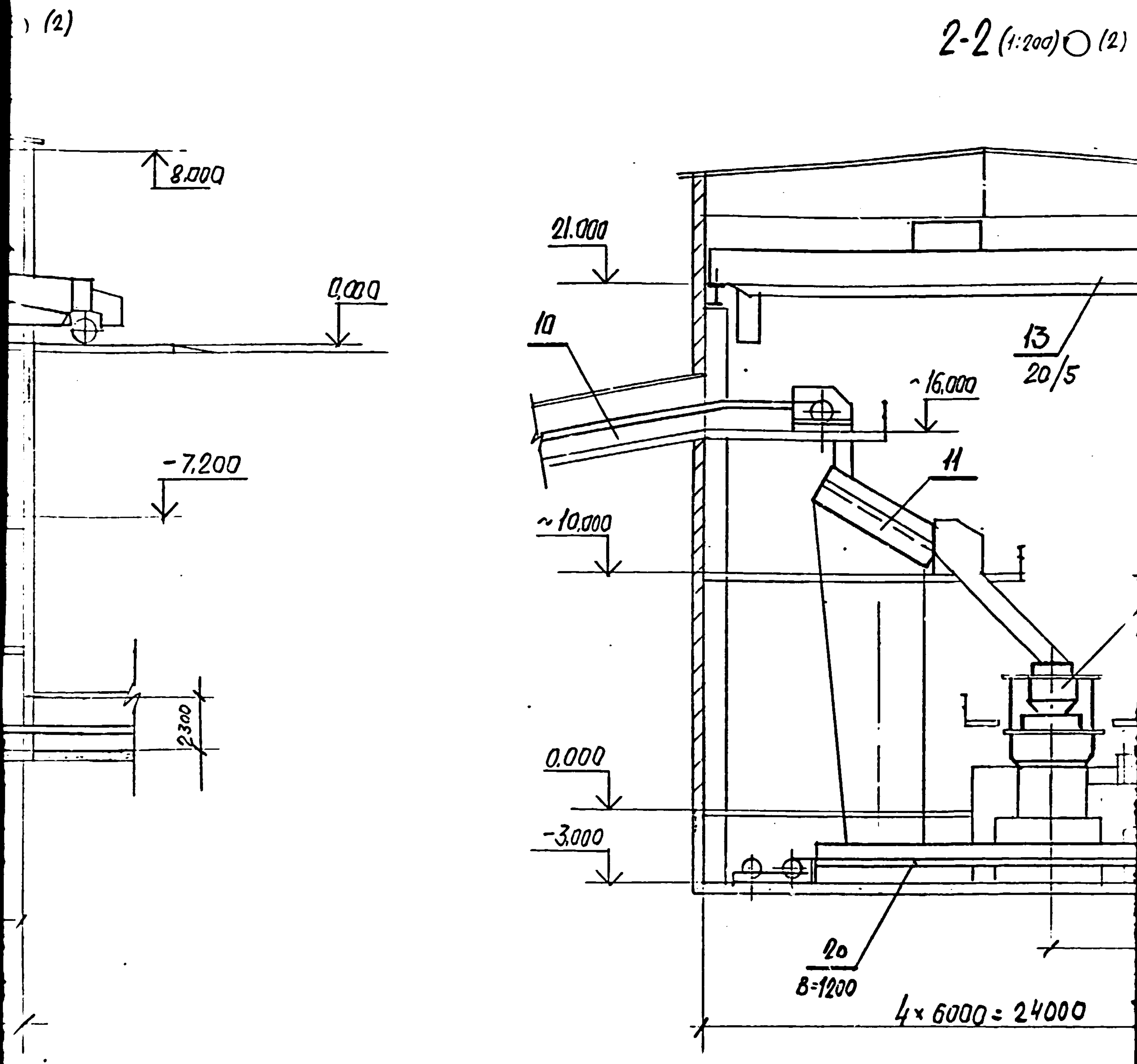
*FINE LIME STONE CRUSHING WITH SCREENING.
LIME STONE STORAGE.
LIME STONE CONVEYOR GALLERY.

CONTRACT N 90/204/205

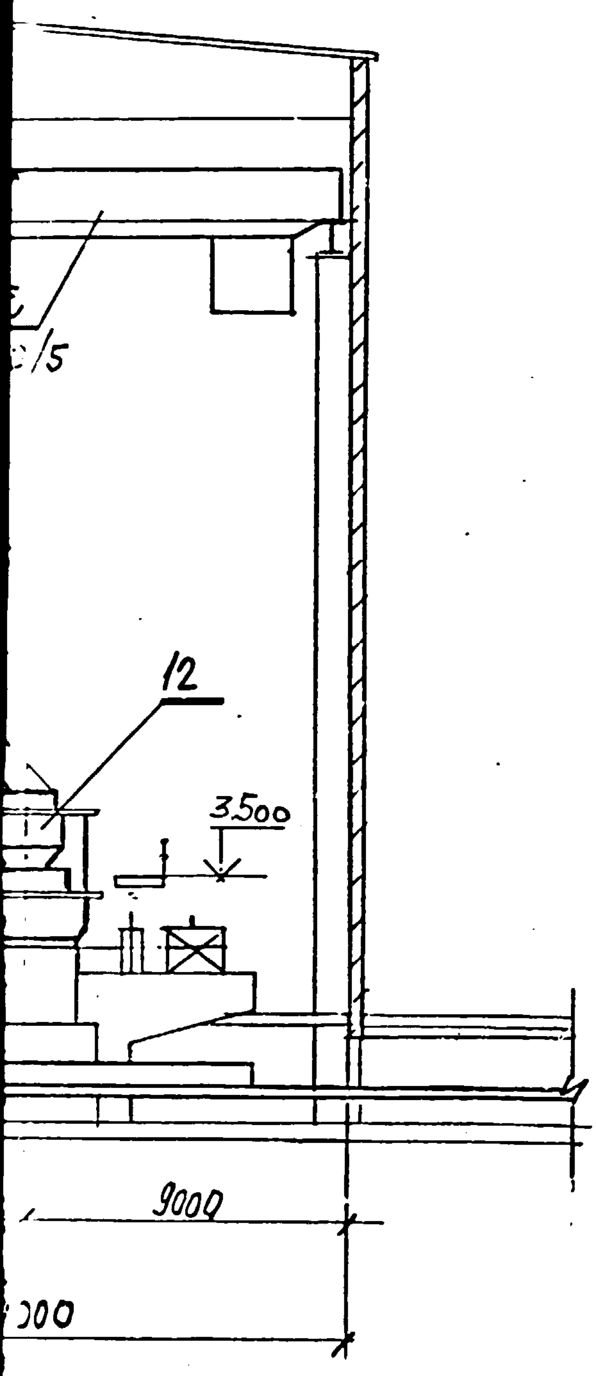
1339637-T			
RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
ALUMINA PRODUCTION. RECEIVING AND COARSE LIME STONE CRUSHING. MEDIUM LIME STONE CRUSHING.*	PHASE	SHEET	SHEETS
	POS	2 .	
LOCATION LAY-OUT..	VAMI LENINGRAD		


1-1 (1:200)
7.000
0,000
-14,000
-17.000
3
50/12,5
1
2
10
B=1200
24000
12000
36000

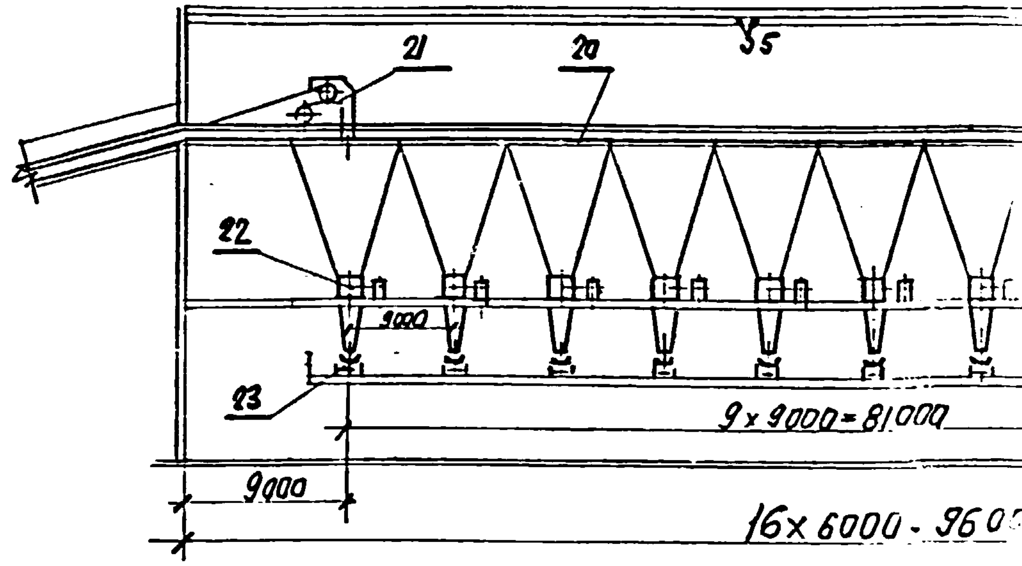
SECTION 1


(2)
2-2 (1:200) (2)
8,000
0,000
-7,200
2300
21,000
10
13
20/5
~16,000
11
~10,000
0,000
-3,000
20
B=1200
4×6000=24000

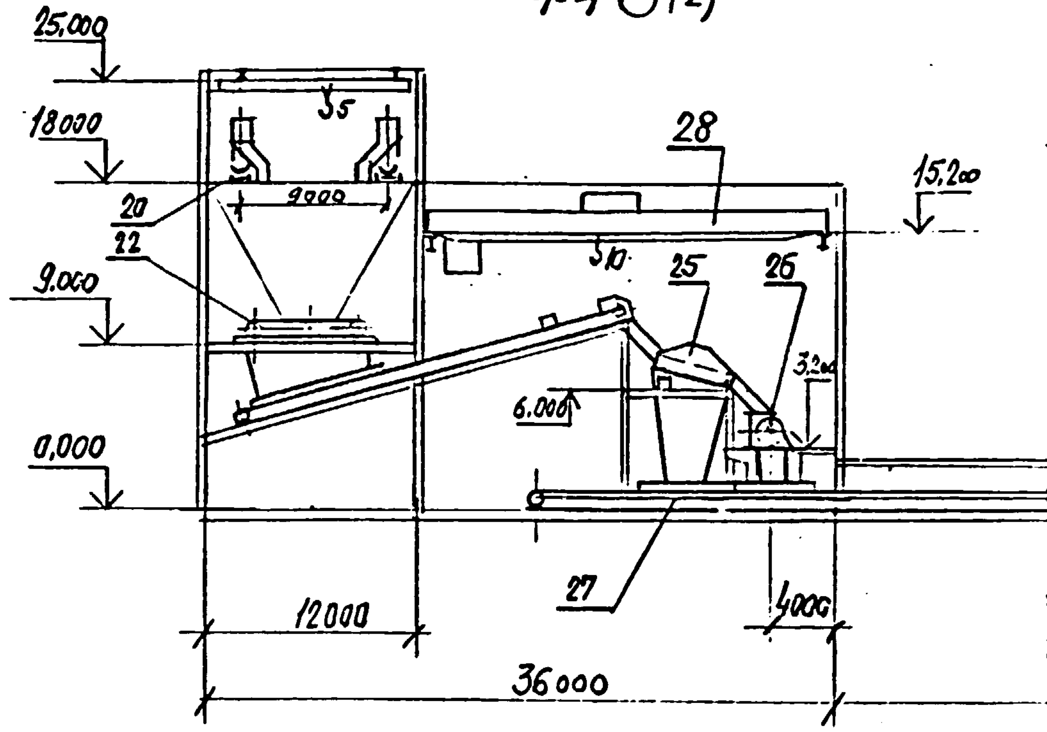
SECTION 2



3-3 (2)

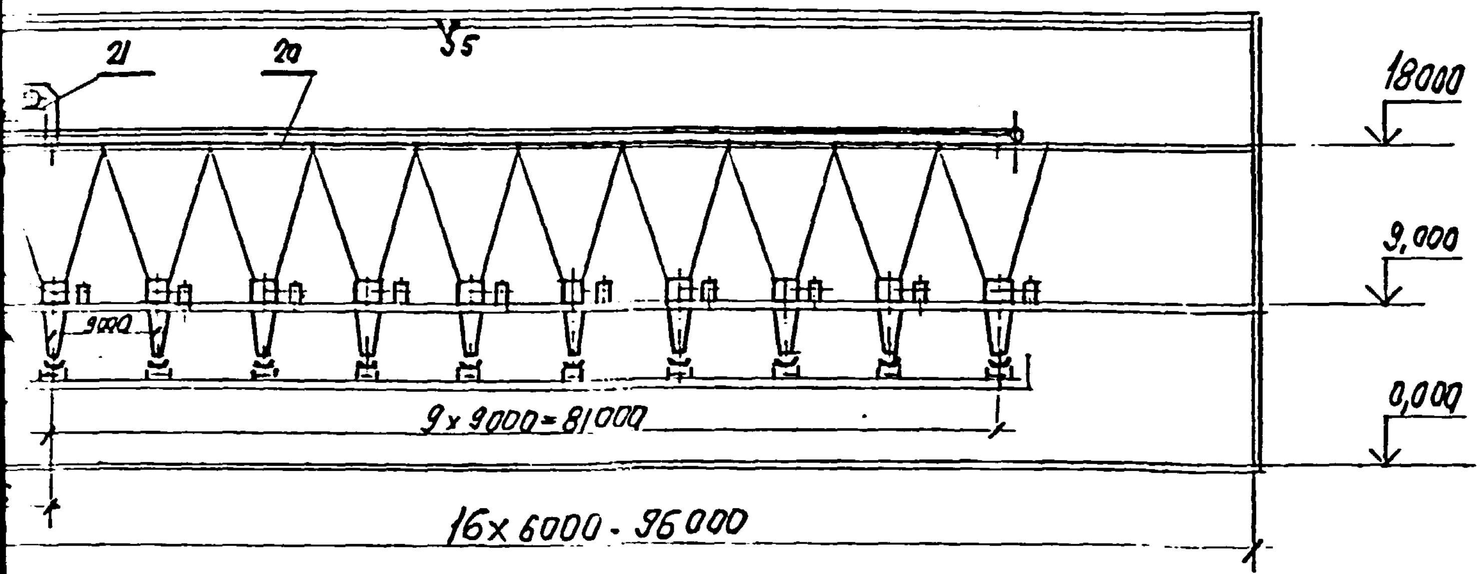


4-4 (2)

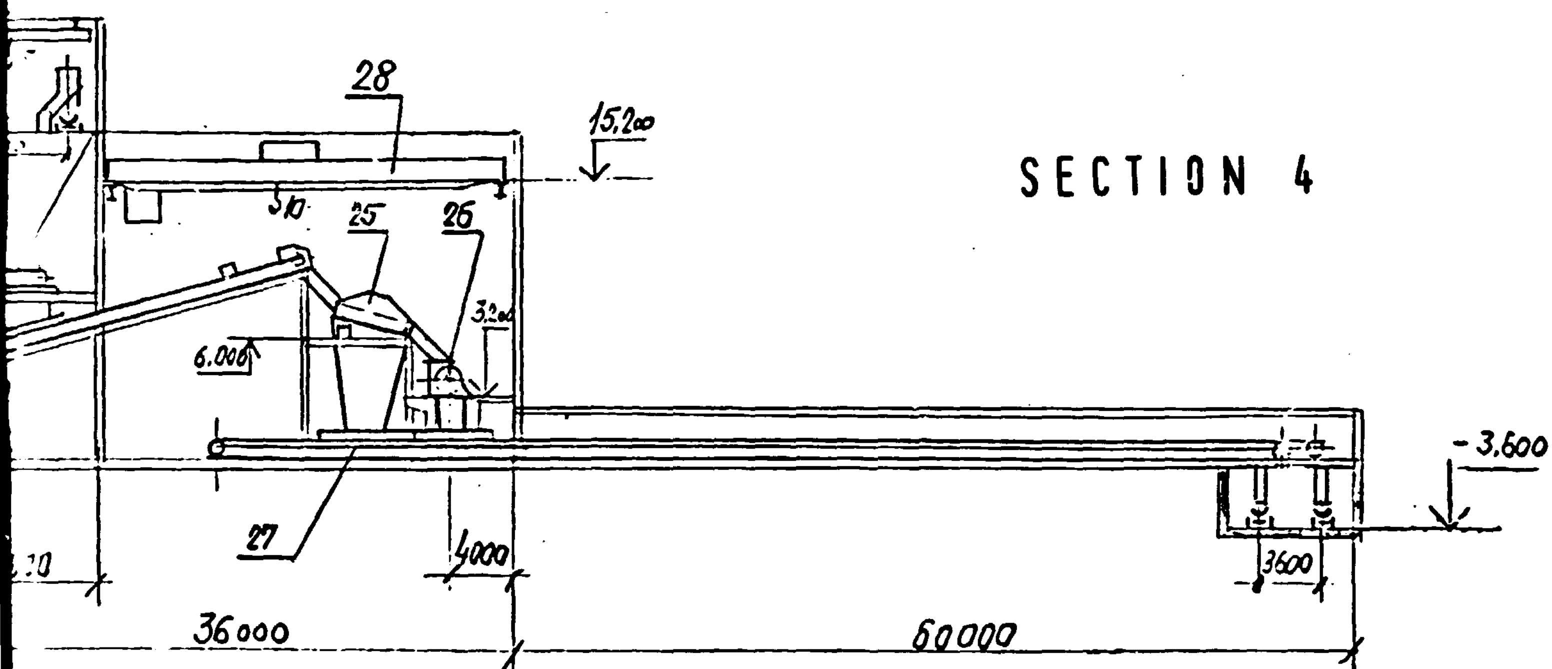


SECTION 3

3-3 (2)



4-4 (2)



SECTION 4

*FINE LIME STONE CRUSHING WITH SCREEN'NG.
LIME STONE STORAGE.
LIME STONE CONVEYOR GALLERY.

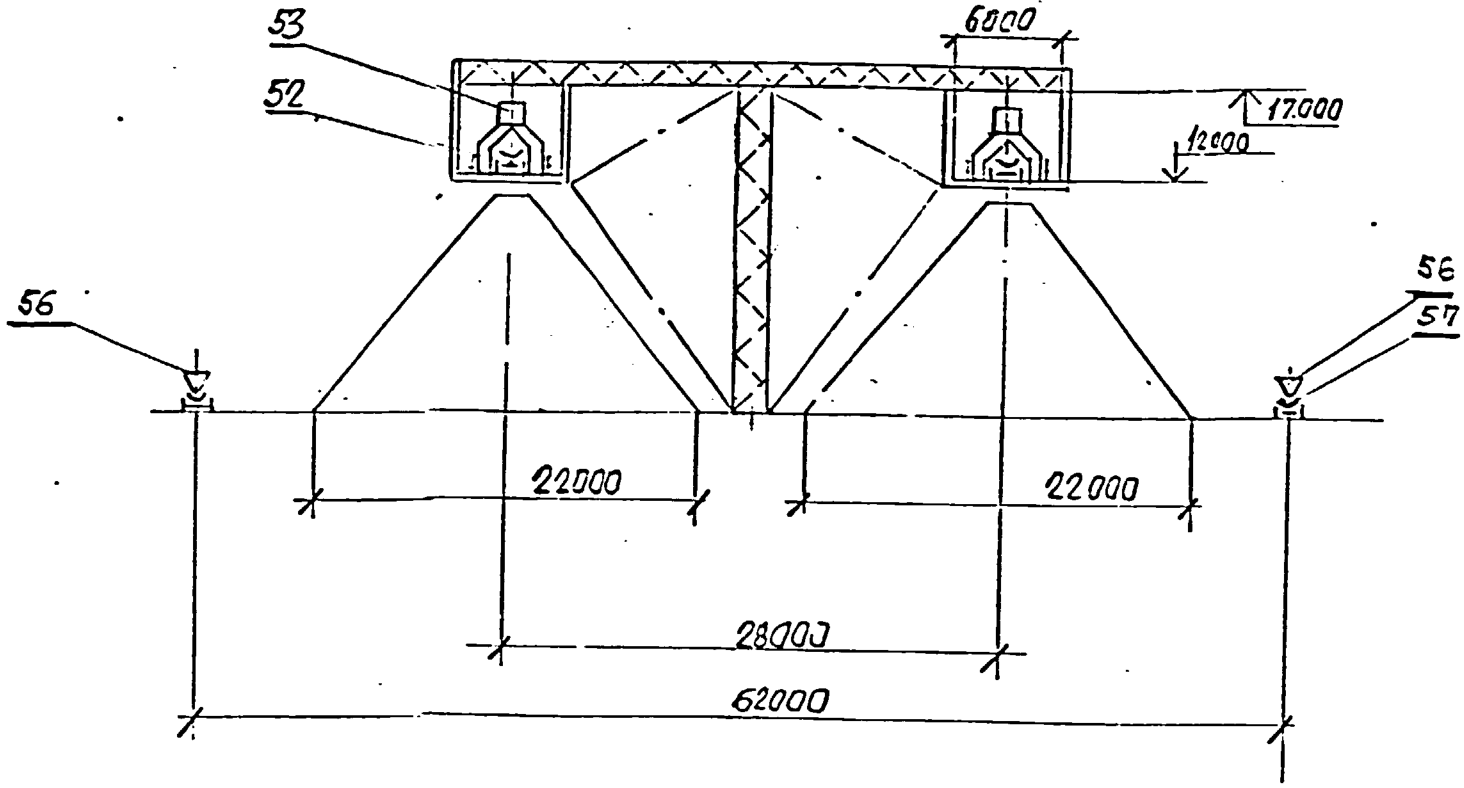
CONTRACT N 90/204/205

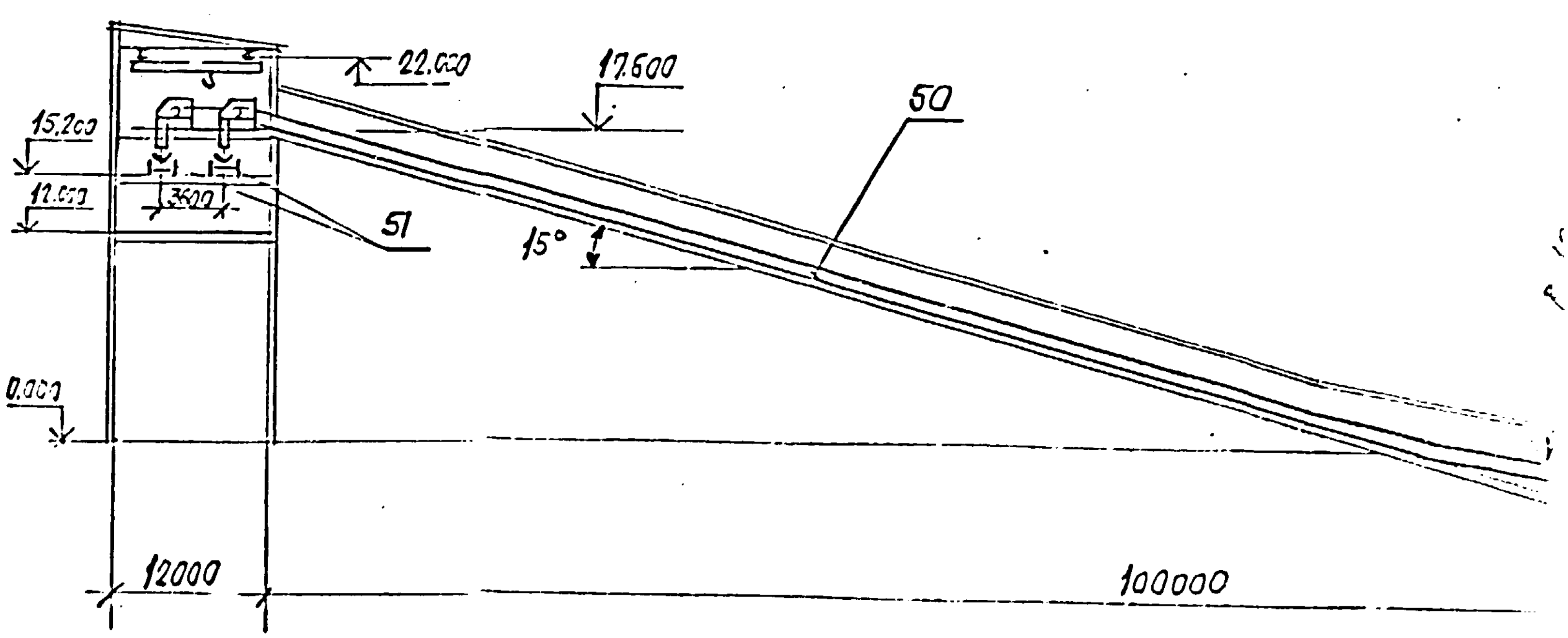
1339637-T

RAZGAH NEPHELINES PROCESSING PLANT (IRAN)

ALUMINA PRODUCTION. RECEIVING AND COARSE LIME STONE CRUSHING. MEDIUM LIME STONE CRUSHING.*	PHASE	SHEET	SHEETS
	POS	3	
SECTIONS	VAMI LENINGRAD		

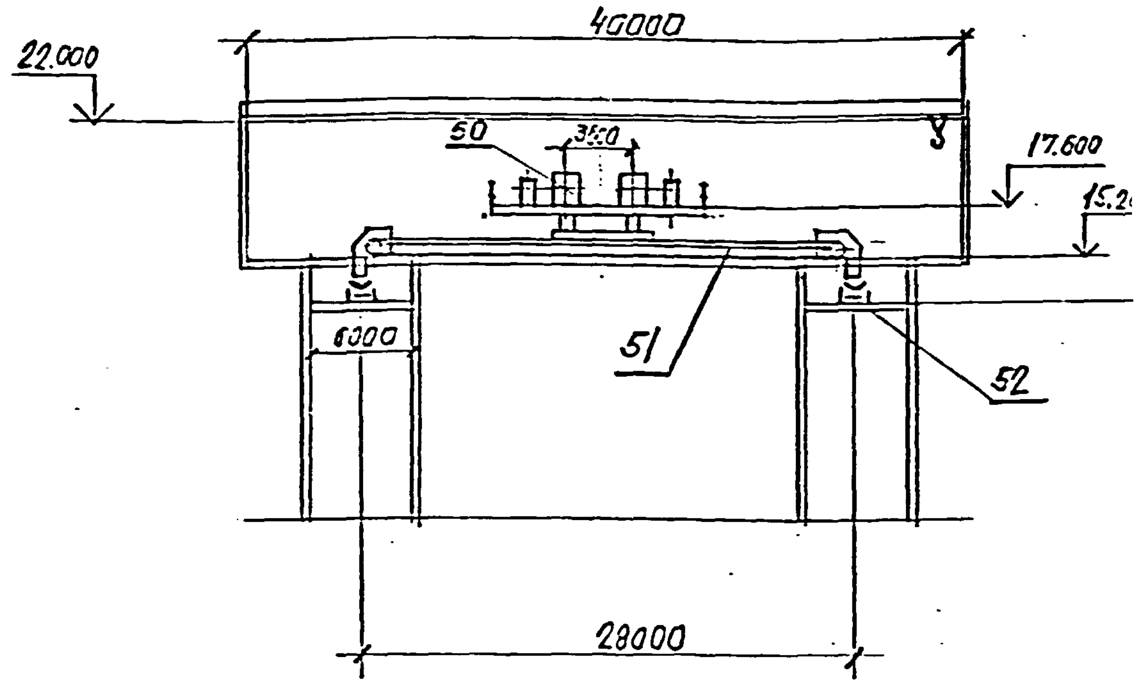
7-70(2)





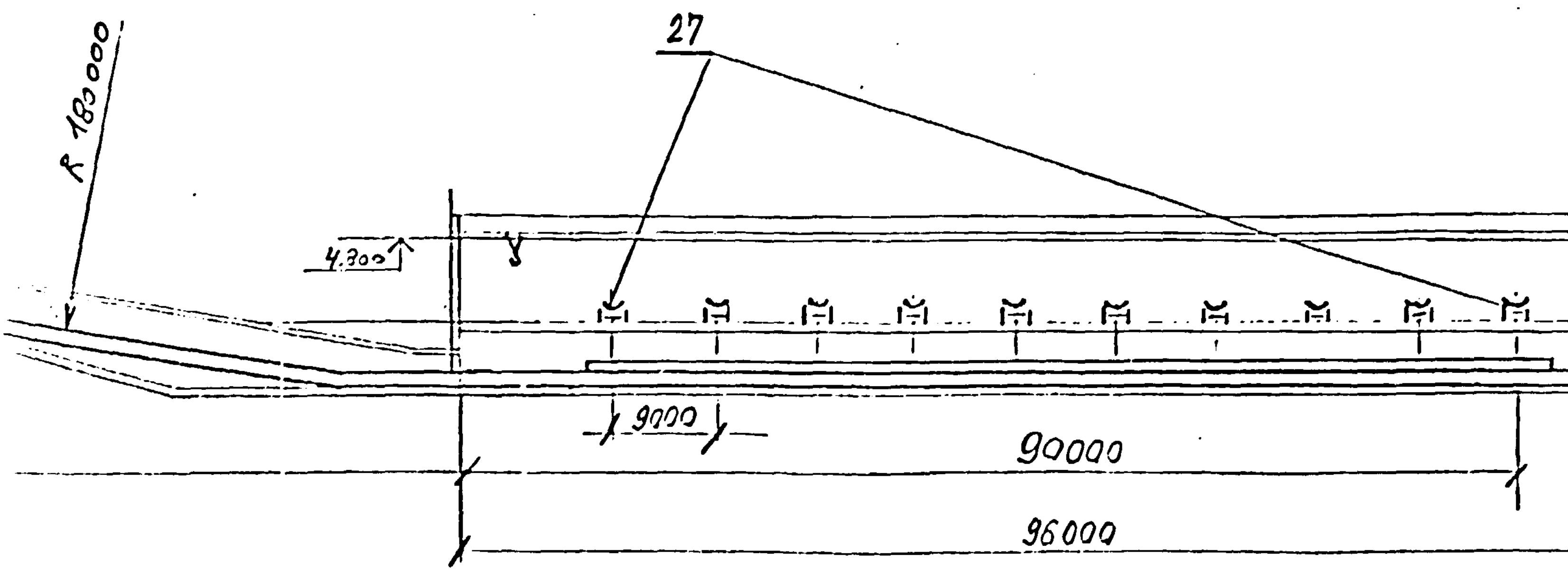
SECTION 1

6-6 (2)

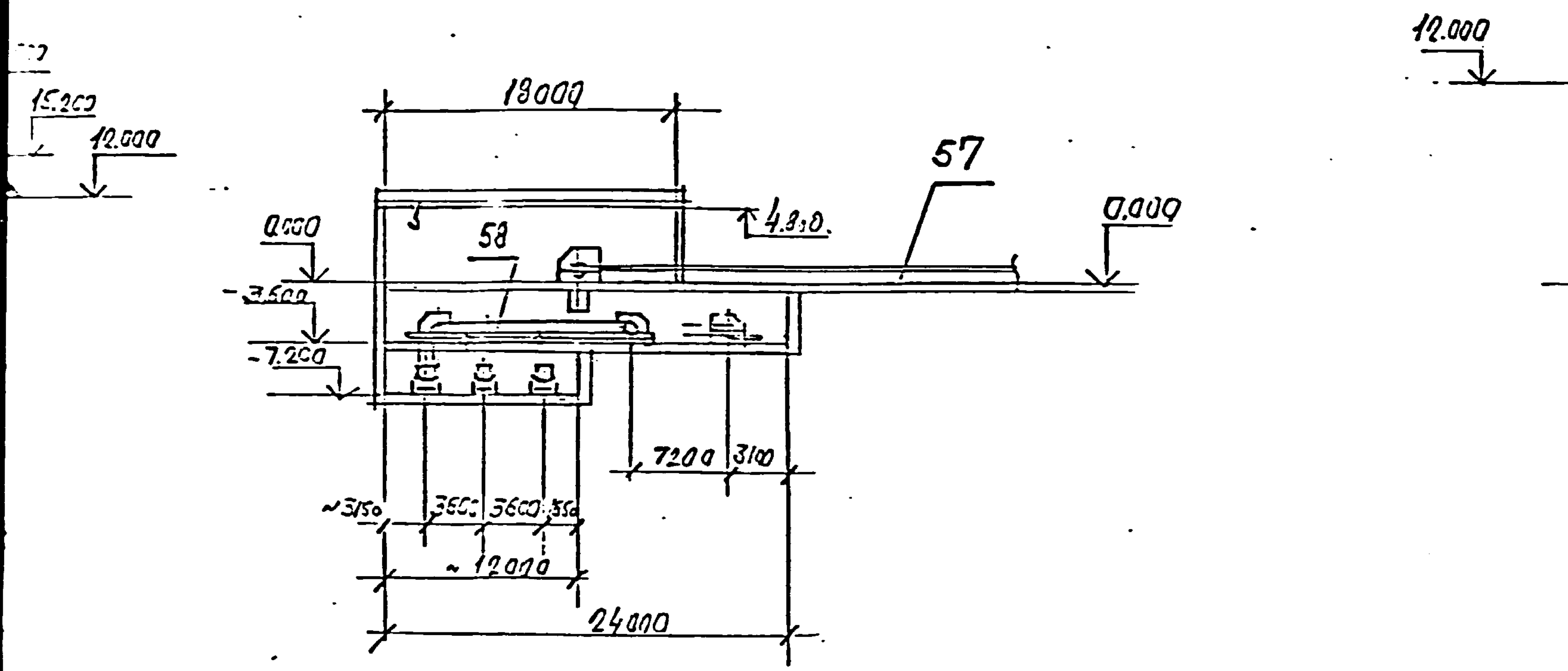


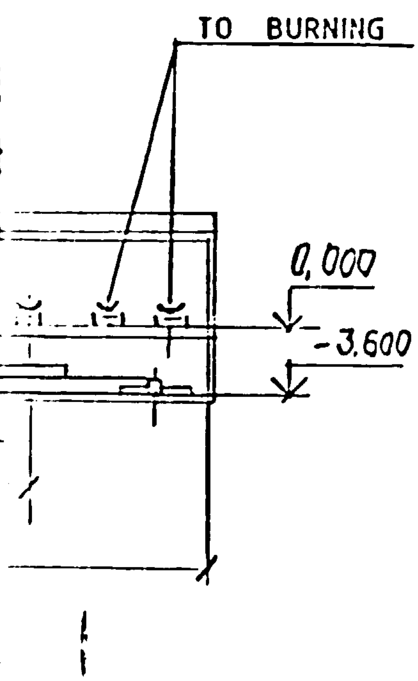
5-5 (2)

SECTION 2



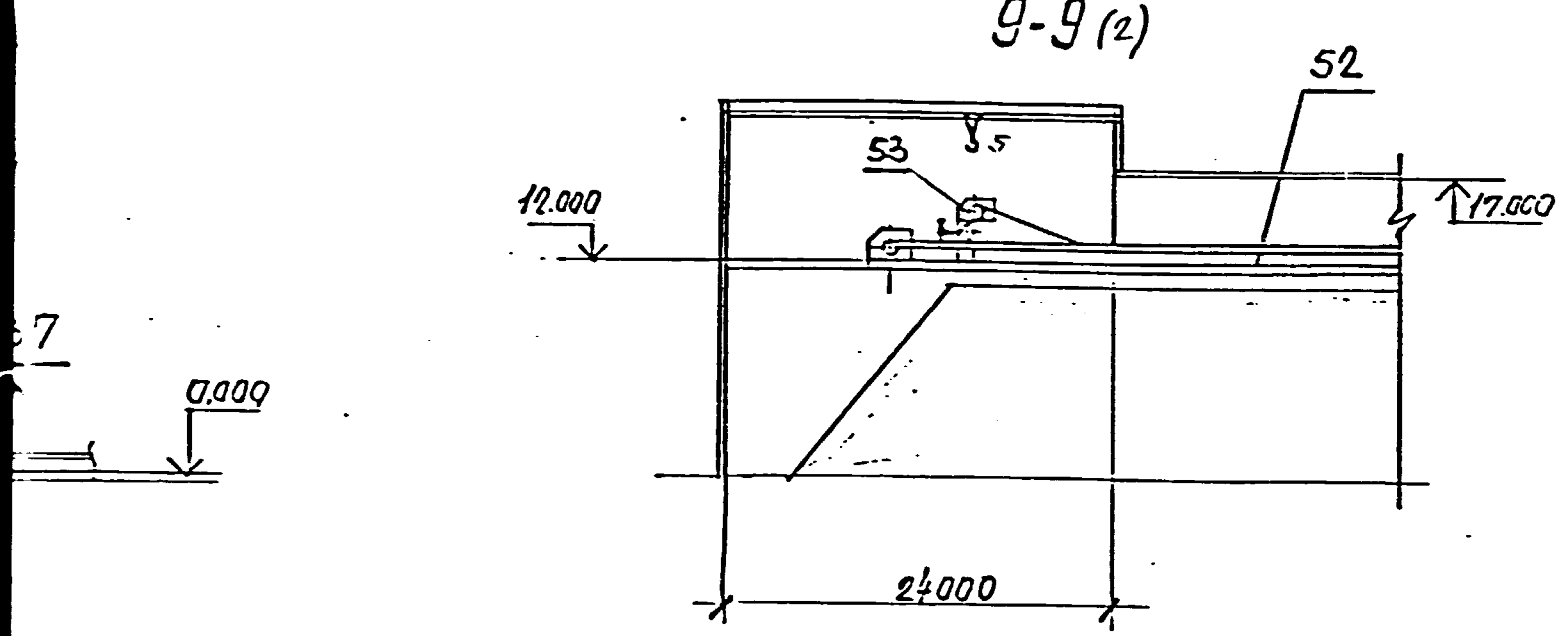
8-8 (2)





SECTION 3

THIS DRAWING IS NOT
REPRODUCED OR TRA
RED TO OTHER ORGANIZ
OR PERSONS WITHOUT
MENT WITH VAMI

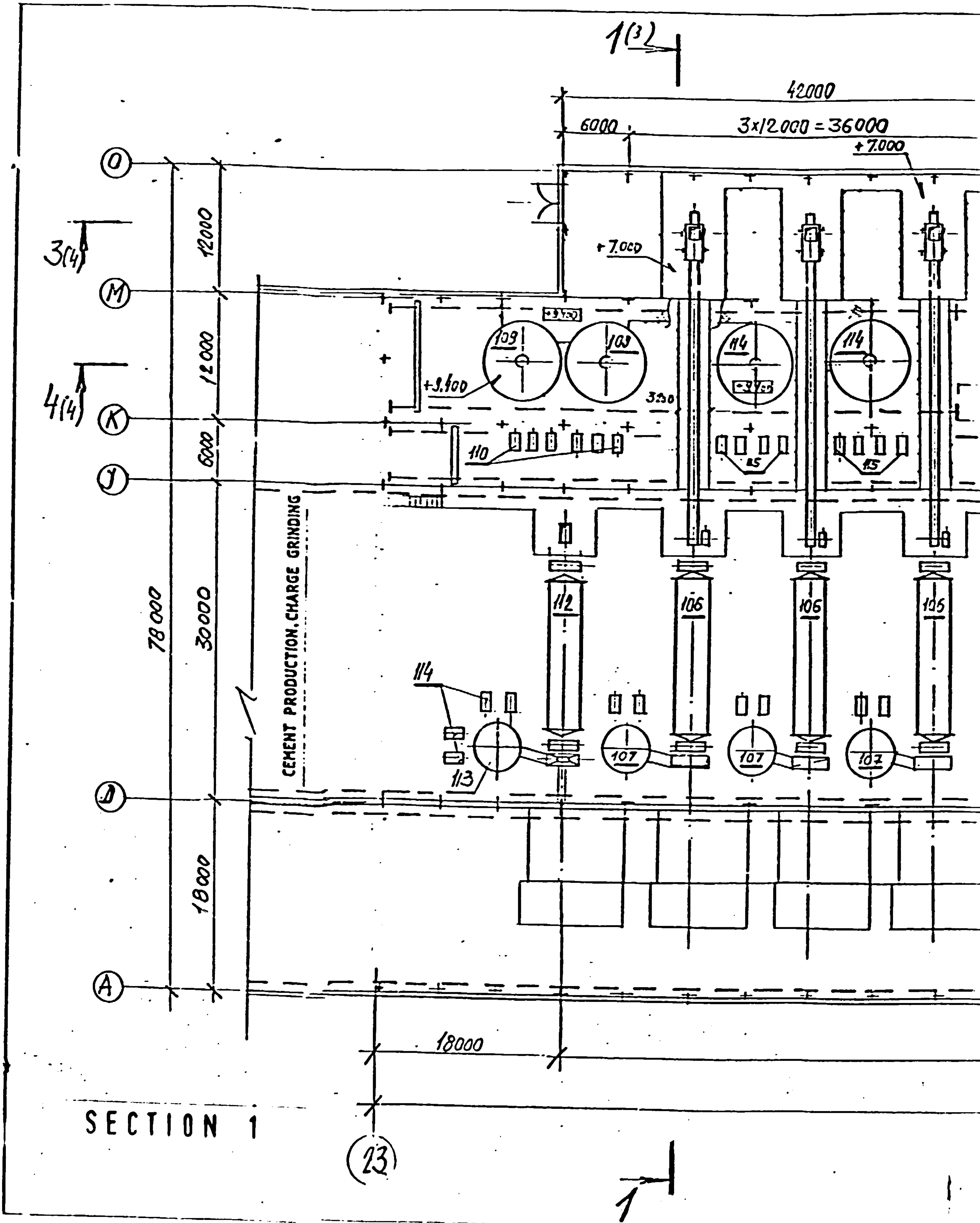


SECTION 4

*FINE LIME STONE CRUSHING WITH SCREENING.
LIME STONE STORAGE
LIME STONE CONVEYOR GALLERY.

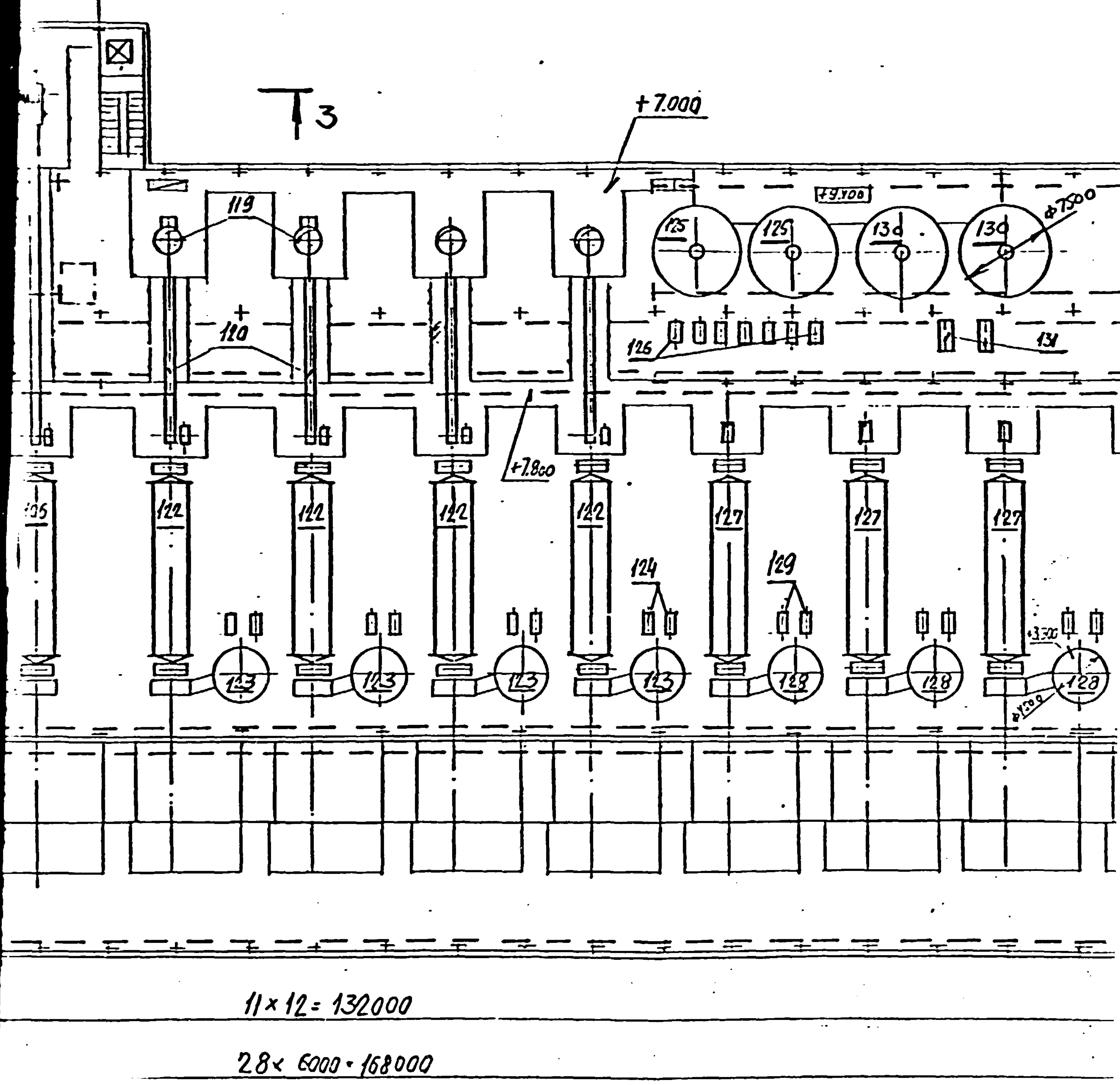
CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339637-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	AUMINA PRODUCTION RECEIVING AND COARSE LIME STONE CRUSHING MEDIUM LIME STONE CRUSHING *	PHASE	SHEET	SHEETS
		FOS	1	
	SECTIONS.	VAMI LENINGRAD		

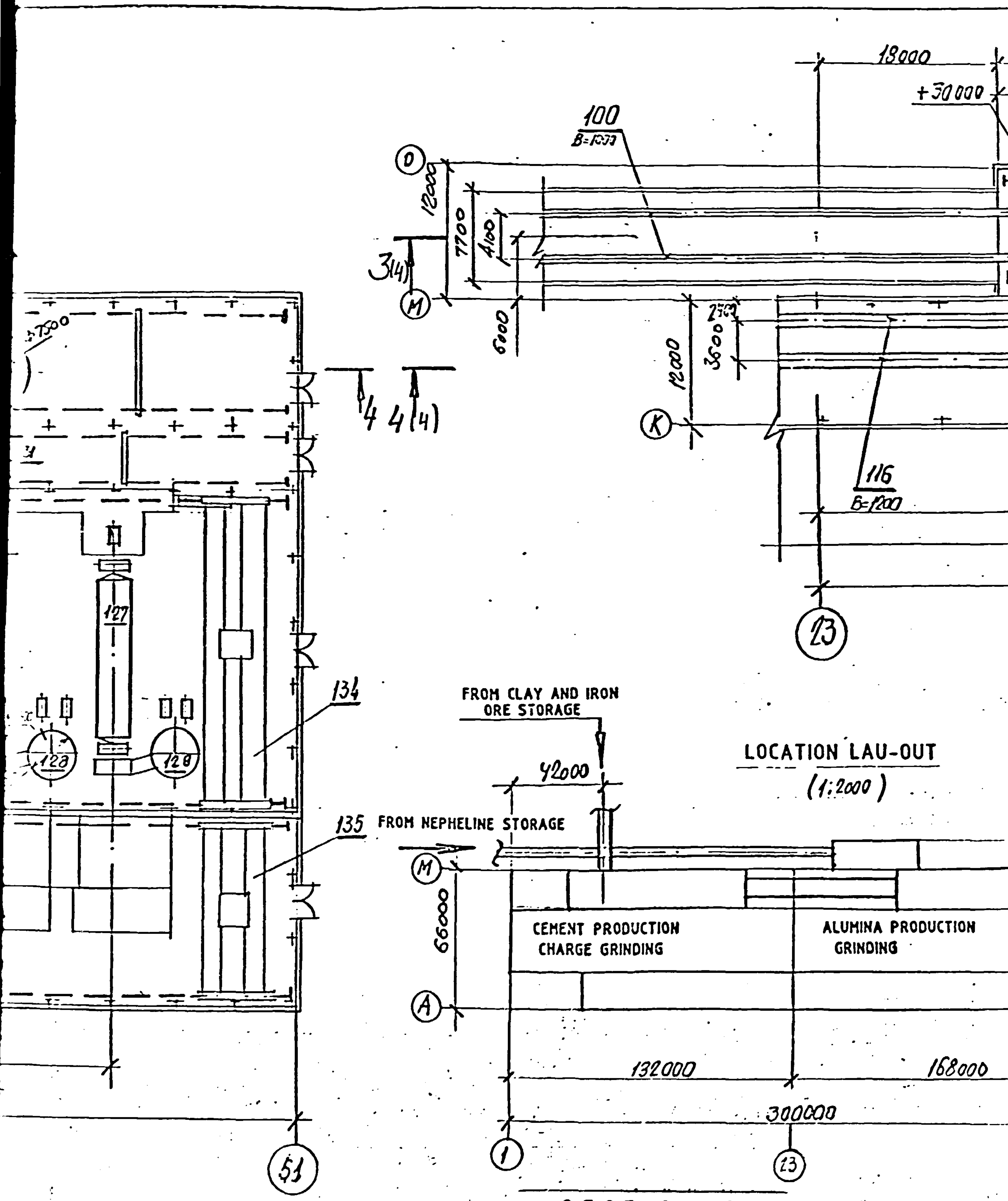

1(3)
42000
6000
3×12000 = 36000
+7.000
+7.000
12000
12000
6000
30000
18000
78000
109
109
114
114
+9.400
110
115
115
112
106
106
106
114
113
107
107
107
CEMENT PRODUCTION, CHARGE GRINDING
18000
23
1
3(4)
4(4)

SECTION 1

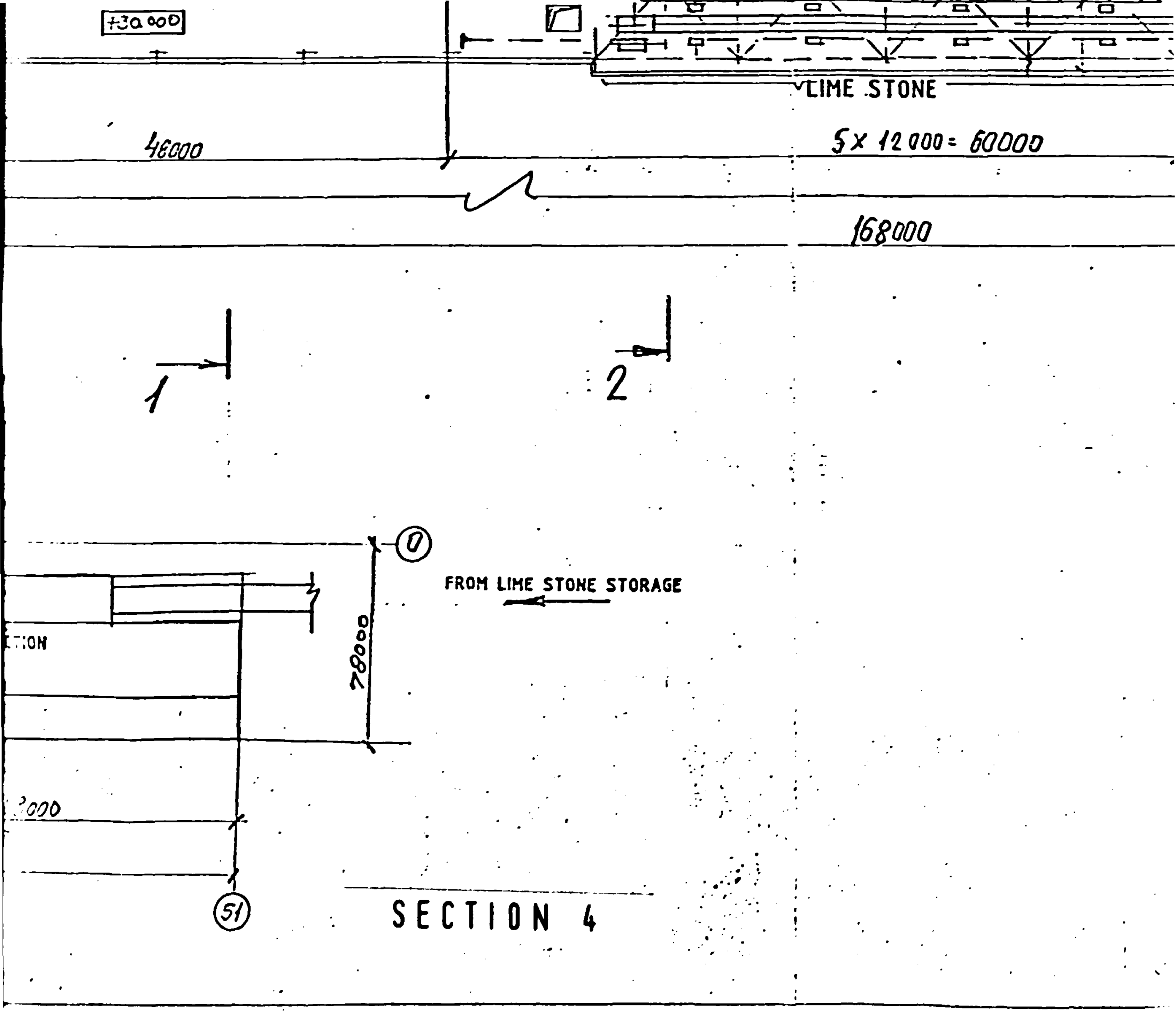
PLAN AT MIDDLE ELEVATIONS

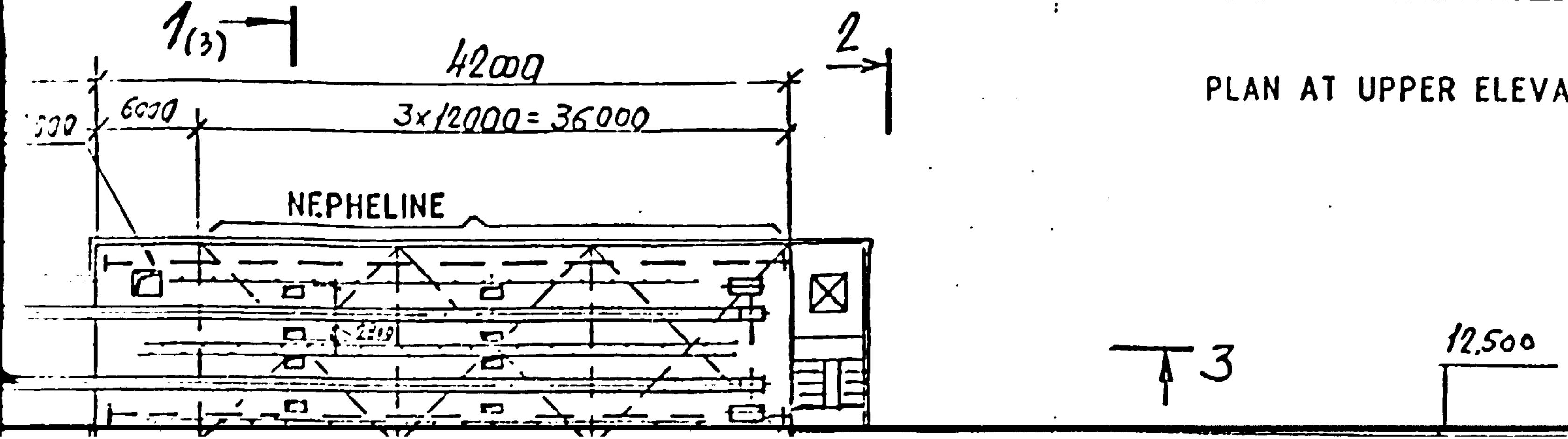


SECTION 2

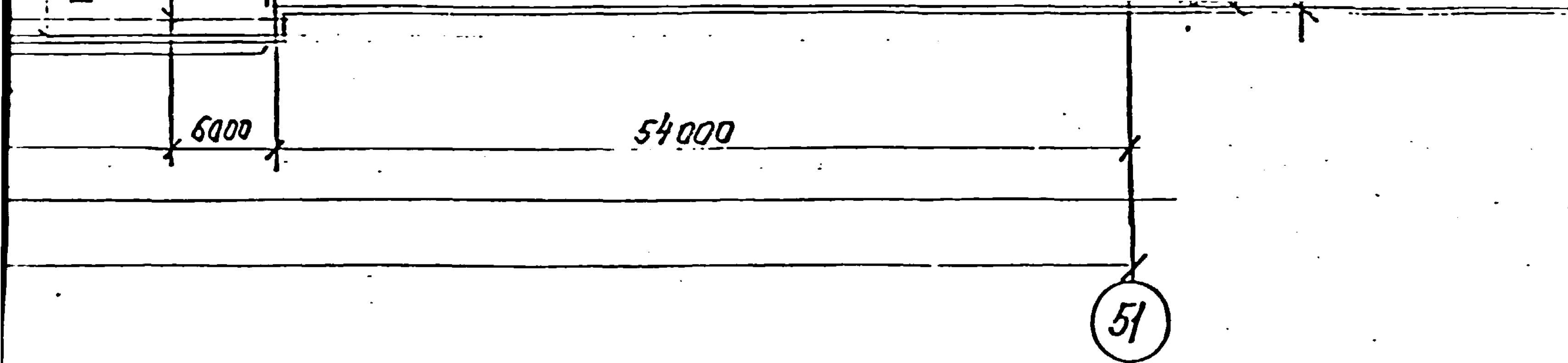

18000
+30000
100
B=1000
O
12000
7700
4100
3(4)
M
6000
2700
3600
12000
K
4 4(4)
116
B=1200
13
127
128
128
134
135
FROM CLAY AND IRON ORE STORAGE
42000
FROM NEPHELINE STORAGE
LOCATION LAU-OUT
(1:2000)
M
66000
CEMENT PRODUCTION CHARGE GRINDING
ALUMINA PRODUCTION GRINDING
A
132000
168000
300000
51
1
13

SECTION 3


+30 000
46000
LIME STONE
5 x 12 000 = 60000
168000
1
2
0
FROM LIME STONE STORAGE
78000
51
SECTION 4



PLAN AT UPPER ELEVA

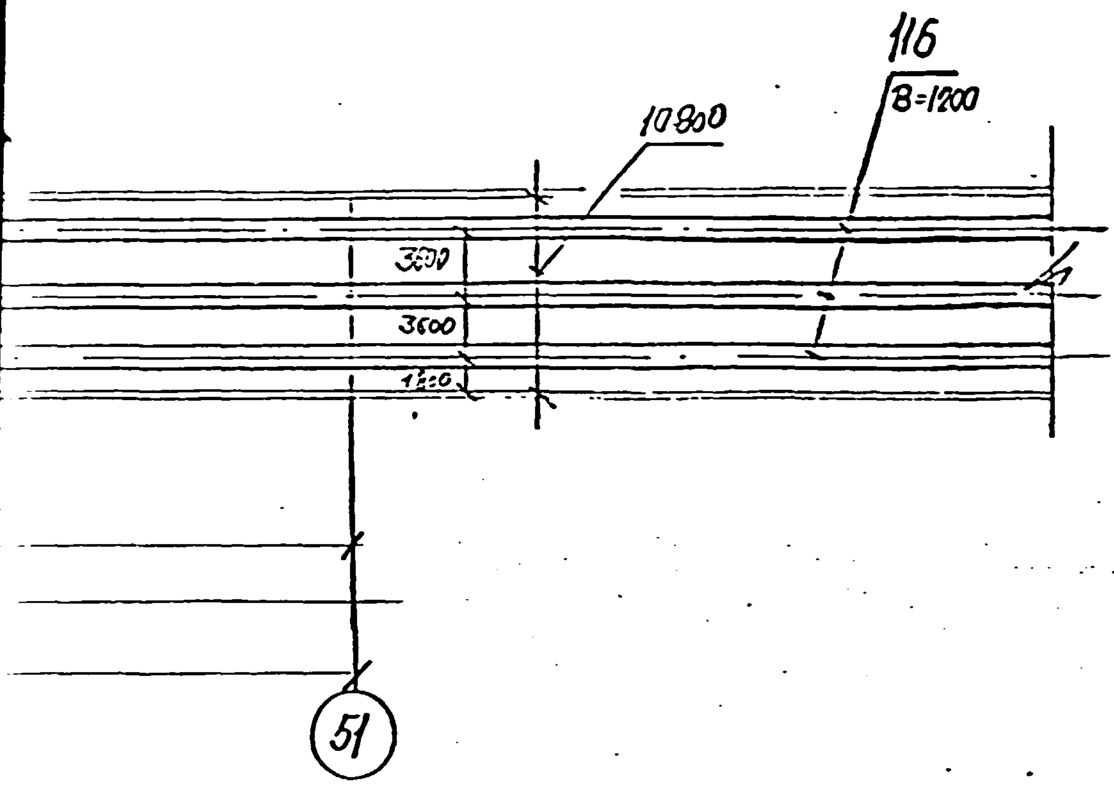


THE VIENS ARE

SECTION 5

CONT.

R ELEVATIONS



SECTION 6

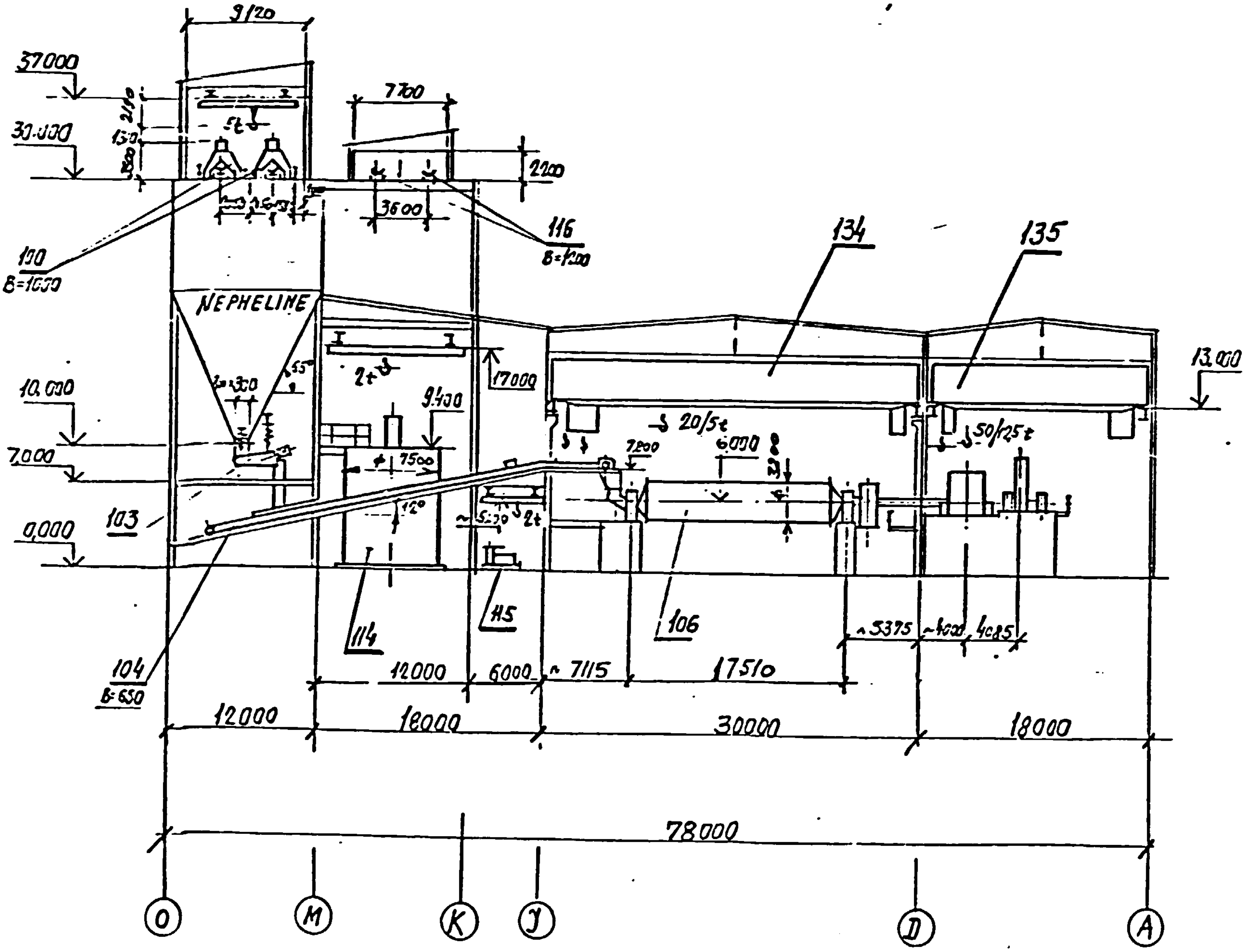
THE VIENS ARE SHOWN IN SCALE 1:400.

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339638-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	ALUMINA PRODUCTION. GRINDING.	PHASE	SHEET	SHEETS
		POS	2	
	PLANS.	VAMI LENINGRAD		

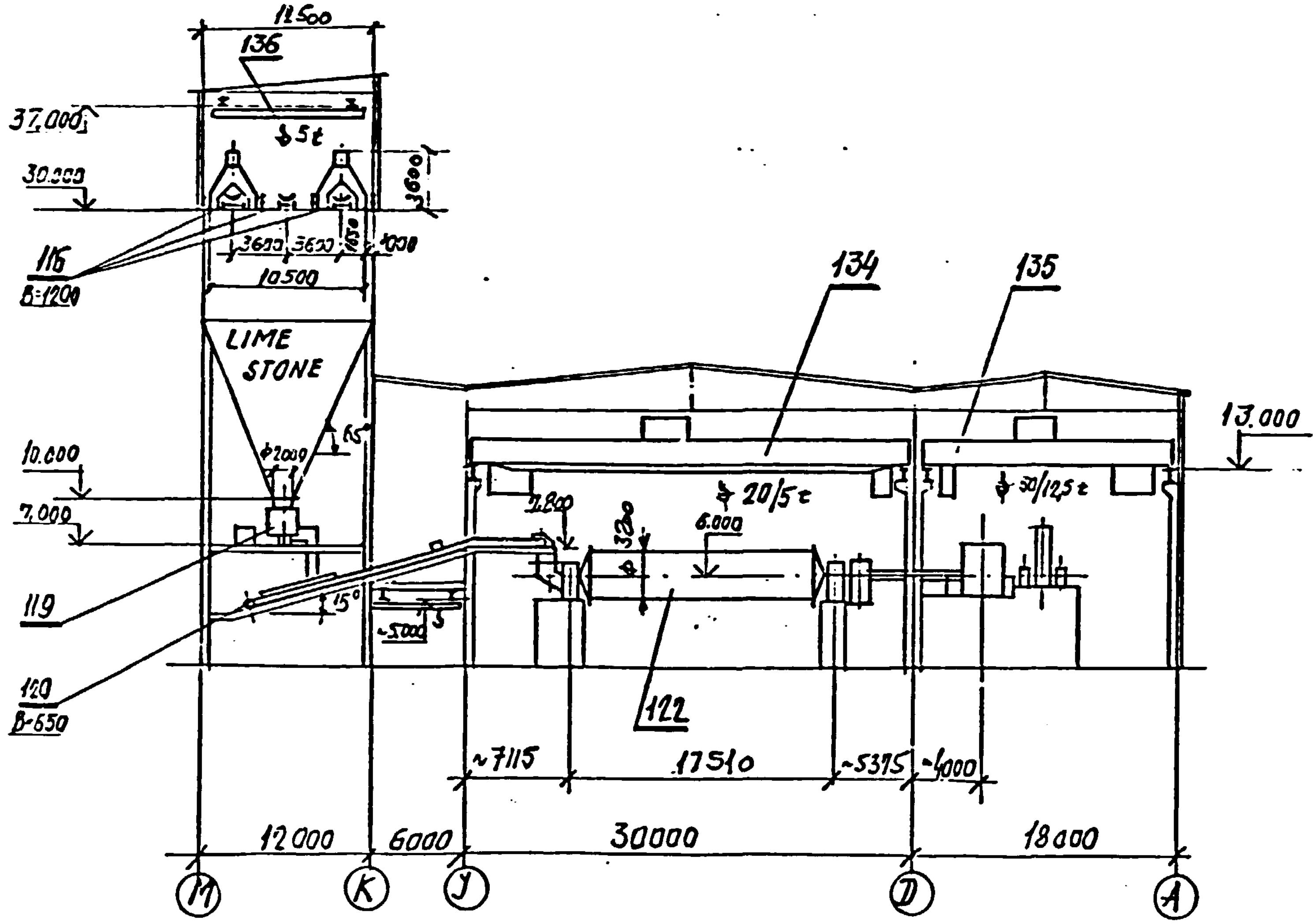
SIZE A 4X6

1-1 ○ (2)



SECTION 1

2-2 O (2)



SECTION 2

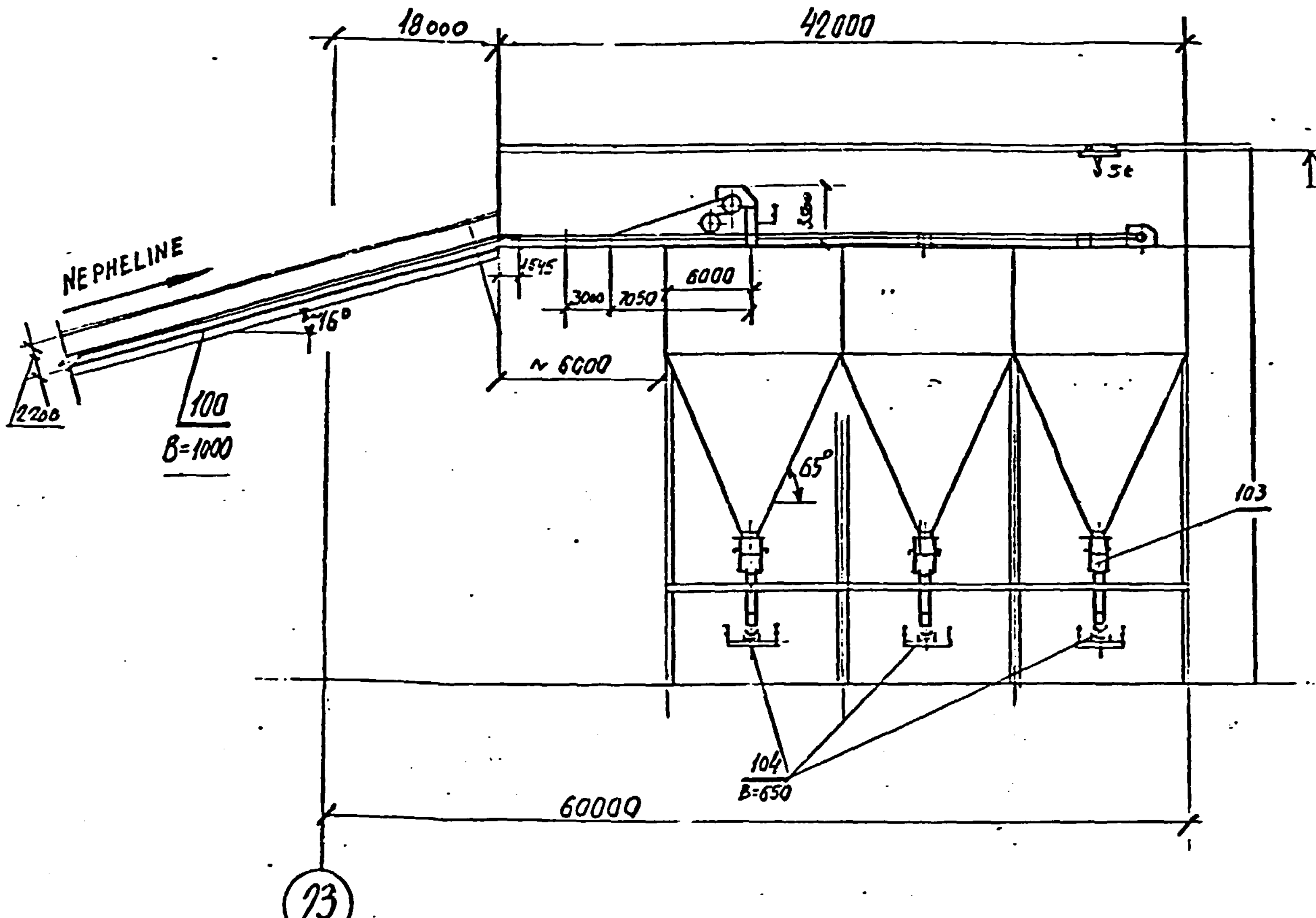
SECTION 3

CONTRACT N 90/204/205

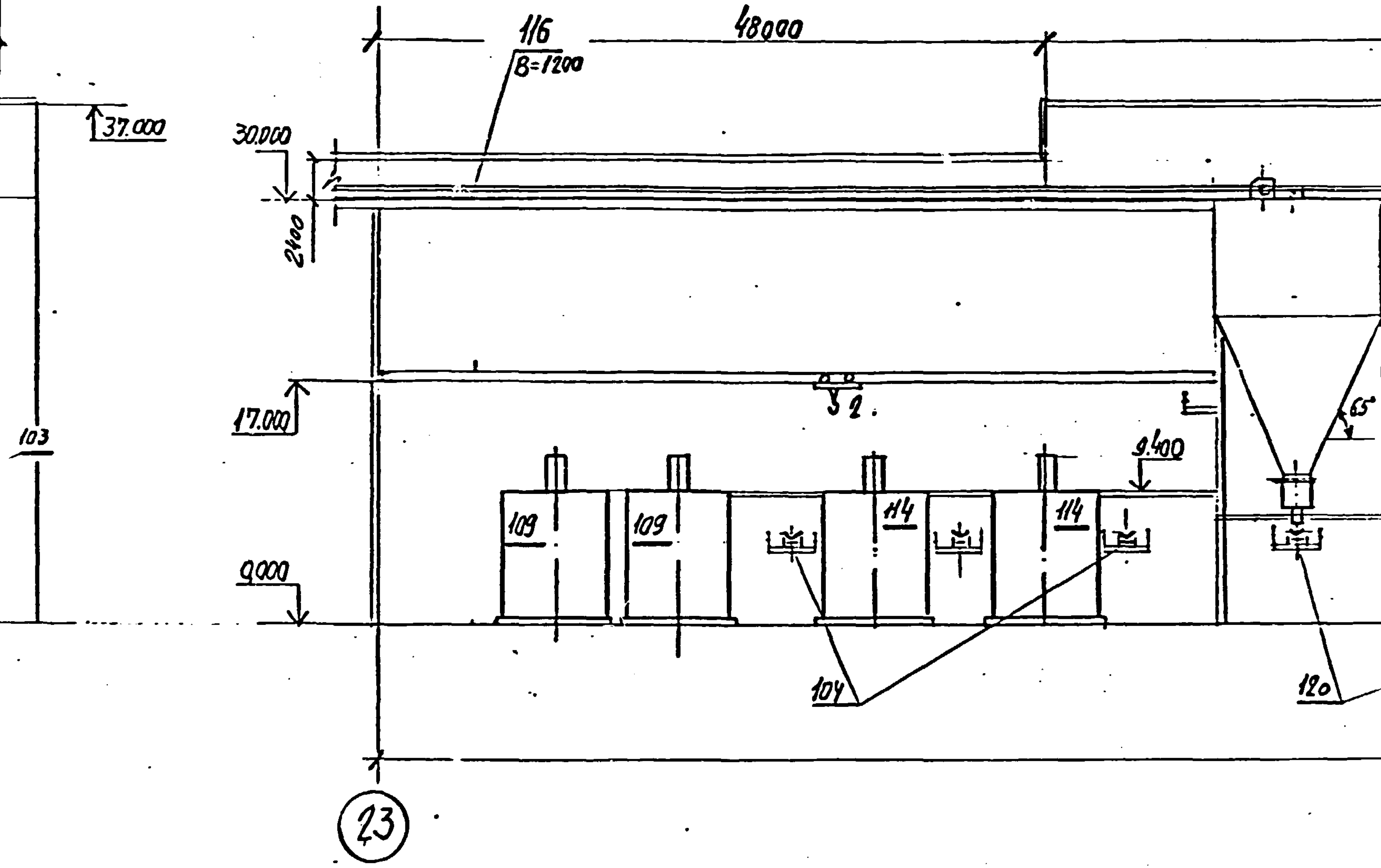
THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339638-T		
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)		
	ALUMINA PRODUCTION GRINDING	PHASE: POS	SHEET: 3	SHEETS:
	SECTIONS.	VAMI LENINGRAD		

SIZE A 4x4

3-3 (2)

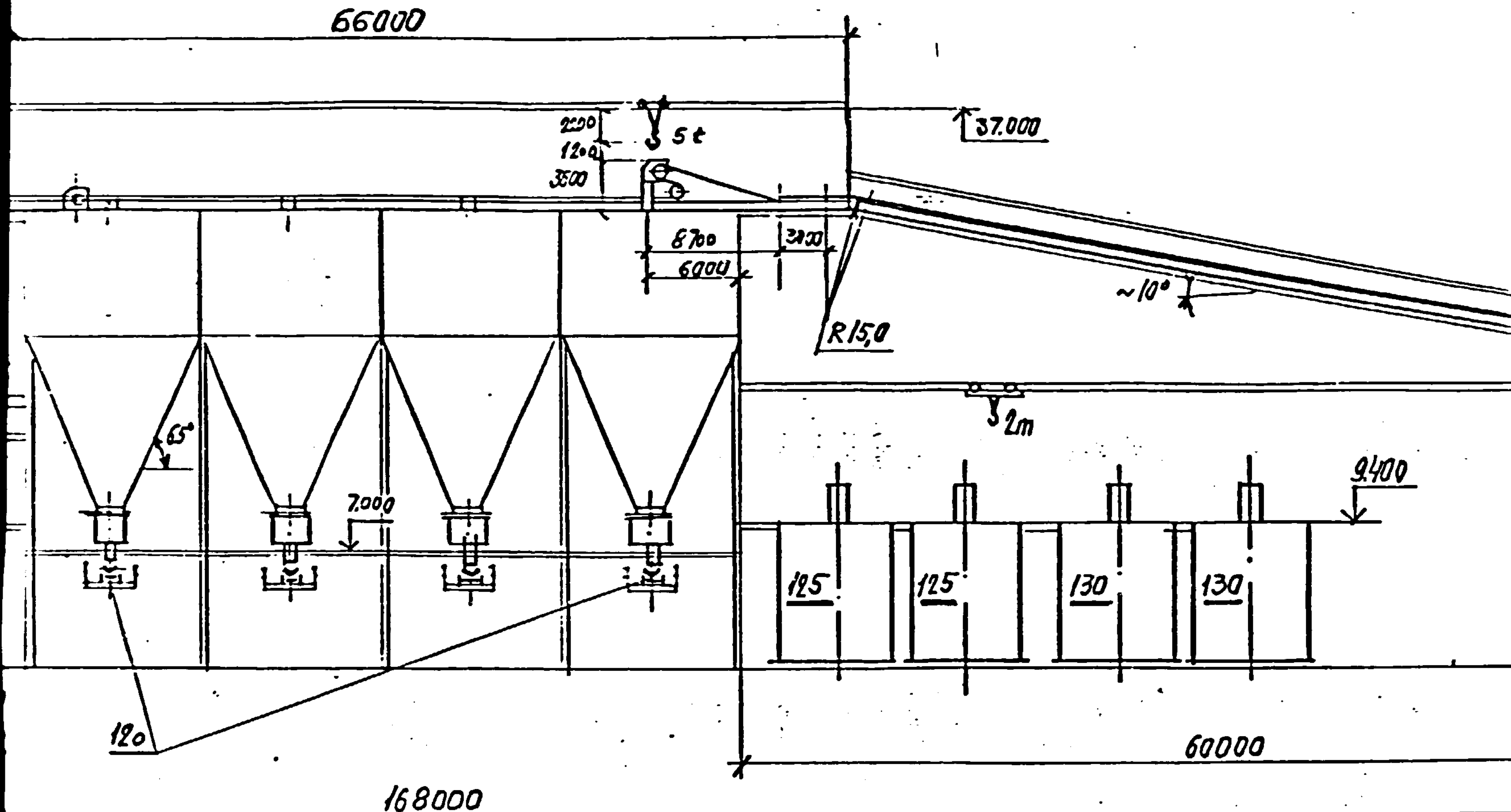


SECTION 1


1/6
B=1200
48000
37.000
30.000
2400
17.000
103
9.400
9.000
109
109
114
114
65°
104
120
23

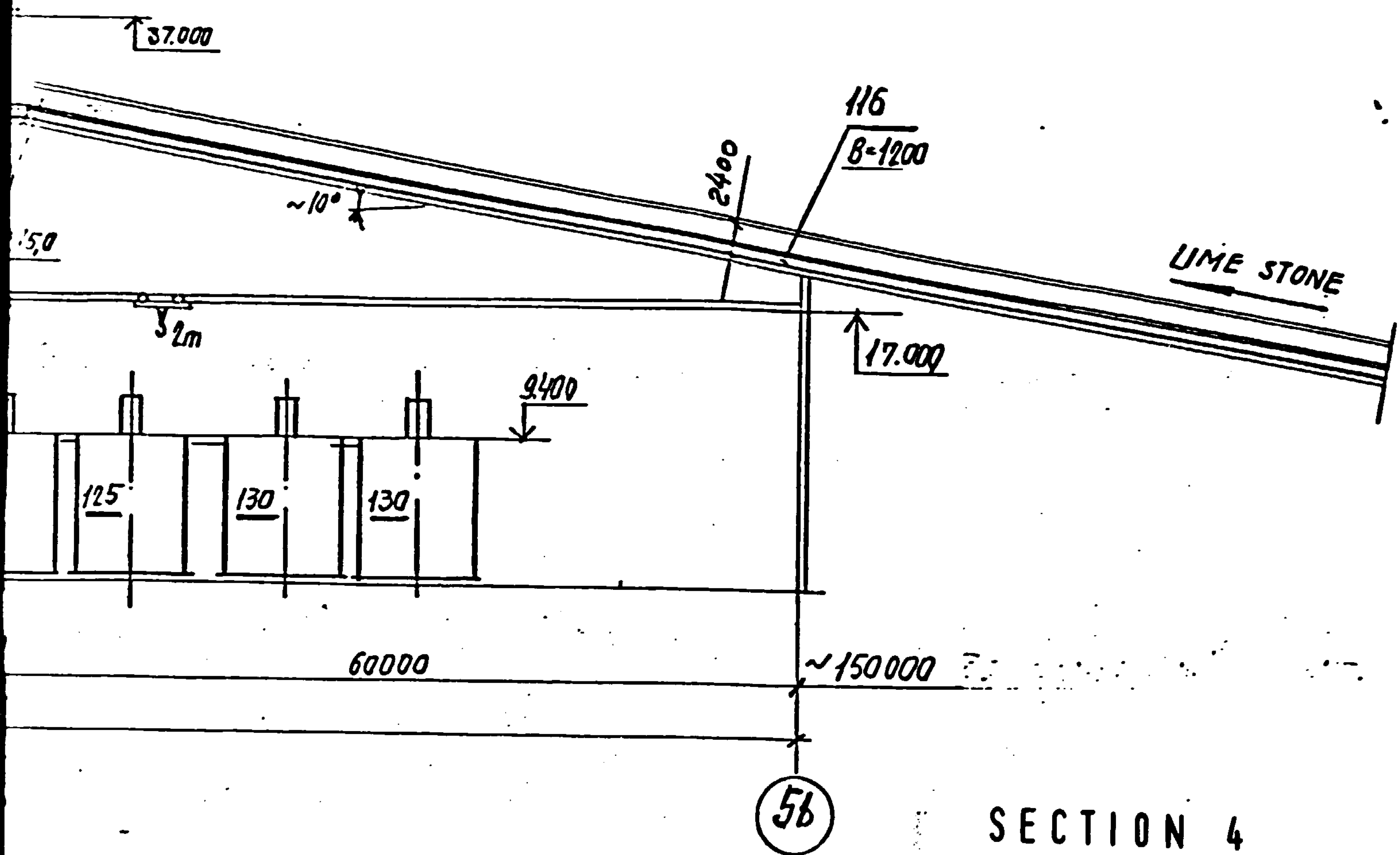
SECTION 2

4-4 (2)



SECTION 3

THIS DRAWING IS NOT
REPRODUCED OR TRA
RED TO OTHER ORGANIZ
OR PERSONS WITHOUT
MENT WITH VAMI



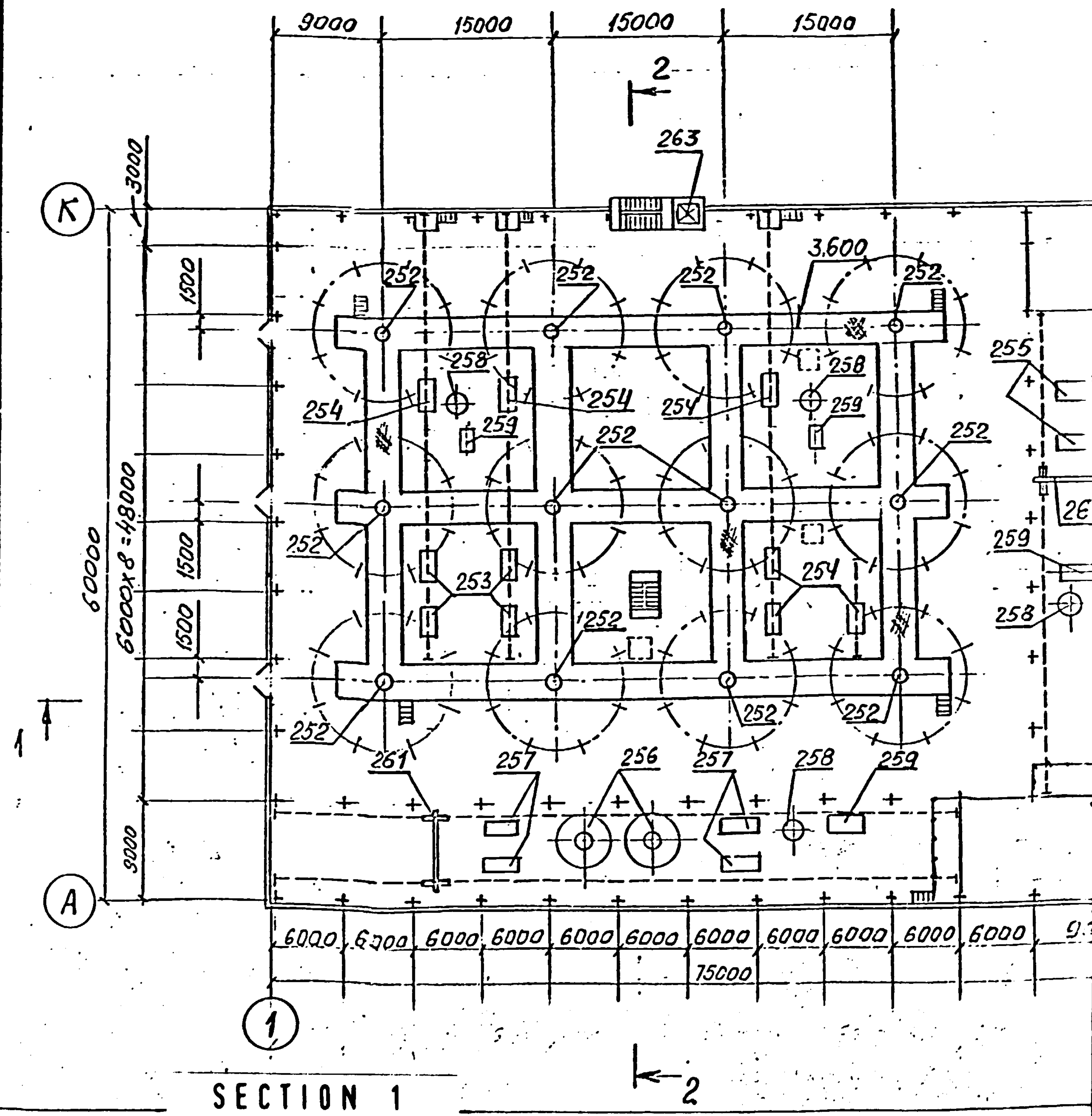
SECTION 4

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339638-T.			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	ALUMINA PRODUCTION GRINDING	PHASE	SHEET	SHEETS
		POS	4	
	SECTIONS	VAMI LENINGRAD		

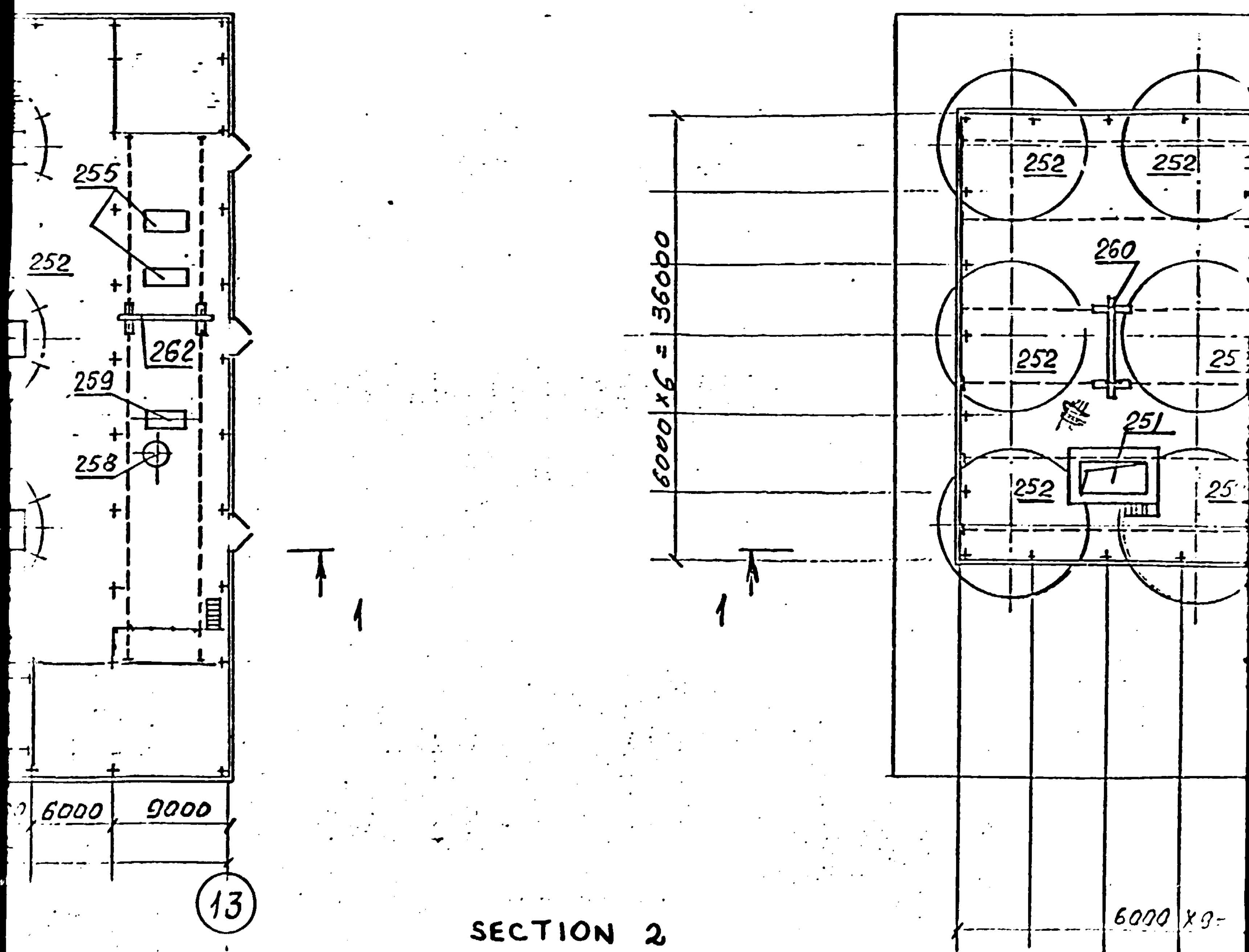
SIZE A 4x4

PLAN ATEL. 0.000



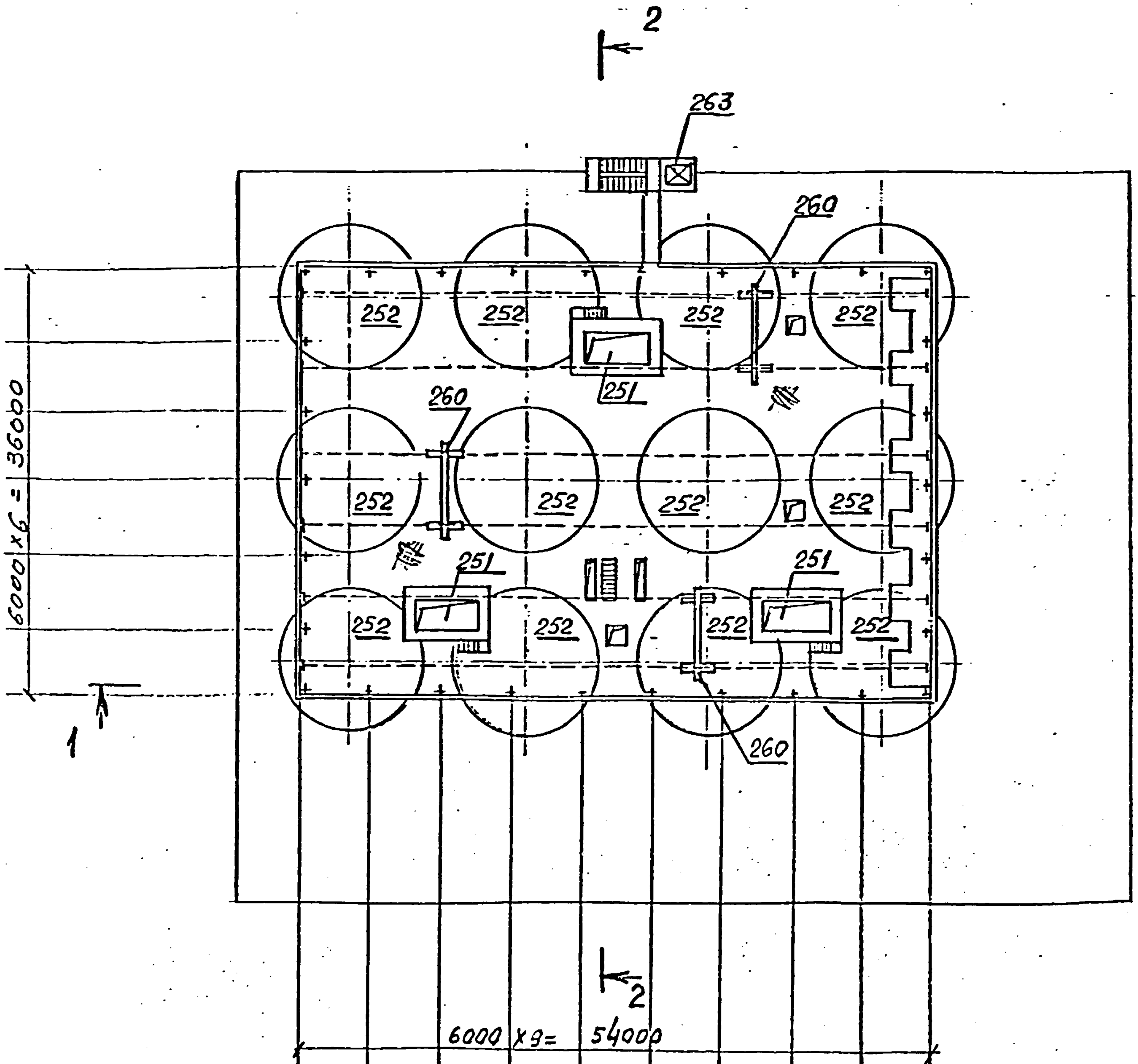
SECTION 1

PLAN UPFER



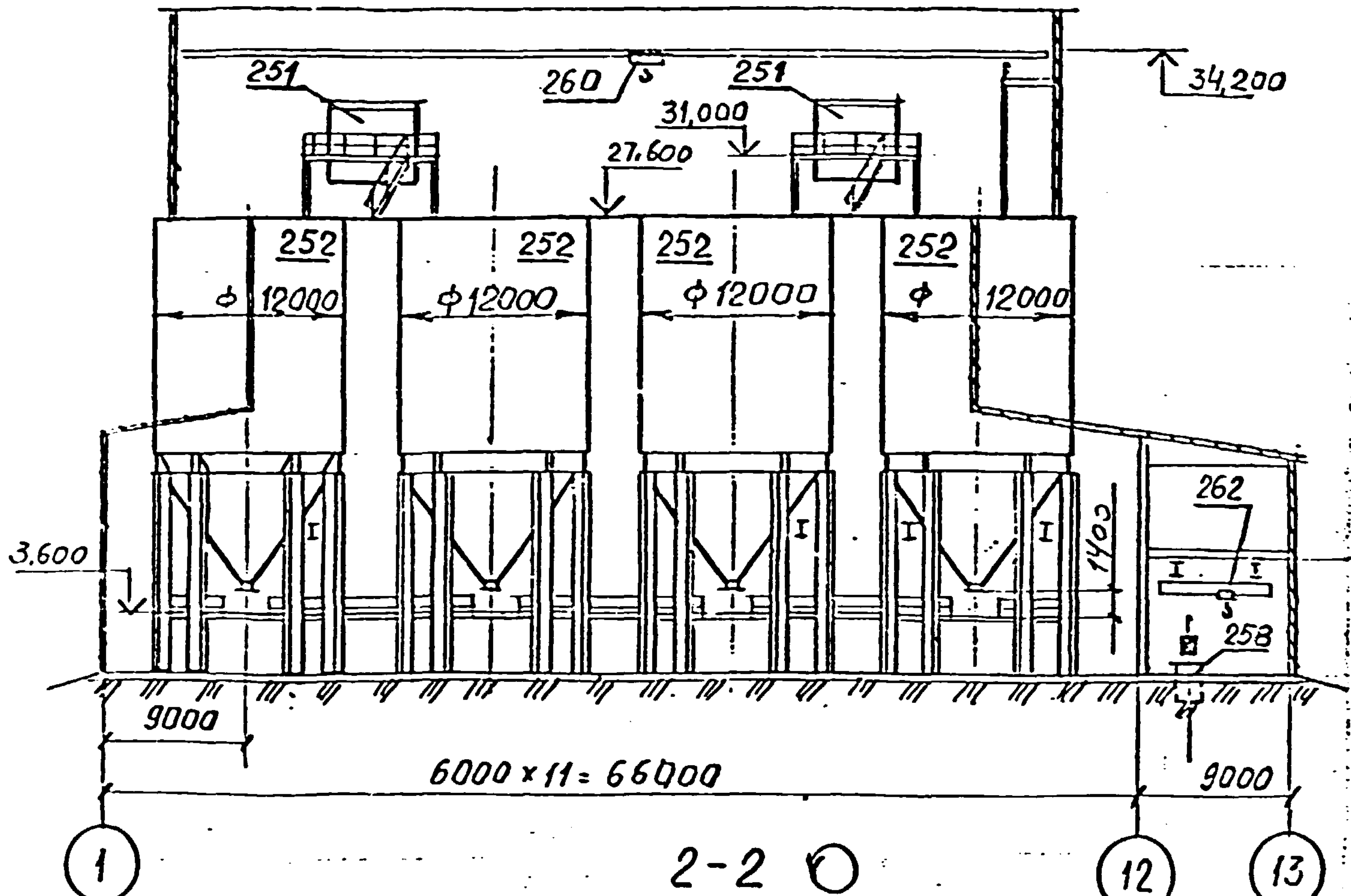
SECTION 2

PLAN UPFER ELEVATIONS

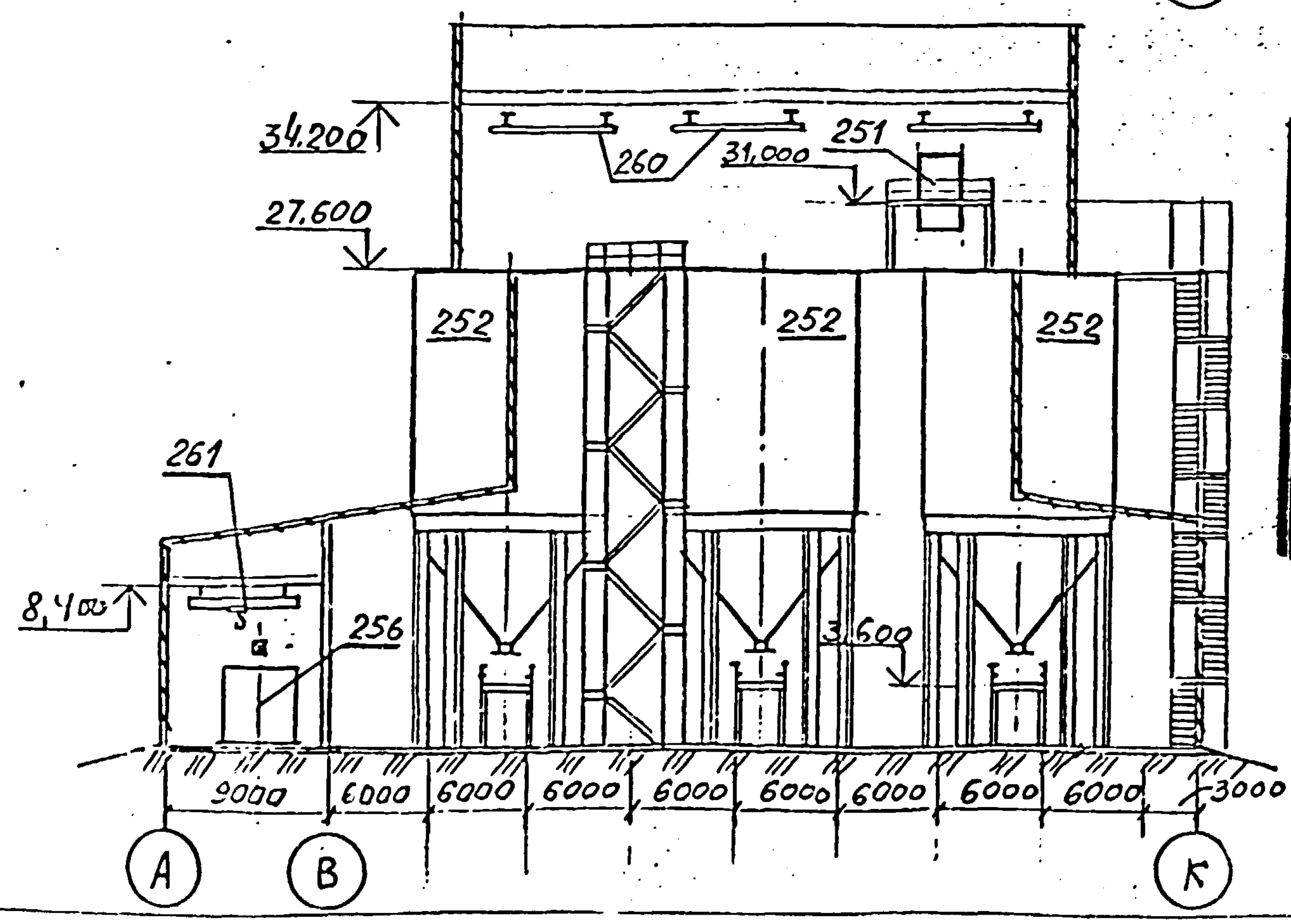


SECTION 3

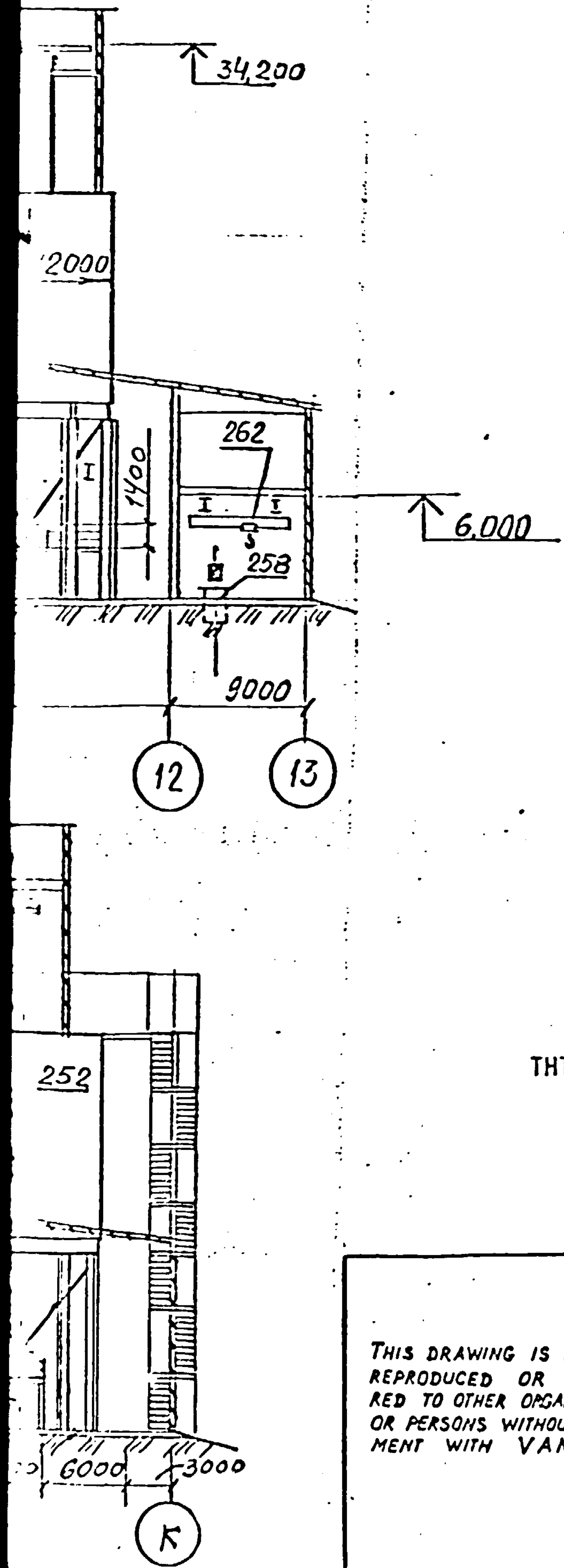
1-1



2-2



SECTION 4



SECTION 5

THE VIEWS ARE SHOWN IN SCALE 1:4000

CONTRACT N 90/204/205

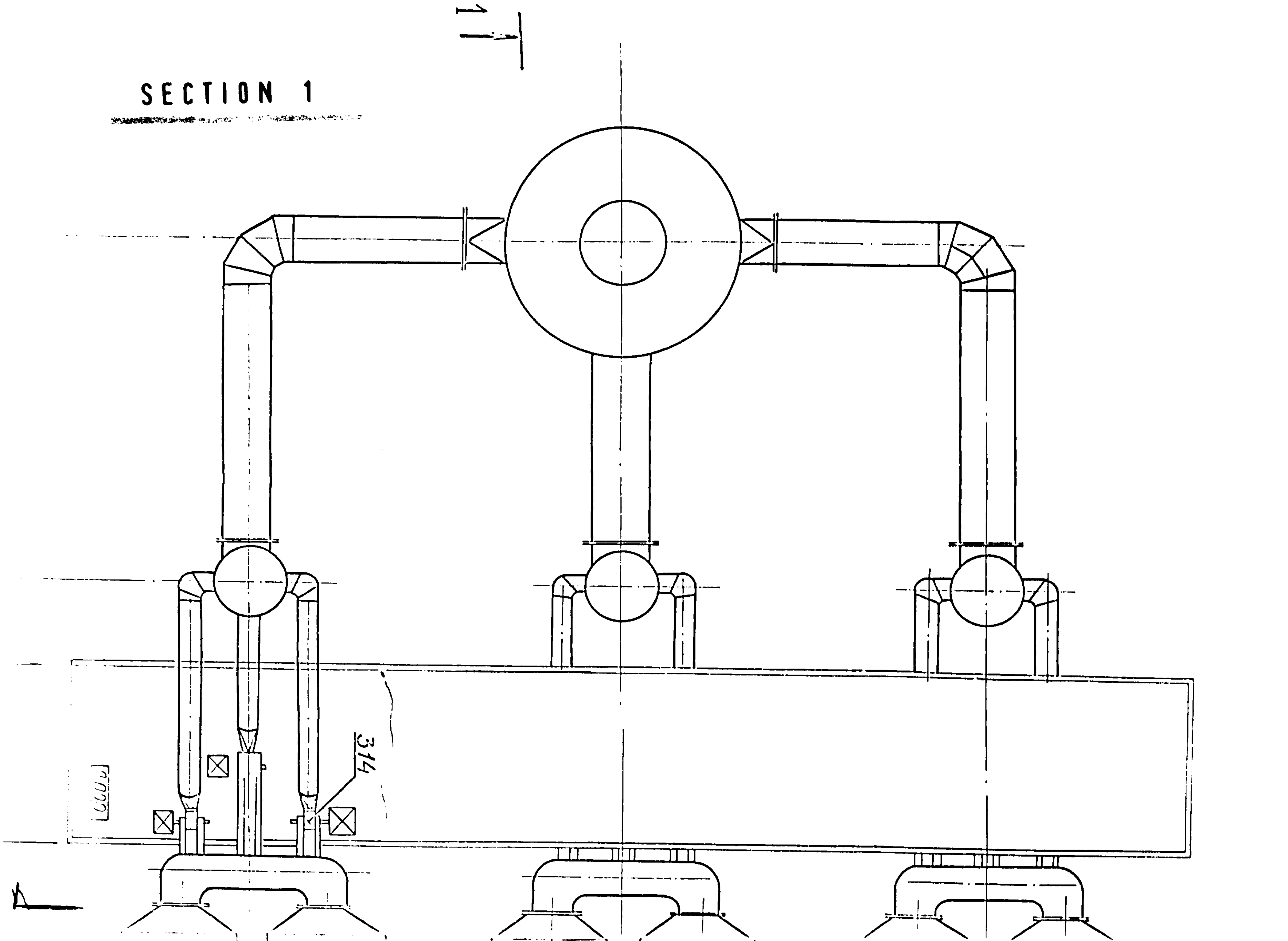
1339639-T

RAZGAH NEPHELINES PROCESSING PLANT (IRAN)

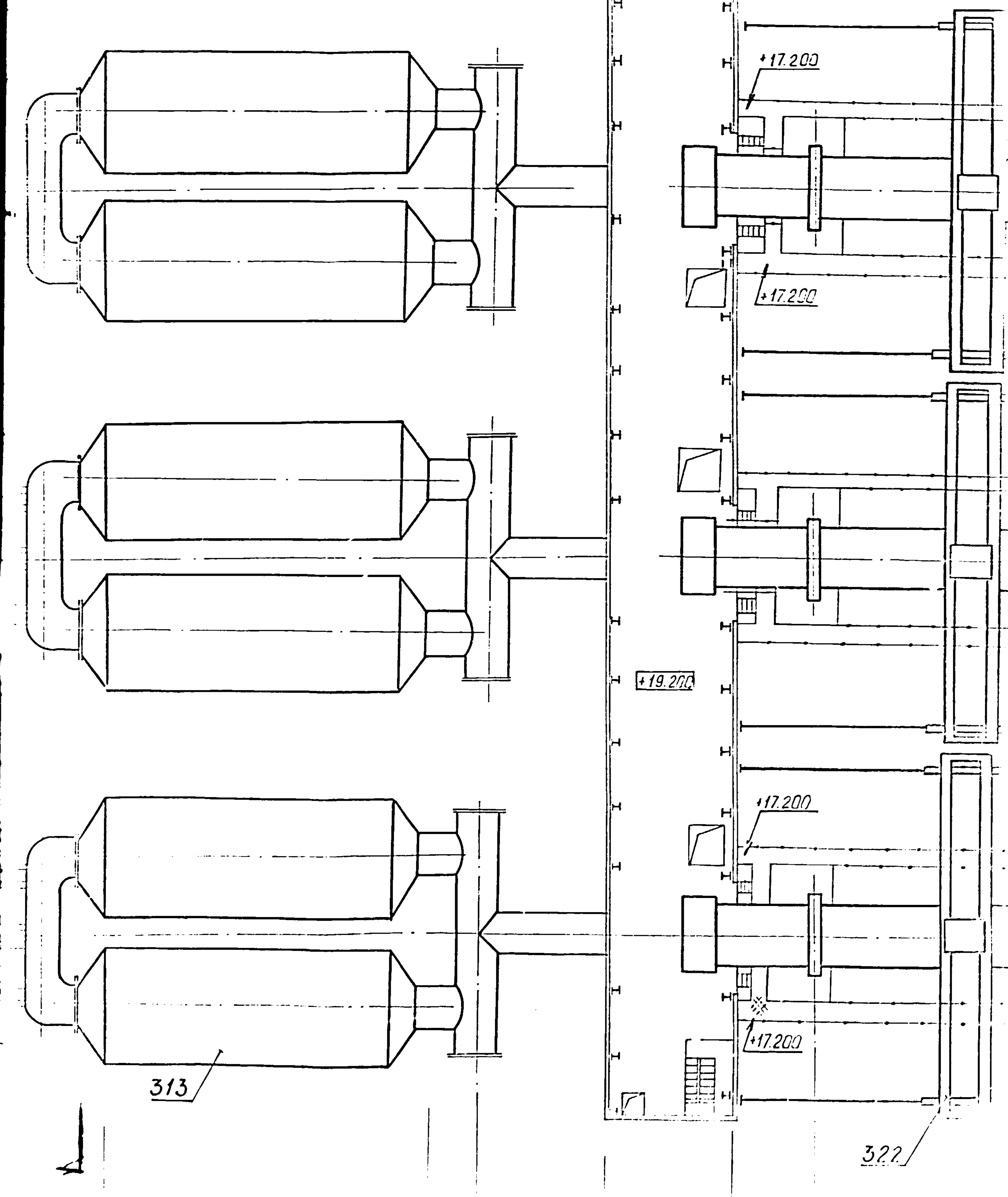
	Phase	Sheet	Sheets
ALUMINA PRODUCTION CORRECTION AND RETENTION BASINS	POS	2	2
PLANS AND SECTIONS	VAMI LENINGRAD		

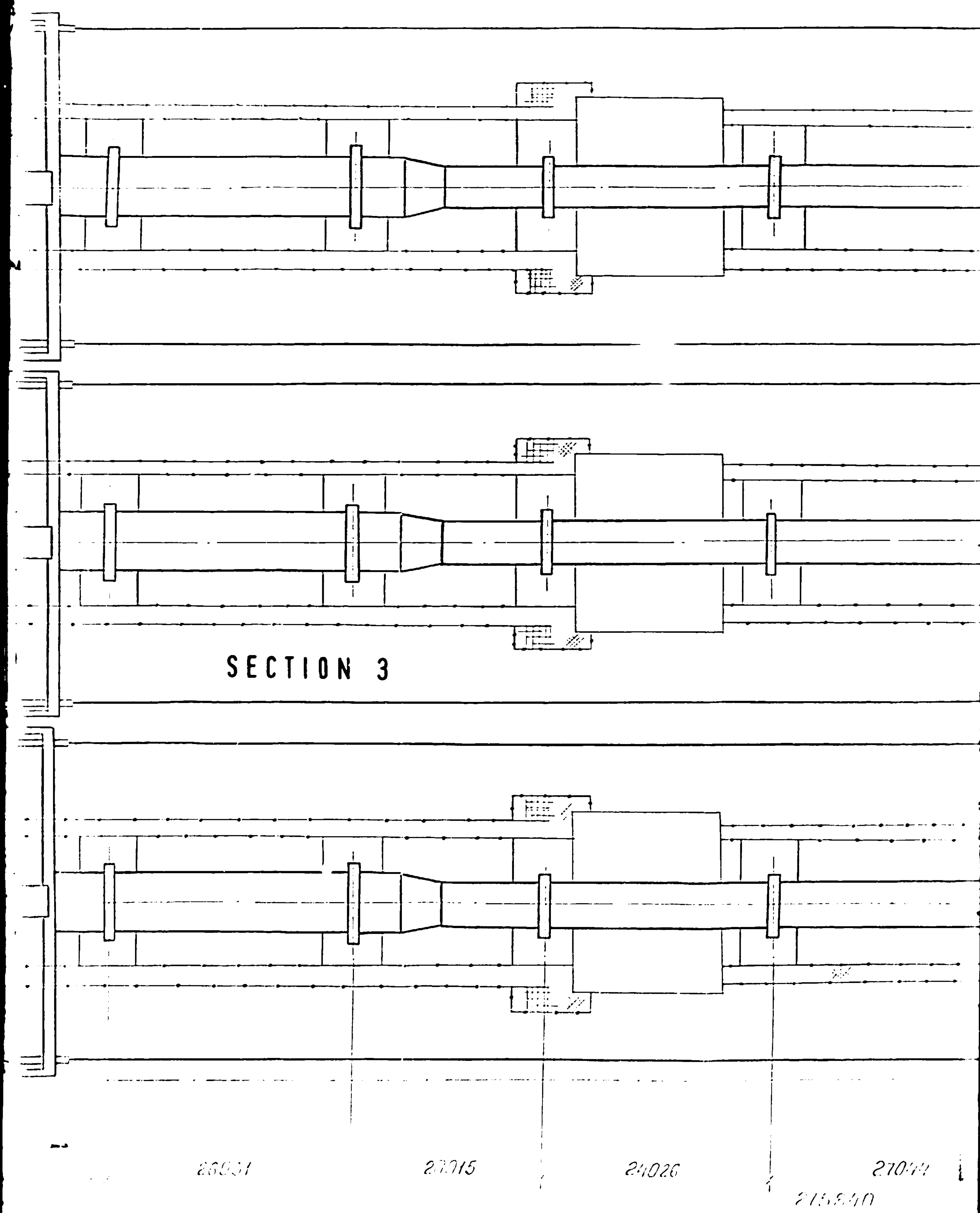
SIZE A

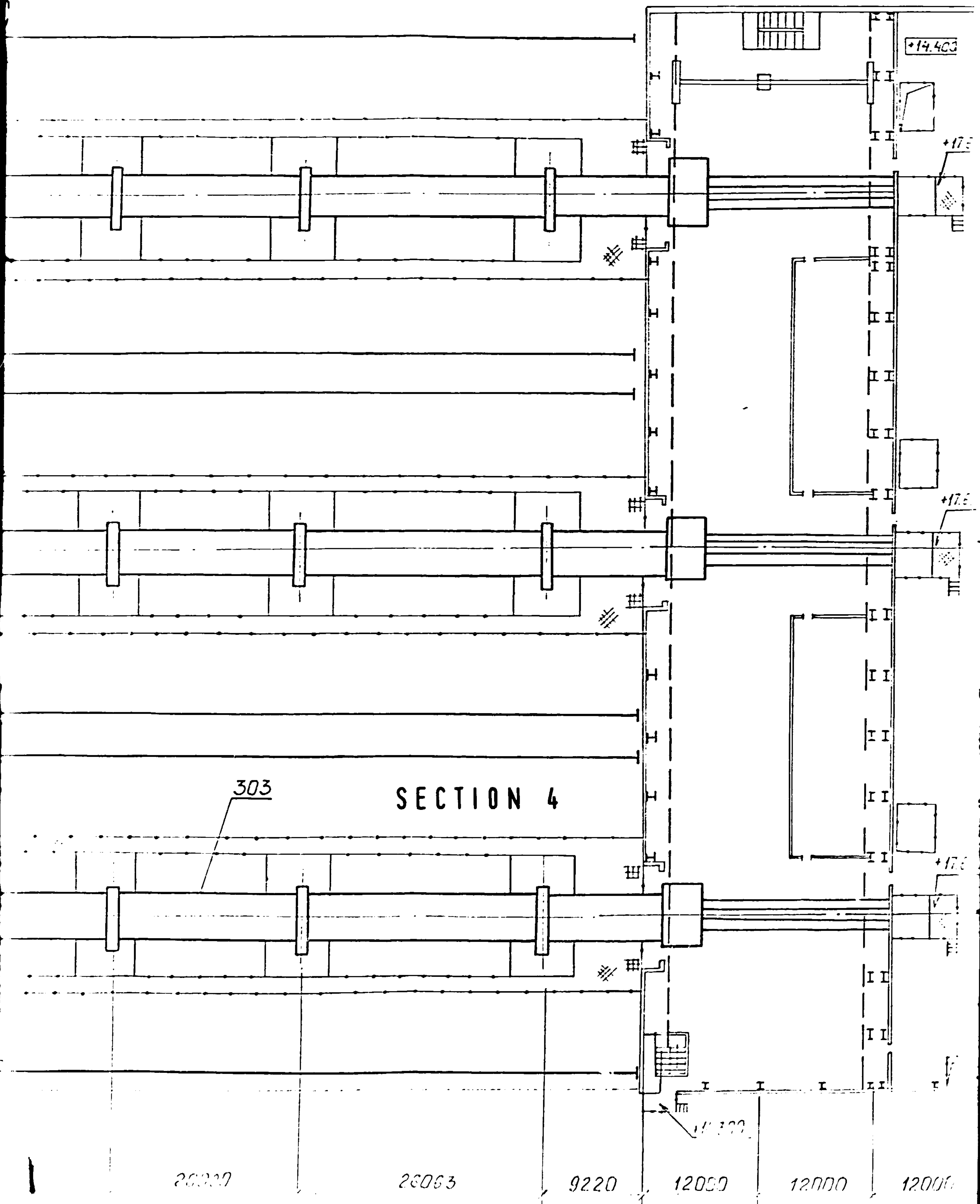
SECTION 1

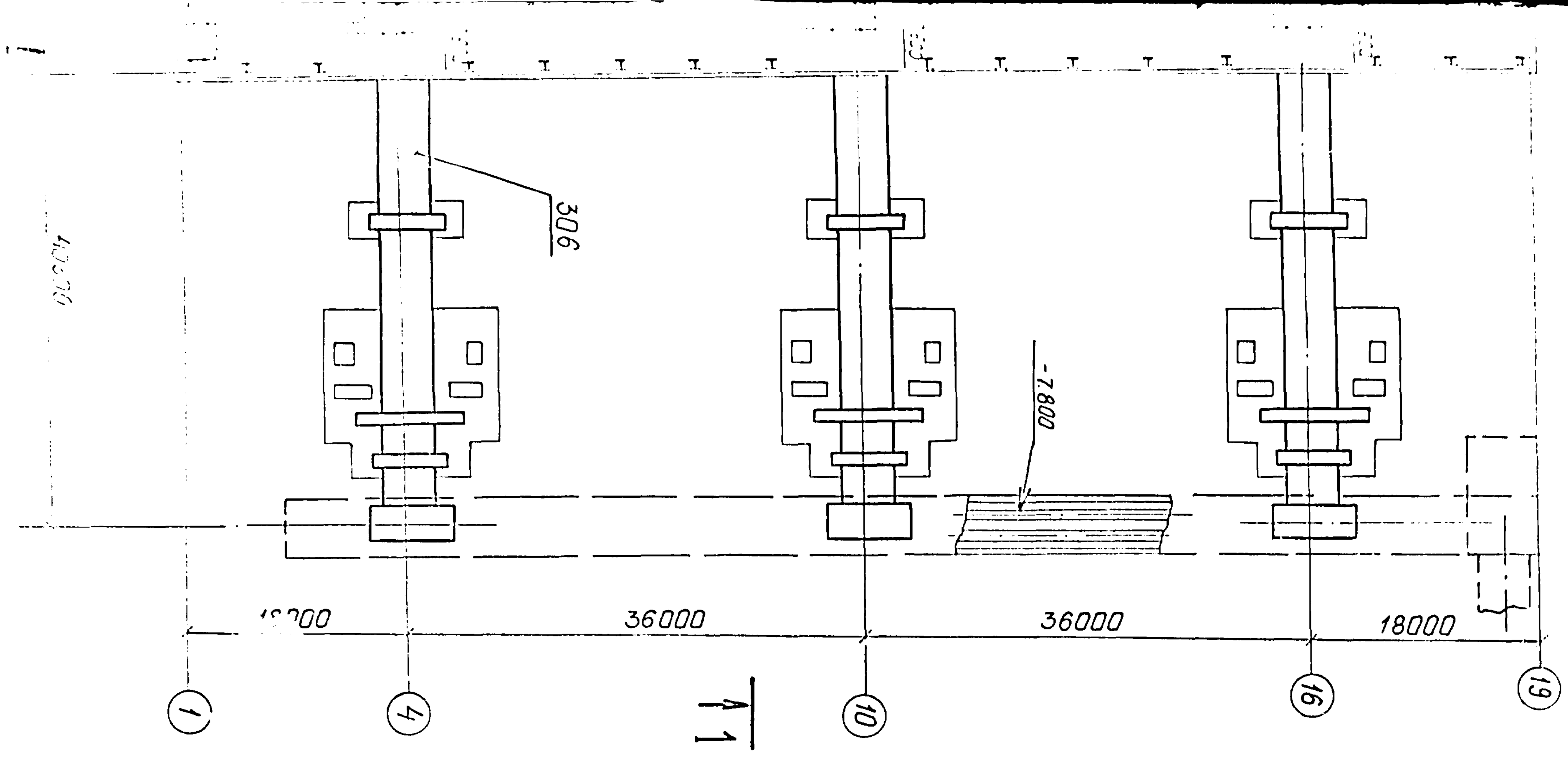


SECTION 2




SECTION 3


+14.400
303
SECTION 4
9220
12000
12000

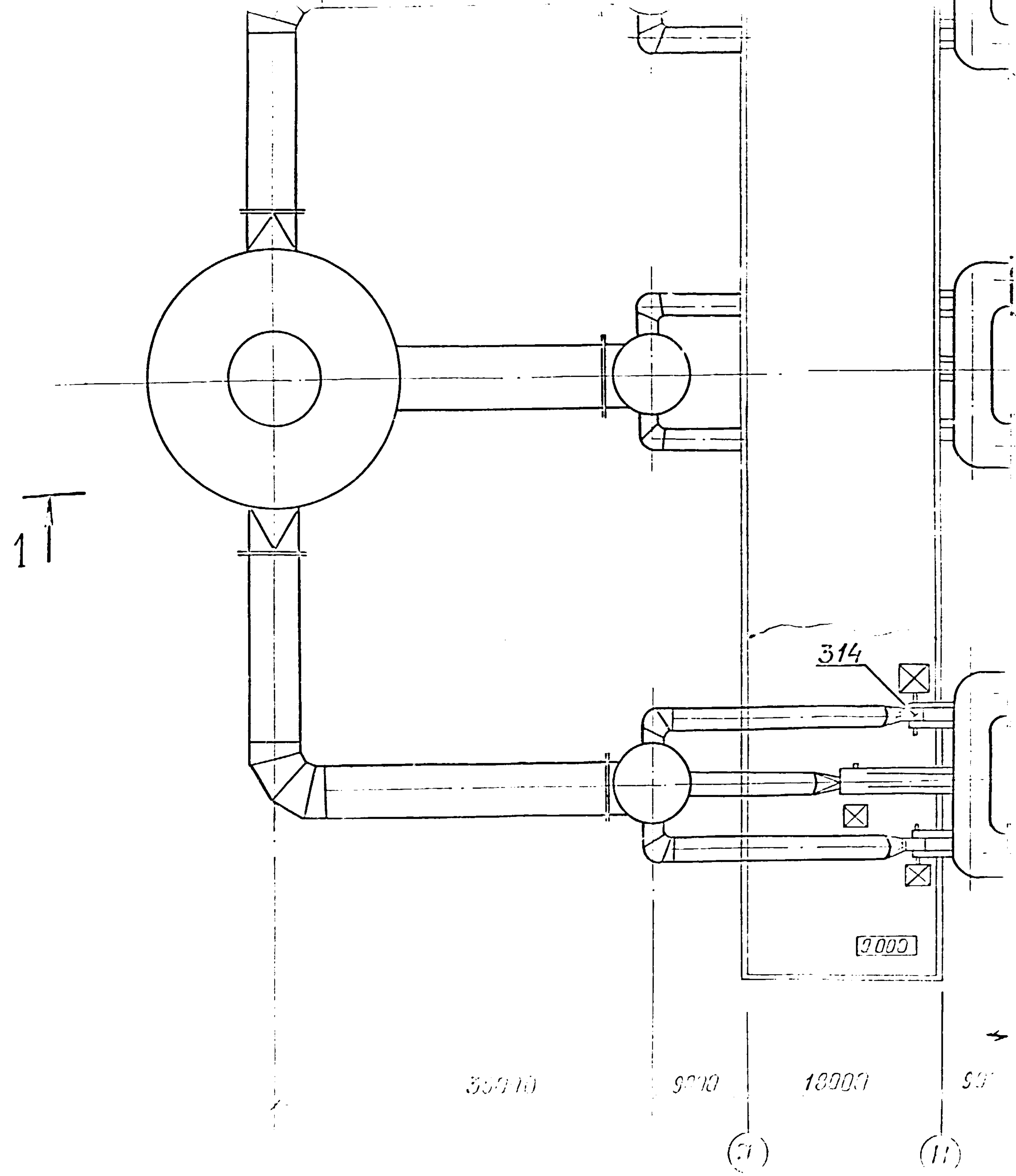


Инв. № подл.	Подп. и дата	Взам. инв. №

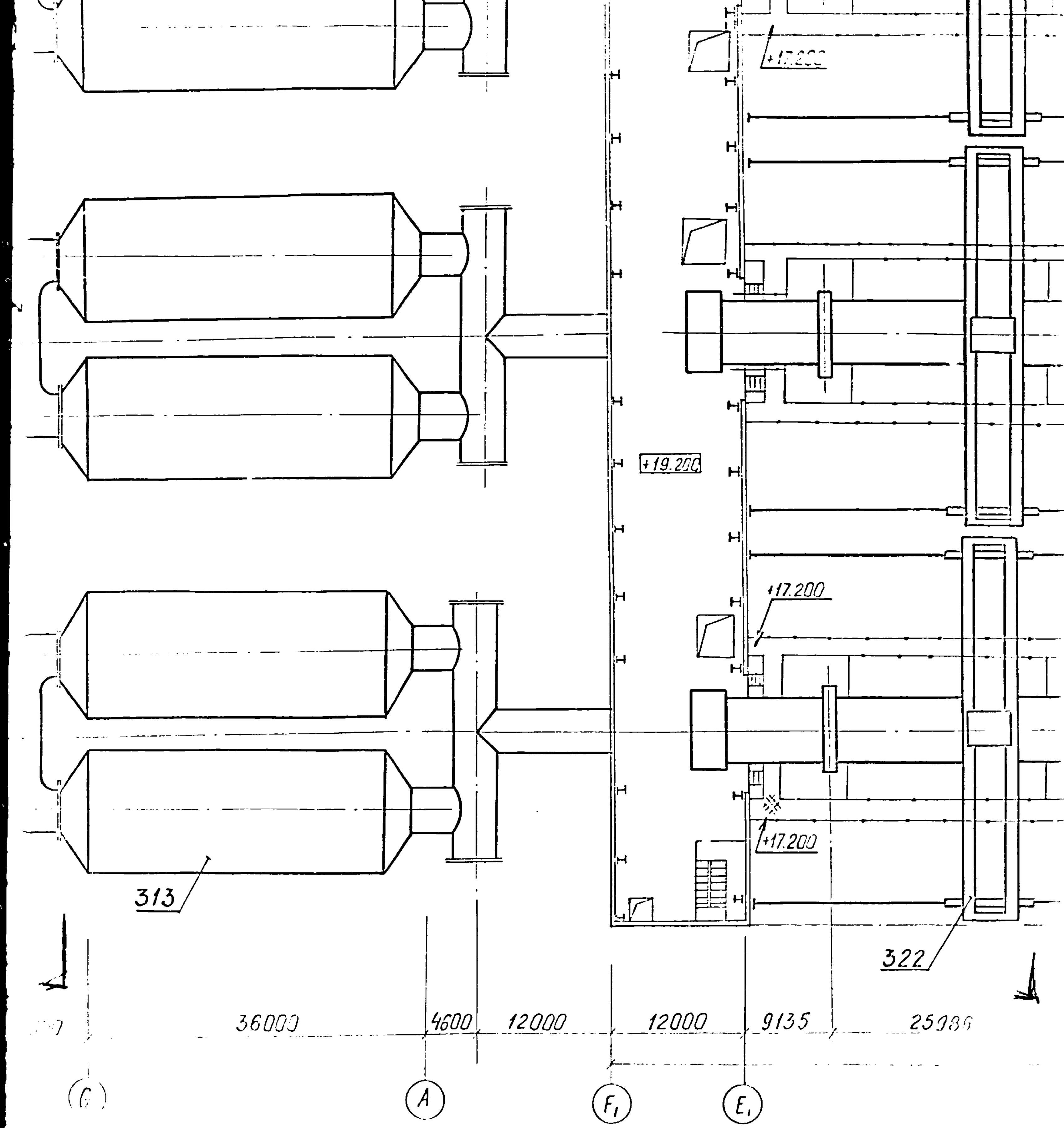
SECTION 5

1398861-Т			
Завод по переработке нефелиновых руд месторождения Разгах (Иран)			
Глиноземное производство	Стадия	Лист	Листов
Спекание	ИВП	2	
План	ВАМИ Ленинград		

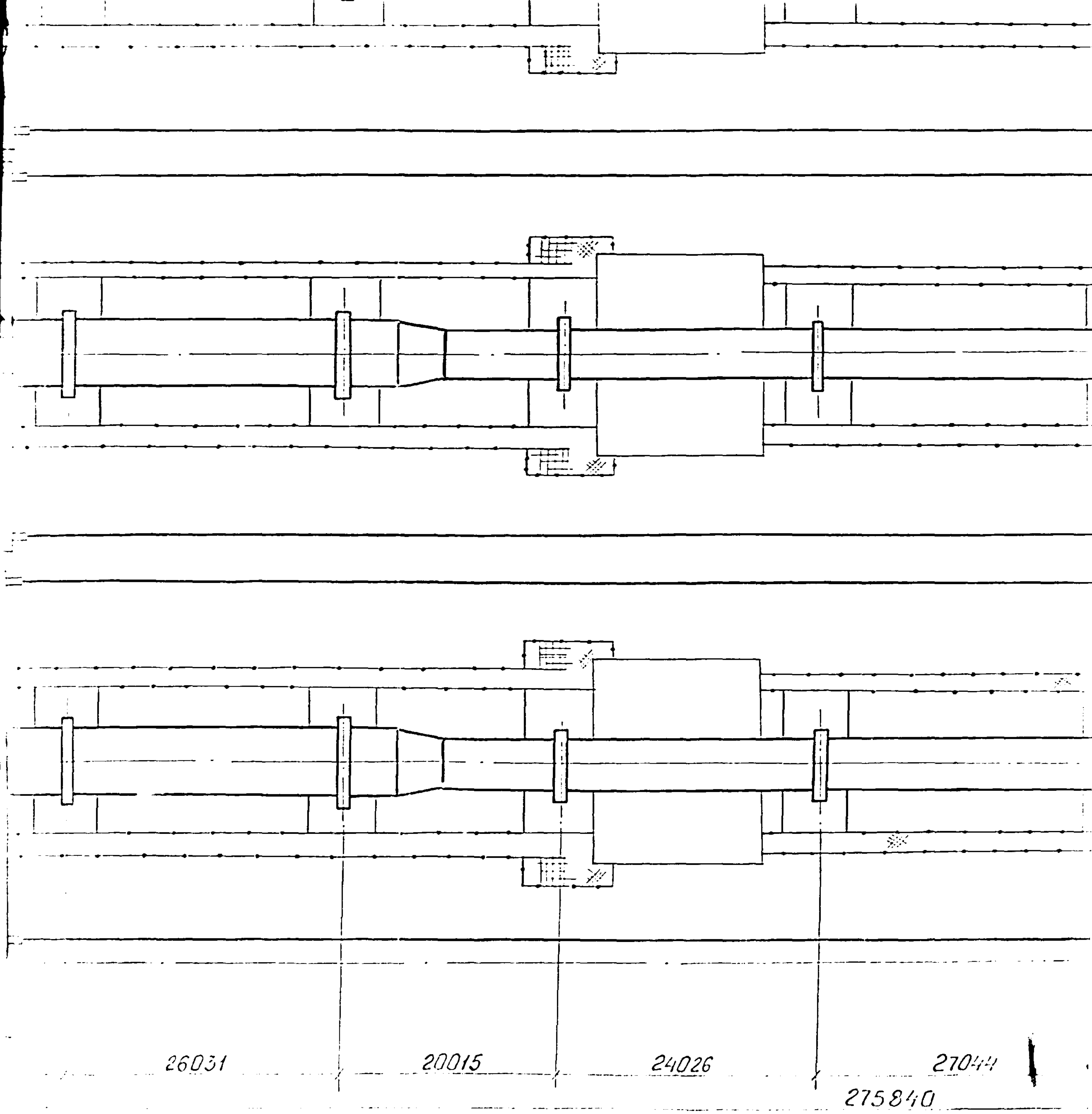
Формат А3×4



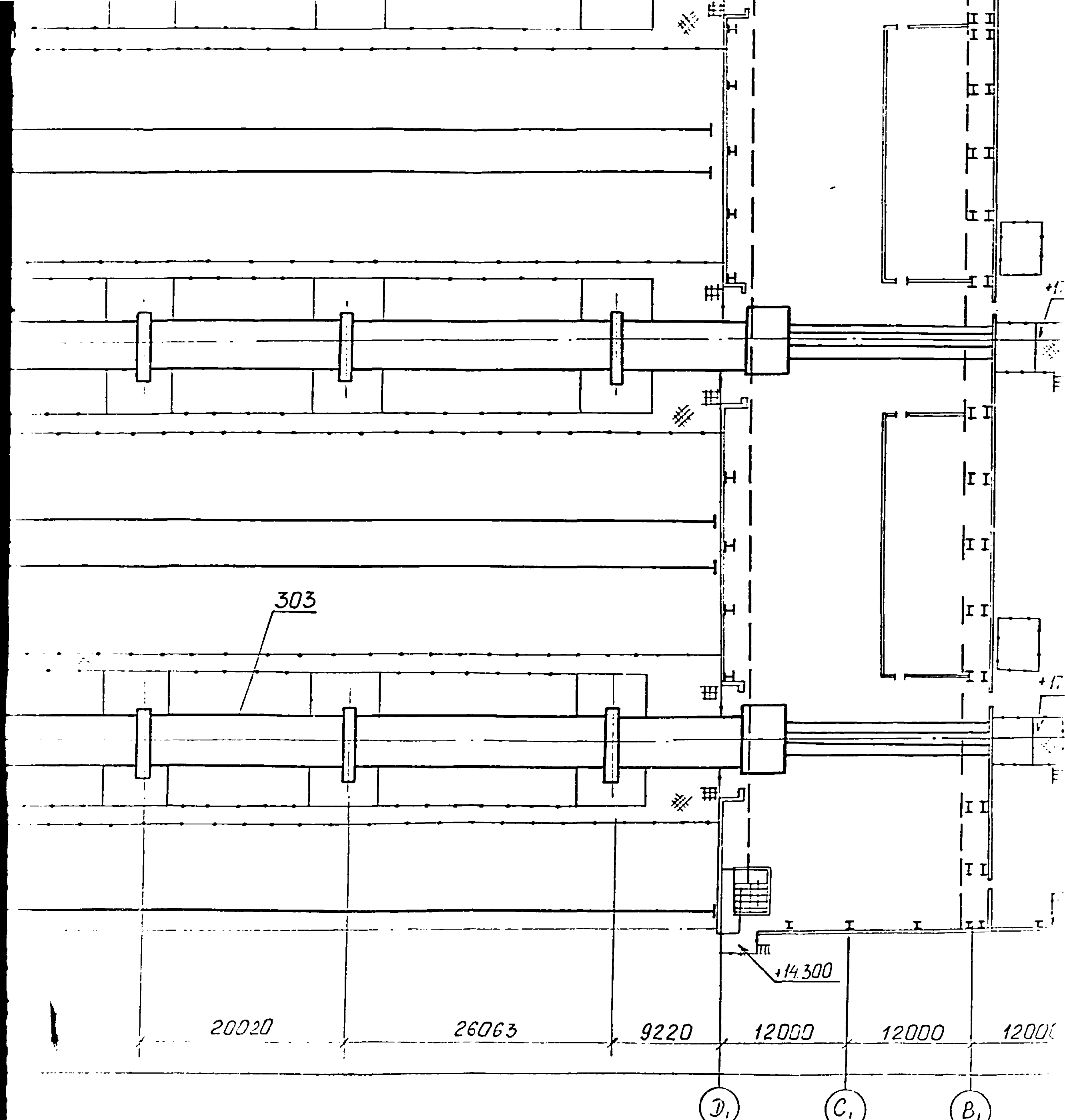
SECTION 6


+17.200
+19.200
+17.200
+17.200
313
322
36000
4600
12000
12000
9135
A
F1
E1

SECTION 7



SECTION 8



SECTION 9

CONTRACT N 90/204/205

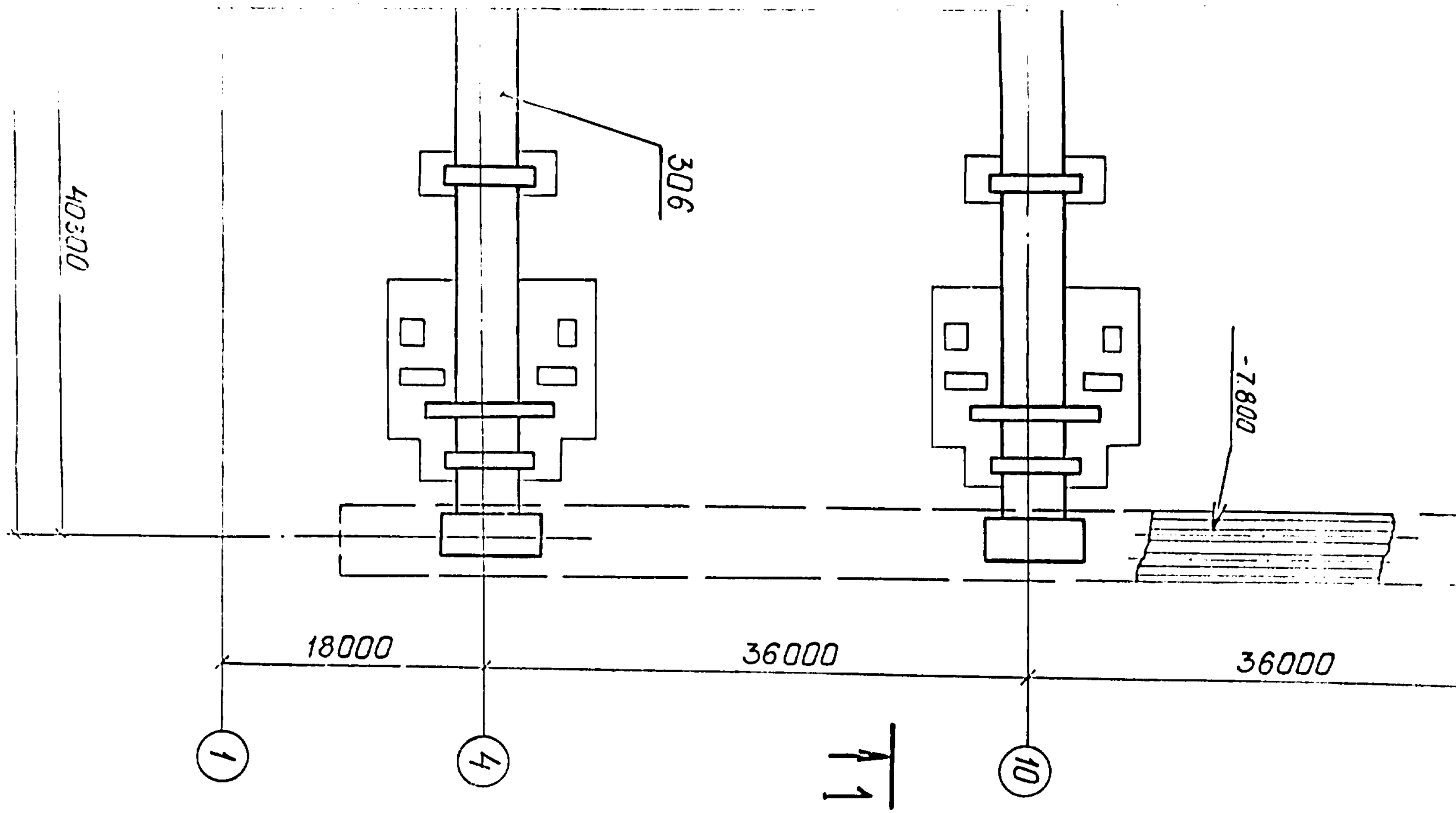
1398861-T

RAZGAN NEPHELINES PROCESSING PLANT (IRAN)

ALUMINA PRODUCTION

SINTERING

PLAN

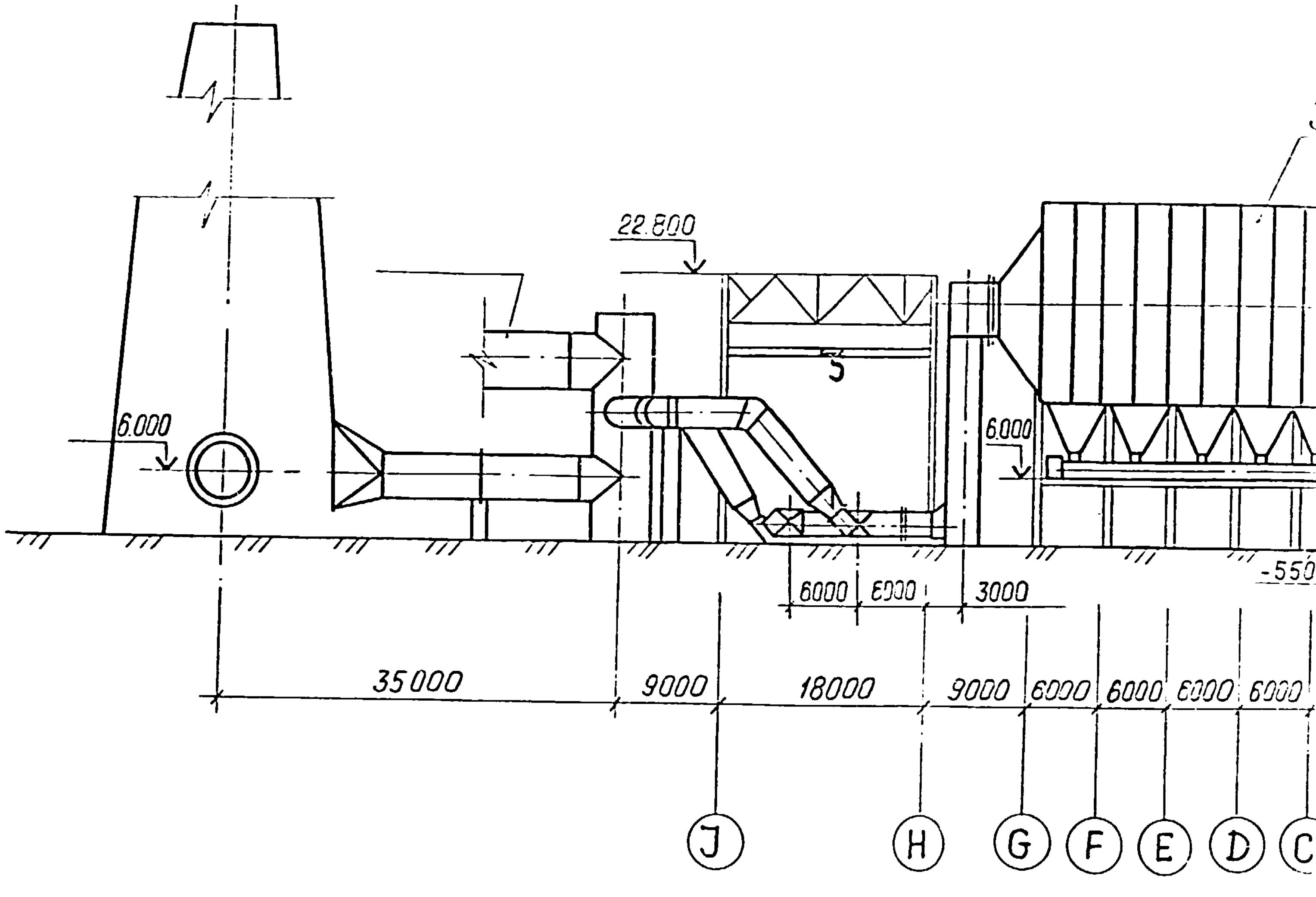


SECTION 10

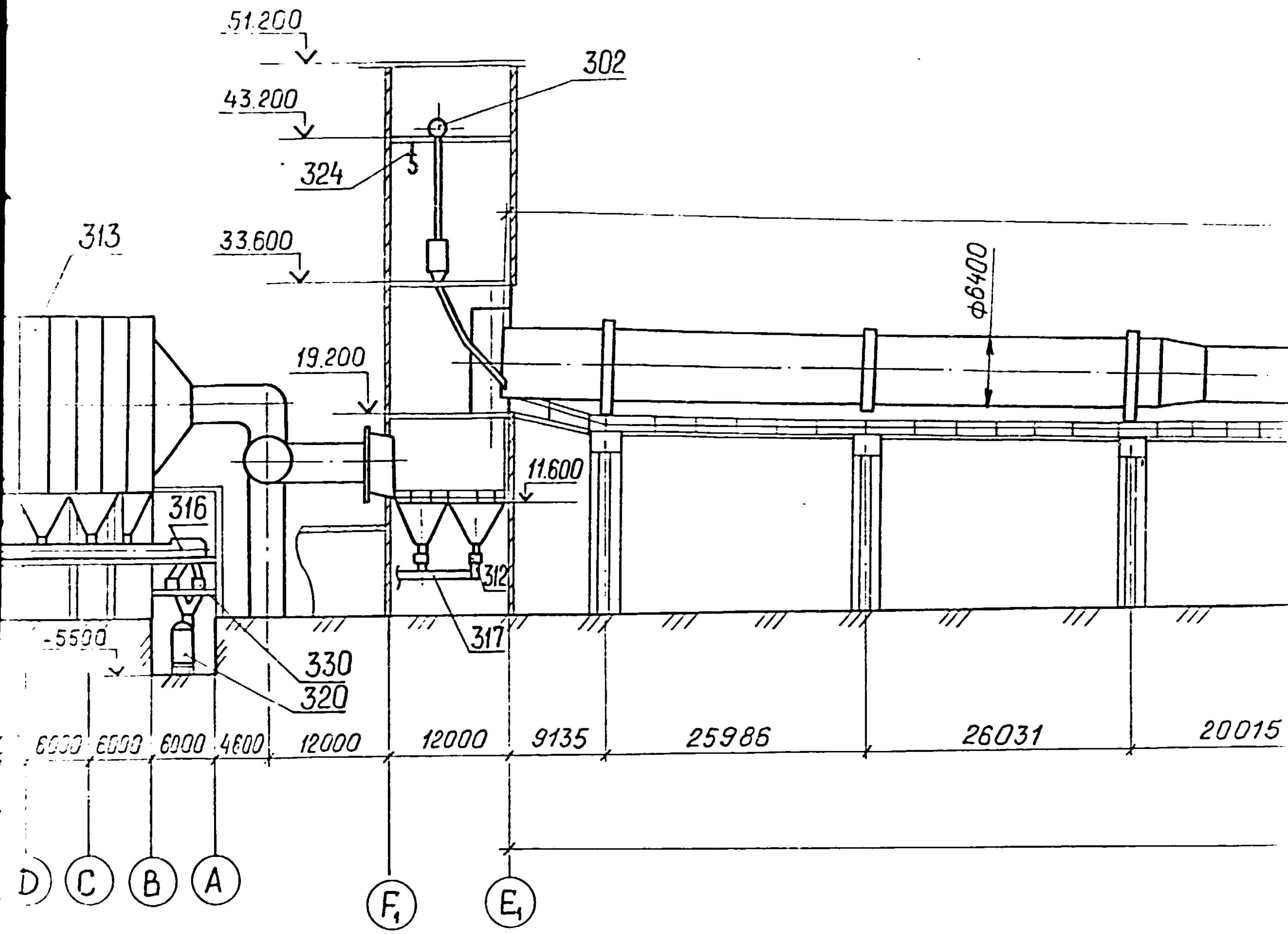
1398861-Т		
ЗАВОД ПО ПЕРЕРАБОТКЕ НЕФЕЛИНОВЫХ РУД МЕСТОРОЖДЕНИЯ РАЗГАХ (ИРАН)		
ГЛИНОЗЕМНОЕ ПРОИЗВОДСТВО. СПЕКАНИЕ	СТАДИЯ: ИВП	ЛИСТ: 2 · ЛИСТОВ:
ПЛАН	ВАМИ ЛЕНИНГРАД	

ФОРМАТ А3×4

ИНВ. № ПОДЛ.	ПОДП. И ДАТА	ВЗАМ. ИНВ. №


22.800
6.000
6.000
5
-550
6000
6000
3000
35000
9000
18000
9000
6000
6000
6000
6000
J
H
G
F
E
D
C

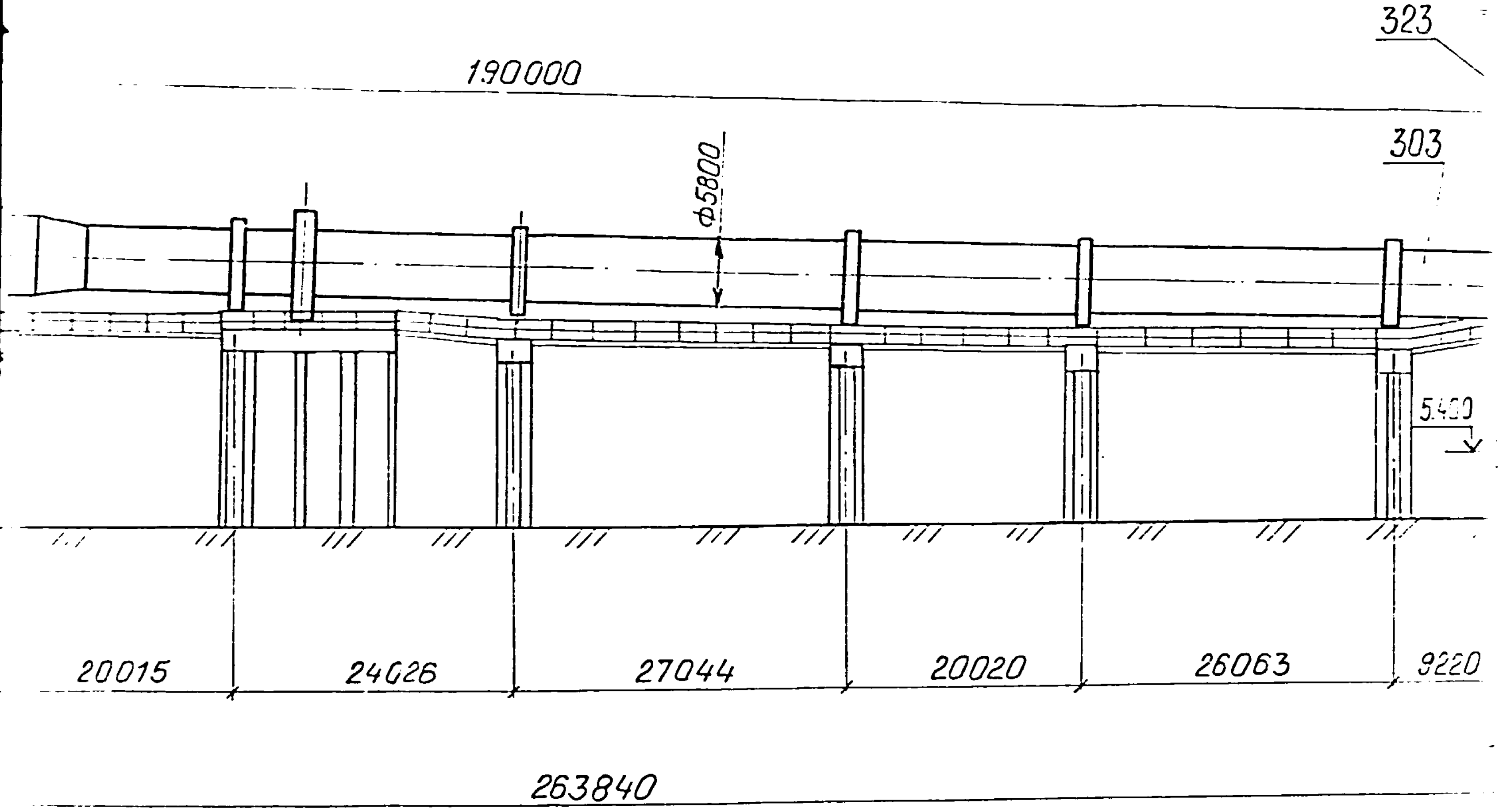
SECTION 1



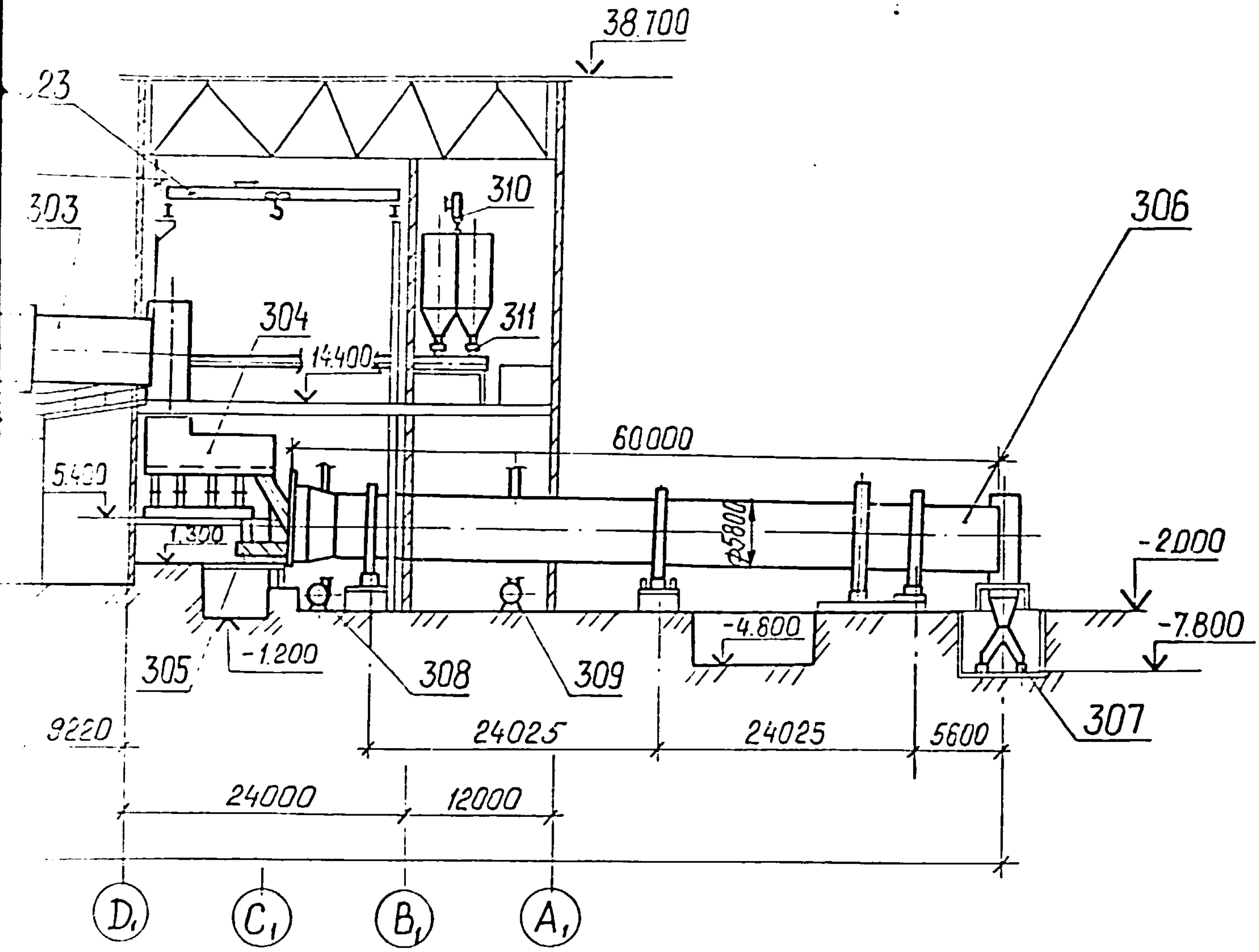
51.200
43.200
302
324
313
33.600
Φ6400
19.200
11.600
316
312
-5500
317
330
320
6000
6000
6000
4800
12000
12000
9135
25986
26031
20015
D
C
B
A
F1
E1

SECTION 2

1 - 1 (1)



SECTION 3



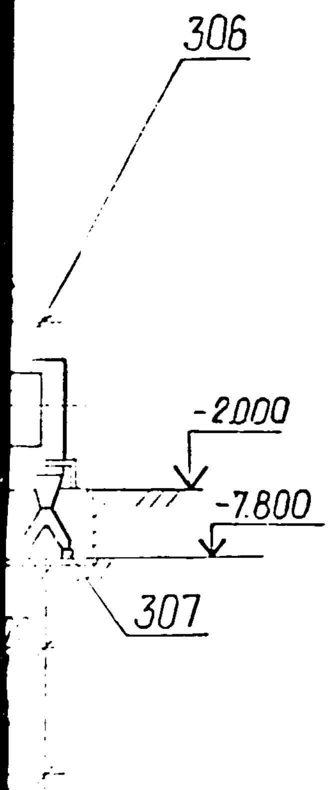
CONTRACT

SECTION 4

RAZG

ALUMI

SEC



SECTION 5

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1398861 - T		
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)		
	ALUMINA PRODUCTION. SINTERING	PHASE / POS	SHEET / 3	SHEETS
	SECTION 1-1	VAMI LENINGRAD		

SIZE A4×5

1398861-Т

ЗАВОД ПО ПЕРЕРАБОТКЕ НЕФЕЛИНОВЫХ РУД МЕСТОРОЖДЕНИЯ РАЗГАХ (ИРАН)

ГЛИНОЗЕМНОЕ ПРОИЗВОДСТВО. СПЕКАНИЕ

СТАДИЯ	ЛИСТ	ЛИСТОВ
ИВП	3	

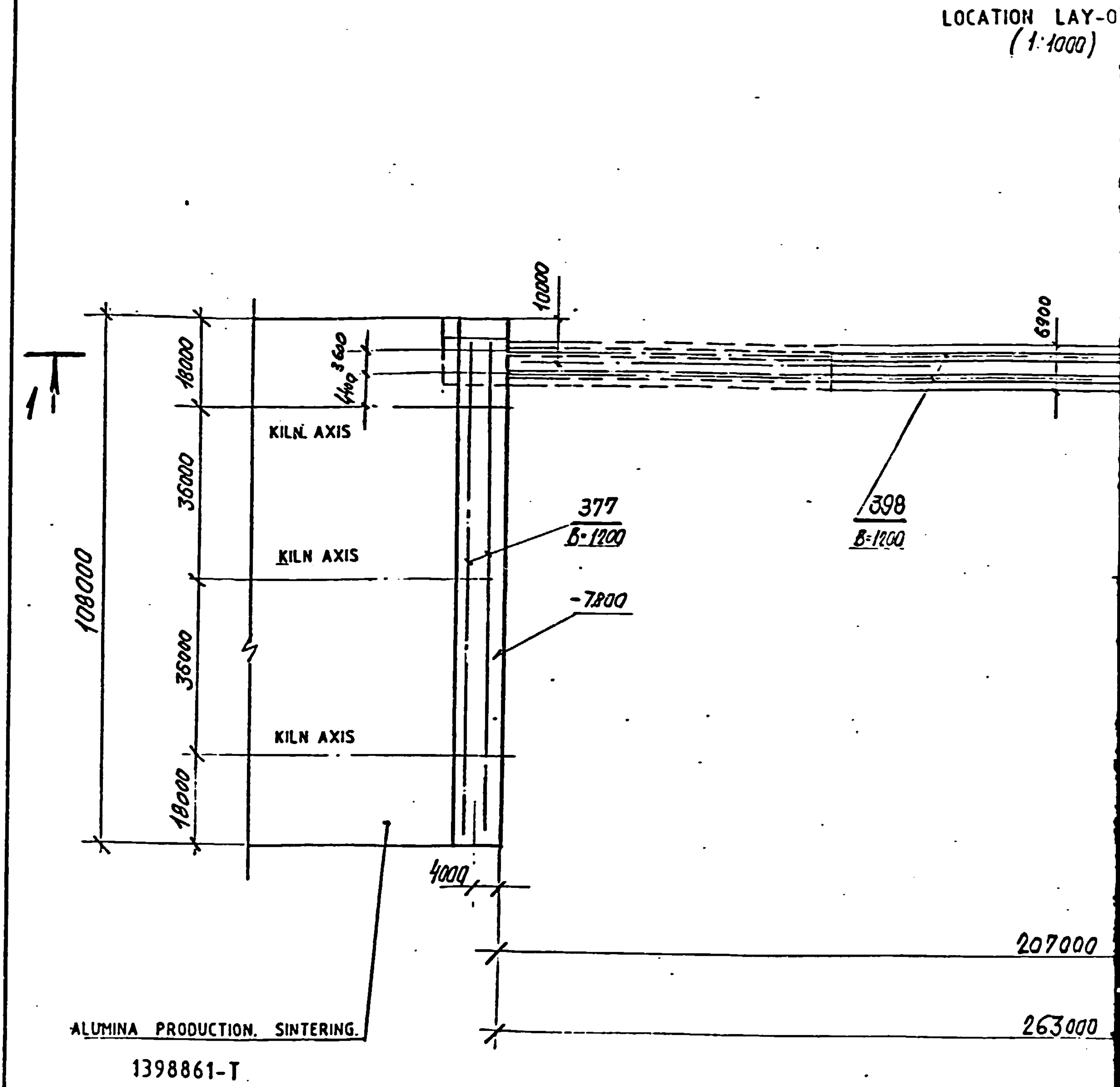
РАЗРЕЗ 1-1

ВАМИ ЛЕНИНГРАД

КОНС	ГОРШКОВА		09.91
ПРОВ	МЕРШАЛОВ		10.91
ПРОВ	ЗВЕРЕВ		
РУК	ЛАКИСОВ		10.91
ГЛ.К	ЯГУД		09.91
НАЧ	ГОЛИКОВ		X.91
НАЧ	БЕЛЯКОВ		
ПЕРЕ	КОРЧАГИН		
Н.КС	РОДНОНОВ		
ГИП	КАИМ		

Инв. № подл. | Подп. и дата | Взам. инв. №

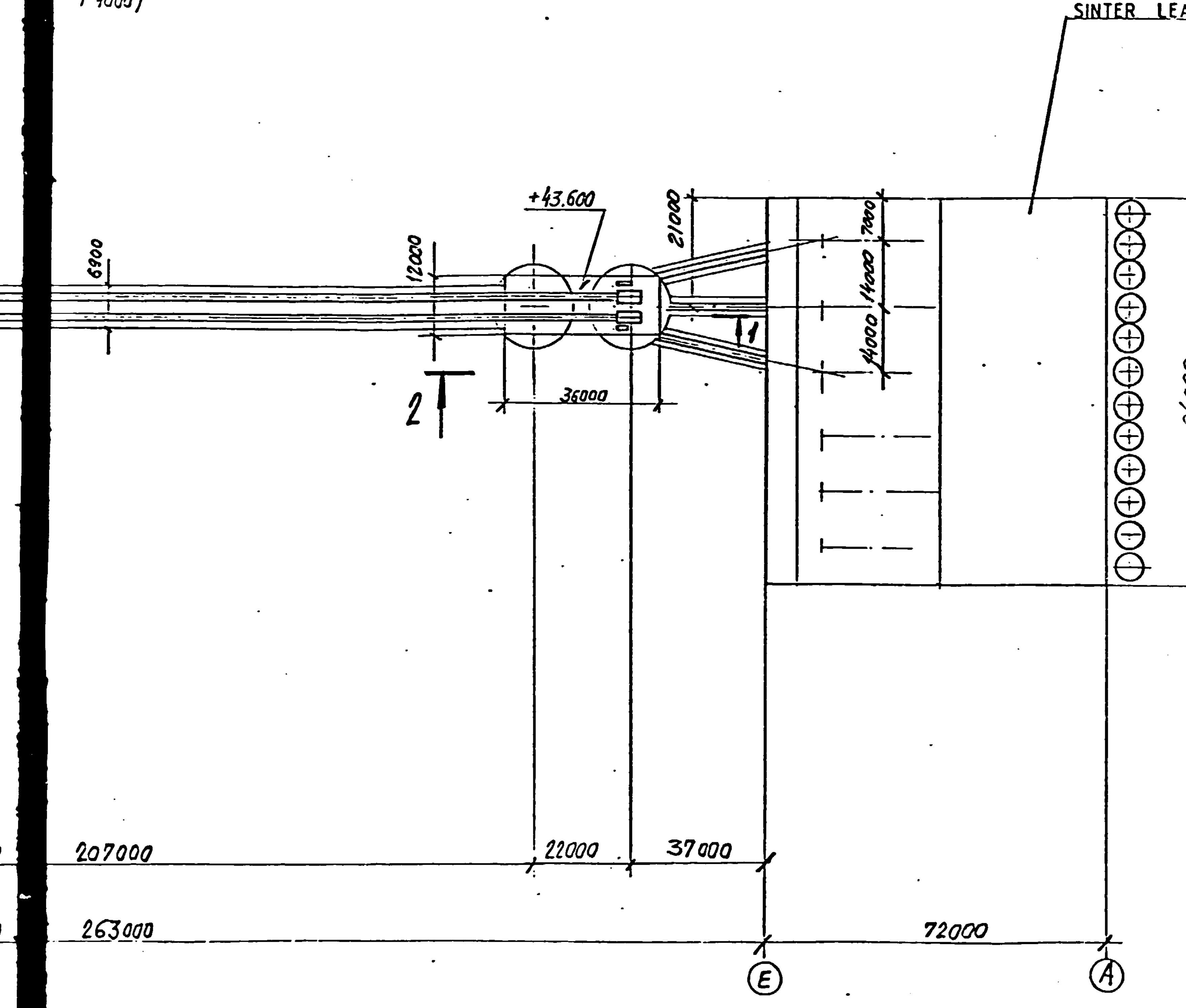
ФОРМАТ А4×5



LOCATION LAY-O
(1:1000)
10000
6900
18000
3600
400
KILN AXIS
36000
KILN AXIS
377
B=1200
398
B=1200
-7.800
108000
36000
KILN AXIS
18000
4000
207000
263000
ALUMINA PRODUCTION. SINTERING.
1398861-T

SECTION 1

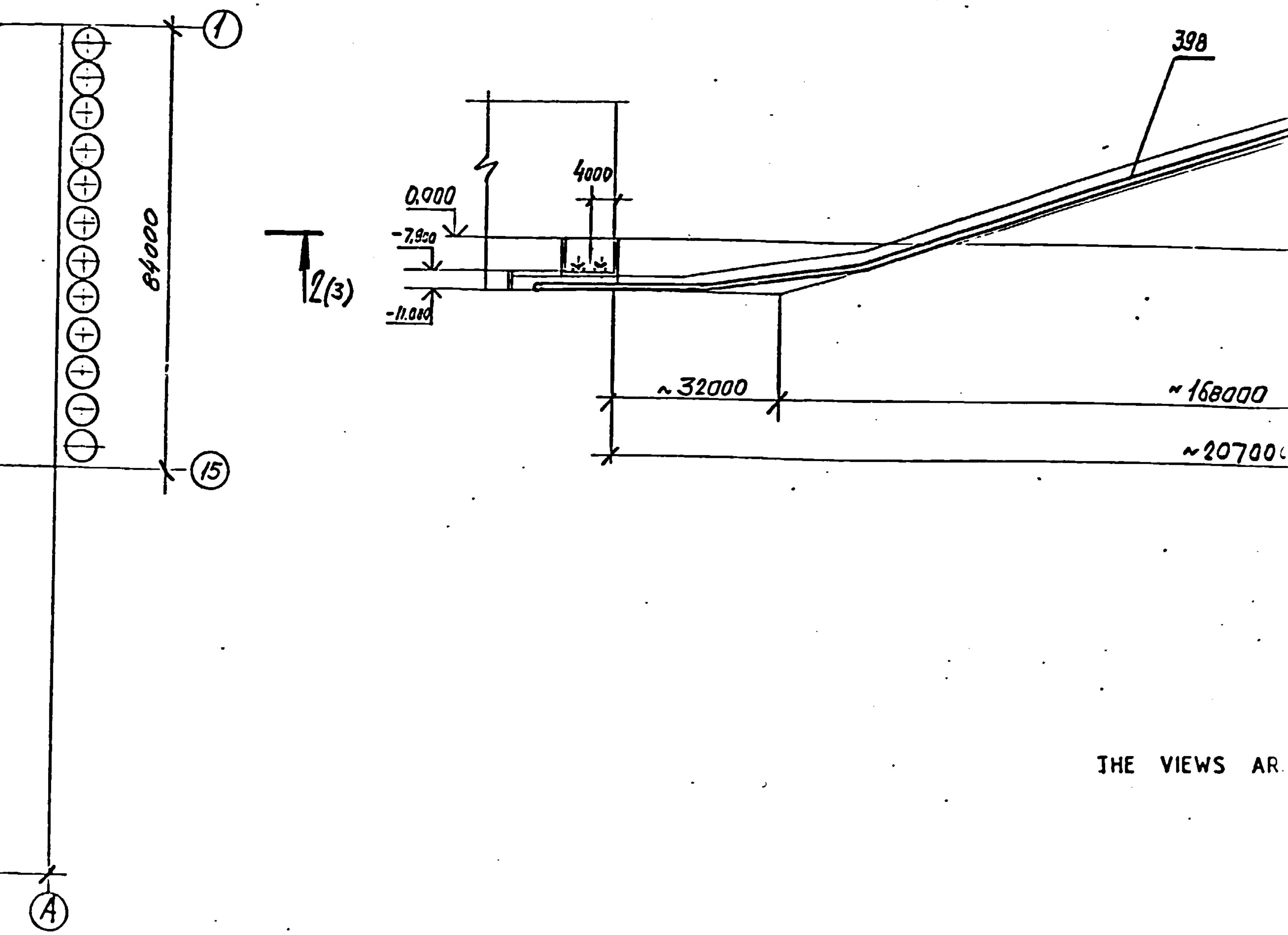
-O… LAY-OUT
(1:1000)



SECTION 2

SINTER LEACHING

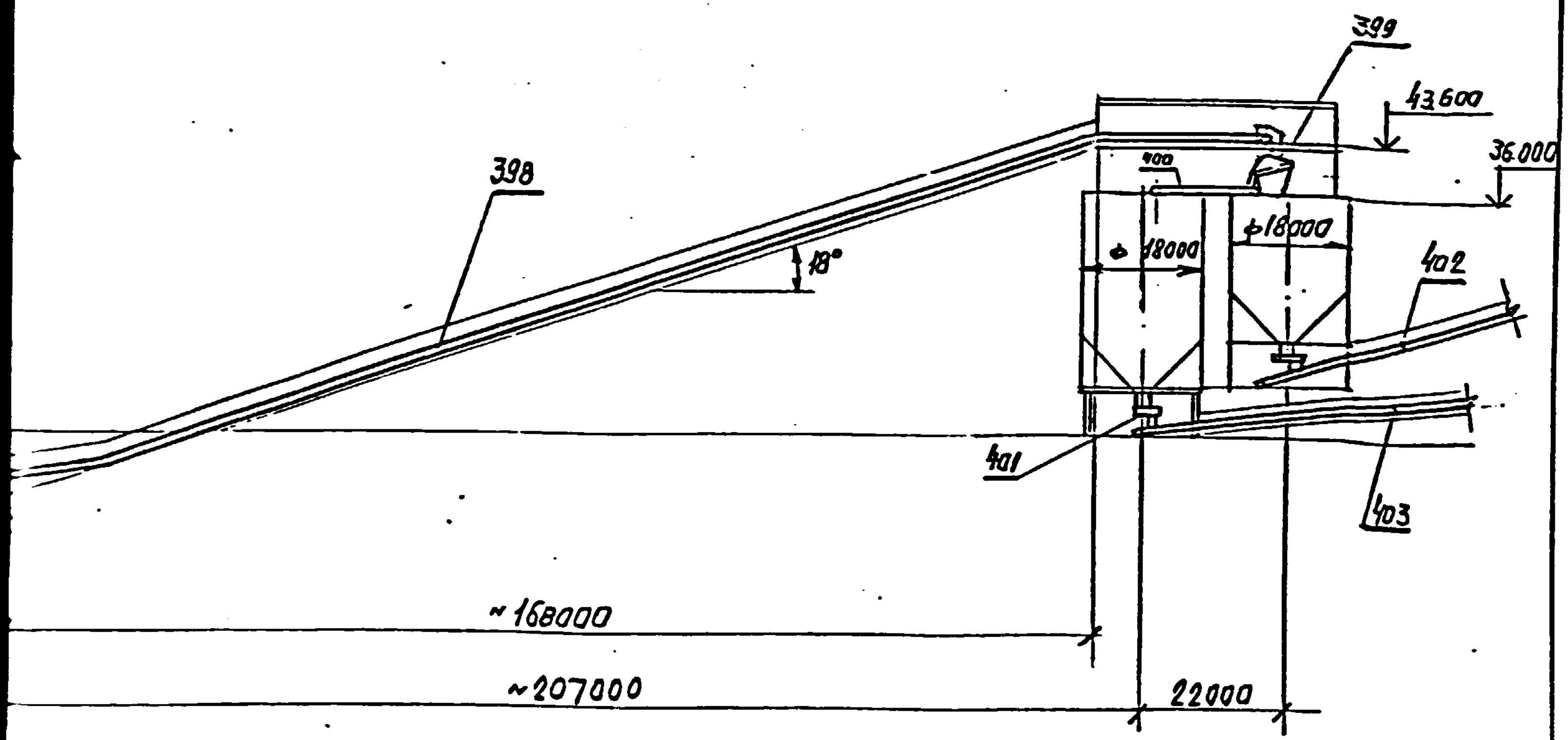
1-1 (1.



THE VIEWS AR.

SECTION 3

1-1 (1:1000)



SECTION 4

THE VIEWS ARE SHOWN IN SCALE 1:400

CONTRACT N 90/204/205

1339640-T

RAZGAH NEPHELINES PROCESSING PLANT (IRAN)

ALUMINA PRODUCTION.
SINTER HANDLING..
SINTER LEACHING.

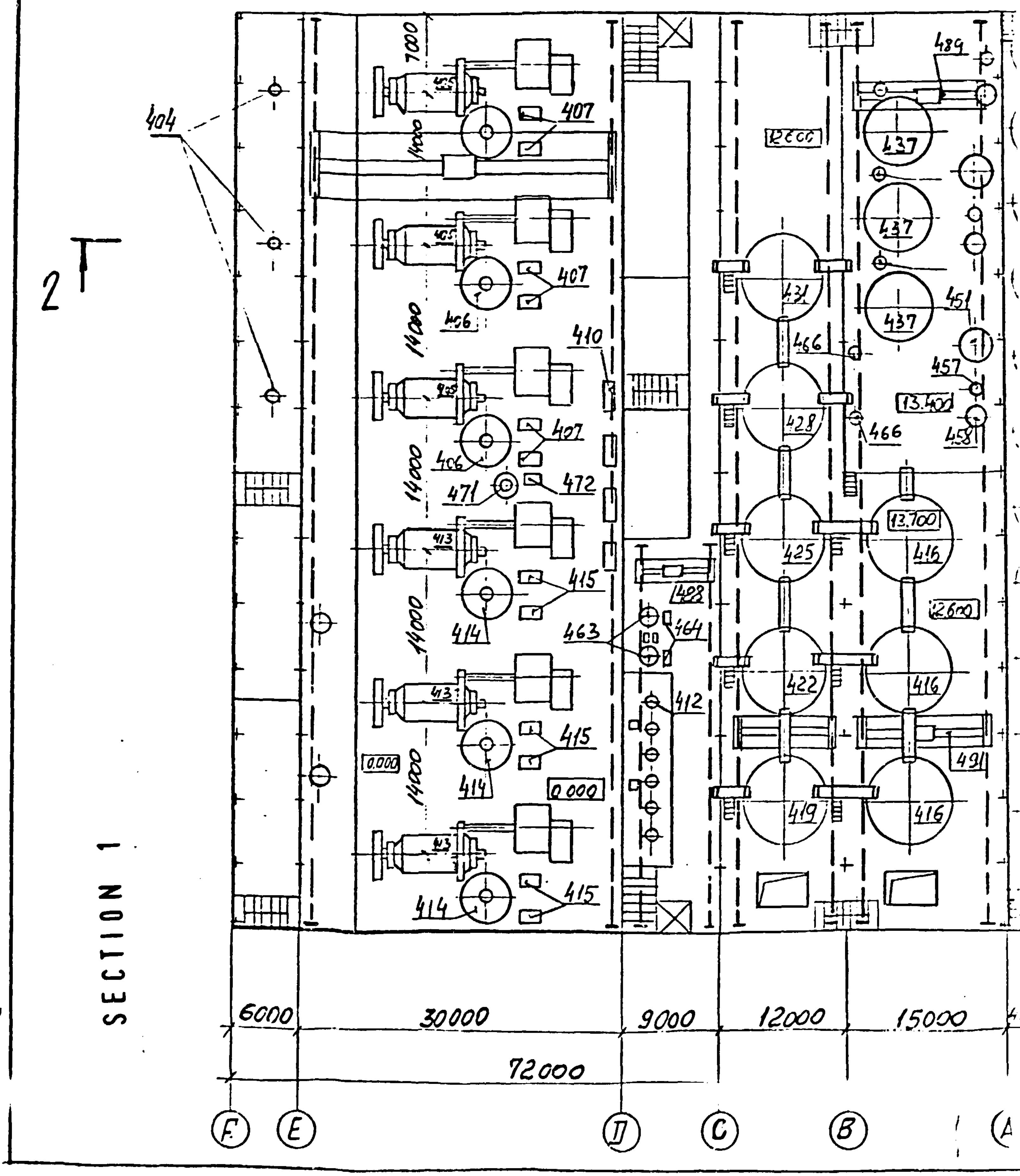
PHASE	SHEET	SHEETS
POS	2	

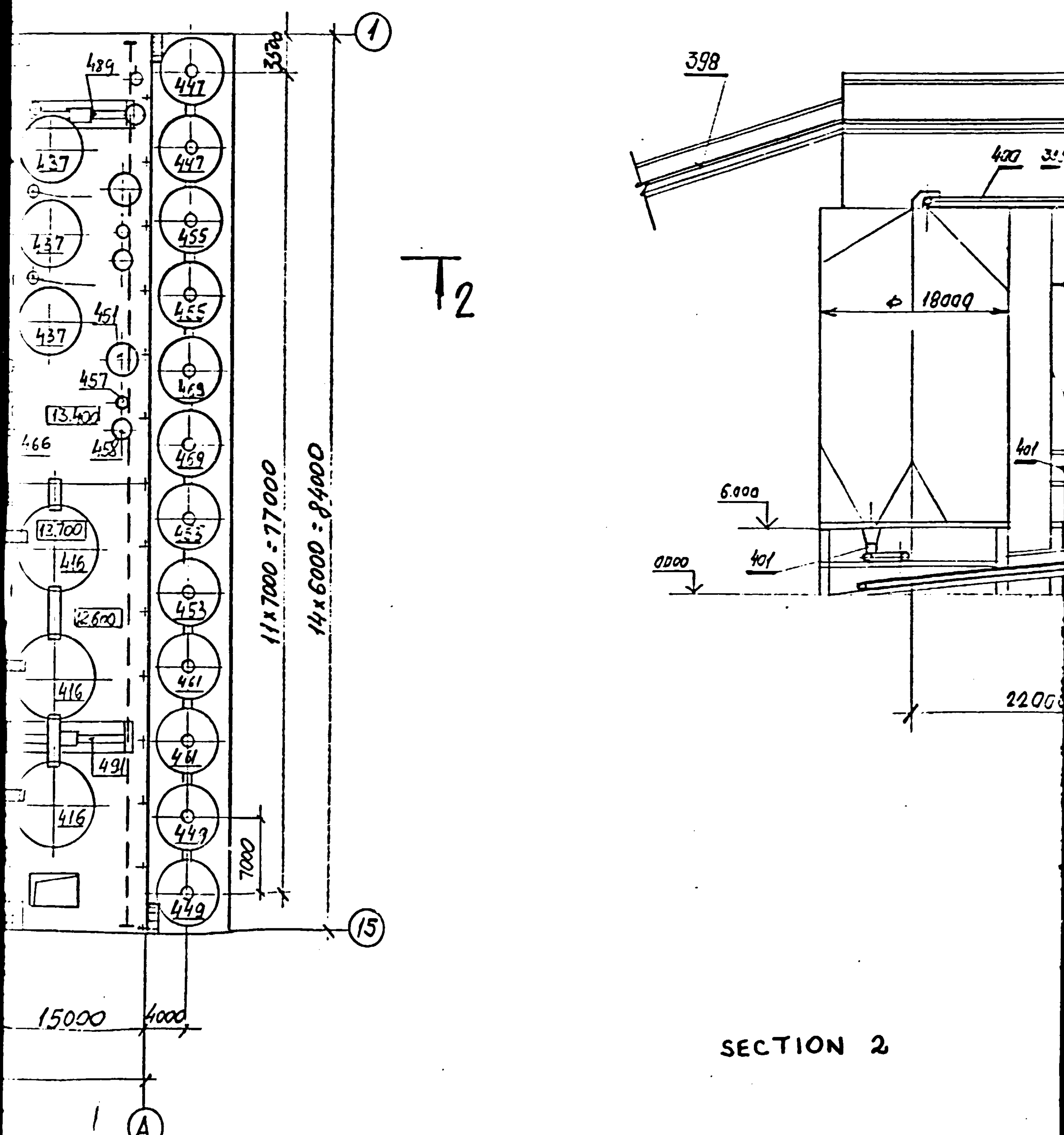
LOCATION LAY-OUT
SECTION

LENINGRAD

SIZE A 4.4

PLAN.


404
2
SECTION 1
405
406
407
410
412
413
414
415
416
419
422
425
428
431
437
451
457
458
463
464
466
471
472
488
489
491
0.000
13.400
13.700
12.600
7000
14000
6000
30000
9000
12000
15000
72000
F
E
Д
C
B
A



T2
489
447
447
437
437
455
455
437
451
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457
13.400
466
458
459
12.700
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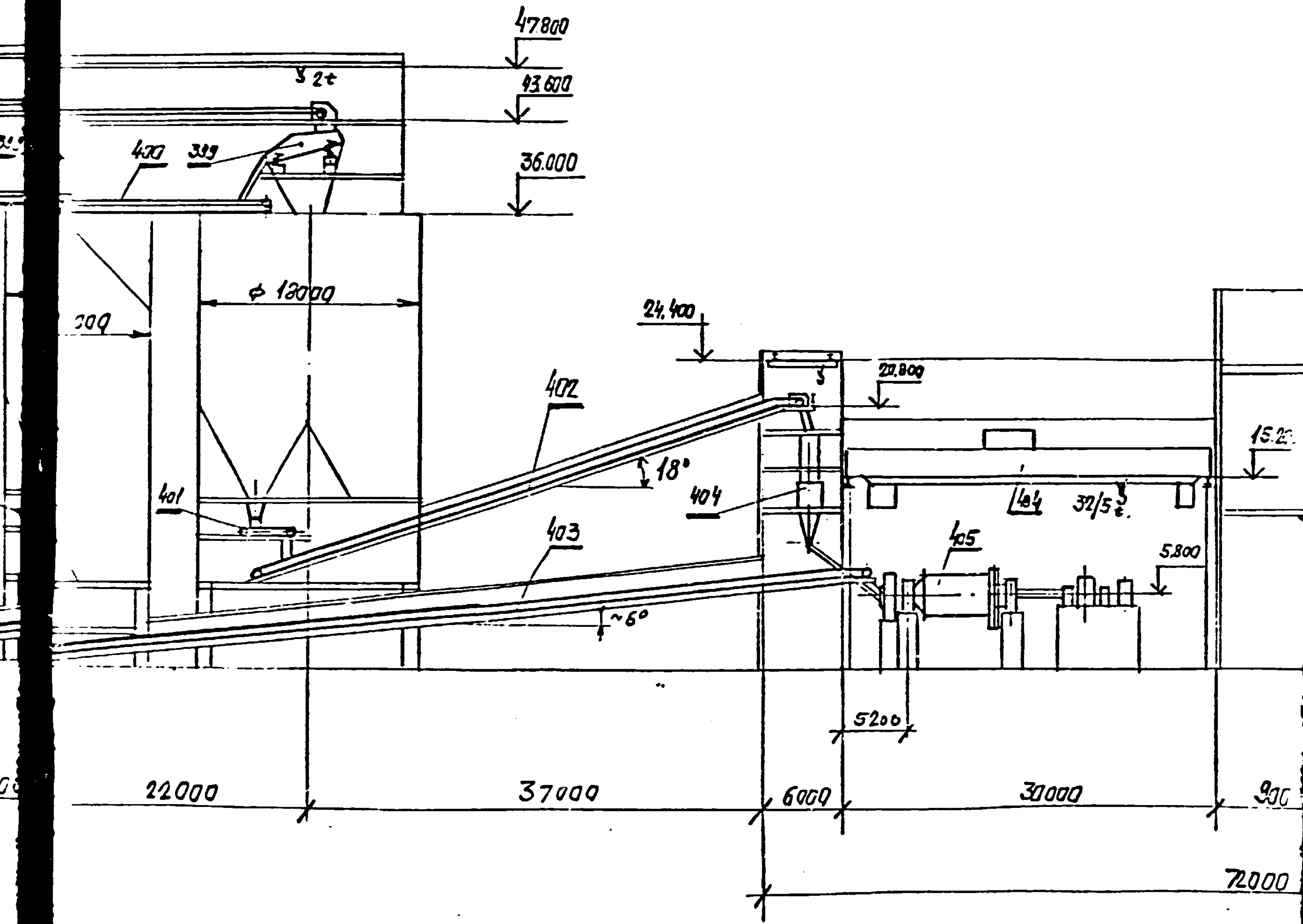
416
453
12.600
416
461
461
491
416
449
449
7000
11x7000=77000
14x6000=84000
3500
1
15
15000
4000
A
398
400
18000
401
6.000
0.000
401
2200

SECTION 2

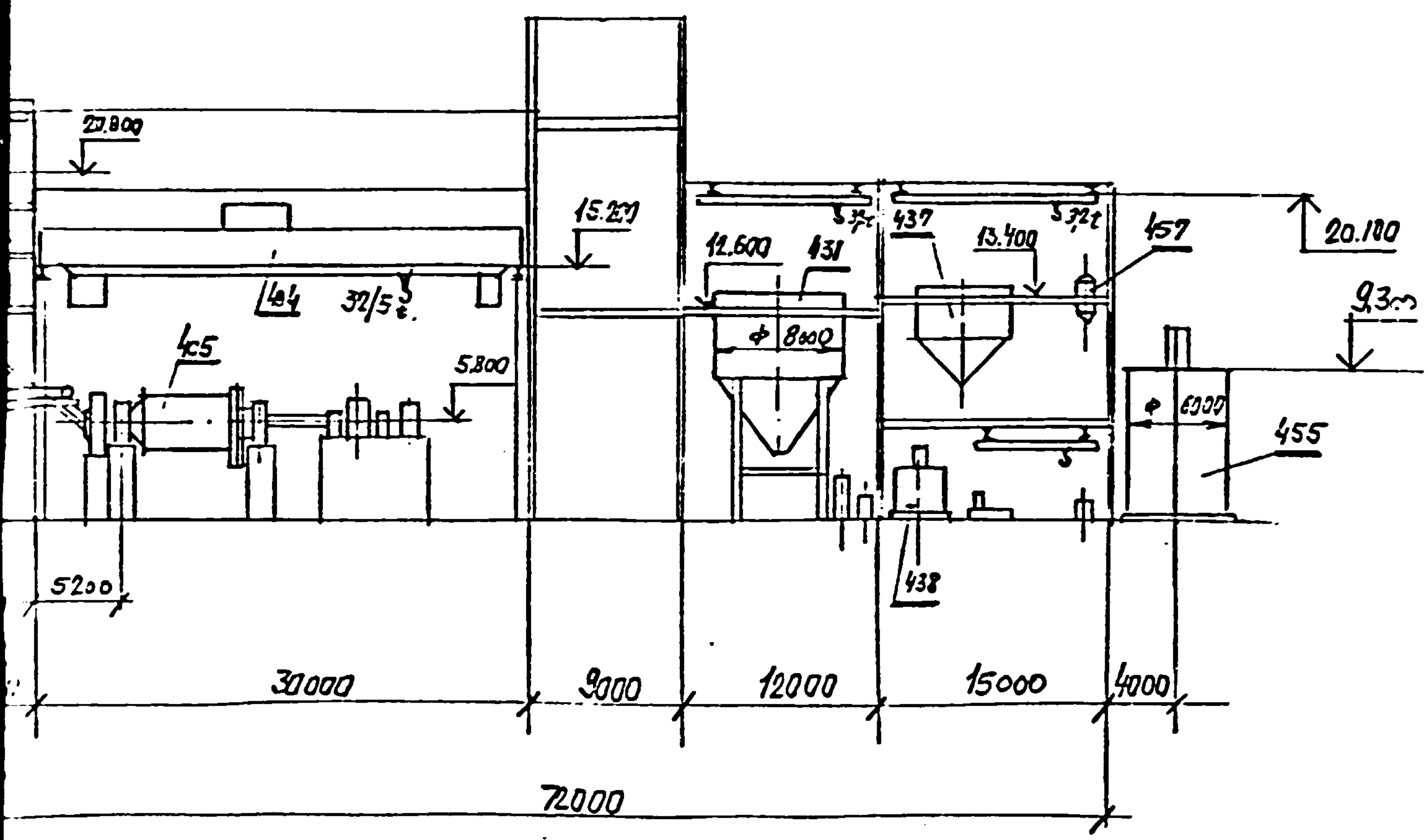
2-2 (2)



SECTION 3

-2 (2)

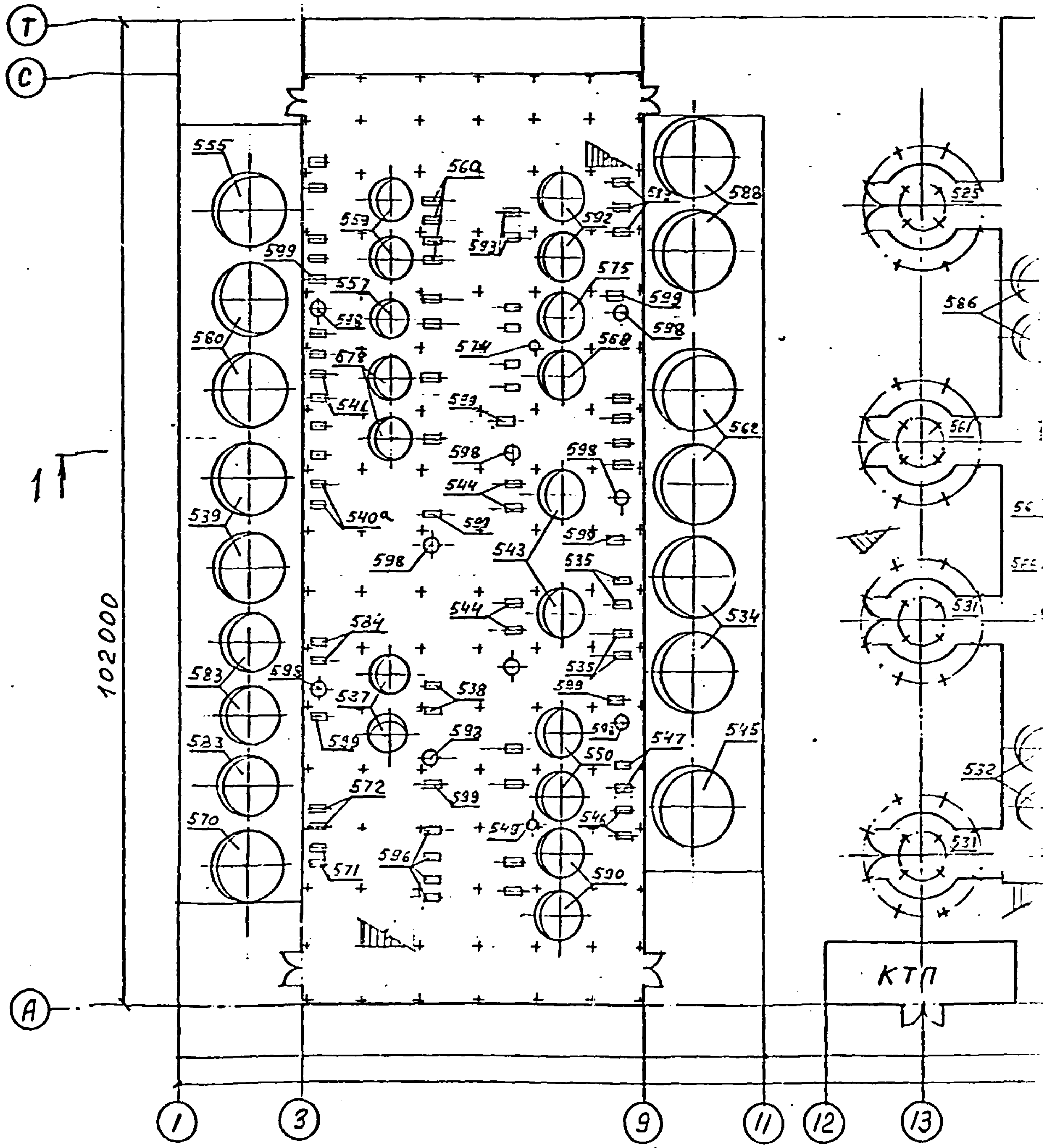
SECTION 4



CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339640-T		
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)		
	ALUMINA PRODUCTION. SINTER HANDLING. SINTER LEACHING.	PHASE: POS	SHEET: 3 / SHEETS:
	PLAN. SECTION.	VAMI LENINGRAD	

SIZE A4x4


T
C
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9
11
12
13
102000
КТП
555
560
539
583
570
599
557
578
541
540a
584
537
572
571
596
560a
559
593
574
598
544
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547
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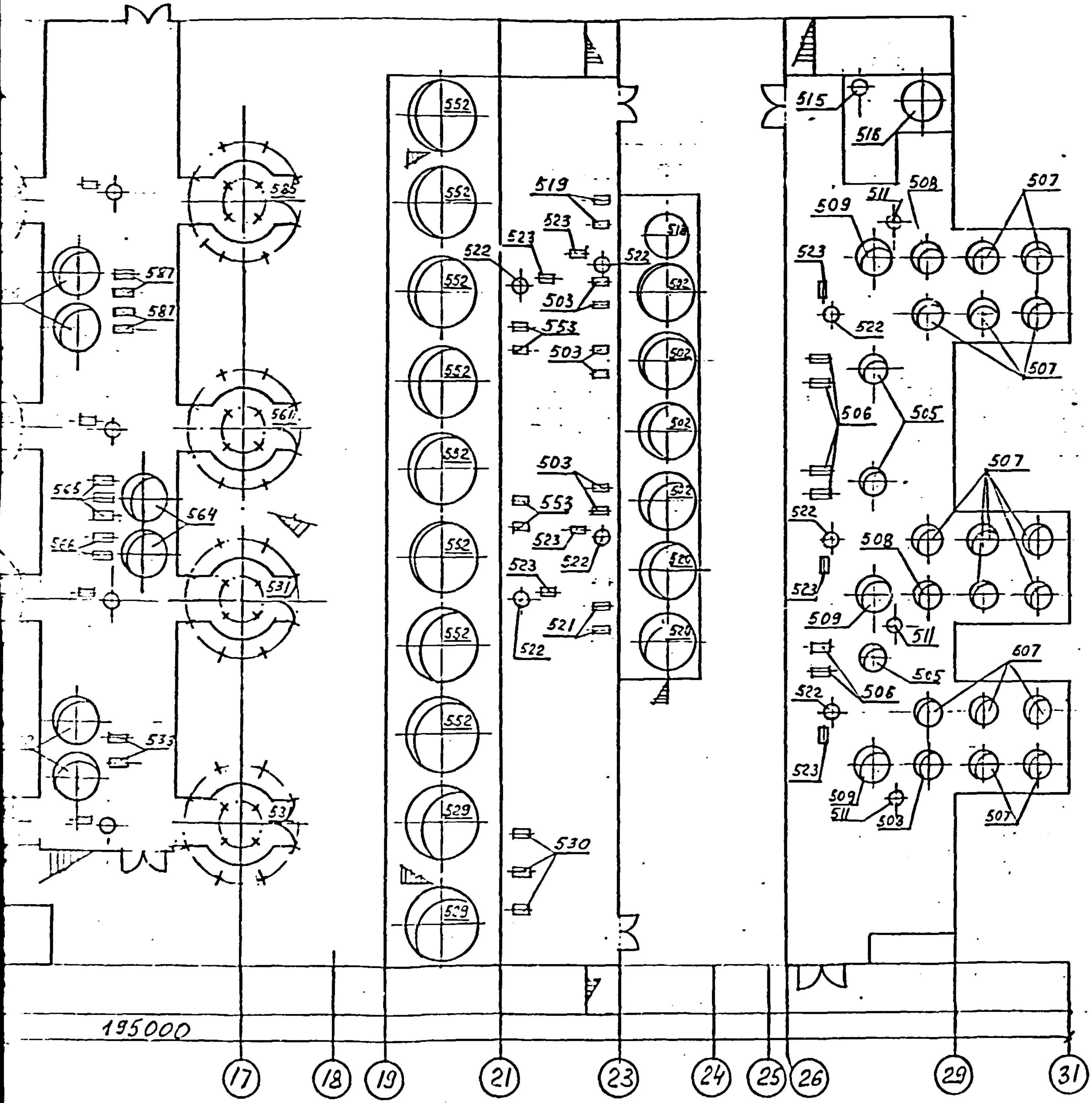
561
531
532
586

SECTION 1


585
561
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531
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533
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519
523
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515
516
509
511
508
507
523
522
507
506
505
507
522
508
523
509
511
505
506
607
522
523
509
511
503
507
195000
17
18
19
21
23
24
25
26
29
31

SECTION 2

SECTION 3

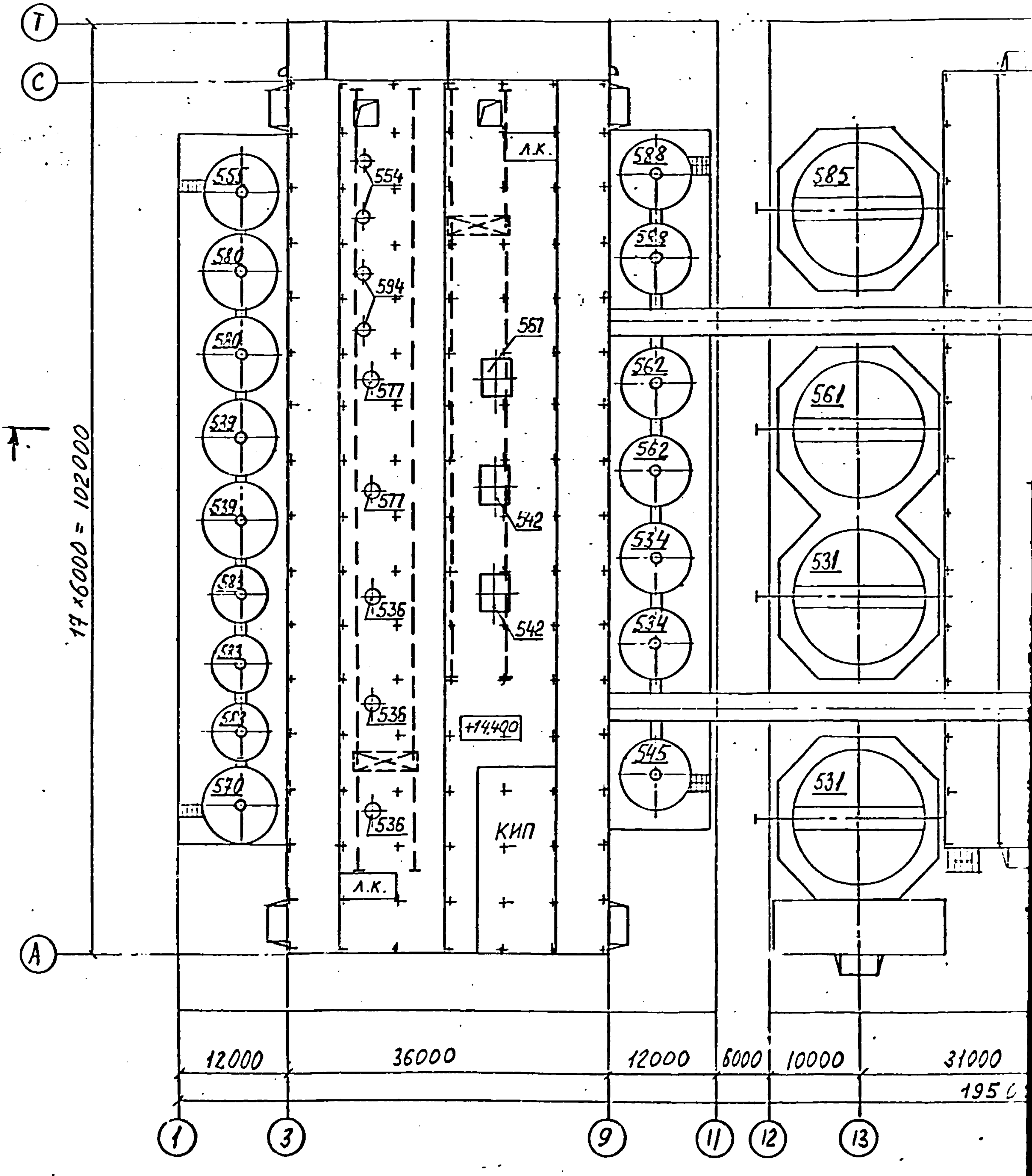
THE VIEWS ARE IN SCALE 1:500

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339641-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	ALUMINA PRODUCTION DESILICATION	PHASE	SHEET	SHEETS
		POS	3	
	PLAN ATEL. 0.000	VAMI LENINGRAD		

SIZE A4x4

SECTION 1



T
C
A
1
17×6000 = 102000
555
580
539
539
570
554
594
577
577
536
536
536
Л.К.
Л.К.
557
542
542
+14.400
КИП
562
562
534
534
545
585
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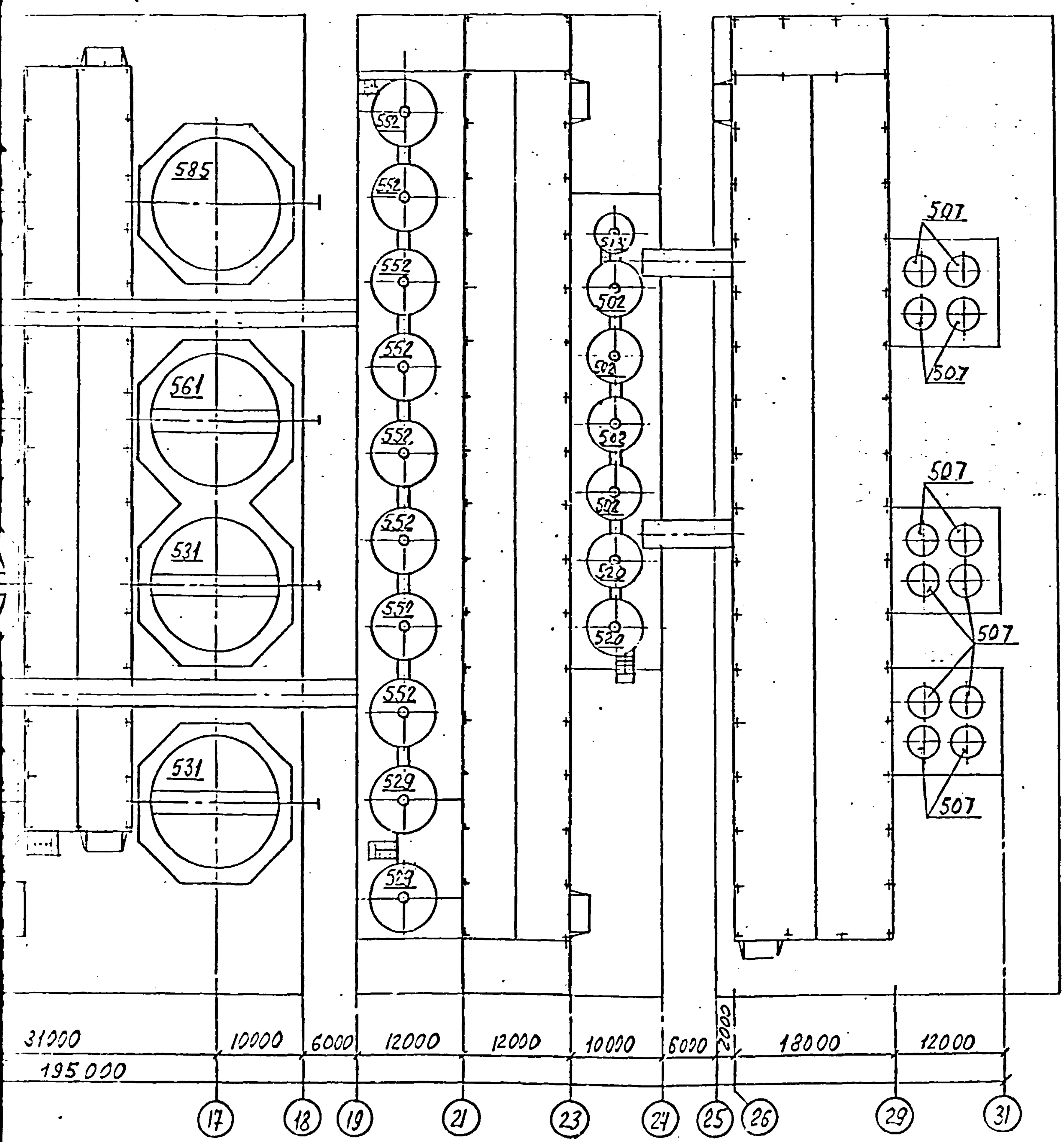
531
531
12000
36000
12000
6000
10000
31000
1
3
9
11
12
13


585
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531
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552
552
552
552
552
552
529
529
513
502
502
502
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520
520
507
507
507
507
507
31000
10000
6000
12000
12000
10000
6000
2000
18000
12000
195 000
17
18
19
21
23
24
25
26
29
31

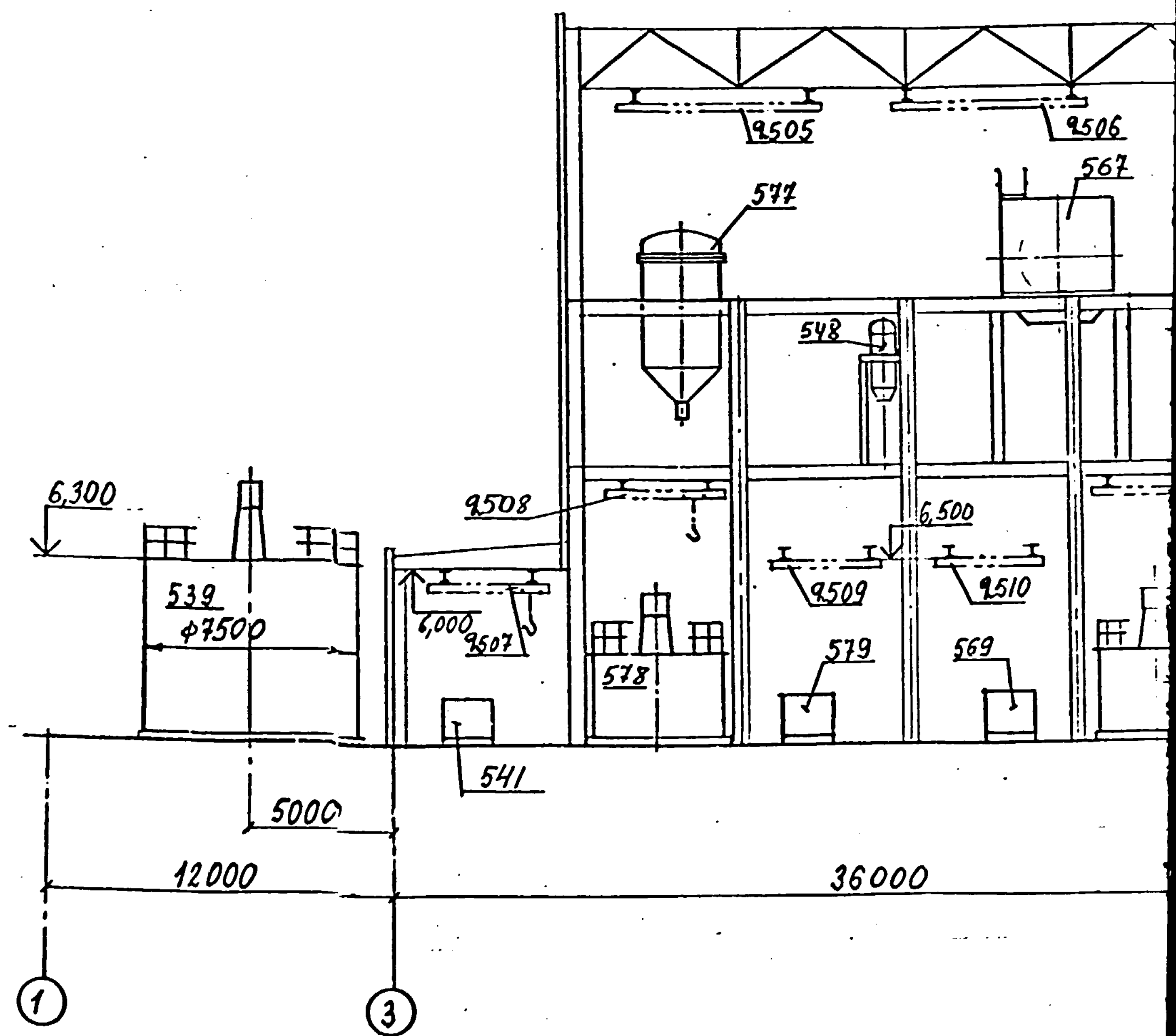
SECTION 2

SECTION 3

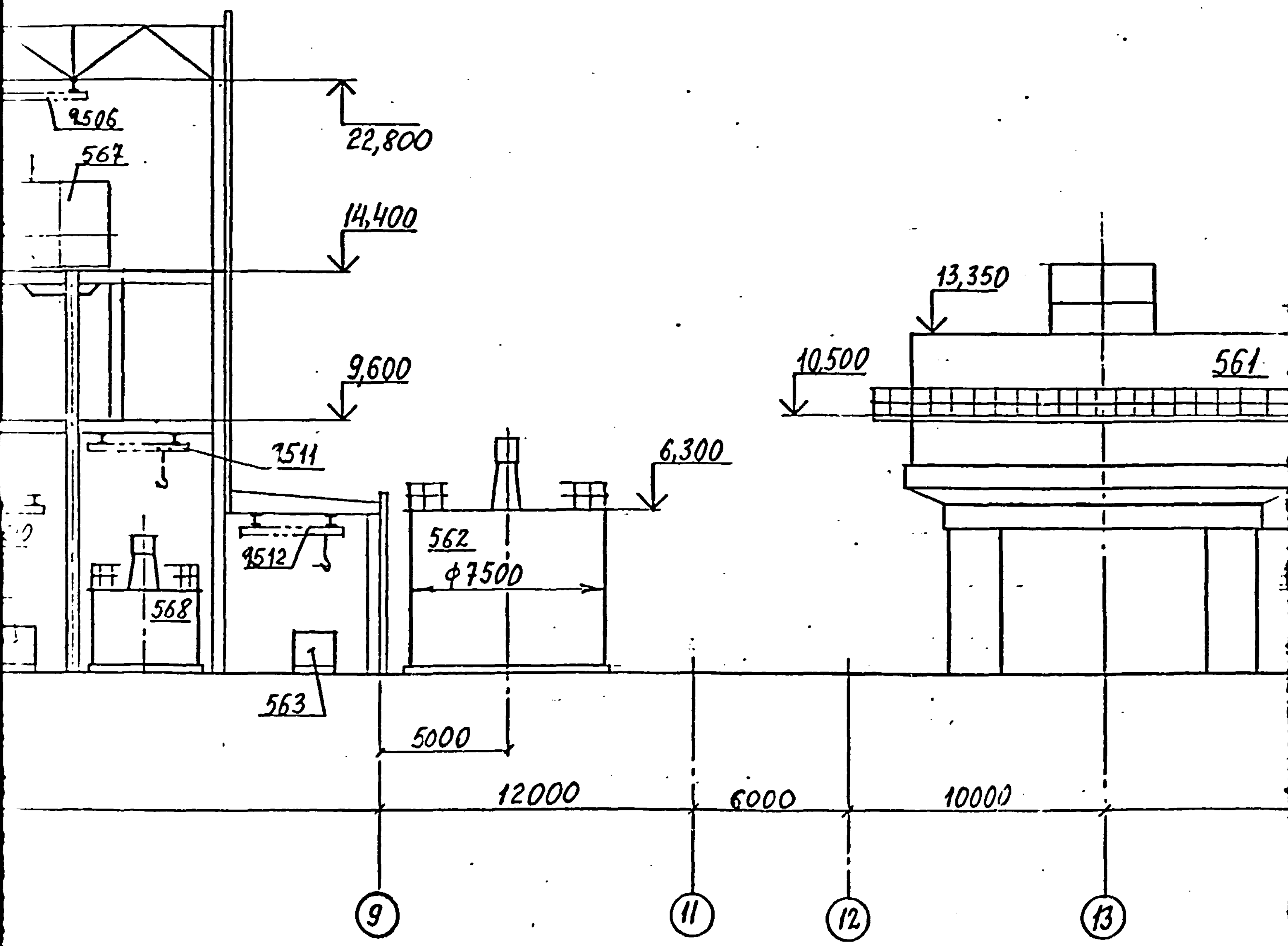
CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339641-T.			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	ALUMINA PRODUCTION DESILICATION	PHASE	SHEET	SHEETS
		POS	4	
	PLAN UPFER ELEVATIONS	VAMI LENINGRAD		

SIZE A4x4

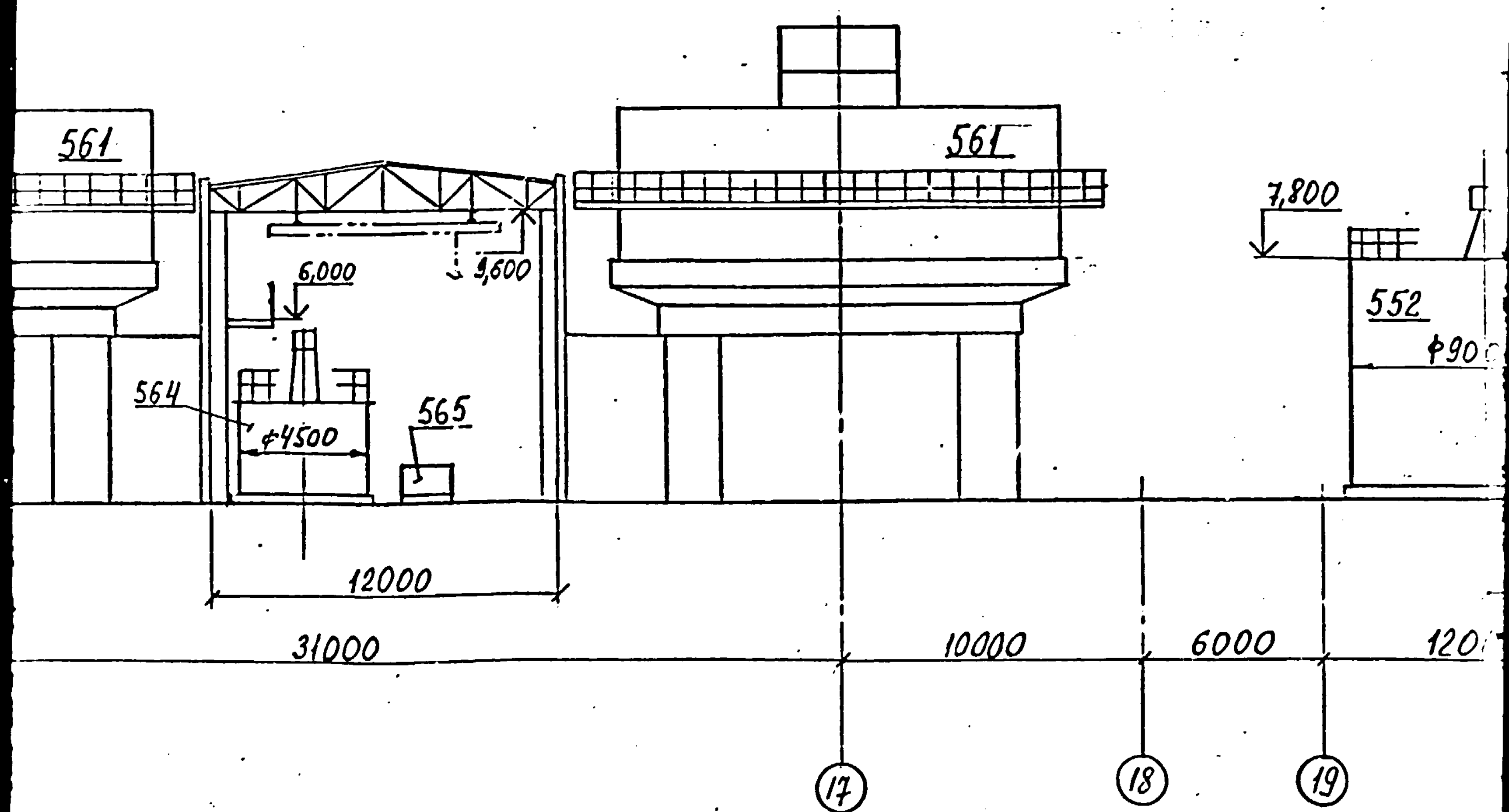

9505
9506
567
577
548
9508
6,500
6,300
539
φ7500
6,000
9507
578
9509
9510
579
569
541
5000
12000
36000
1
3

SECTION 1



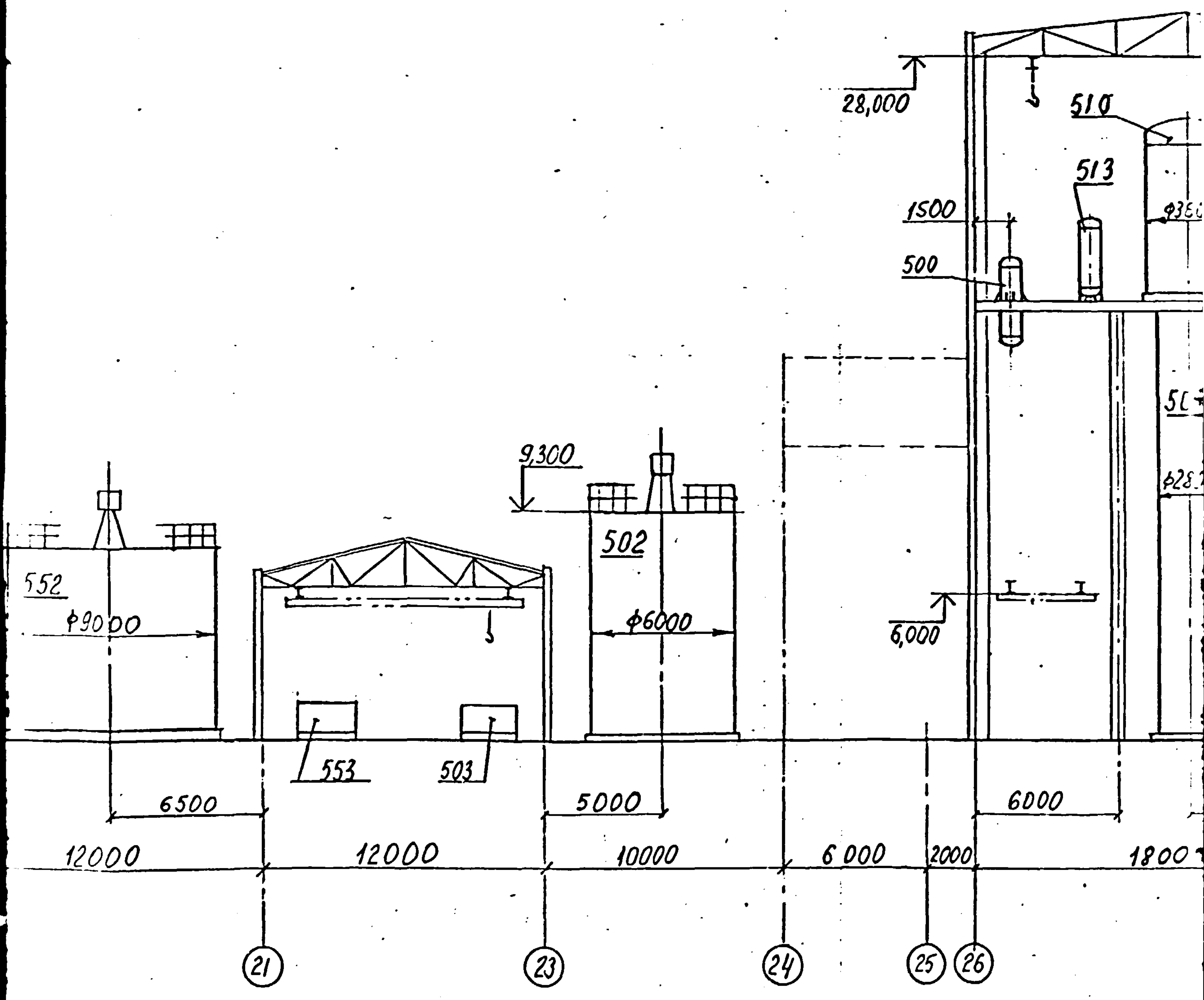
9506
567
22,800
14,400
9,600
1511
9512
568
563
562
φ7500
6,300
5000
12000
6000
10000
13,350
10,500
561
9
11
12
13

SECTION 2



561
561
7,800
6,000
9,600
552
φ90
564
φ4500
565
12000
31000
10000
6000
120
17
18
19

SECTION 3


28,000
510
513
1500
500
9,300
502
552
φ9000
φ6000
6,000
553
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6500
5000
6000
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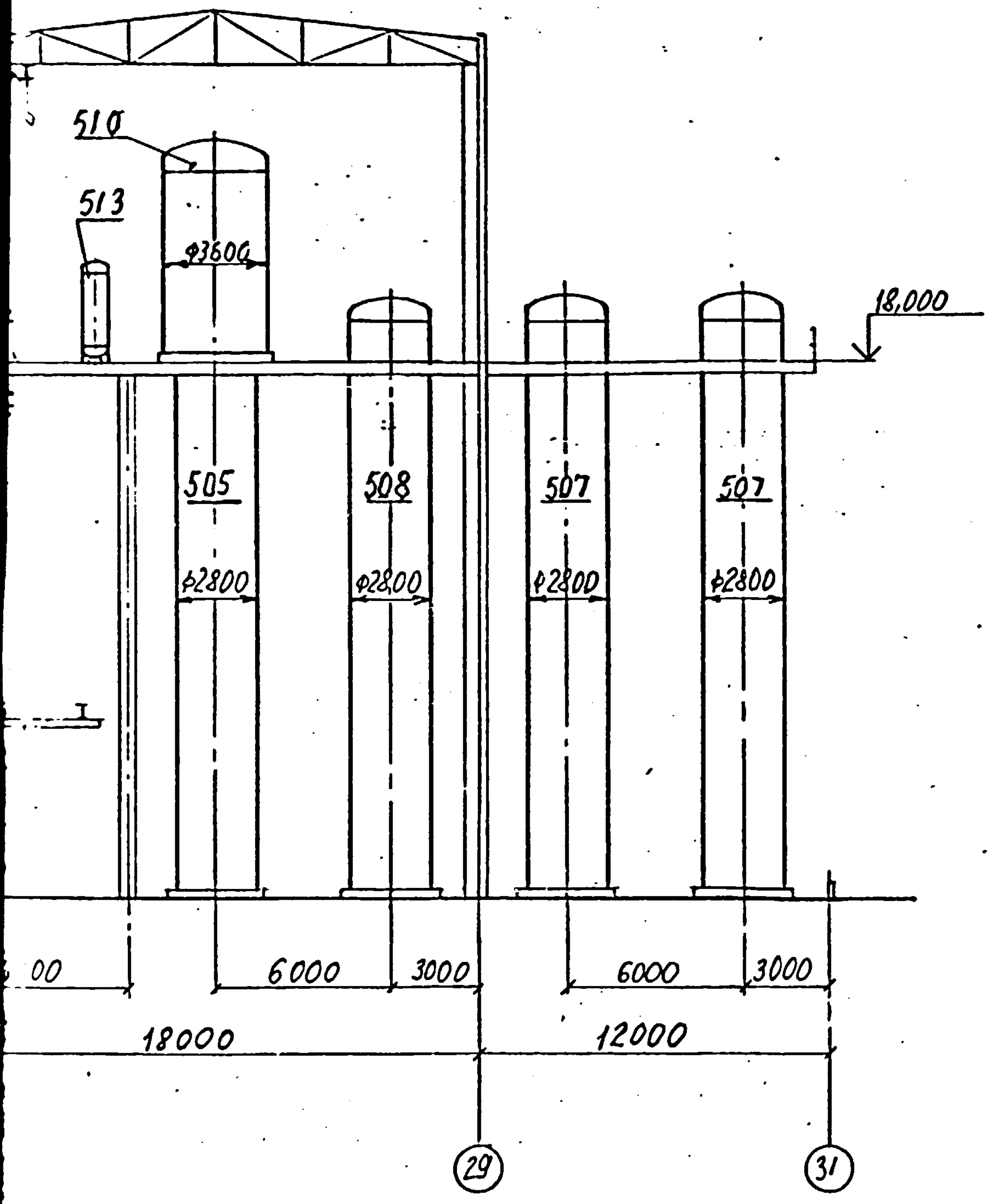
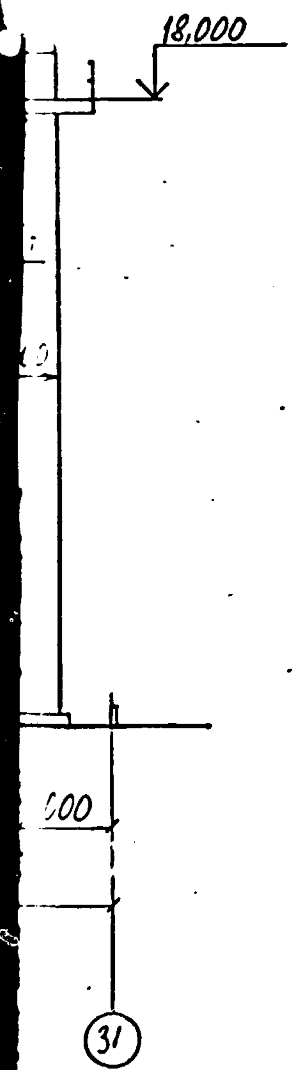
12000
10000
6 000
2000
21
23
24
25
26

SECTION 4



SECTION 5

CONT.

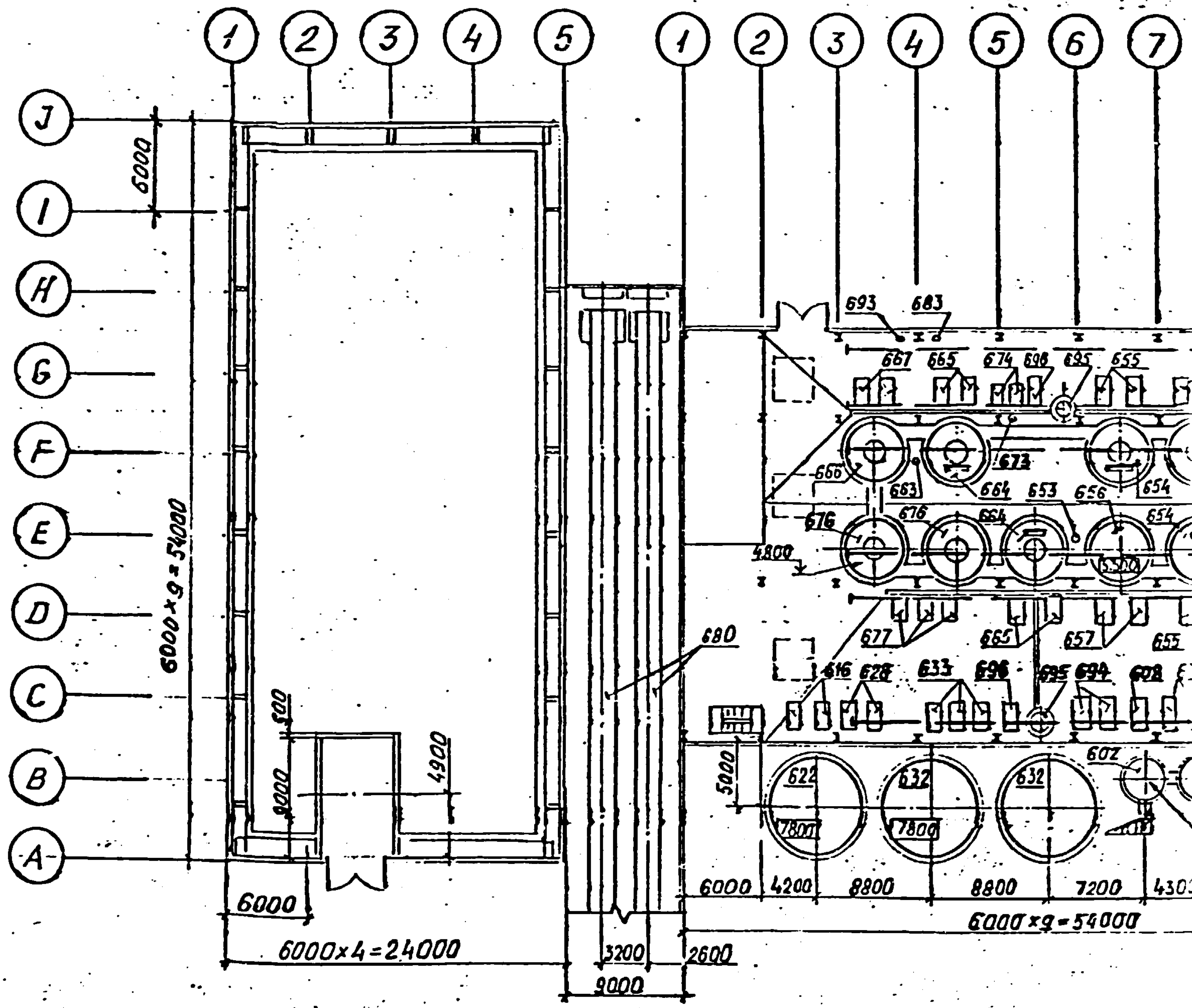


SECTION 6

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	[illegible]41-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	ALUMINA PRODUCTION DESILICATION	PHASE	SHEET	SHEETS
		POS	5	
	SECTION 1-1.	VAMI LENINGRAD		

SIZE A4x6



6000
6000×9=54000
500
9000
4900
6000
6000×4=24000
3200
9000
2600
693
683
667
665
674
695
655
660
663
664
673
653
656
654
676
4800
677
665
657
655
680
616
628
633
694
608
602
622
632
7800
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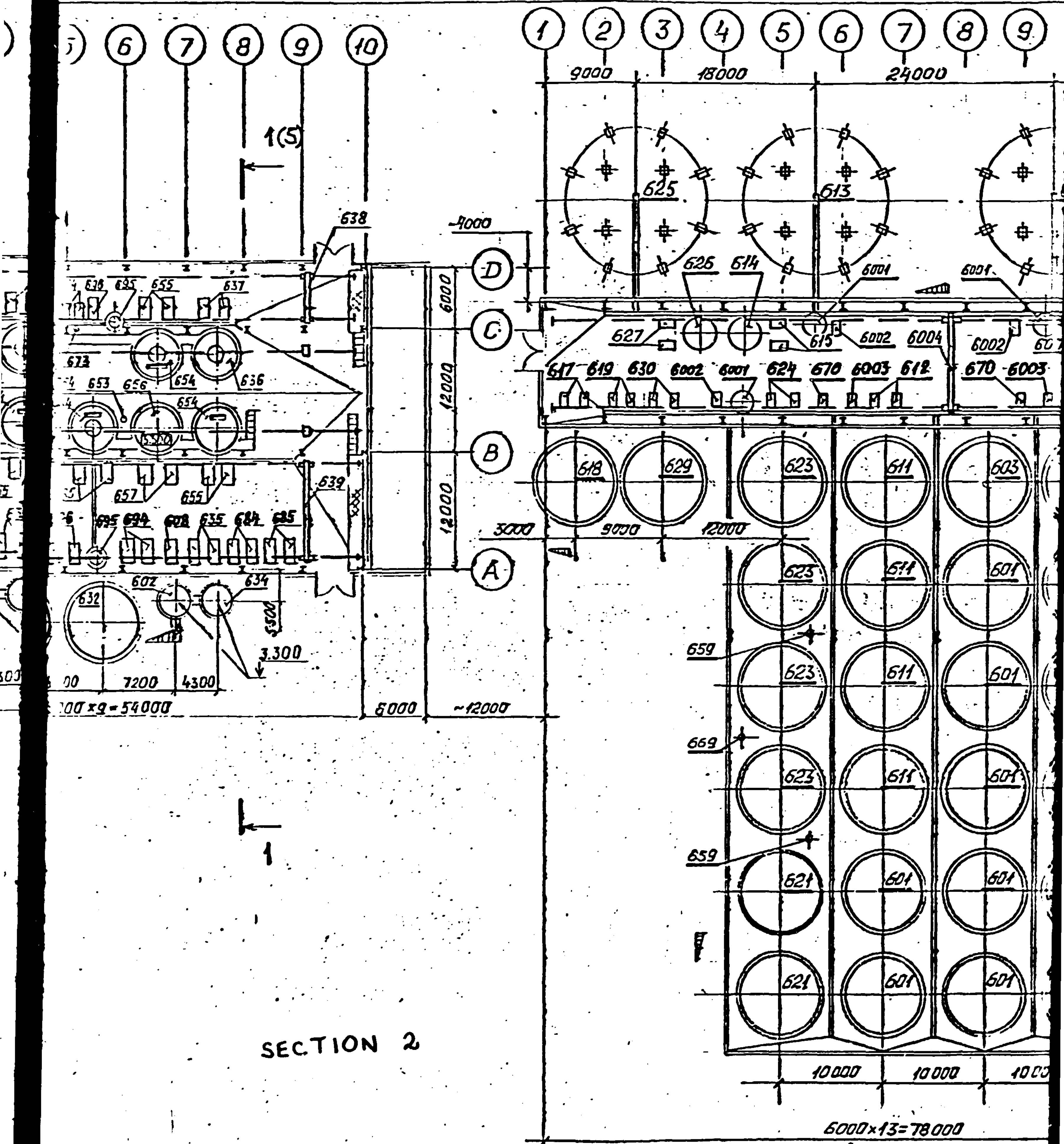
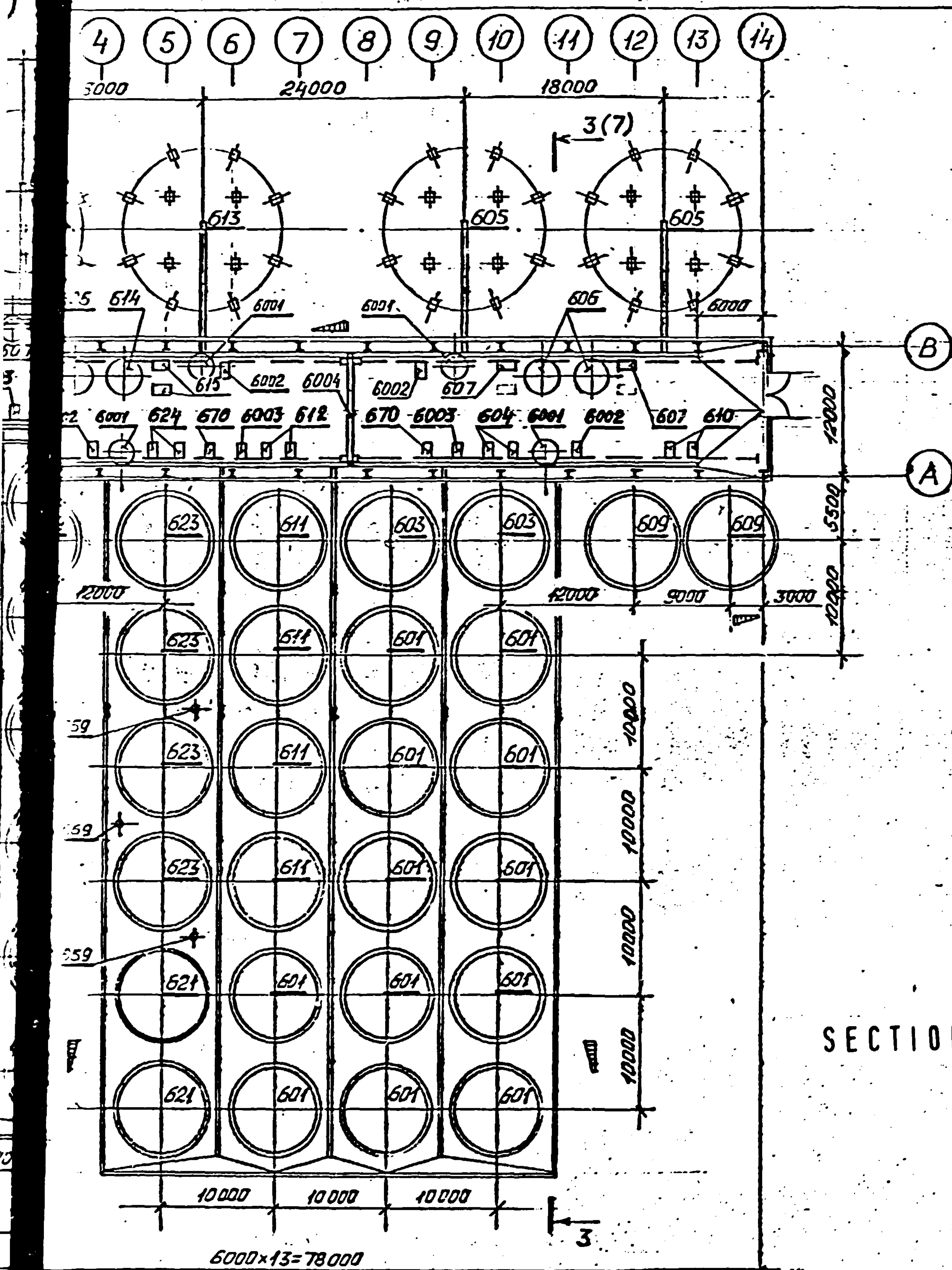
8800
7200
6000×9=54000

SECTION 1



1(5)
638
637
636
639
632
602
634
3.300
7200
4300
6000
~12000
D
C
B
A
9000
18000
24000
625
613
626
614
6001
6002
6004
627
615
617
619
630
624
670
6003
612
618
629
623
611
603
601
621
659
669
3000
12000
10000
6000×13=78000

SECTION 2



4
5
6
7
8
9
10
11
12
13
14
24000
18000
3(7)
613
605
605
614
6001
6001
606
6000
B
A
615
6002
6004
6002
607
607
624
670
6003
612
670
6003
604
6001
6002
610
12000
5500
10000
623
611
603
603
609
609
12000
12000
9000
3000
601
621
10000
10 000
10 000
10 000
3
6000×13=78000

SECTION 3

SECTION 4

THE VIEWS ARE SHOWN IN SCALE 1:400

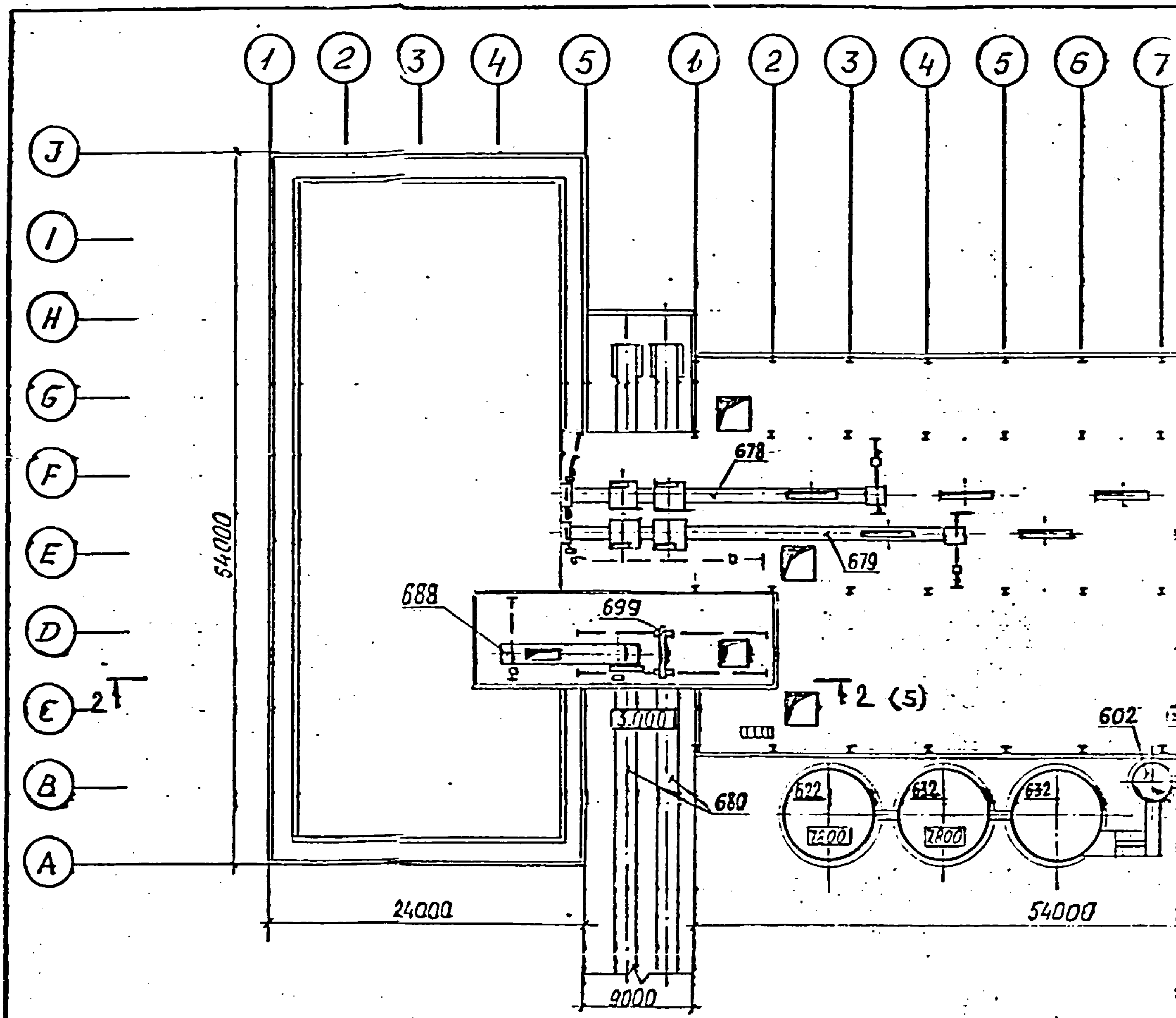
CONTRACT N 90/204/205

1339642-T

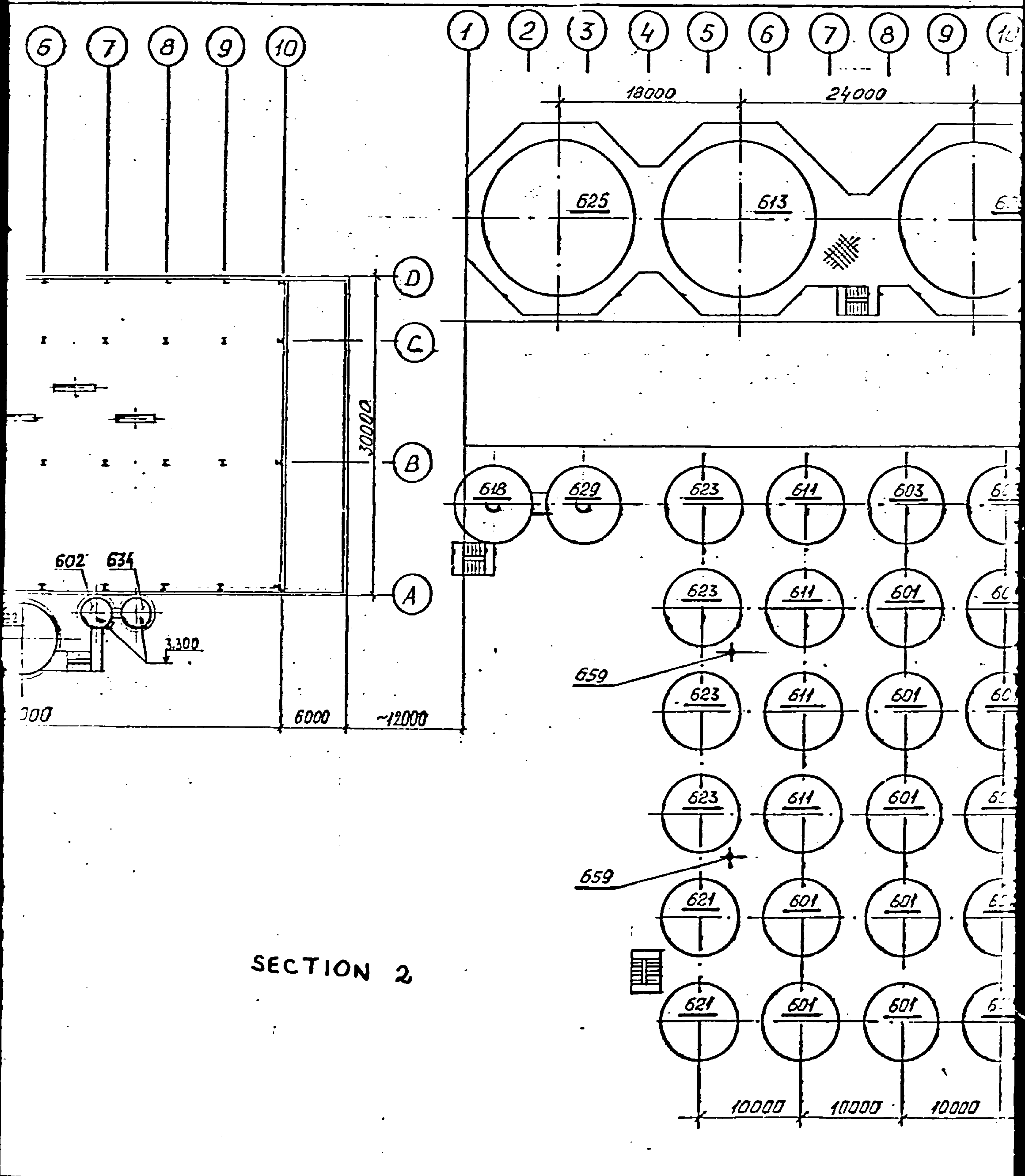
RAZGAH NEPHELINES PROCESSING PLANT (IRAN)

	Phase	Sheet	Sheets
ALUMINA PRODUCTION. CARBONIZATION AND HYDRATE TREATMENT.	POS	6	
PLAN AT EL. 0.000	VAMI LENINGRAD		

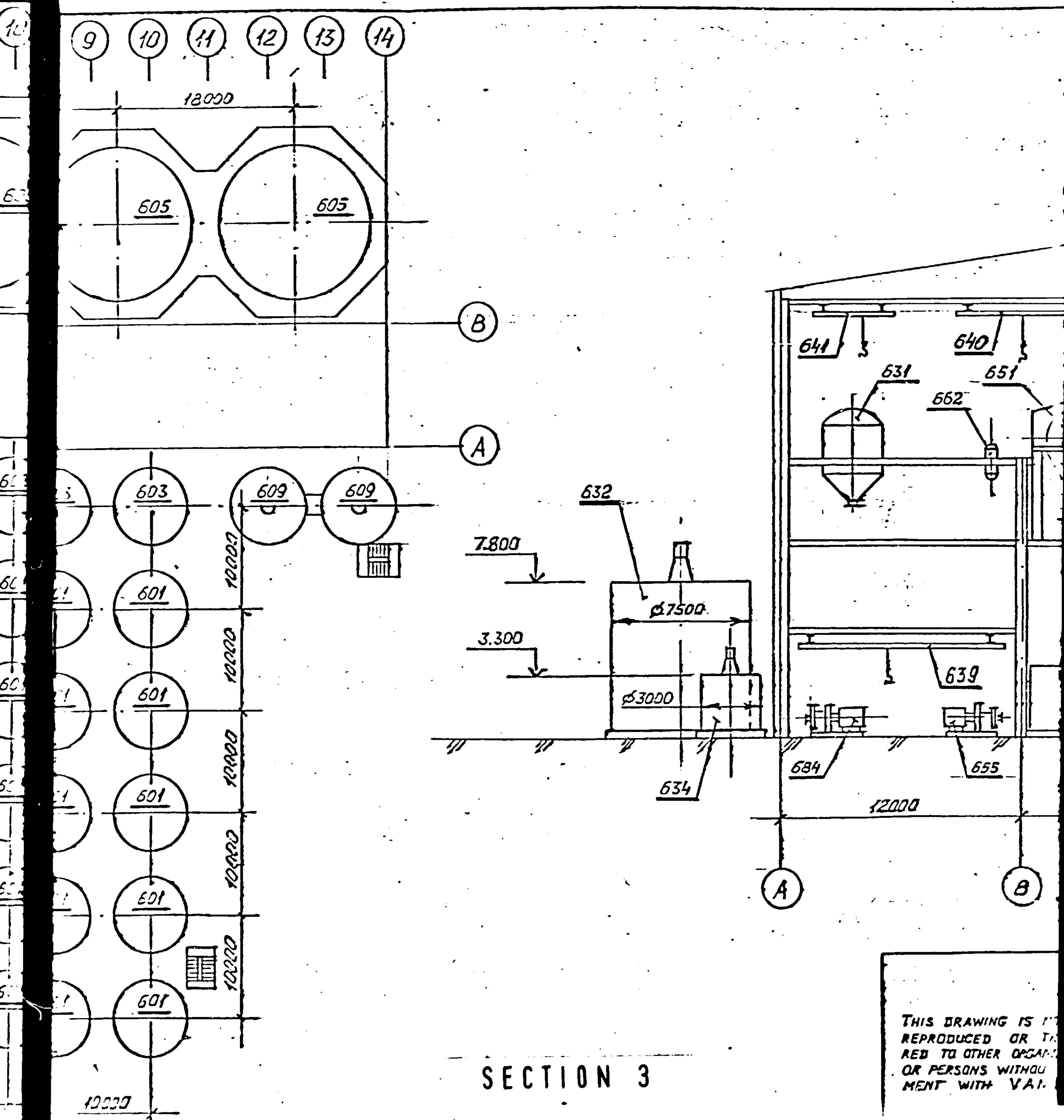
Size A4x4


1
2
3
4
5
1
2
3
4
5
6
7
J
I
H
G
F
E
D
C
B
A
54000
678
679
688
699
2
2 (5)
3000
680
602
622
632
632
24000
54000
9000

SECTION 1



6
7
8
9
10
1
2
3
4
5
6
7
8
9
18000
24000
625
613
D
C
B
A
30000
602
634
3.300
6000
~12000
618
629
623
611
603
601
659
621
10000
SECTION 2

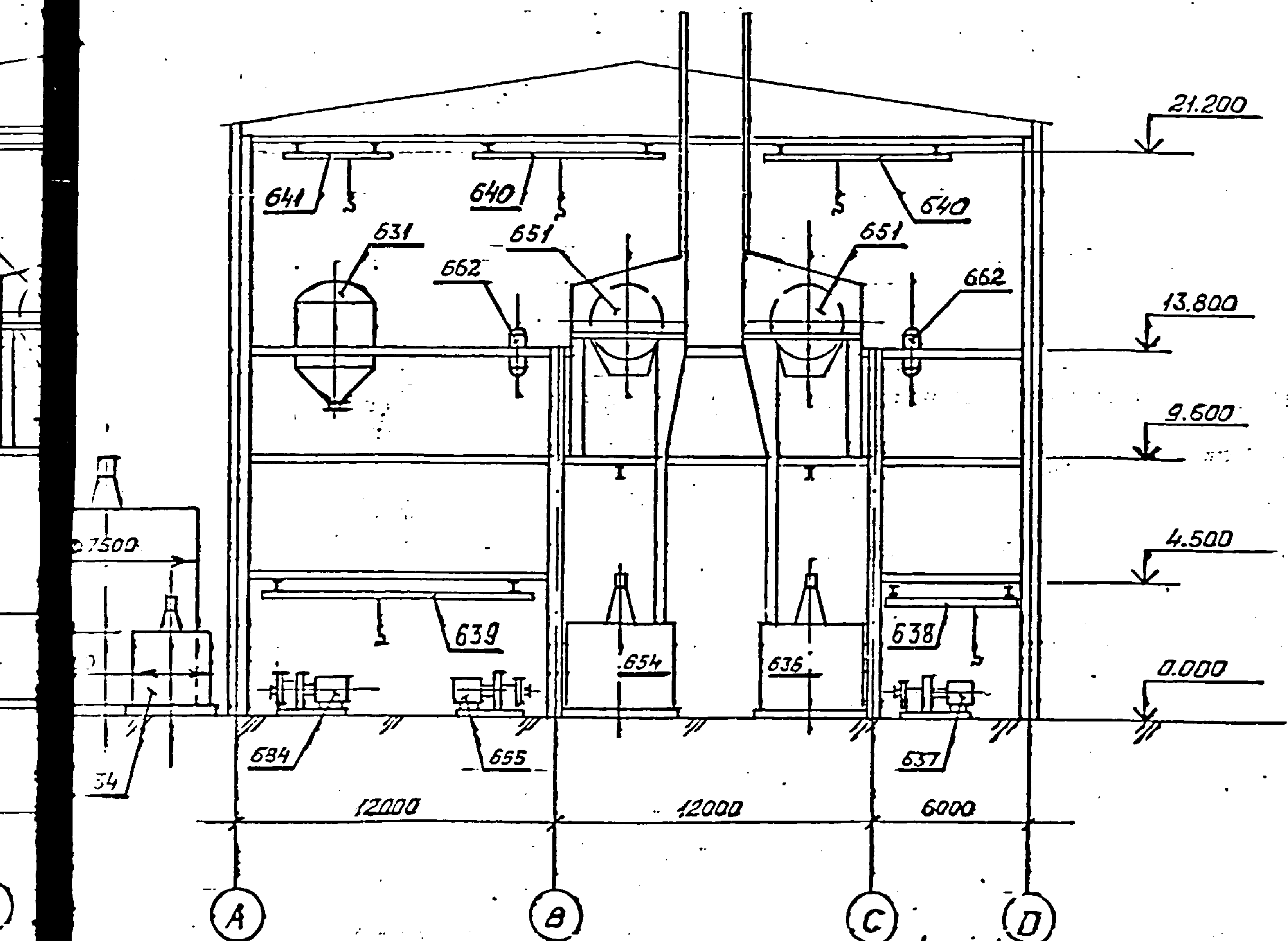


SECTION 3

THIS DRAWING IS
REPRODUCED OR
RED TO OTHER ORGAN
OR PERSONS WITHOU
MENT WITH VAI

1-1 (1:200) (4)

SECTION 4



CONTRACT N 90/204/205

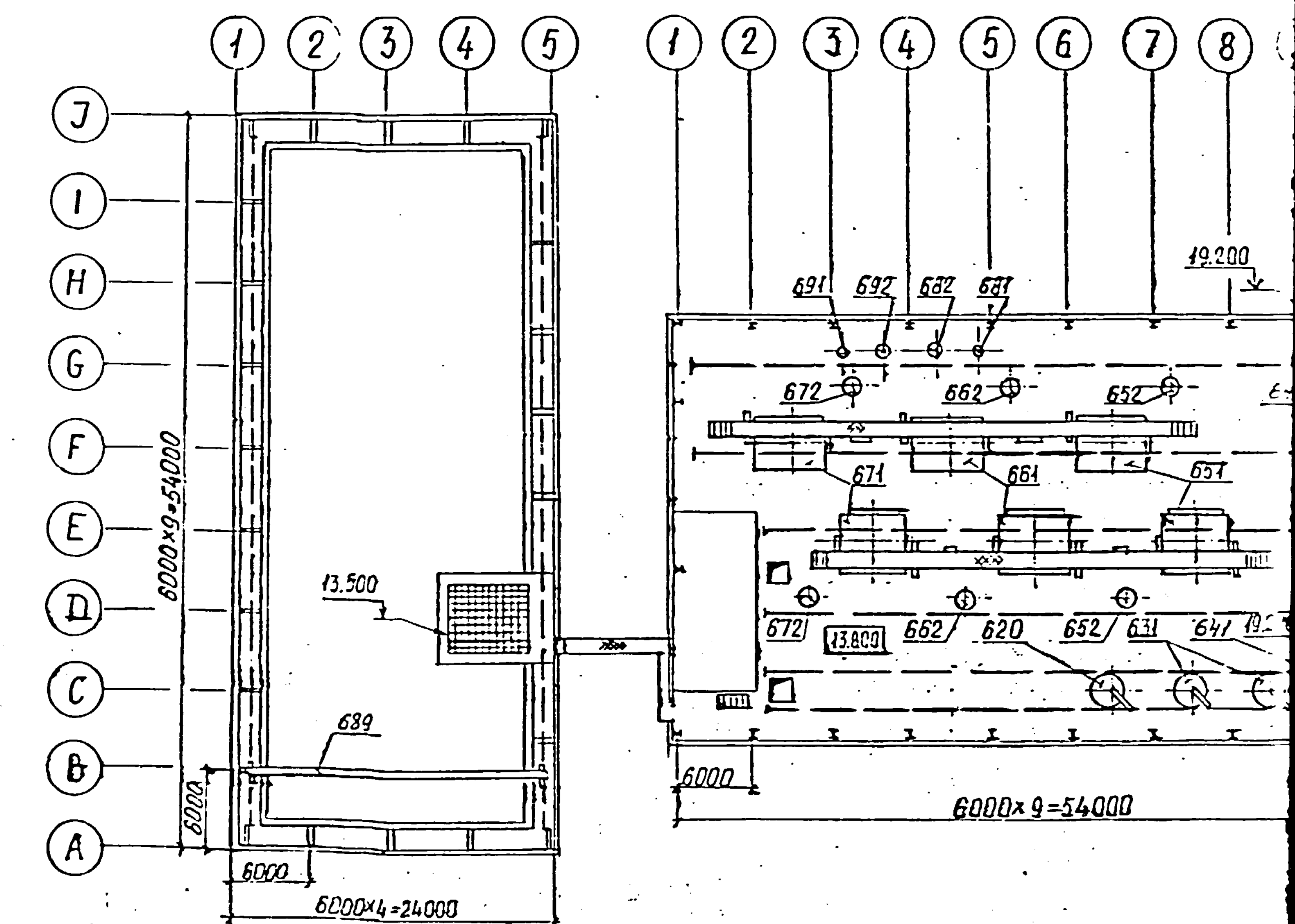
THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI

1339642-T

RAZGAH NEPHELINES PROCESSING PLANT (IRAN)

ALUMINA PRODUCTION CARBONIZATION AND HYDRATE TREATMENT.	PHASE	SHEET	SHEETS
PLAN AT EL. 9.600 SECTION 1-1	VAMI LENINGRAD		

SIZE A 4x4



1
2
3
4
5
J
I
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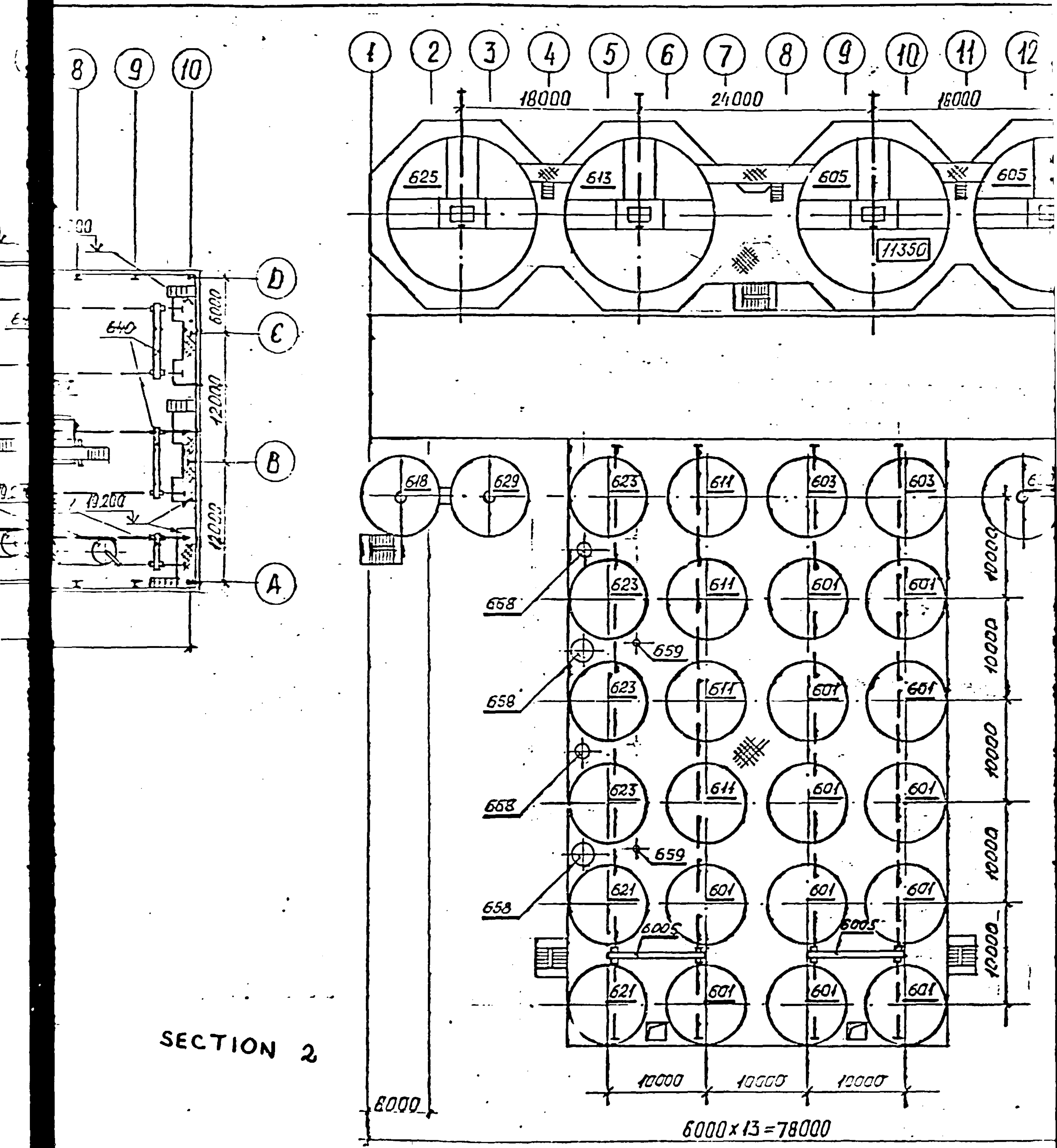
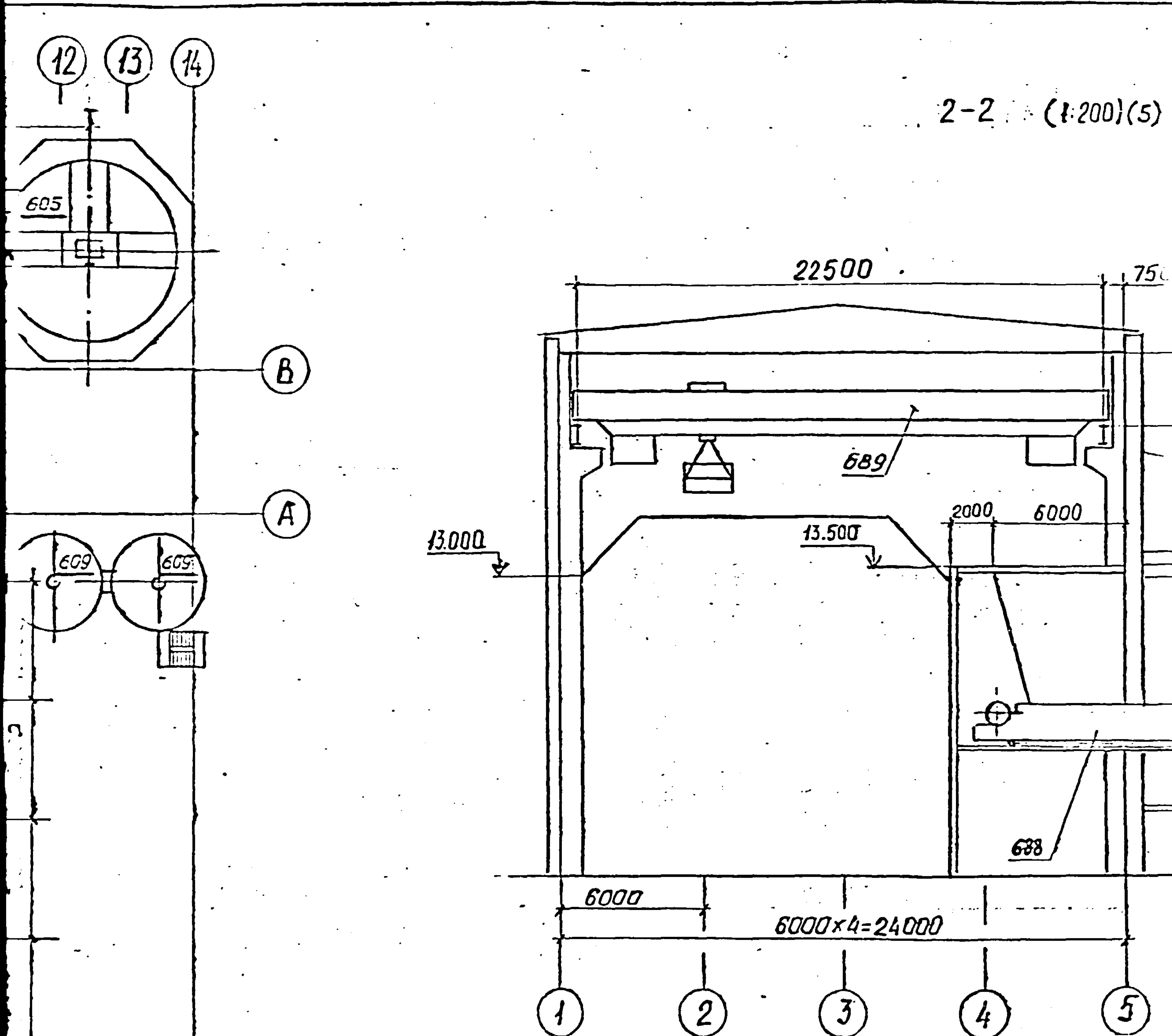
G
F
E
D
C
B
A
6000×9=54000
13.500
689
6000
6000
6000×4=24000
19.200
691
692
682
681
672
662
652
671
661
651
672
13.800
662
620
652
631
641
6000
6000×9=54000

SECTION 1



1 2 3 4 5 6 7 8 9 10 11 12
18000
24000
18000
625
613
605
605
11350
D
C
B
A
8 9 10
6000
12000
12000
640
19.200
618
629
623
611
603
603
601
658
659
621
6005
10000
10000
10000
6000 x 13 = 78000
8000

SECTION 2



CONTRACT

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI

RAZ

ALUM

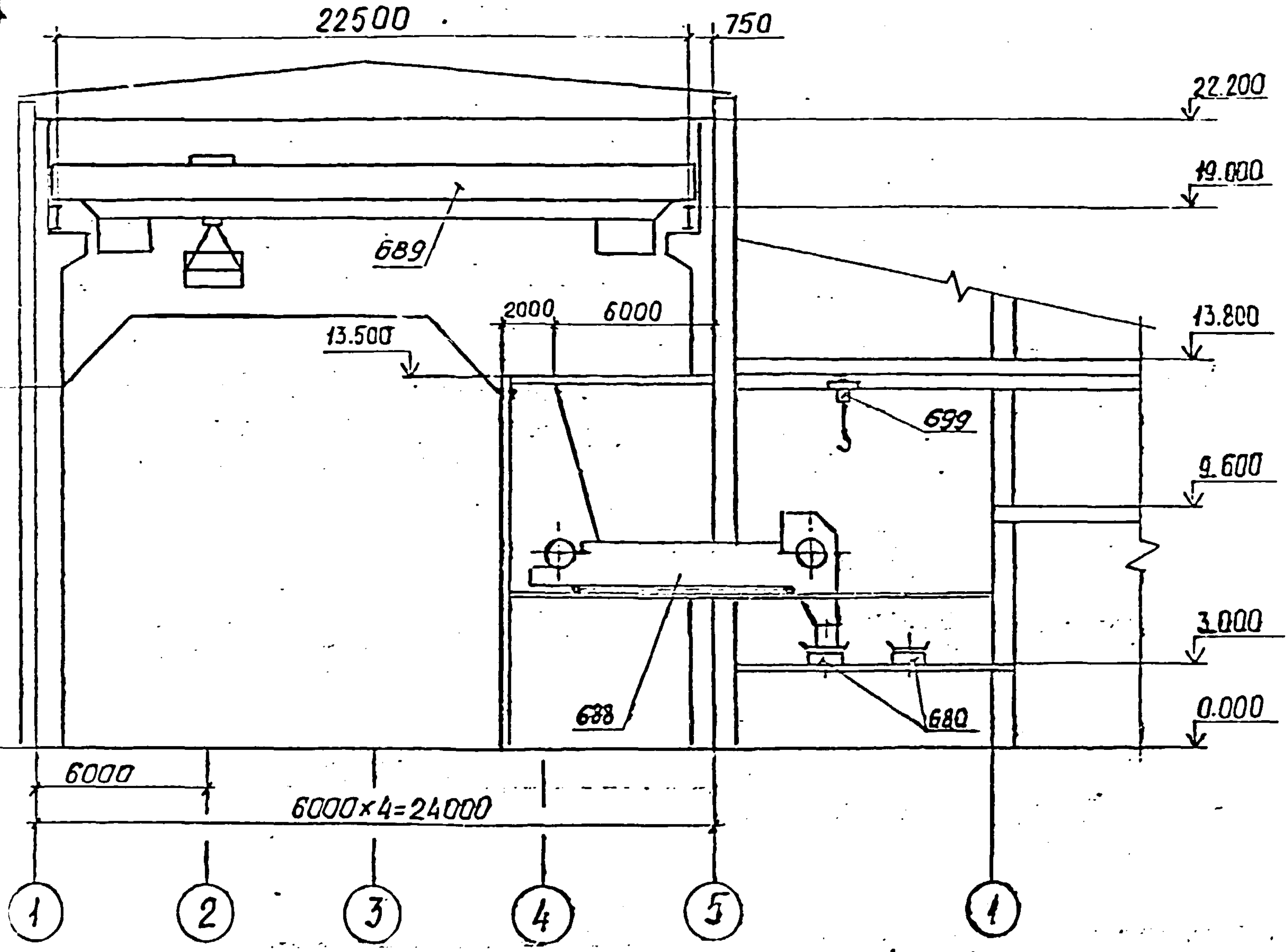
CARBON
TREATM

PLAN A
SECTION

SECTION 3

2-2 (1:200)(5)

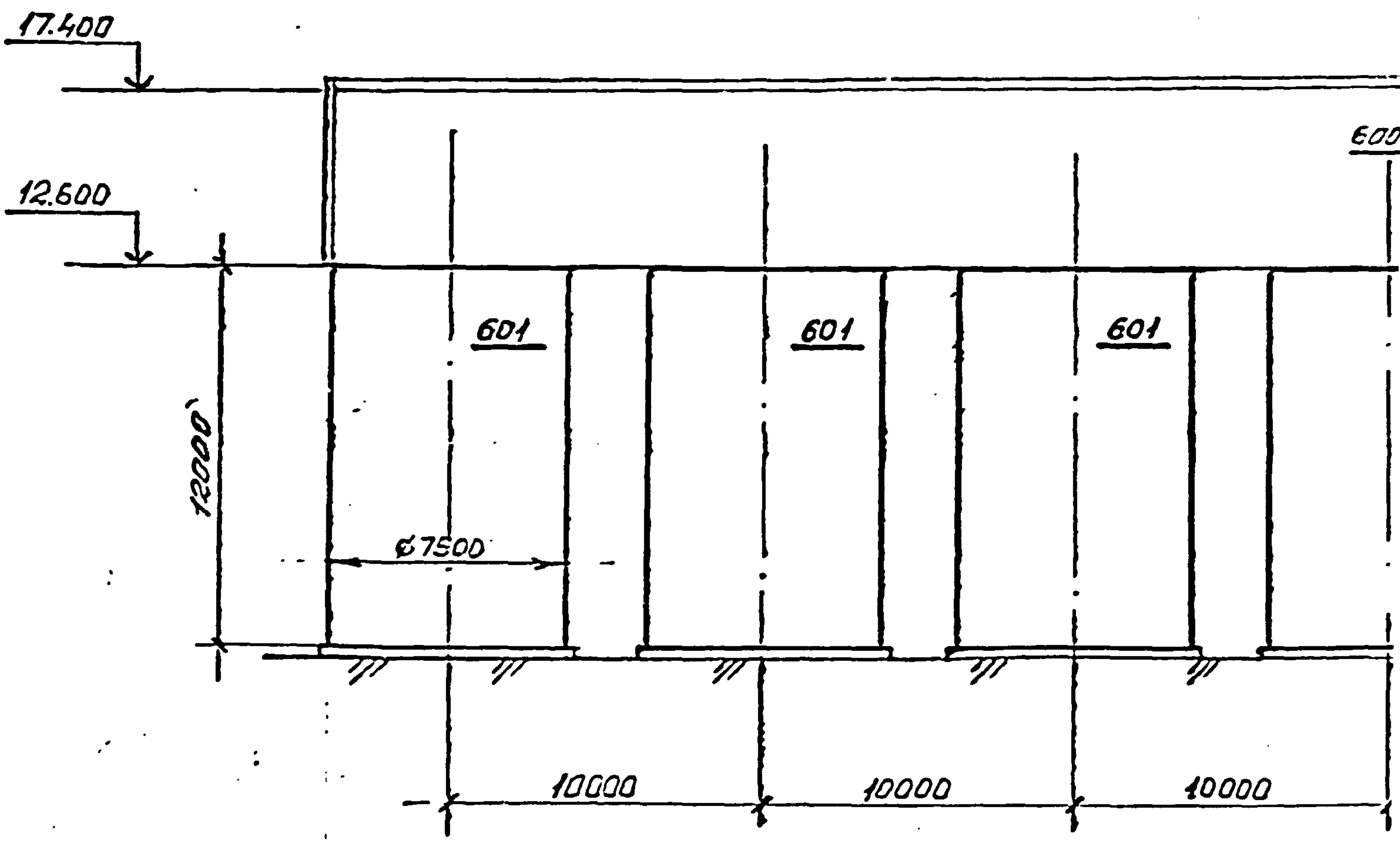
SECTION 4



CONTRACT N 90/204/205

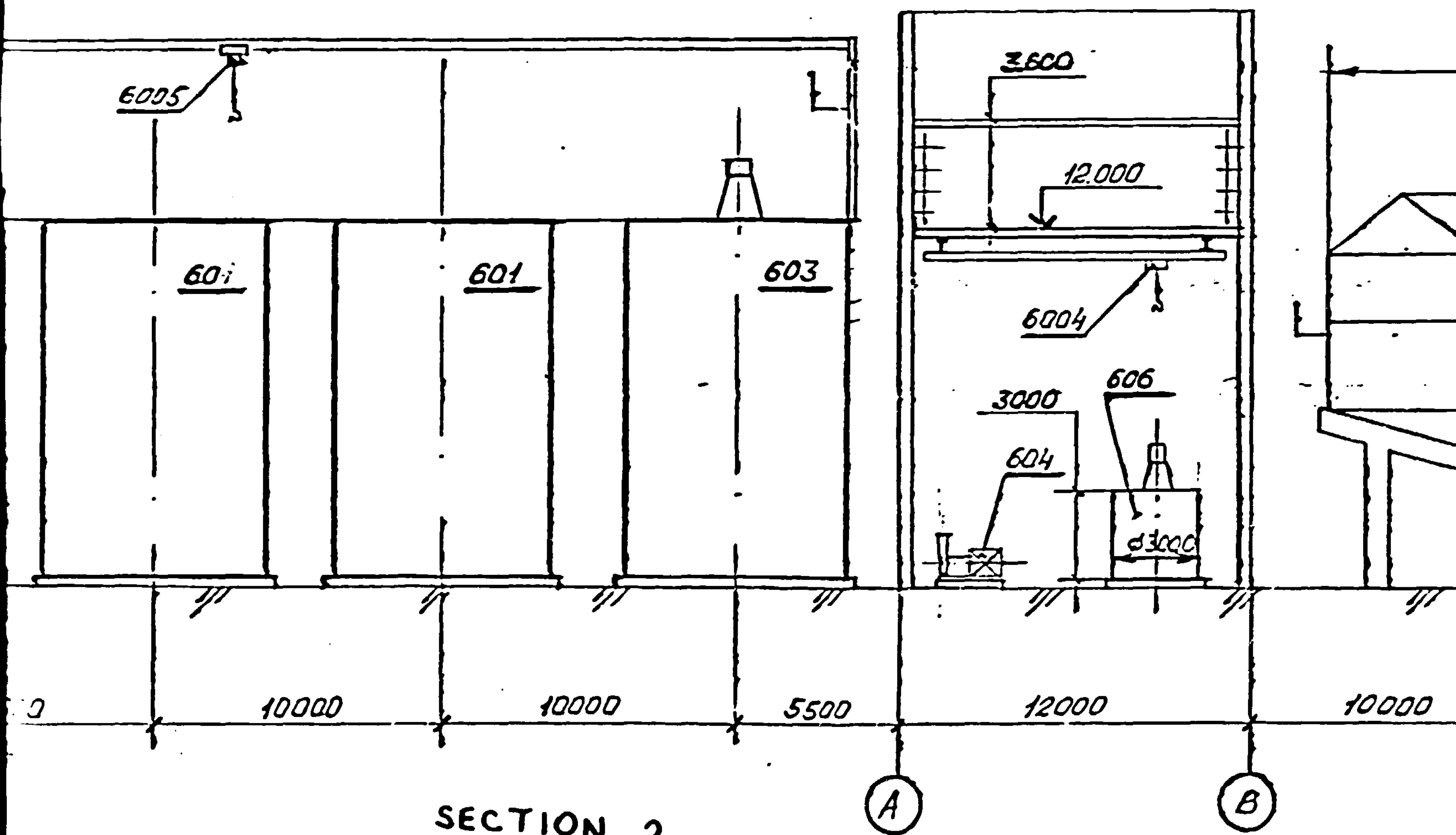
THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339642-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	ALUMINIA PRODUCTION. CARBONIZATION AND HYDRATE TREATMENT.	PHASE	SHEET	SHEETS
		POS	6	
	PLAN AT EL. 13.800 SECTION 2-2.	VAMI LENINGRAD		

SIZE A 4×4

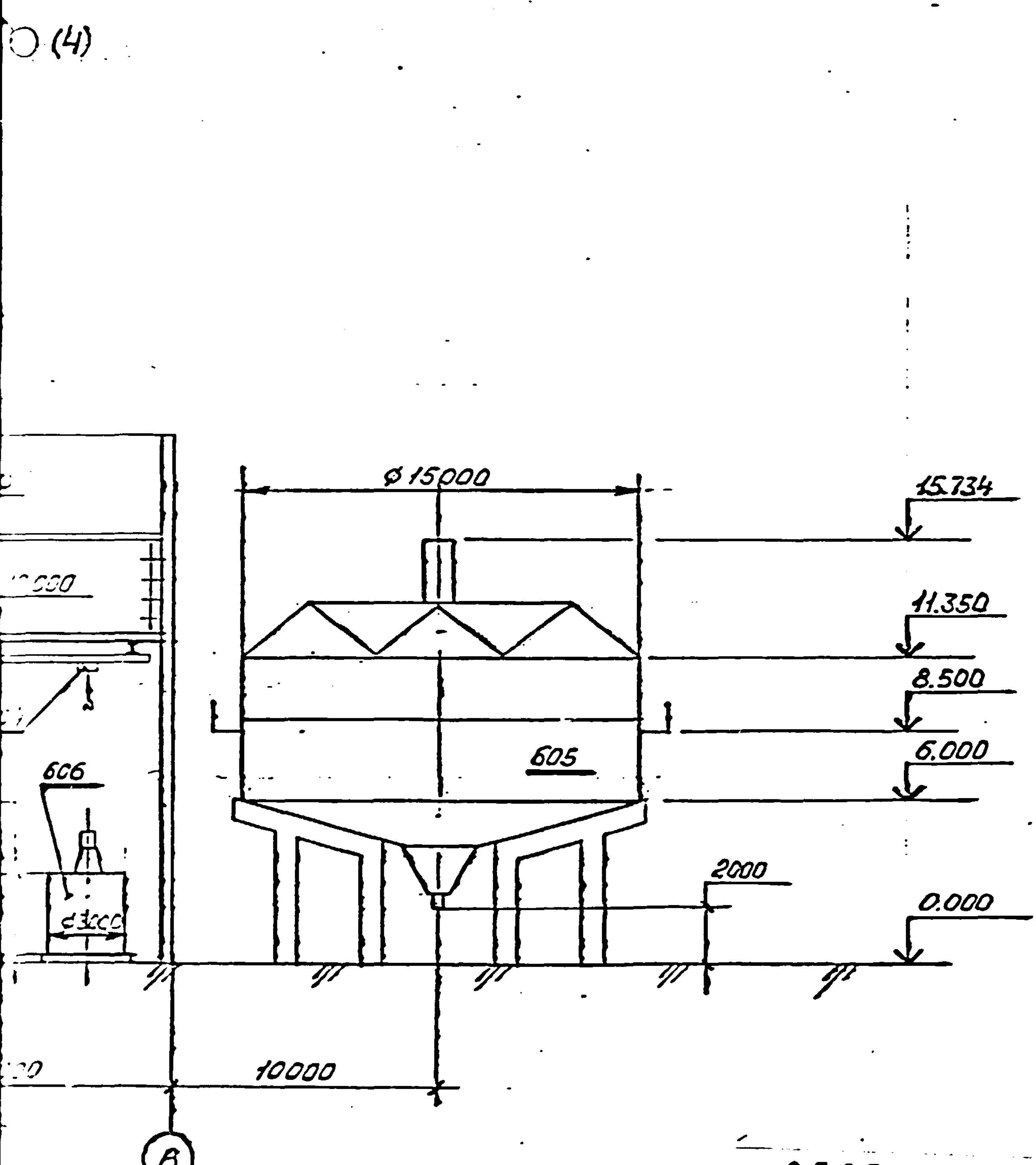


SECTION 1

3-3 (1:200) (4)



SECTION 2



SECTION 3

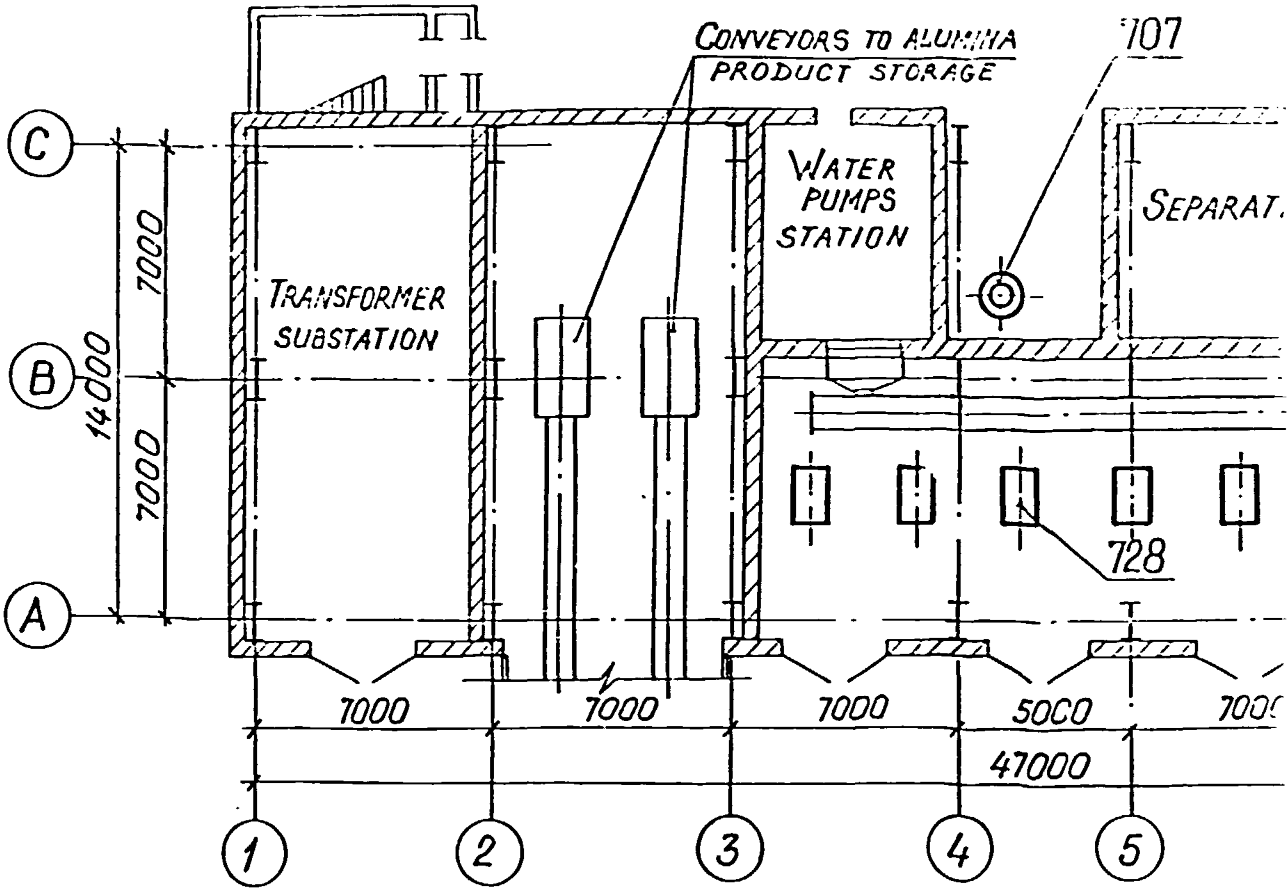
SECTION 4

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339642-T		
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)		
	ALUMINA PRODUCTION. CARBONIZATION AND HYDRATE TREATMENT.	PHASE / POS	SHEET / 7	SHEETS
	SECTION 3-3.	VAMI LENINGRAD		

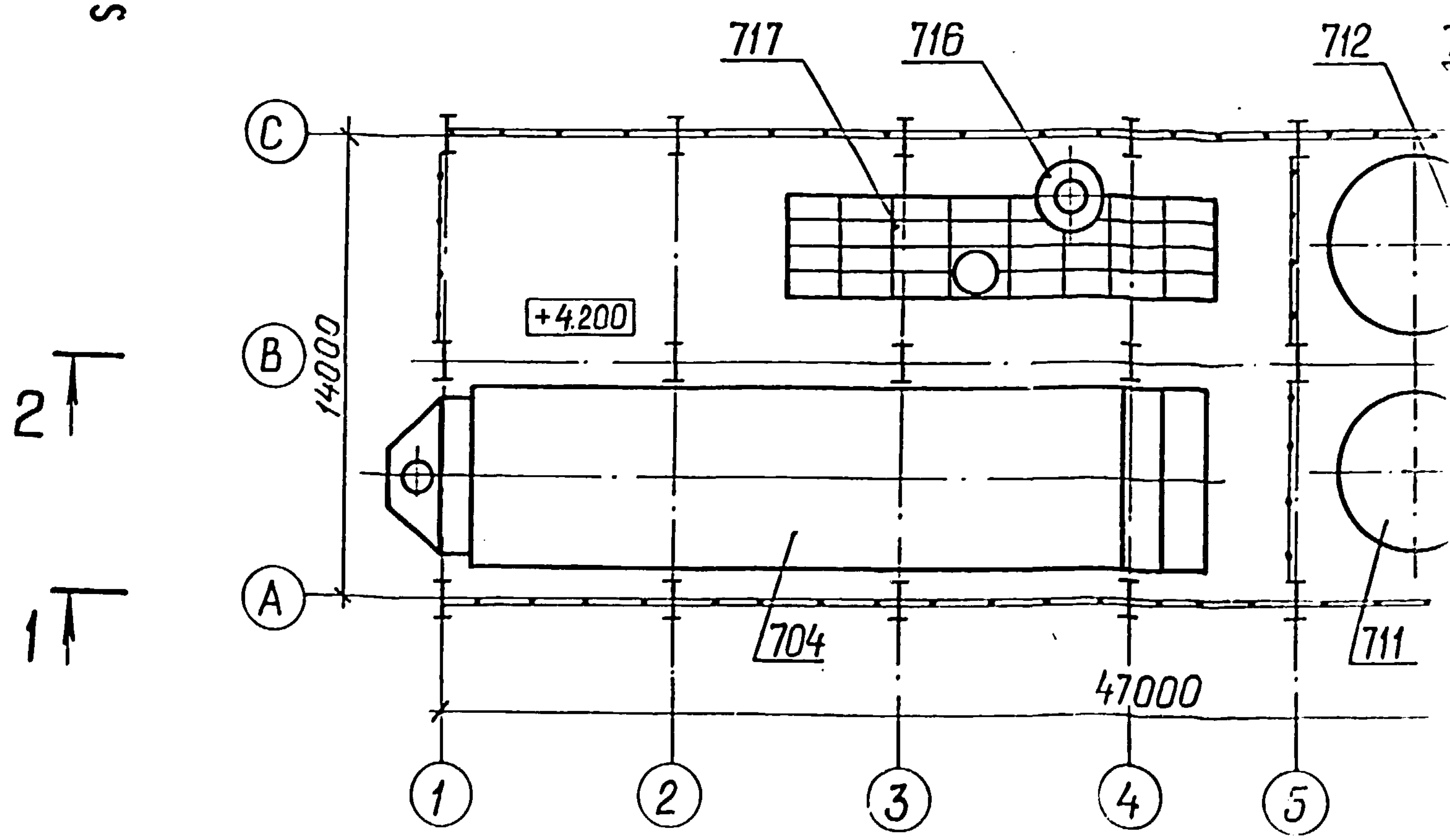
Size A 4x4

PLAN AT EL. 0.000

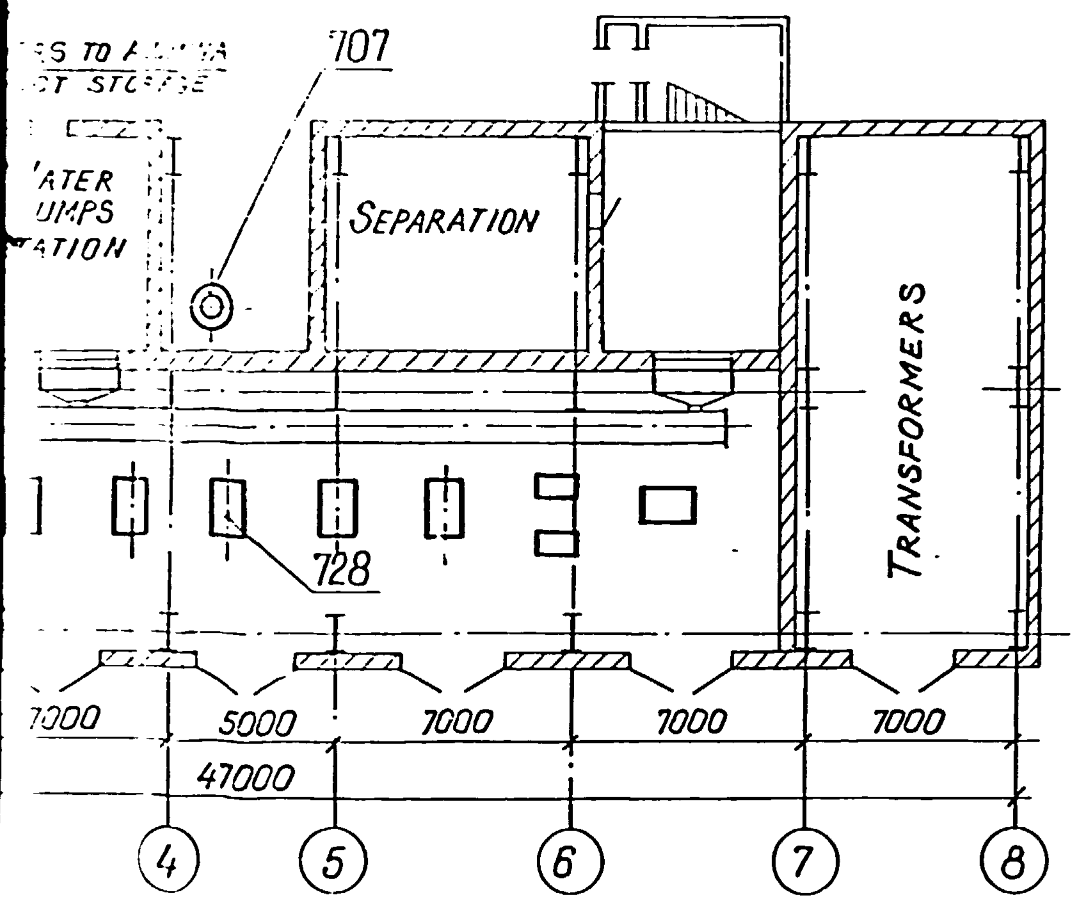


SECTION 1

PLAN AT TOP ELEVATIONS

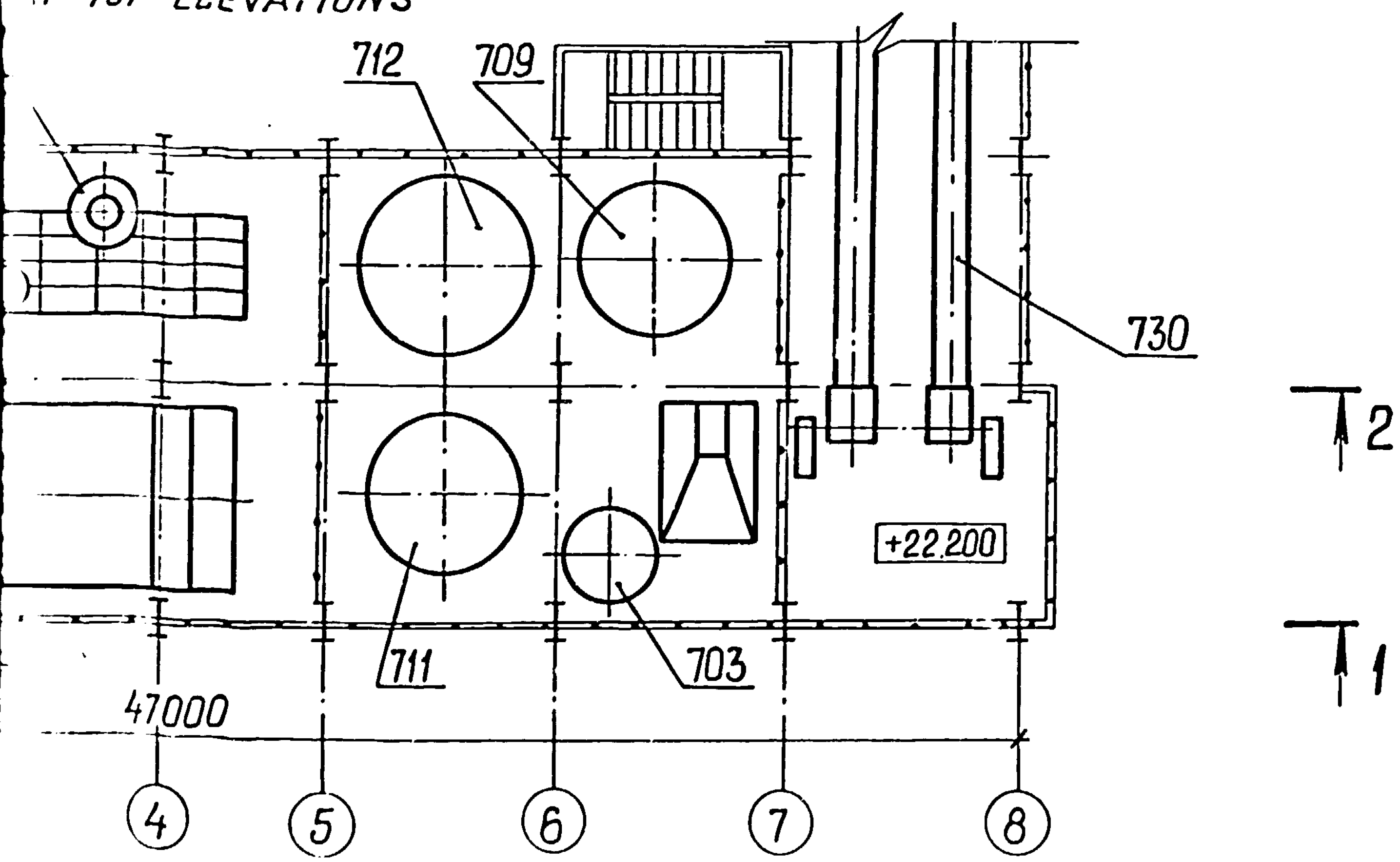


AN AT EL. 0.000



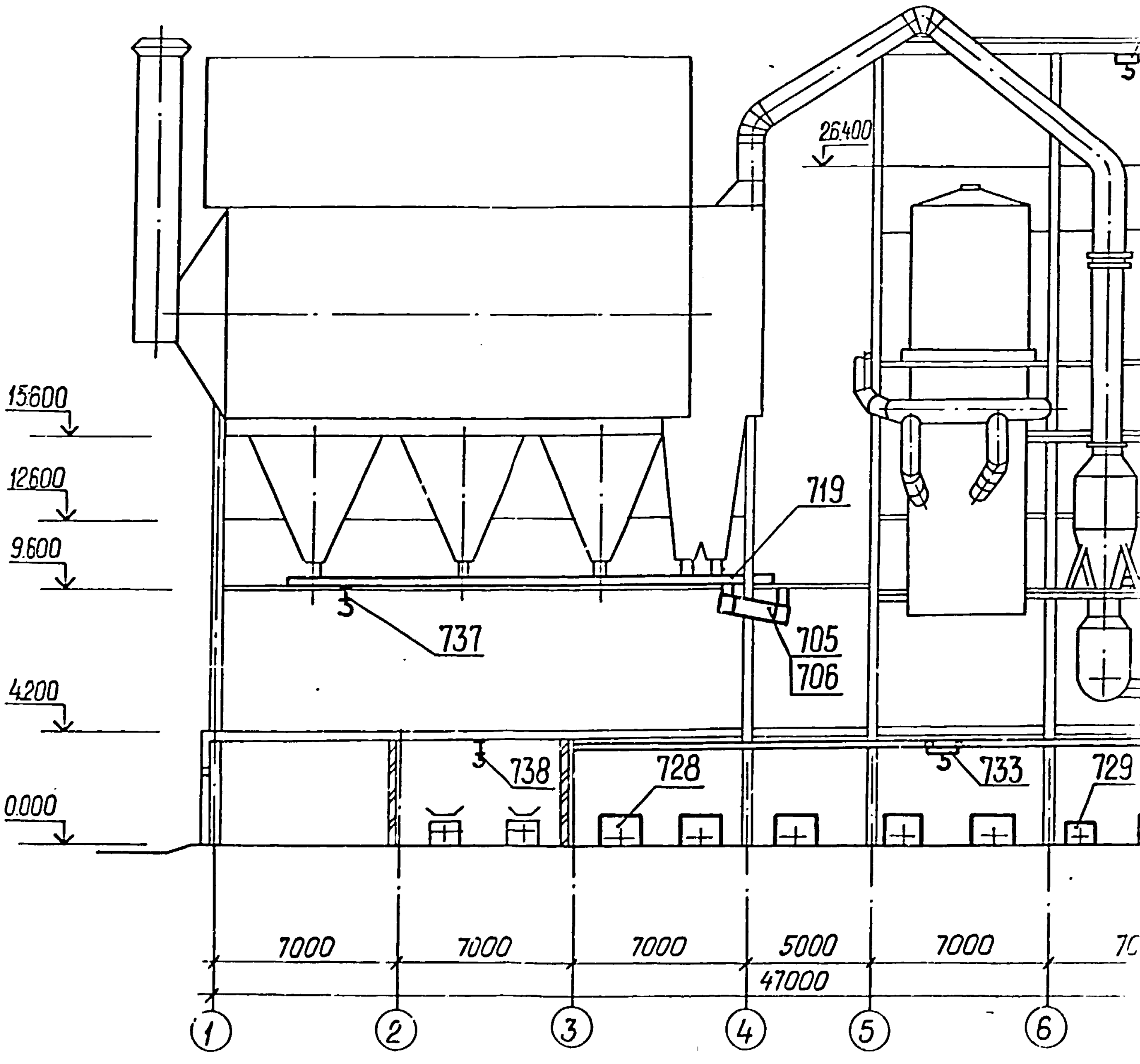
SECTION 2

AT TOP ELEVATIONS



1–1

SECTION 3



26.400
15.600
12.600
9.600
4.200
0.000
719
737
705
706
738
728
733
729
7000
7000
7000
5000
7000
47000
1
2
3
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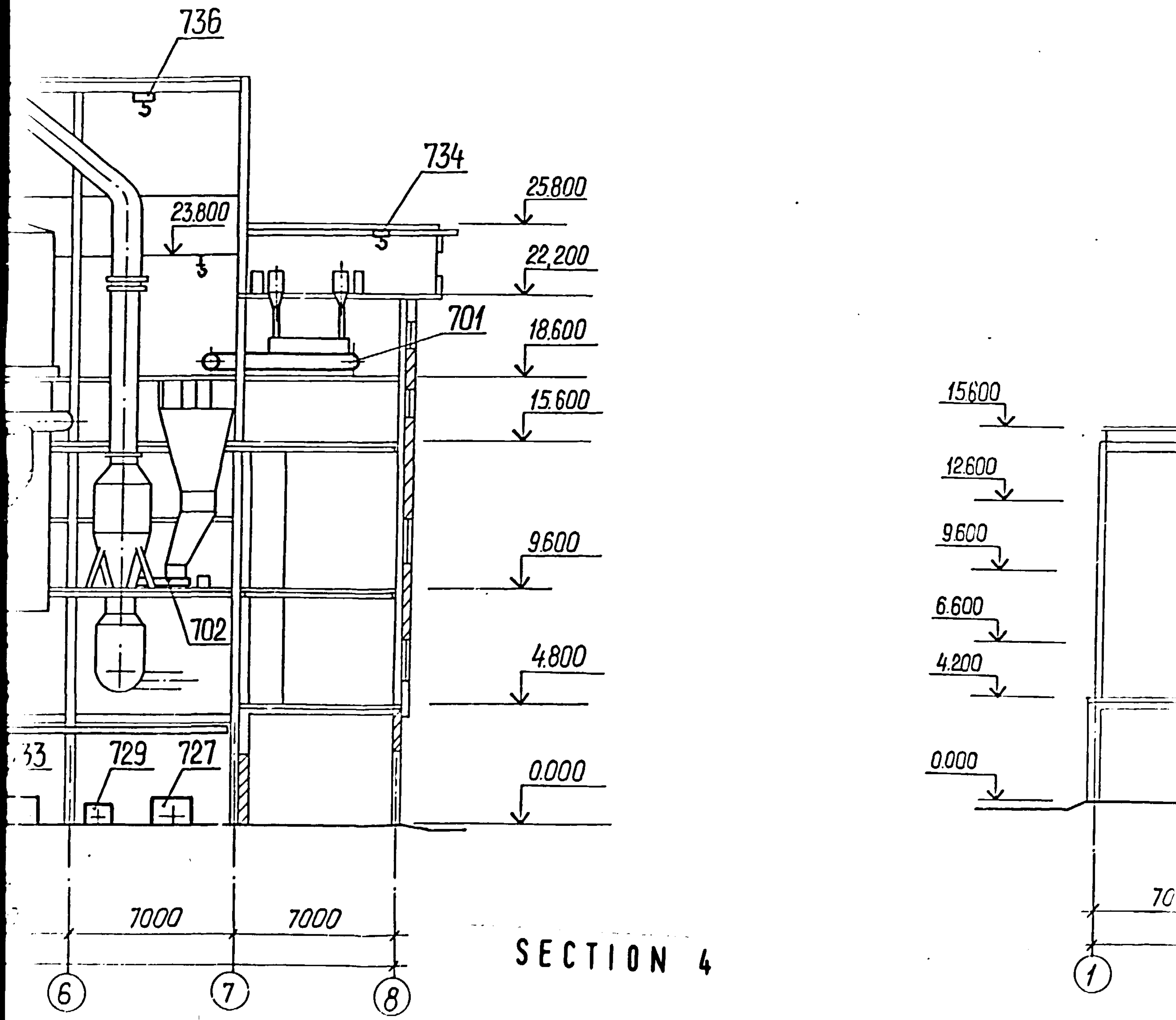
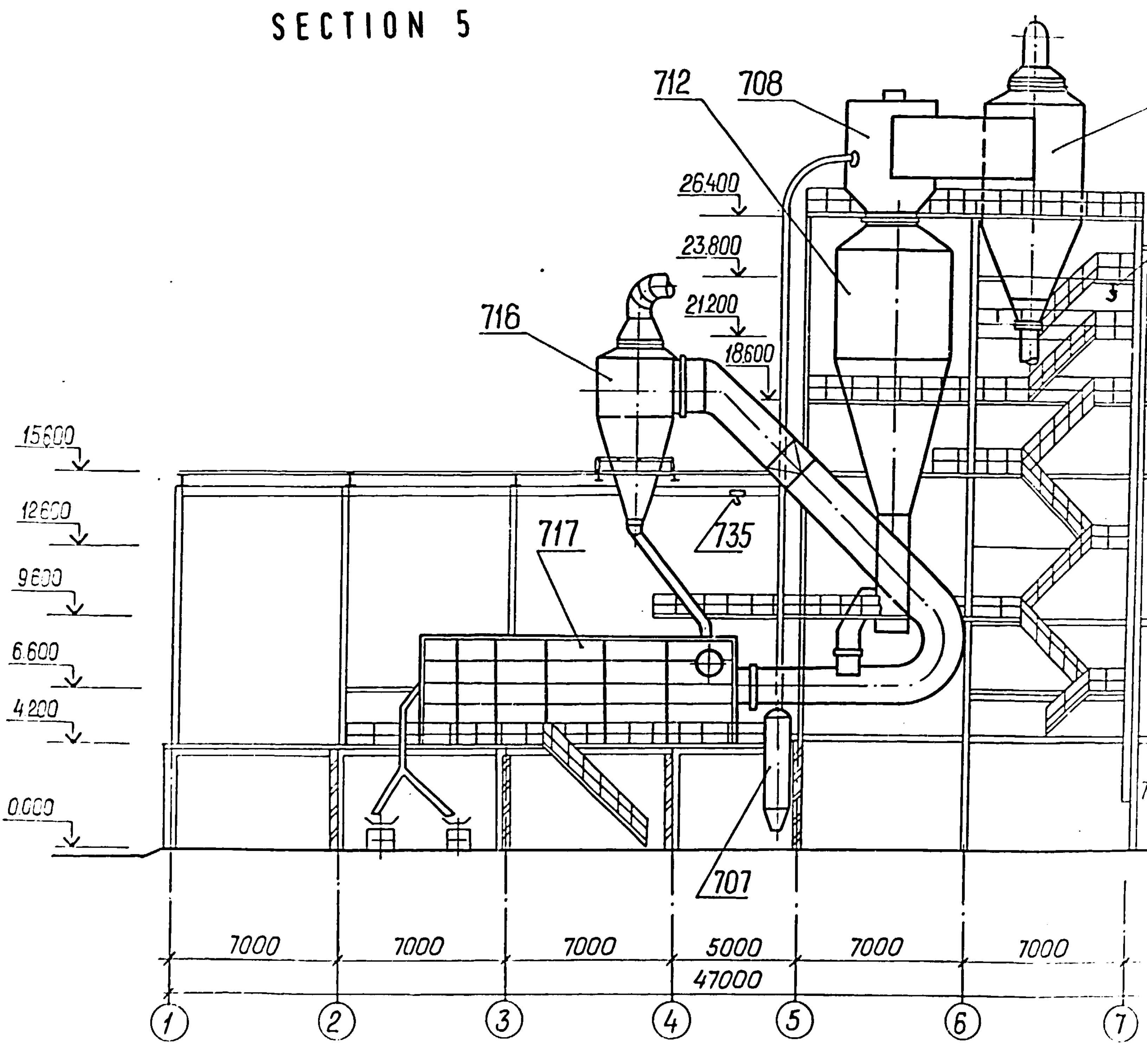
5
6



736
734
25.800
23.800
22.200
701
18.600
15.600
9.600
702
4.800
33
729
727
0.000
7000
7000
6
7
8
15.600
12.600
9.600
6.600
4.200
0.000
70
1

SECTION 4

2-2


SECTION 5
712
708
716
717
735
707
26.400
23.800
21.200
18.600
15.600
12.600
9.600
6.600
4.200
0.000
7000
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7000
5000
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7000
47000
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2
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4
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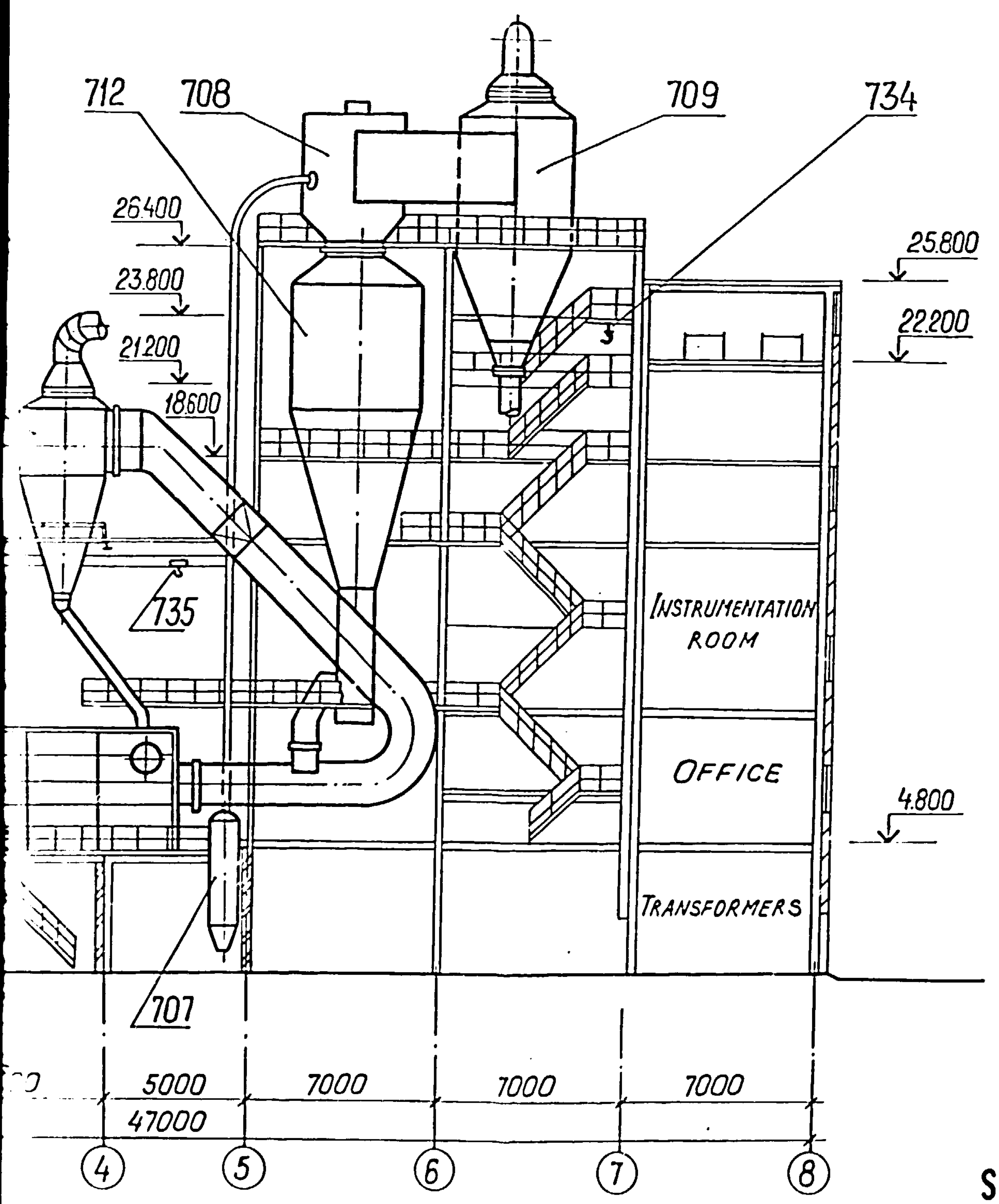
6
7

2-2


712
708
709
734
26.400
23.800
21.200
18.600
25.800
22.200
735
INSTRUMENTATION ROOM
OFFICE
4.800
TRANSFORMERS
707
5000
7000
7000
7000
47000
4
5
6
7
8

SECTION 6

SECTION 7

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1398862 - T		
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)		
	ALUMINA PRODUCTION. CALCINATION	PHASE	SHEET	SHEETS
		POS	2	2
	PLANS AND SECTIONS	VAMI LENINGRAD		

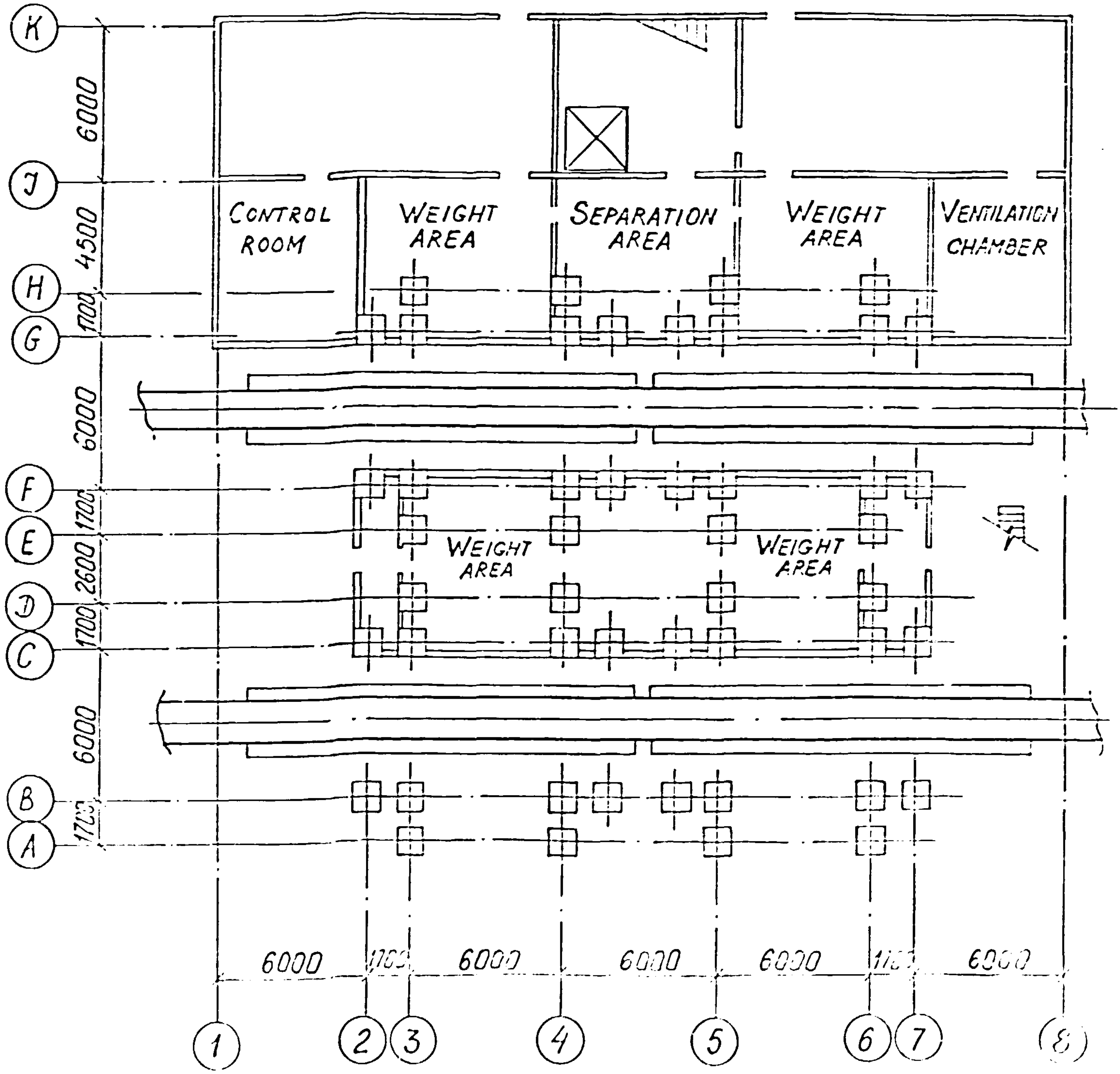
SIZE A4/7

Инв. № подл.	Подп. и дата	Взам. инв. №

Констр.	Горшкова		1398862-Т
Проверил	Мершалов	10.91	
Проверил	Зверев		Завод по переработке нефелиновых руд месторождения Разгах (Иран)
Рук. гр.	Лакисов	08.91	
Гл. констр.	Ягуд	09.91	Глиноземное производство. Кальцинация
Нач. сект.	Голиков	IX.91	Стадия: ИВП; Лист: 2; Листов:
Нач. отд.	Беляков		
Перевод	Корчагин		Планы и разрезы
Н. контр.	Родионов	10.91	
ГИП	Каим		ВАМИ Ленинград

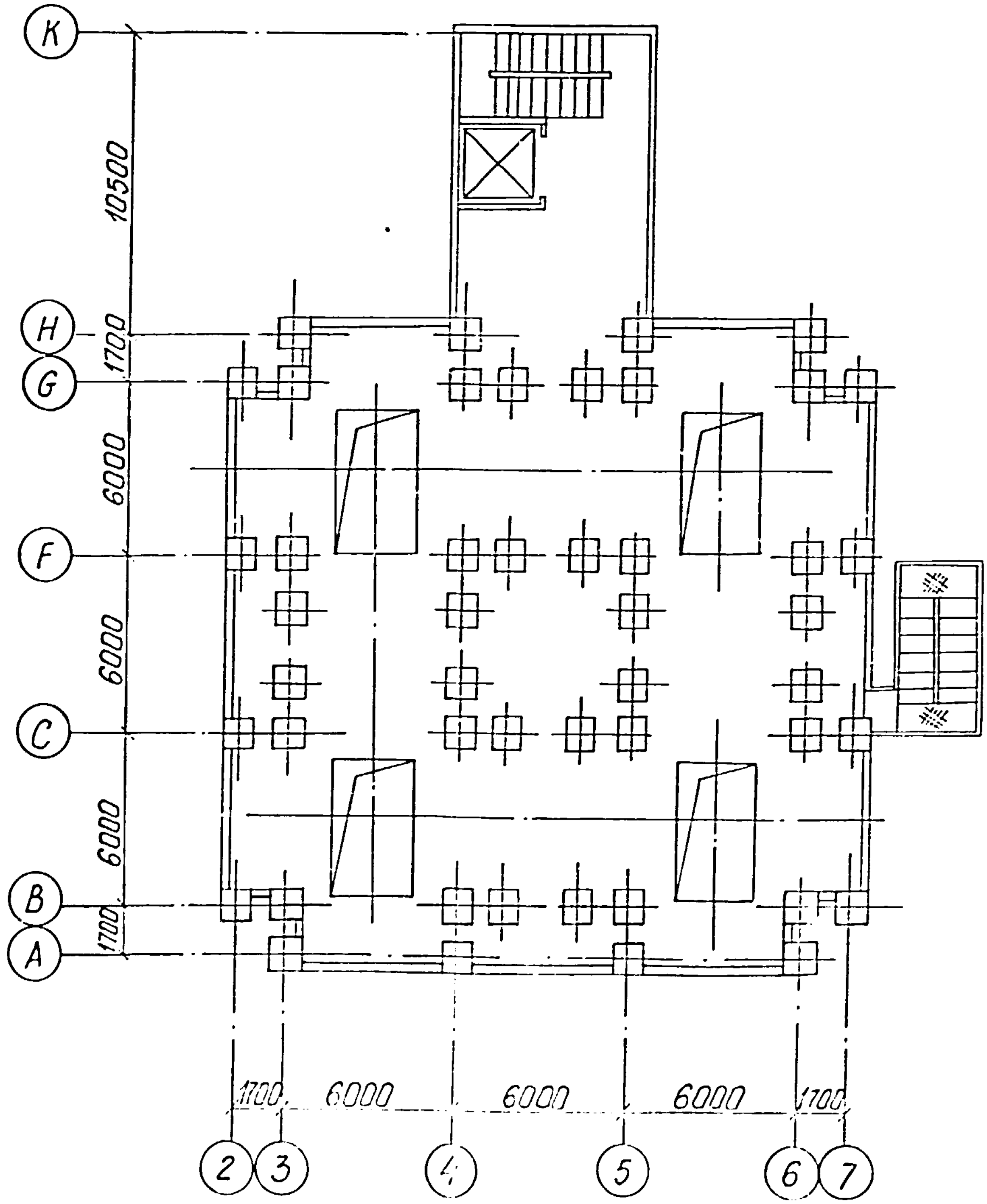
Формат А4х7

PLAN AT EL. 0.000



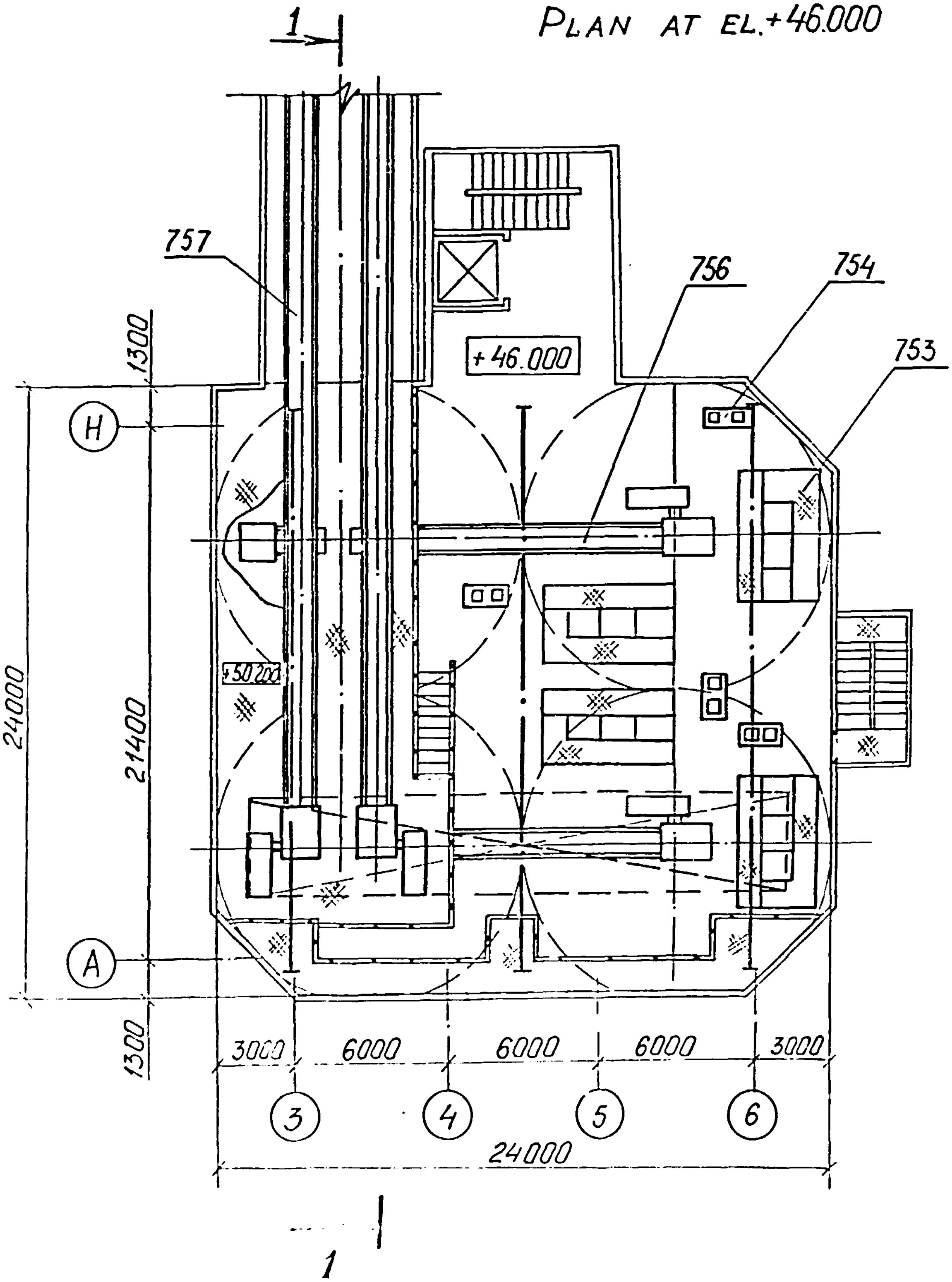
SECTION 1

PLAN AT EL.+6.000



SECTION 2

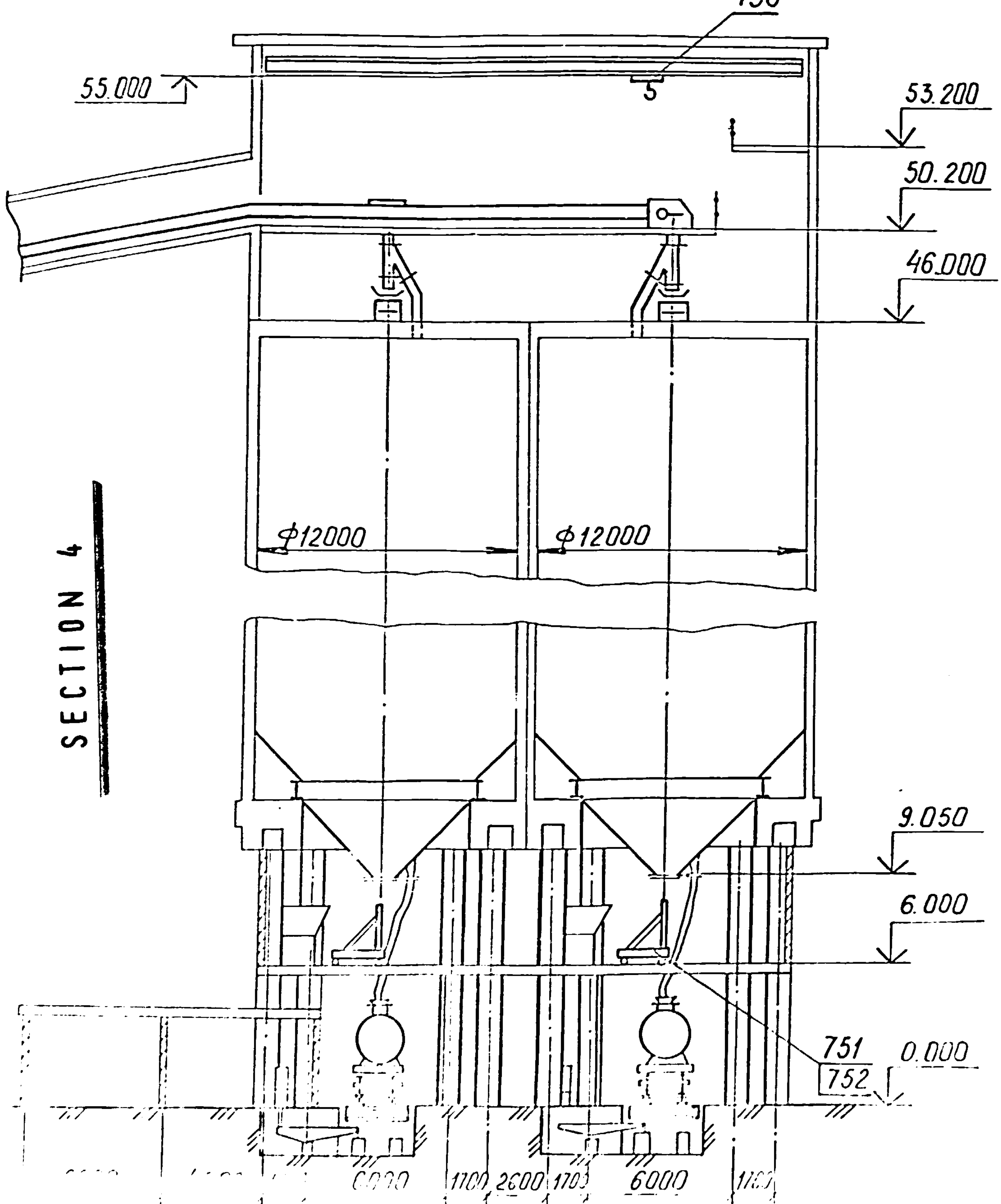
PLAN AT EL.+46.000



SECTION 3

SECTION 4

1—1



758
55.000
5
53.200
50.200
46.000
Φ12000
Φ12000
9.050
6.000
751
752
0.000
6000
1100
2600
1700
6000
1100
K
J
H
G
F
E
D
C
B
A

SECTION 5

CONTRACT N 90/204/205

1398863 - T			
RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
ALUMINA PRODUCTION. ALUMINA PRODUCT STORAGE	PHASE	SHEET	SHEETS
	POS	2	
PLANS AND SECTION 1-1	VAMI LENINGRAD		

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS WITHOUT AGREEMENT WITH VAMI

1398863 - T

ЗАВОД ПО ПЕРЕРАБОТКЕ НЕФЕЛИНОВЫХ РУД МЕСТОРОЖДЕНИЯ РАЗГАХ (ИРАН)

ГЛИНОЗЕМНОЕ ПРОИЗВОДСТВО
СКЛАД ТОВАРНОГО ГЛИНОЗЕМА

СТАДИЯ	ЛИСТ	ЛИСТОВ
ИВП	2	

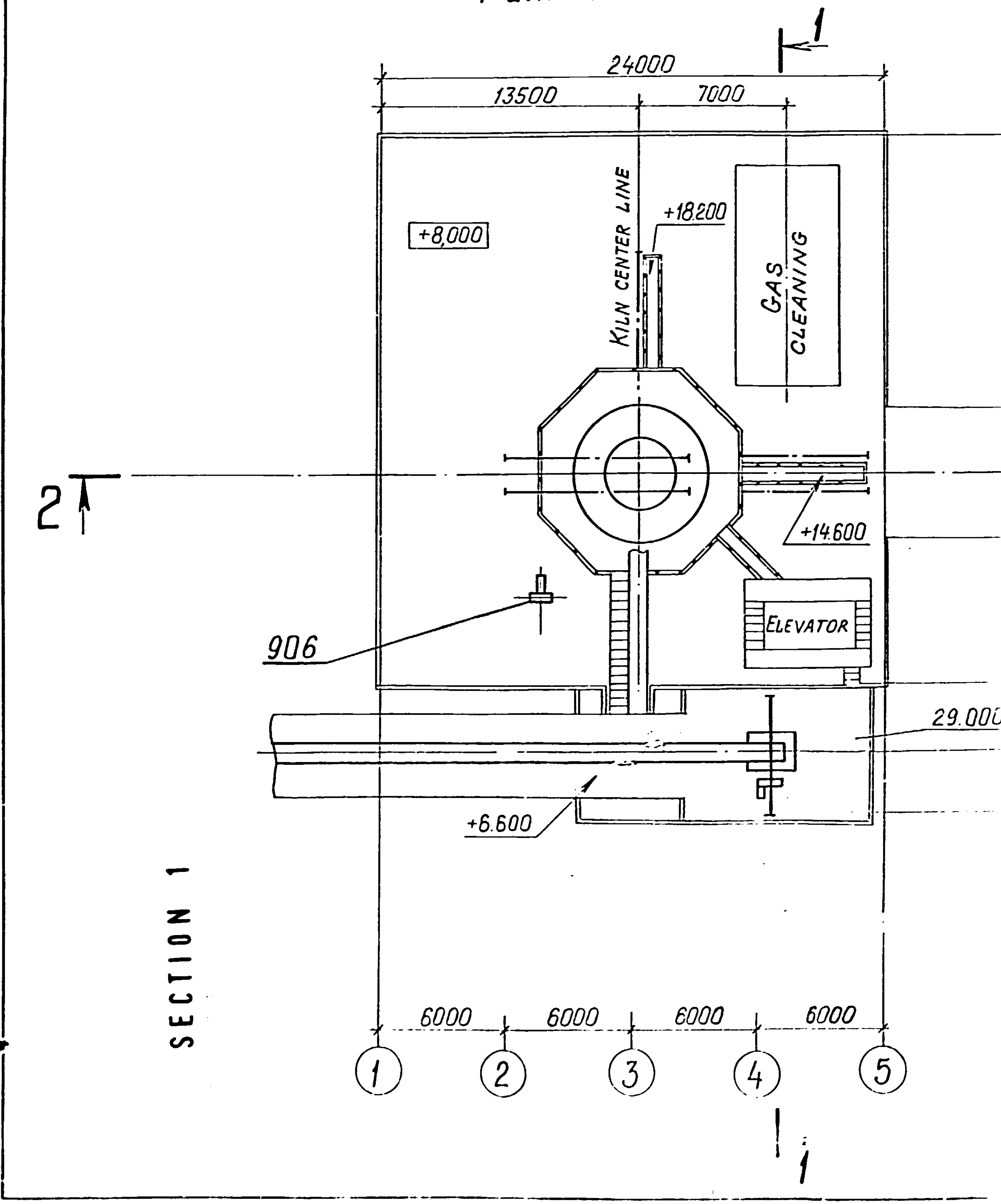
ПЛАНЫ И РАЗРЕЗ 1-1

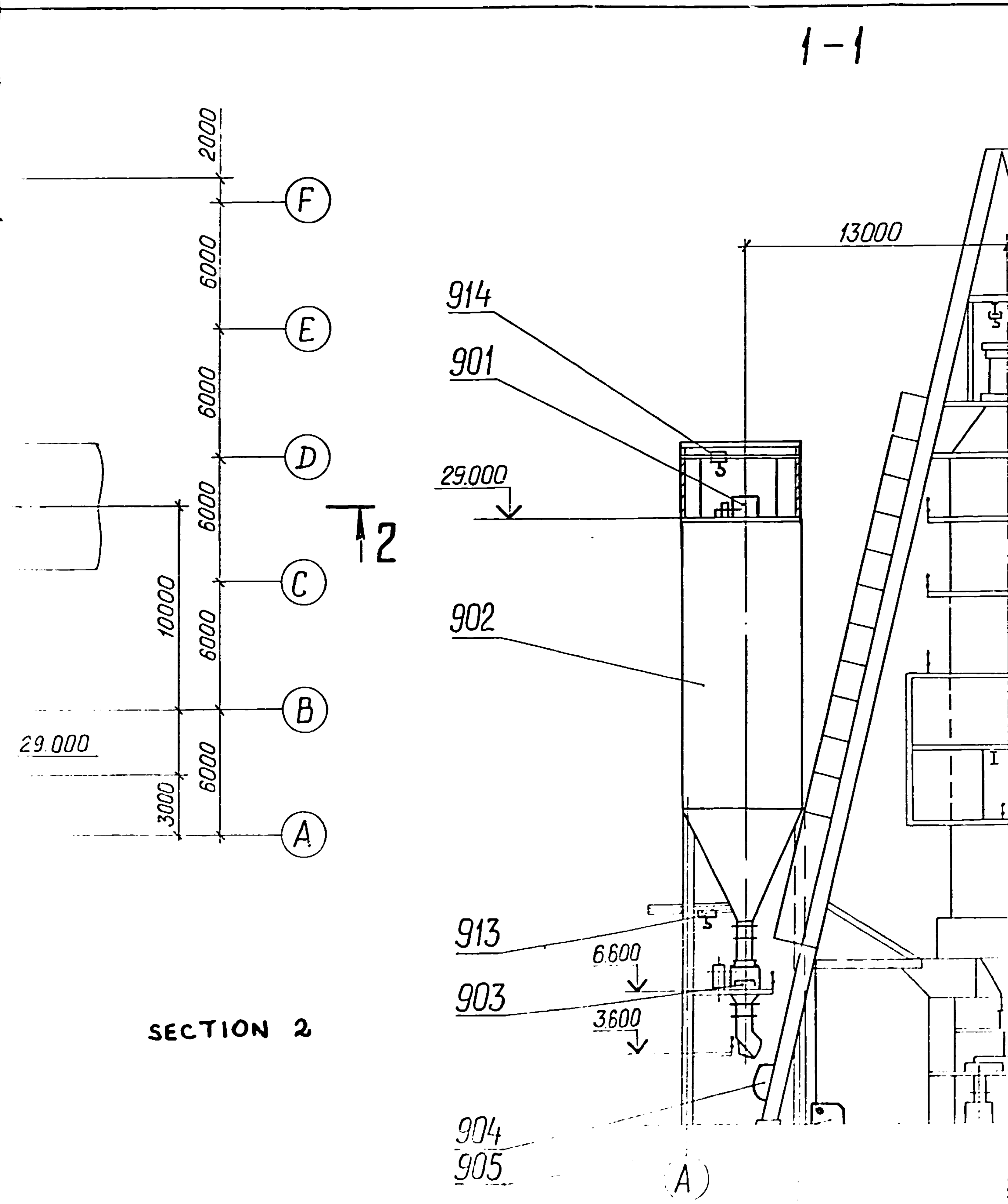
ВАМИ ЛЕНИНГРАД

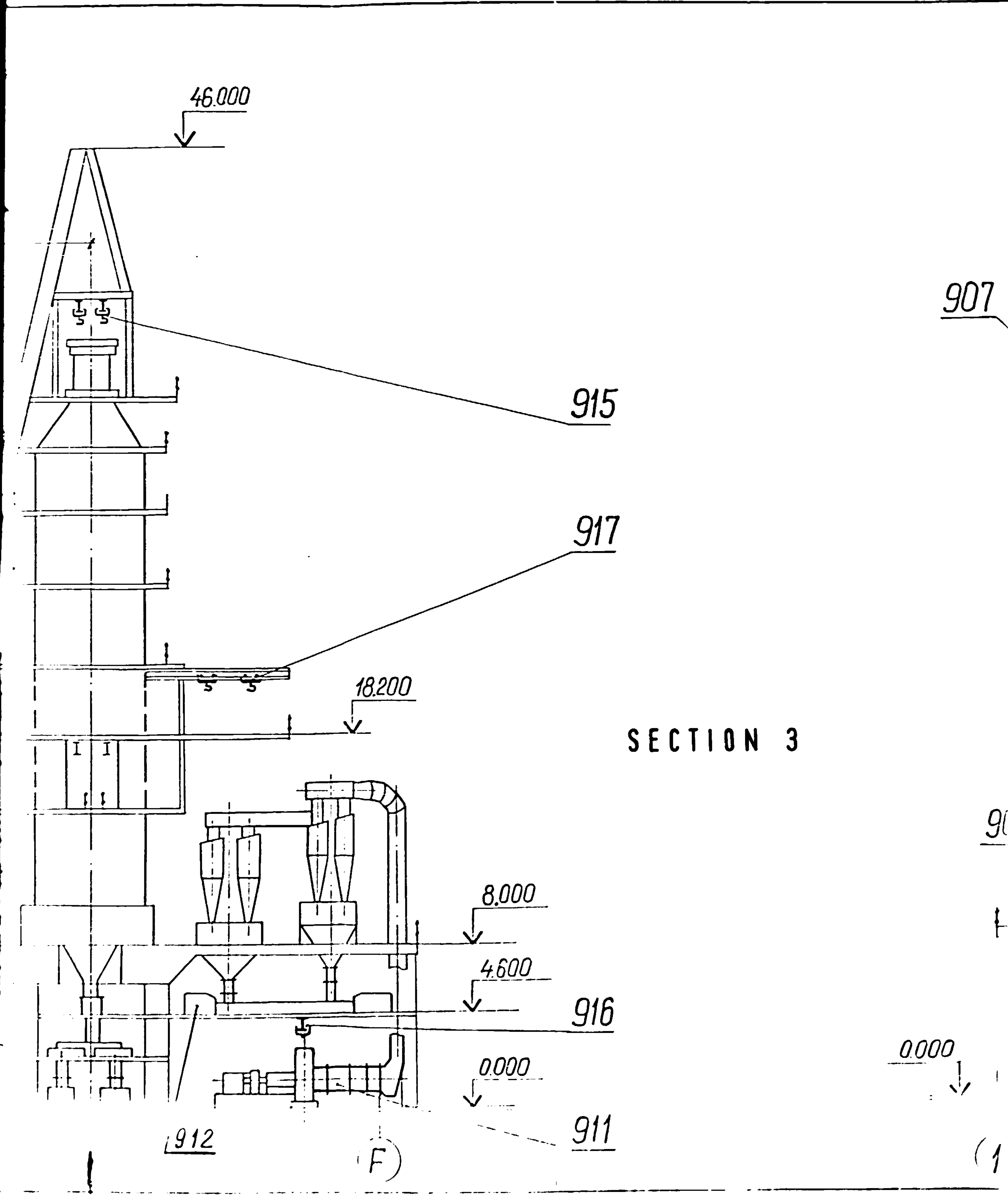
ФОРМАТ А4×6

ИНВ. № ПОДЛ.	ПОДП. И ДАТА	ВЗАМ. ИНВ. №

PLAN AT TOP ELEVATIONS

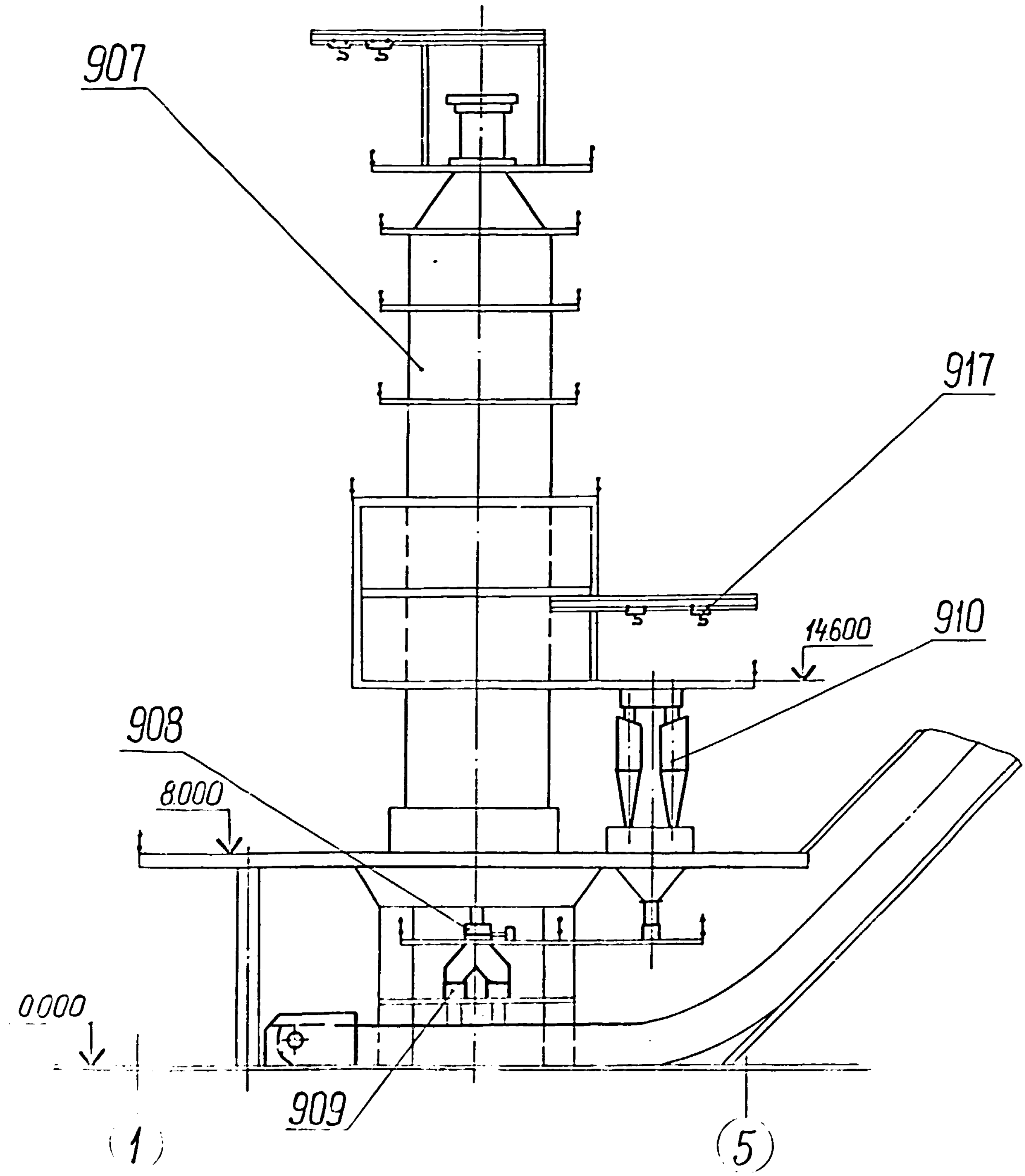



1-1
2000
6000
6000
6000
6000
6000
10000
3000
F
E
D
C
B
A
29.000
2
13000
914
901
29.000
902
913
6.600
903
3600
904
905
A
SECTION 2


46.000
907
915
917
18.200
SECTION 3
8.000
4.600
916
0.000
0.000
911
912
F

2-2

SECTION 4



SECTION 5

CONTRACT № 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1398864-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	ALUMINA PRODUCTION. LIME STONE BURNING	PHASE	SHEET	SHEETS
		PDS	2	
	PLAN AND SECTIONS	VAMI LENINGRAD		

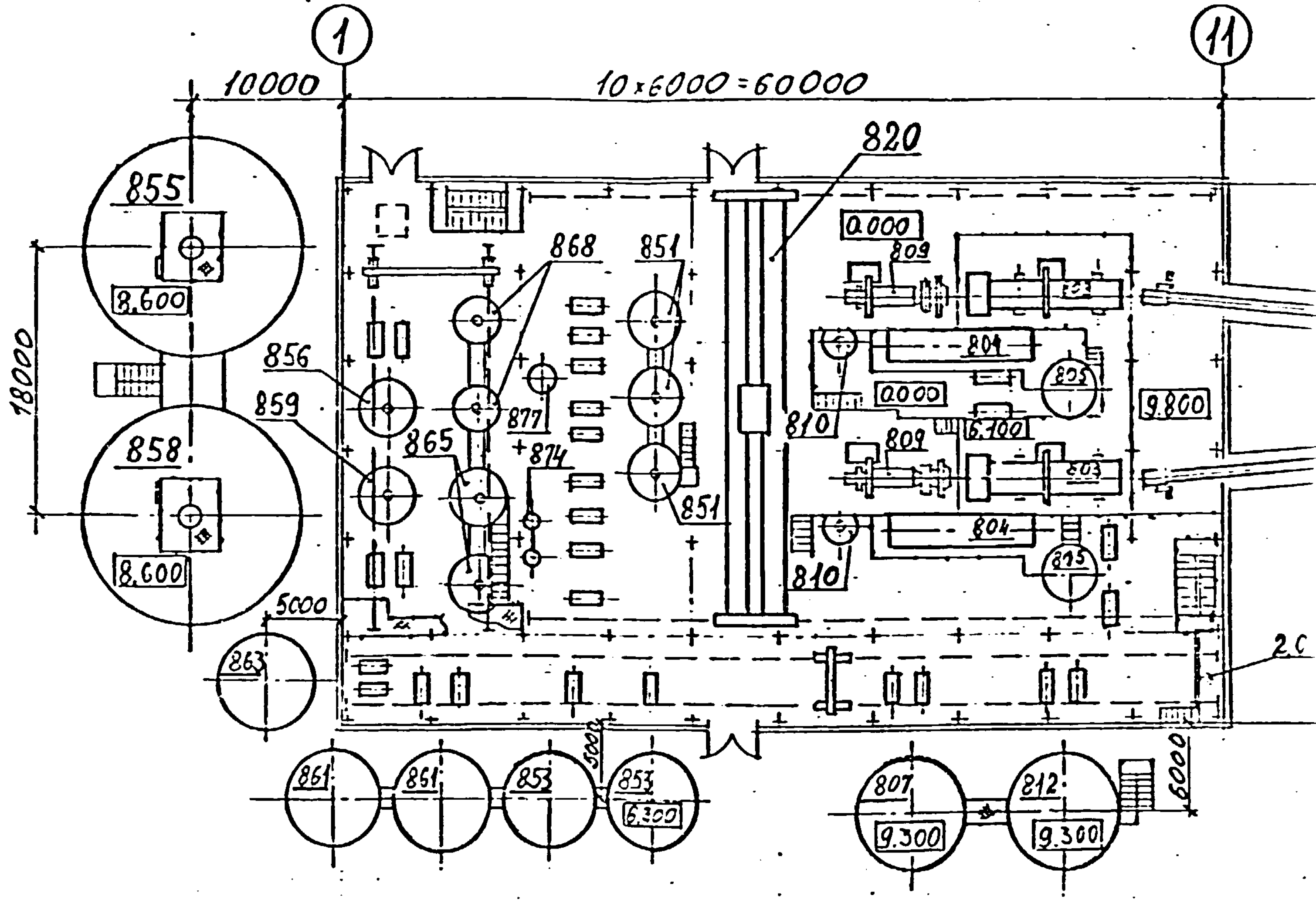
SIZE A4x5

Инв.№ подл.	Подп. и дата	Взам. инв.№

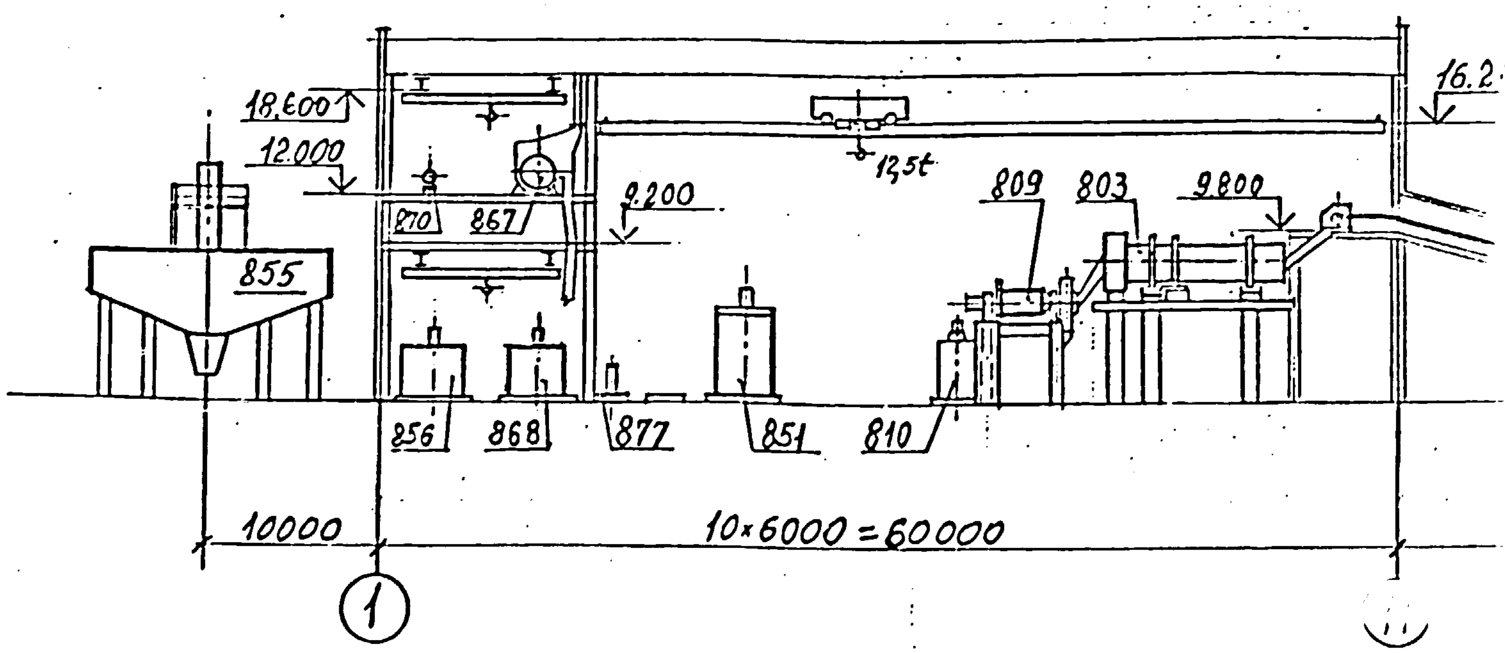
1398864-Т			
ЗАВОД ПО ПЕРЕРАБОТКЕ НЕФЕЛИНОВЫХ РУД МЕСТОРОЖДЕНИЯ РАЗГАХ (ИРАН)			
ГЛИНОЗЕМНОЕ ПРОИЗВОДСТВО. ОБЖИГ ИЗВЕСТНЯКА	СТАДИЯ	ЛИСТ	ЛИСТОВ
	ИВП	2	
ПЛАН И РАЗРЕЗЫ	ВАМИ ЛЕНИНГРАД		

ФОРМАТ А4х5

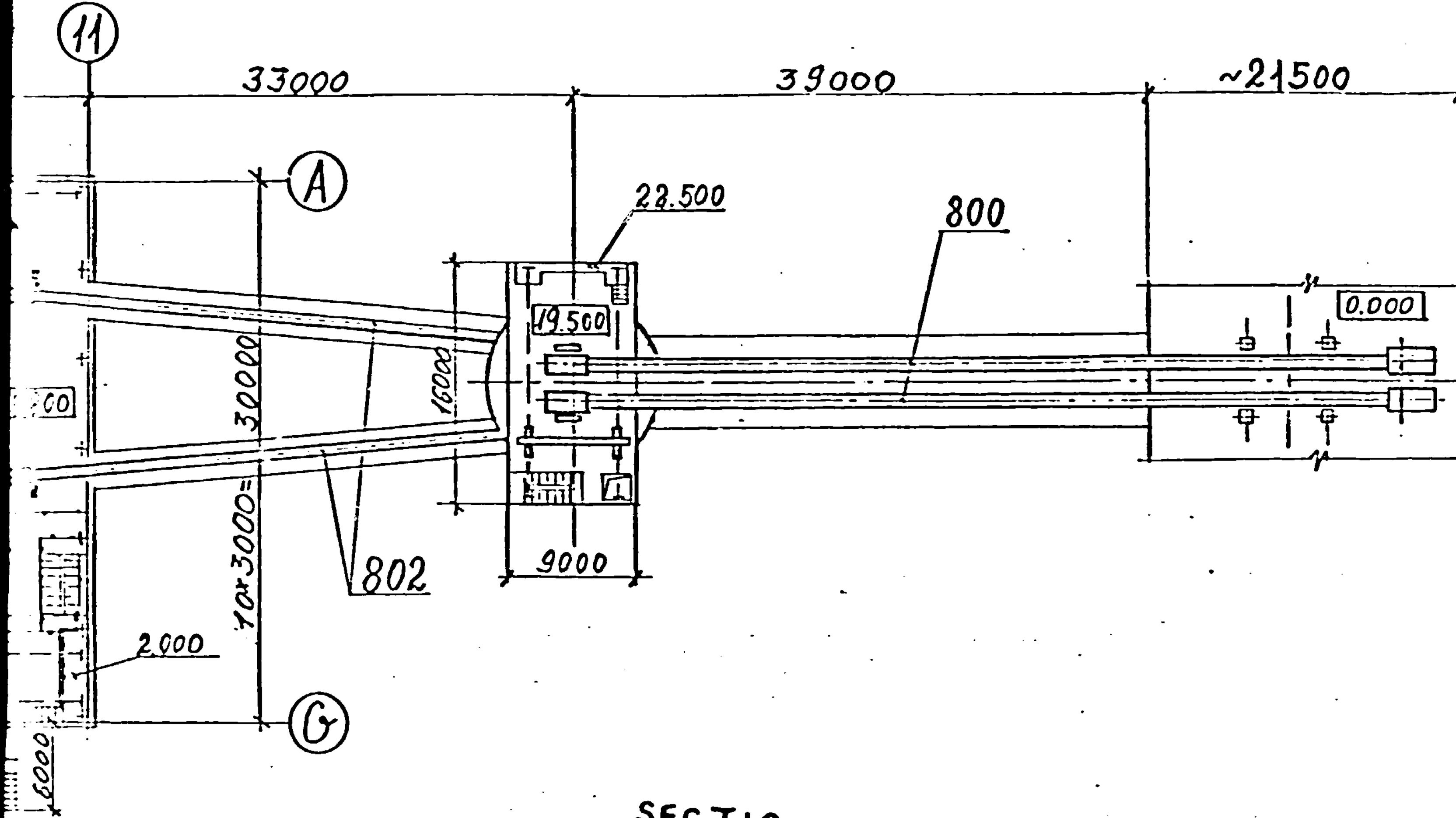
PLAN AT ELEVATION 0.000 AND MIDDLE ELEVA



SECTION 1

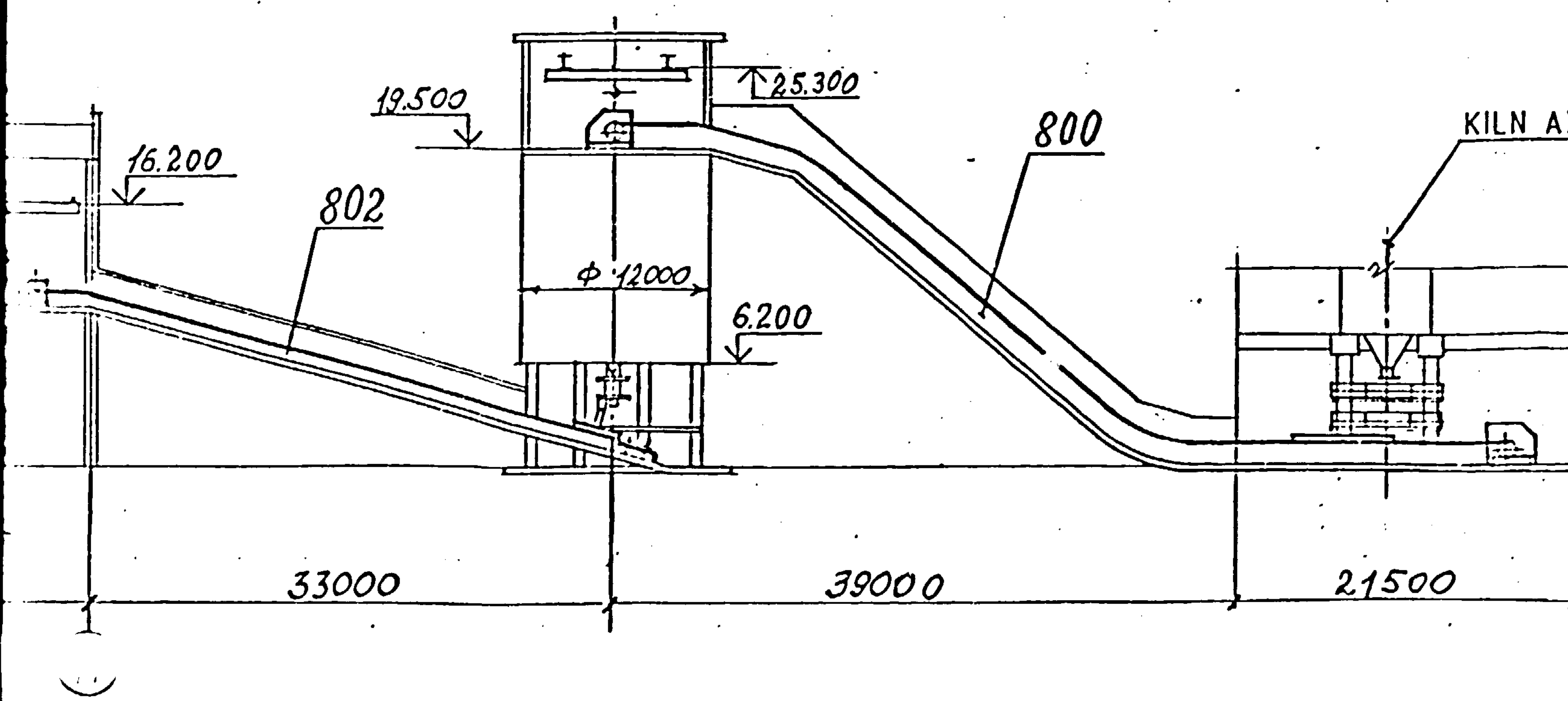


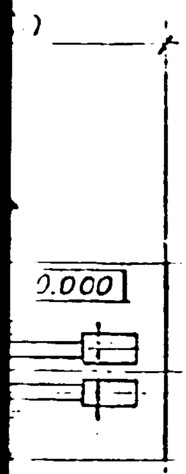
A … CLE ELEVATIONS.



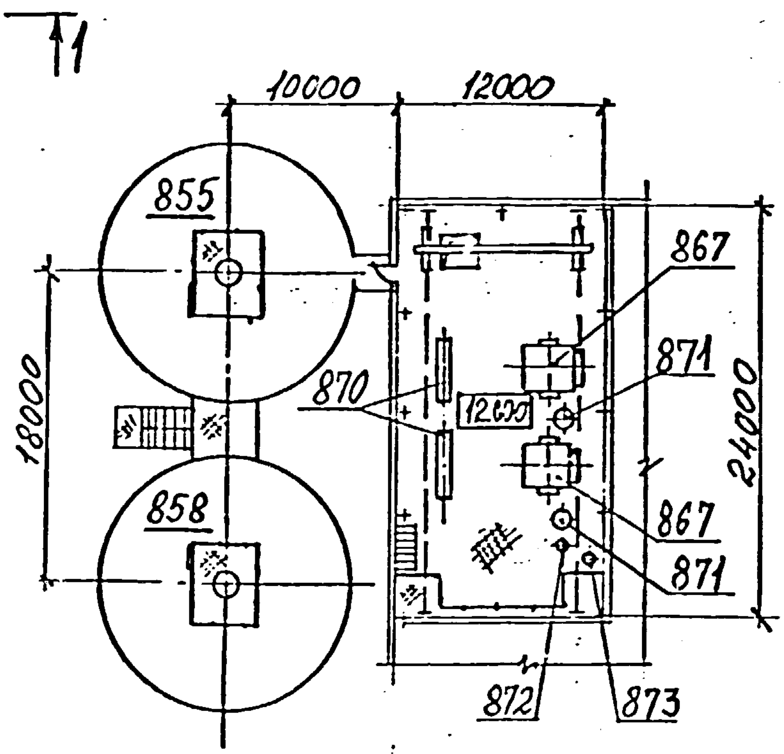
SECTION 2

1-1

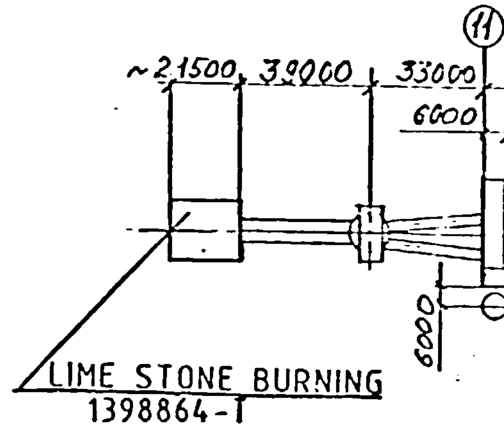




PLAN AT ELEVATION 12.000.



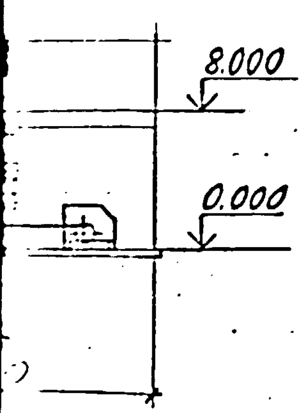
LOCATION LA
1:2000.



KILN AXIS

THE VIEWS ARE SHOWN IN SC

SECTION 3



CONTRACT N 90/

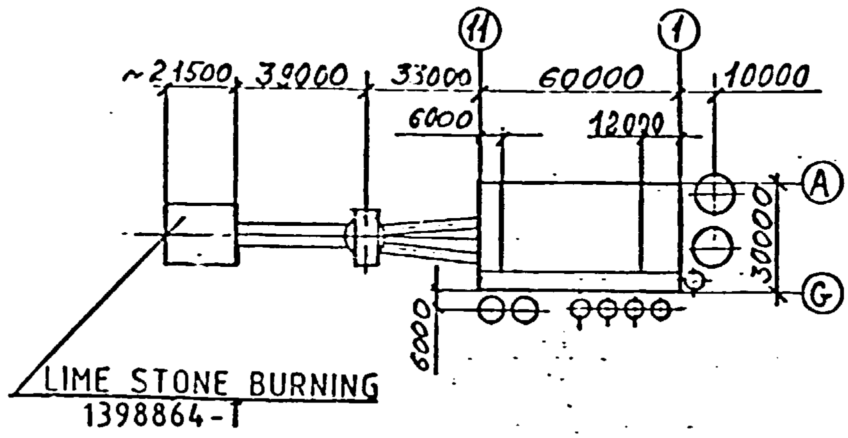
THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI

RAZGAH NEPI
(

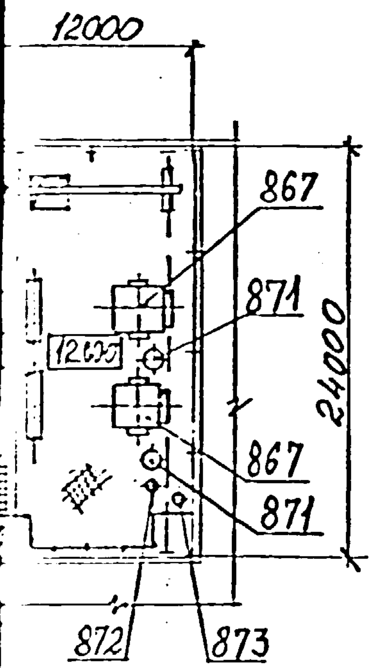
ALUMINA PRODUCTIC
LIME MILK PREPAR
AND CAUST

LOCATION LAY-C
.PLANS. SECTION.

LOCATION LAY-OUT.
1:2000.



ION 12.000.



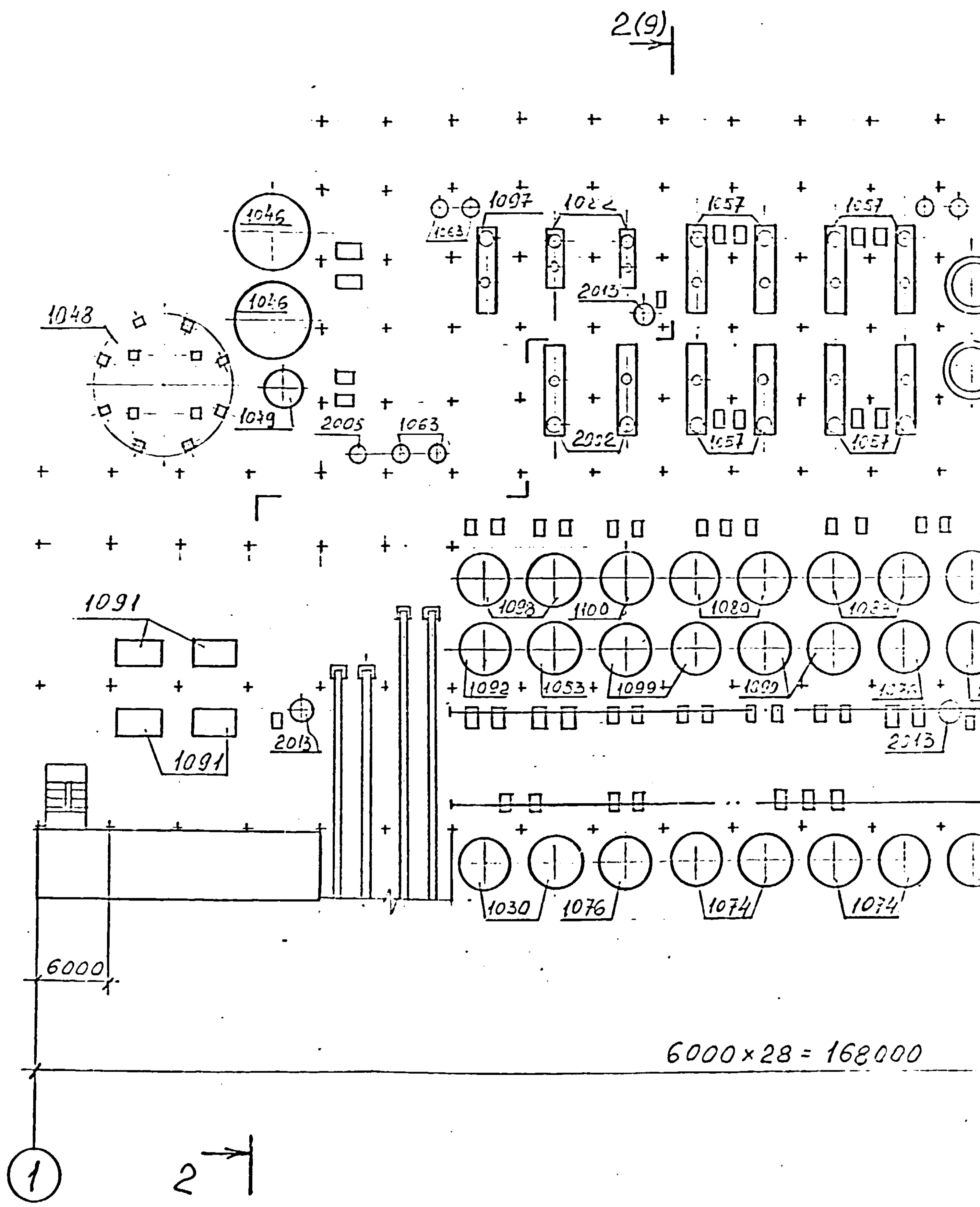
SECTION 4

THE VIEWS ARE SHOWN IN SCALE 1:400

CONTRACT N 90/204/205

1339643-T			
RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
ALUMINA PRODUCTION. LIME MILK PREPARATION AND CAUSTICIZATION.	PHASE	SHEET	SHEETS
	POS	3	
LOCATION LAY-OUT., PLANS. SECTION.	VAMI LENINGRAD		

SIZE A4x4


2(9)
1046
1046
1048
1079
1097
1063
1022
2013
1057
1057
1057
1057
2005
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2022
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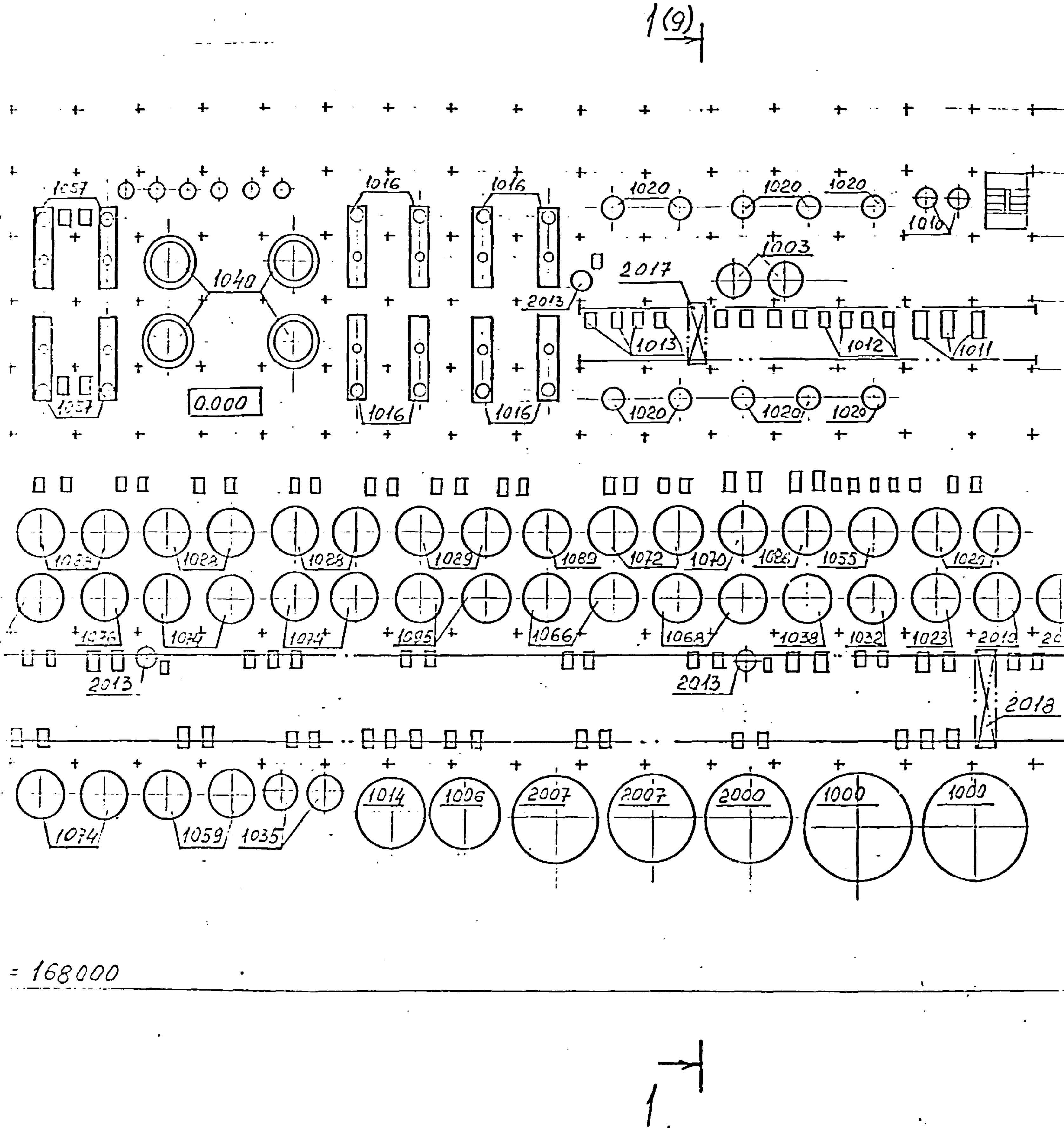
1091
2013
1098
1100
1080
1092
1053
1099
2013
1030
1076
1074
1074
6000
6000 × 28 = 168000
1
2

SECTION 1


1(9)
1057
1016
1016
1020
1020
1020
1010
1040
1003
2017
2013
1013
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1011
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1016
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1020
1066
2013
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1059
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1006
2007
2007
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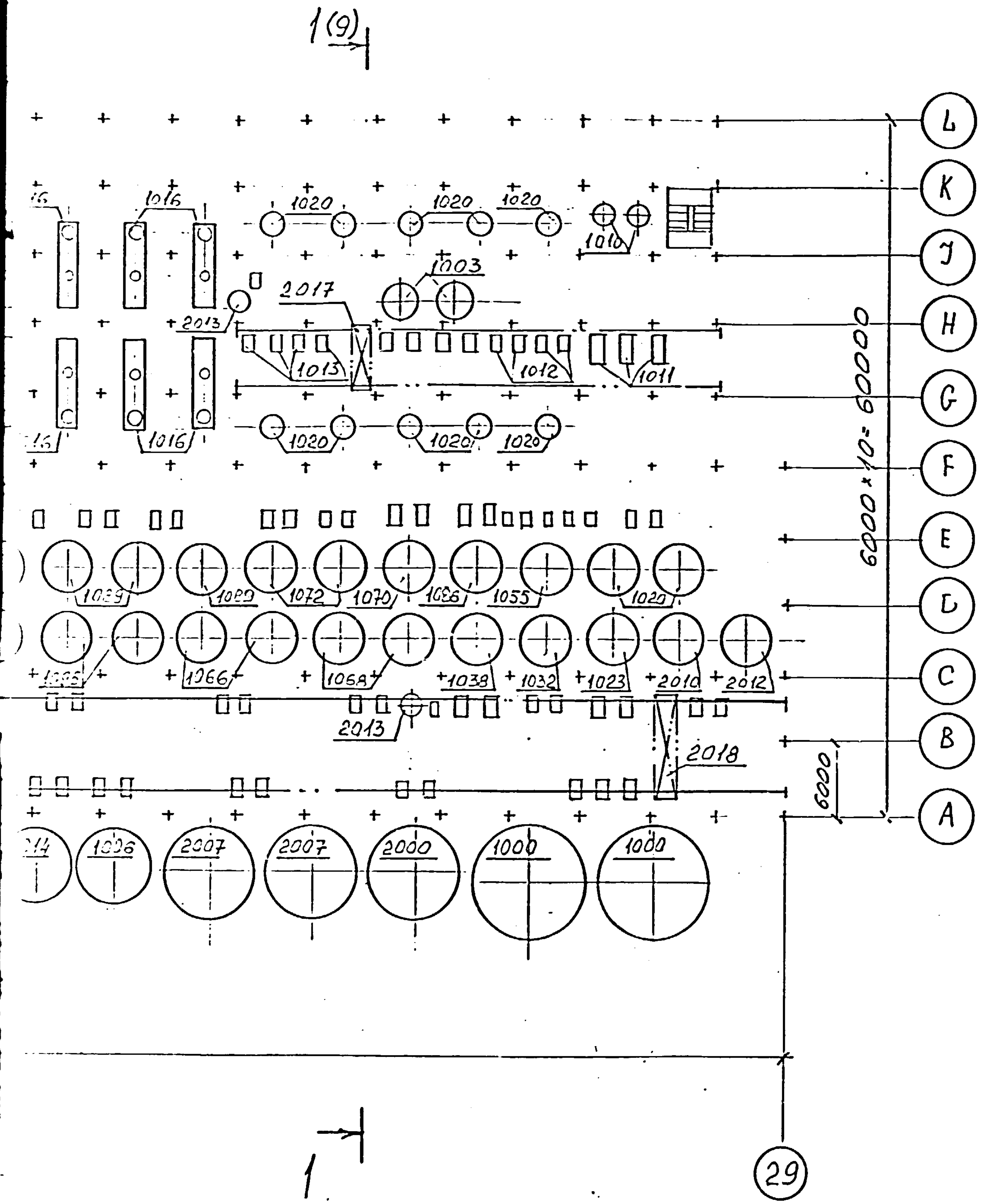
= 168000
1

SECTION 2



1(9)
L
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A
6000×10=60000
6000
1016
1020
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2017
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1013
1012
1011
1039
1029
1072
1070
1055
1066
1068
1038
1032
1023
2010
2012
2018
2007
2000
1000
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1

SECTION 3

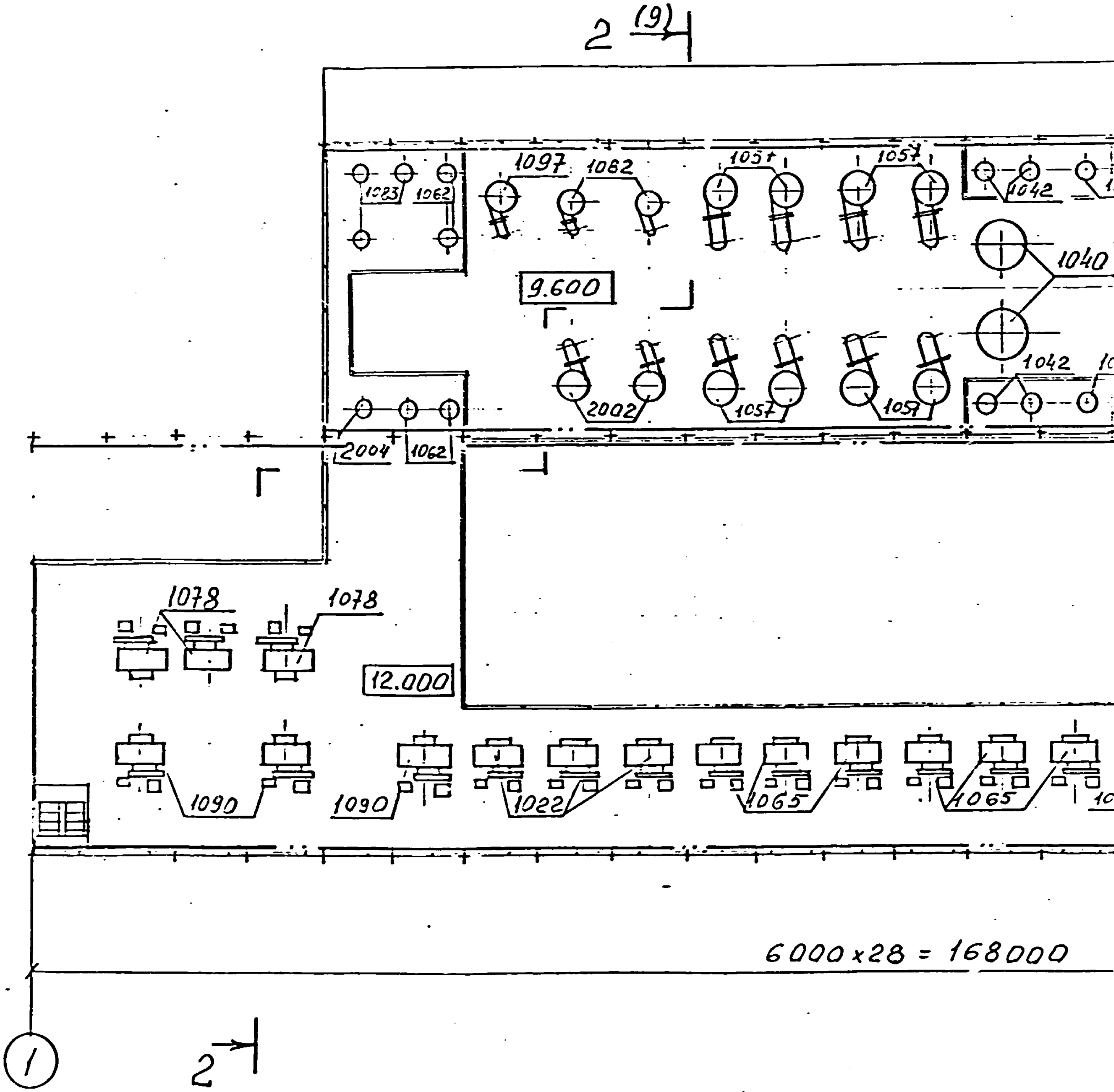
SECTION 4

THE VIEWS ARE SHOWN IN SCALE 1:400

CONTRACT N 90/204/205

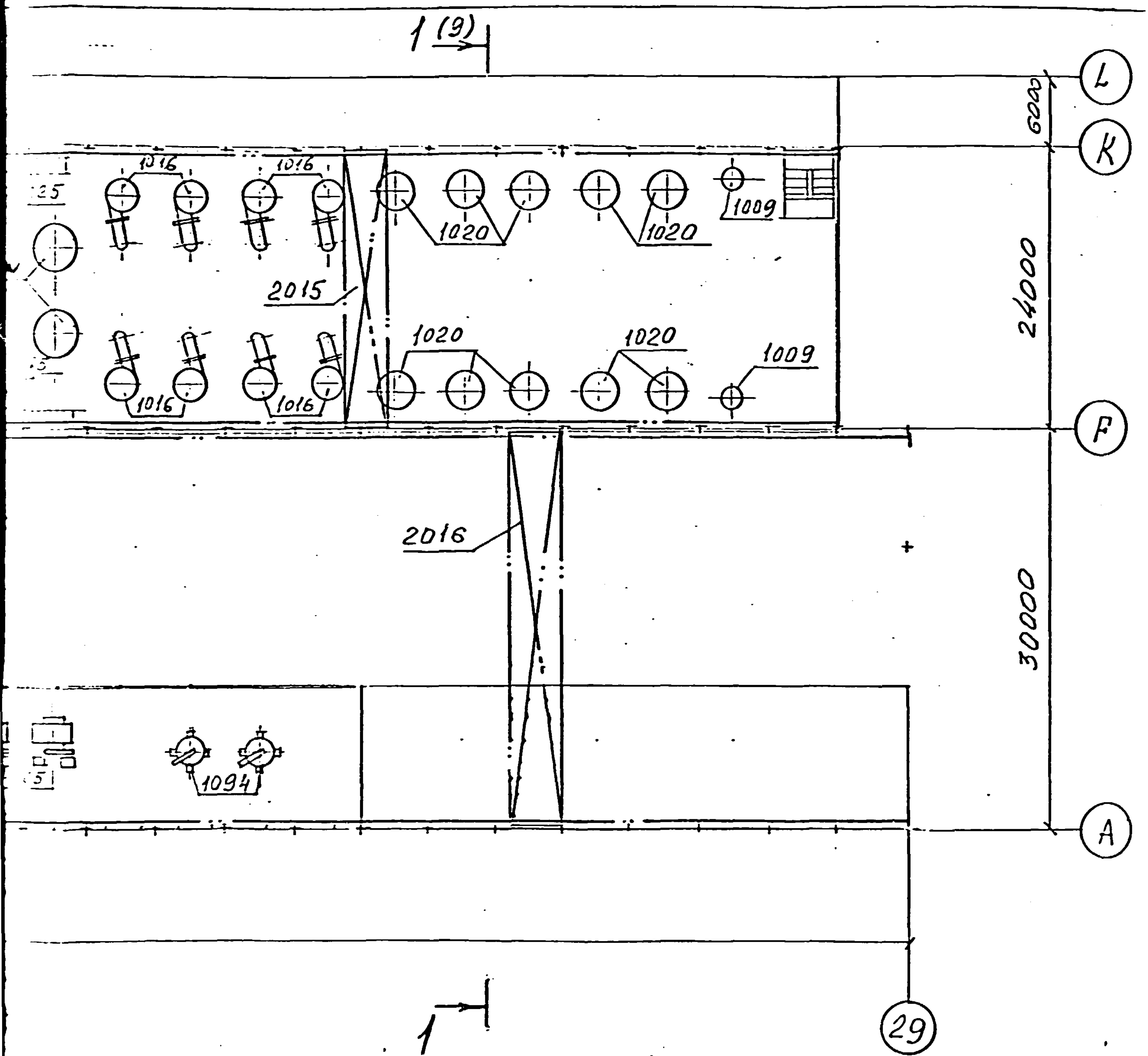
THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339645-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	SODIUM CARBONATE AND POTASH PRODUCTION. EVAPORATION. CRYSTALLIZATION AND CENTRIFUGING.	PHASE	SHEET	SHEETS
		POS	1	
	PLAN AT EL. 0.000	VAMI LENINGRAD		

SIZE A 4×4



2 (9)
1097
1082
1057
1057
1042
1040
1083
1062
9.600
2002
1057
1057
1042
2004
1062
1078
1078
12.000
1090
1090
1022
1065
1065
6000 x 28 = 168000
1
2

SECTION 1


1 (9)
1016
1016
1016
1016
1020
1020
1020
1020
1009
1009
2015
2016
1094
6000
24000
30000
L
K
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29
1

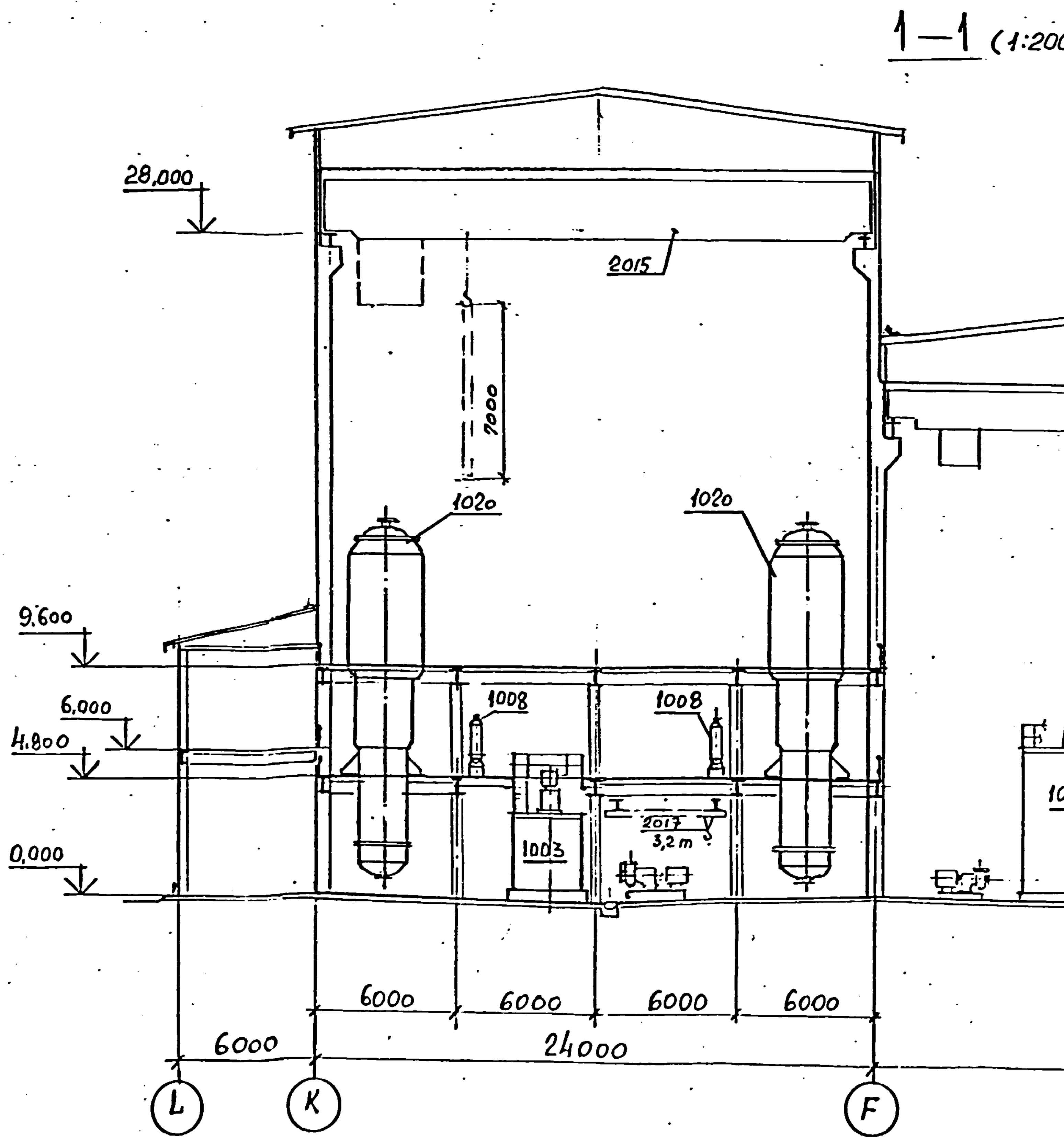
SECTION 2

SECTION 3

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339645-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	SODIUM CARBONATE AND POTASH PRODUCTION. EVAPORATION, CRYSTALLIZATION AND CENTRIFUGING.	PHASE	SHEET	SHEETS
		POS	8	
	PLAN AT EL. 12.000	VAMI LENINGRAD		

SIZE A 4x4



1—1 (1:200
28,000
2015
7000
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1020
9.600
6,000
4.800
1008
1008
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3,2 m
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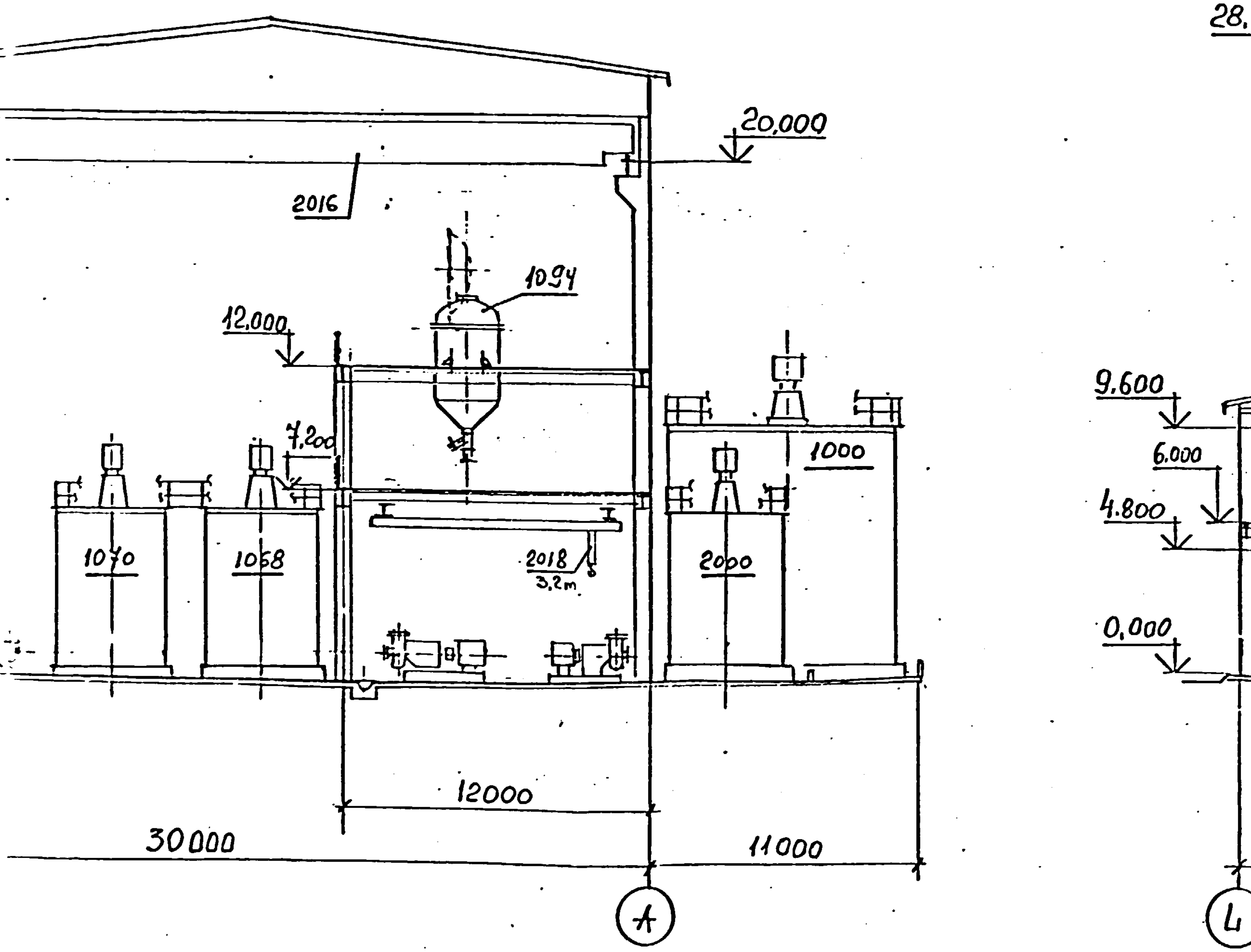
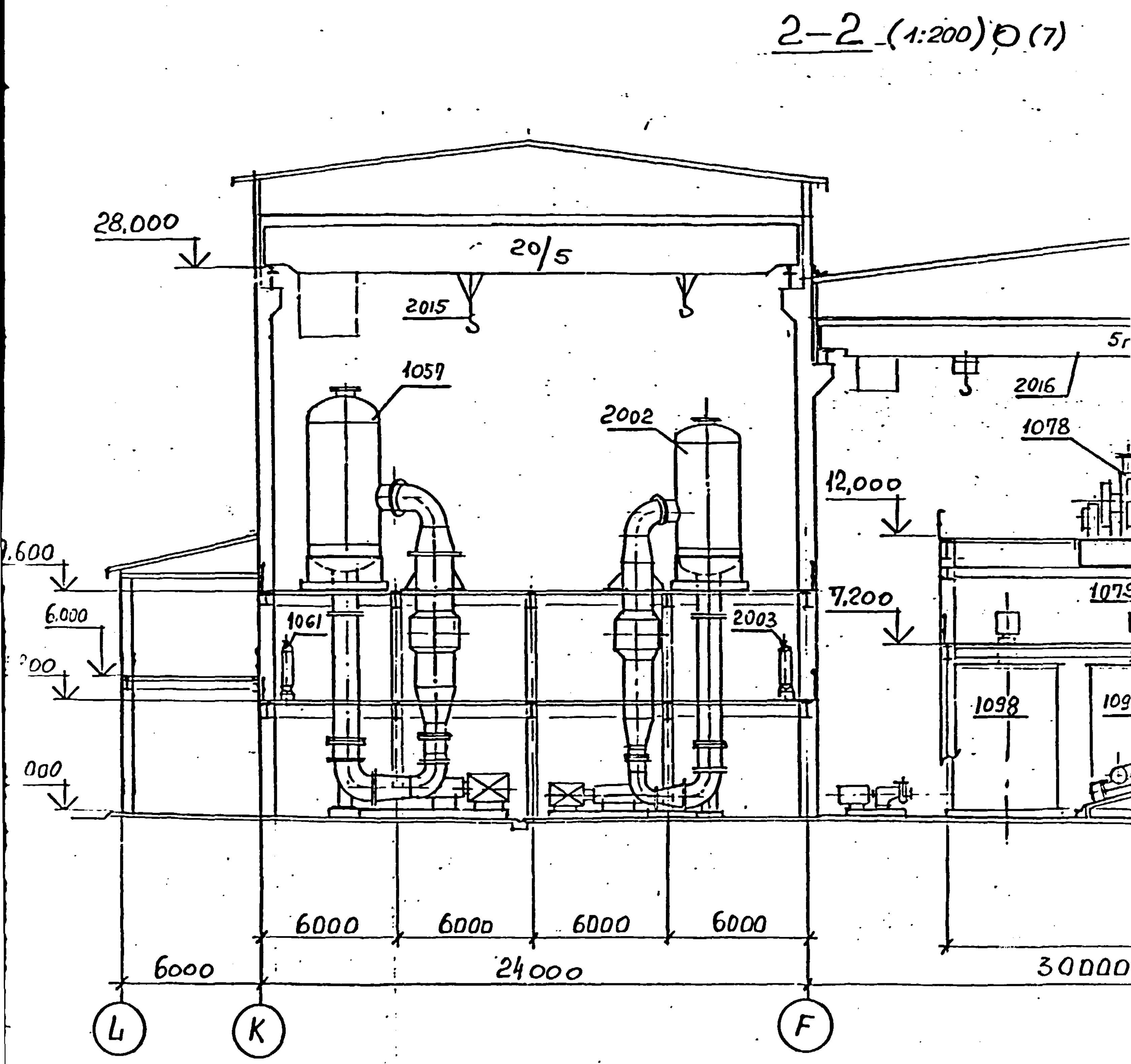
L
K
F

SECTION 1

(1:200) Ⓞ (7)



SECTION 2



2-2 (1:200)
28,000
20/5
2015
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2002
2016
1078
12,000
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1061
2003
6.000
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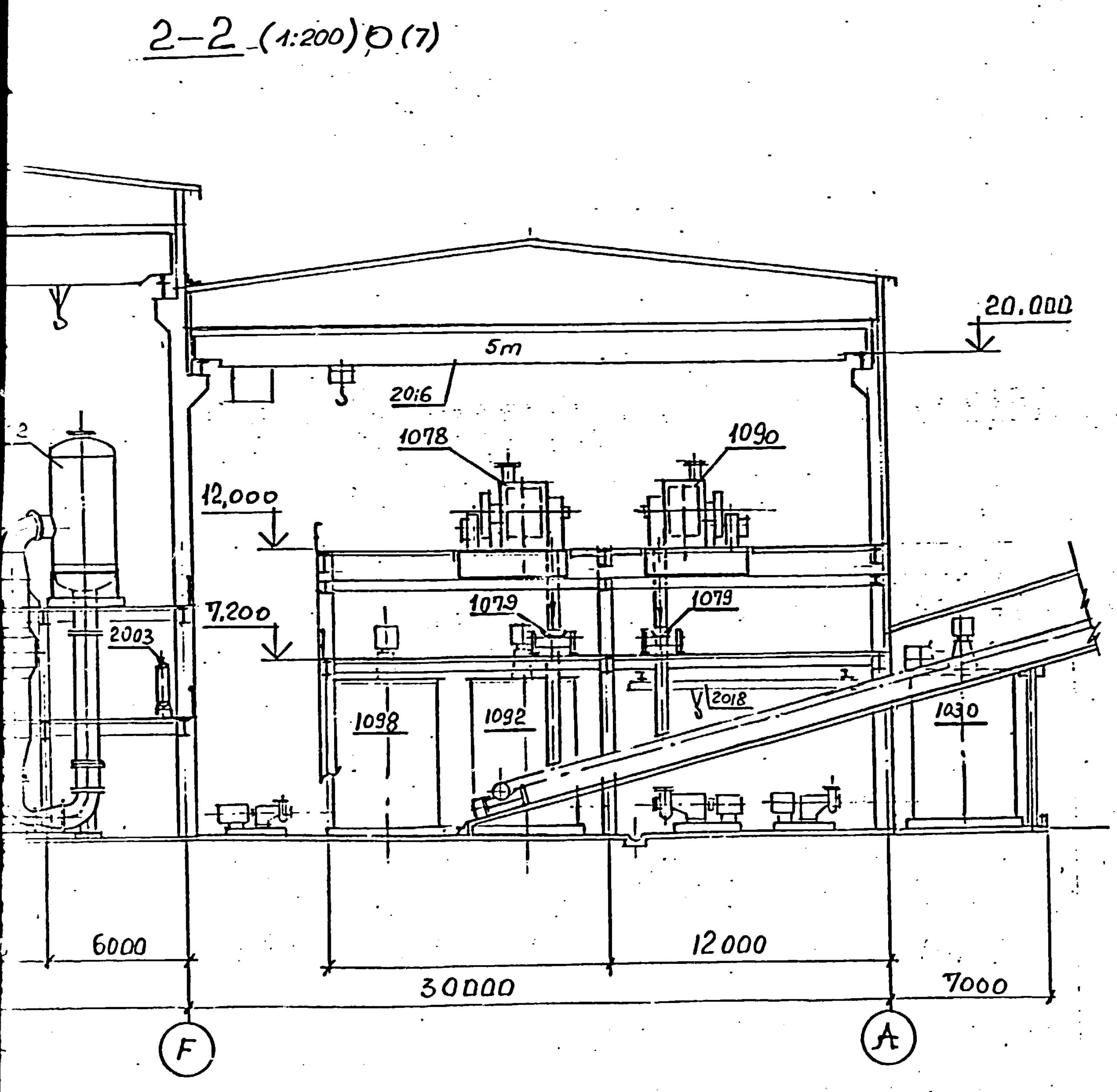
SECTION 3


2-2 (1:200) O (7)
20.000
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12,000
7,200
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2003
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1092
2018
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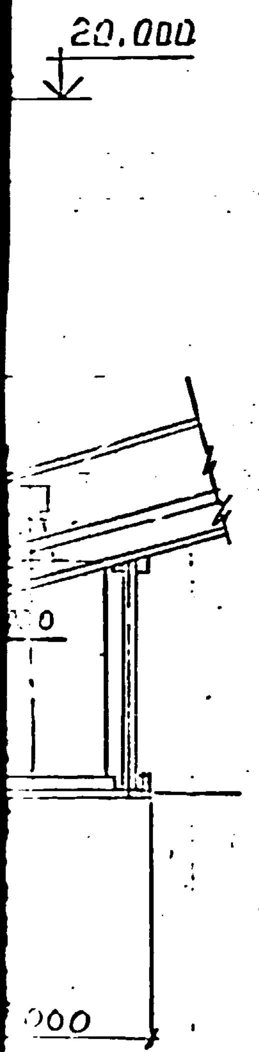
A

SECTION 4



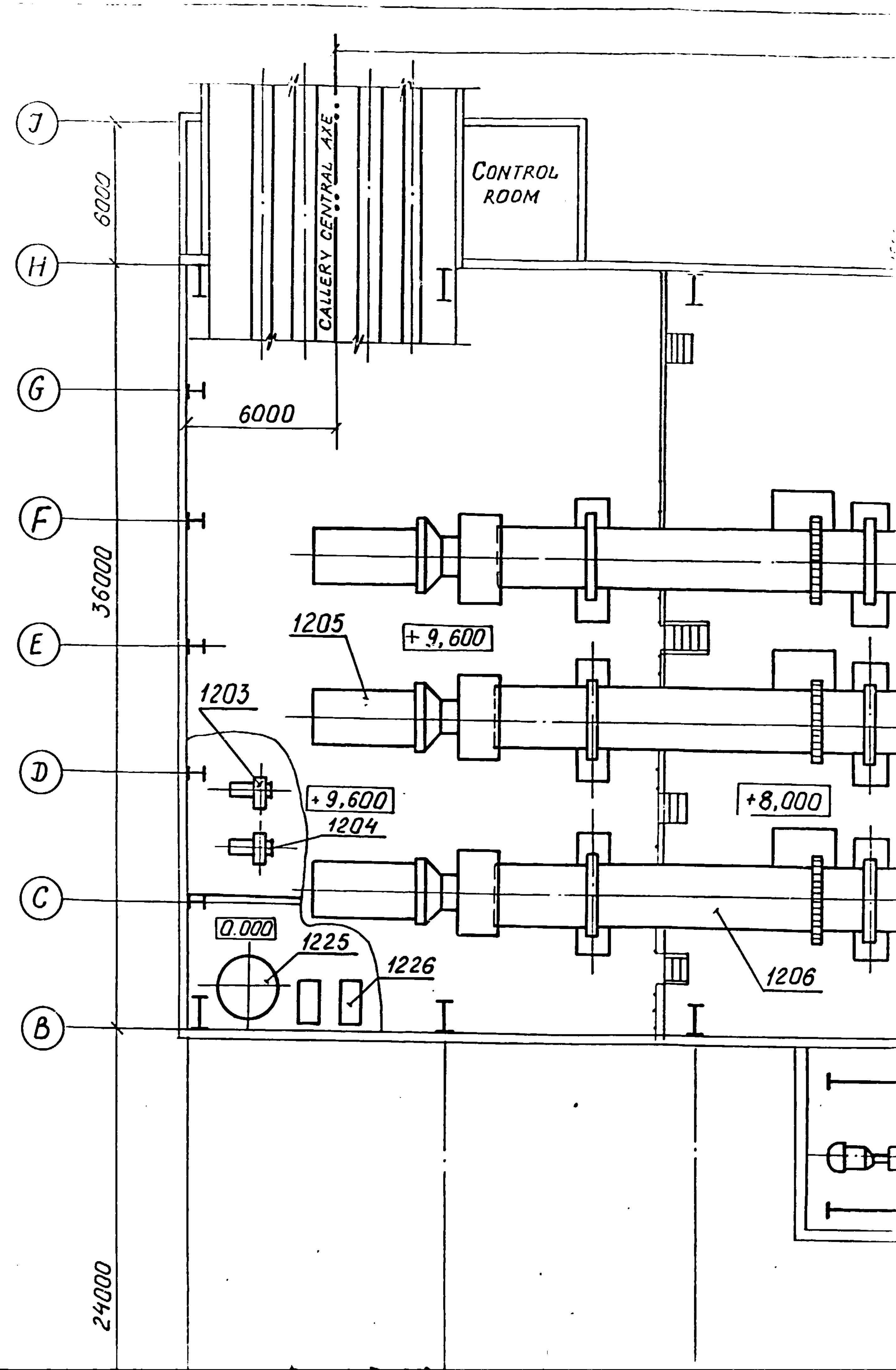
SECTION 5

CONTRACT N 90/204/205

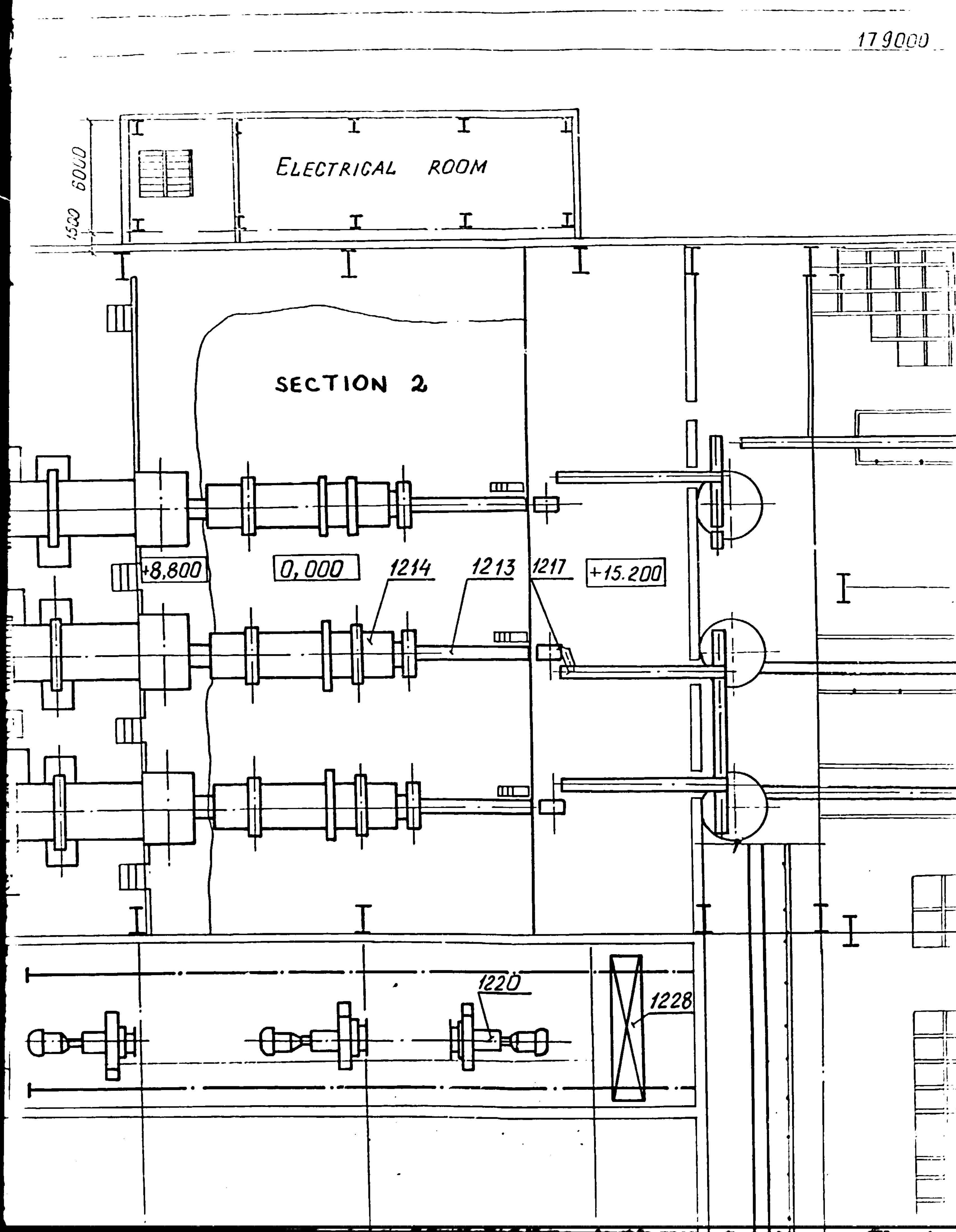
1339645-T			
RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
SODIUM CARBONATE AND POTASH PRODUCTION. EVAPORATION, CRYSTALLIZATION AND CENTRIFUGING.	PHASE	SHEET	SHEETS
	POS	9	
SECTIONS 1-1;2-2	VAMI LENINGRAD		

Size A 4x5

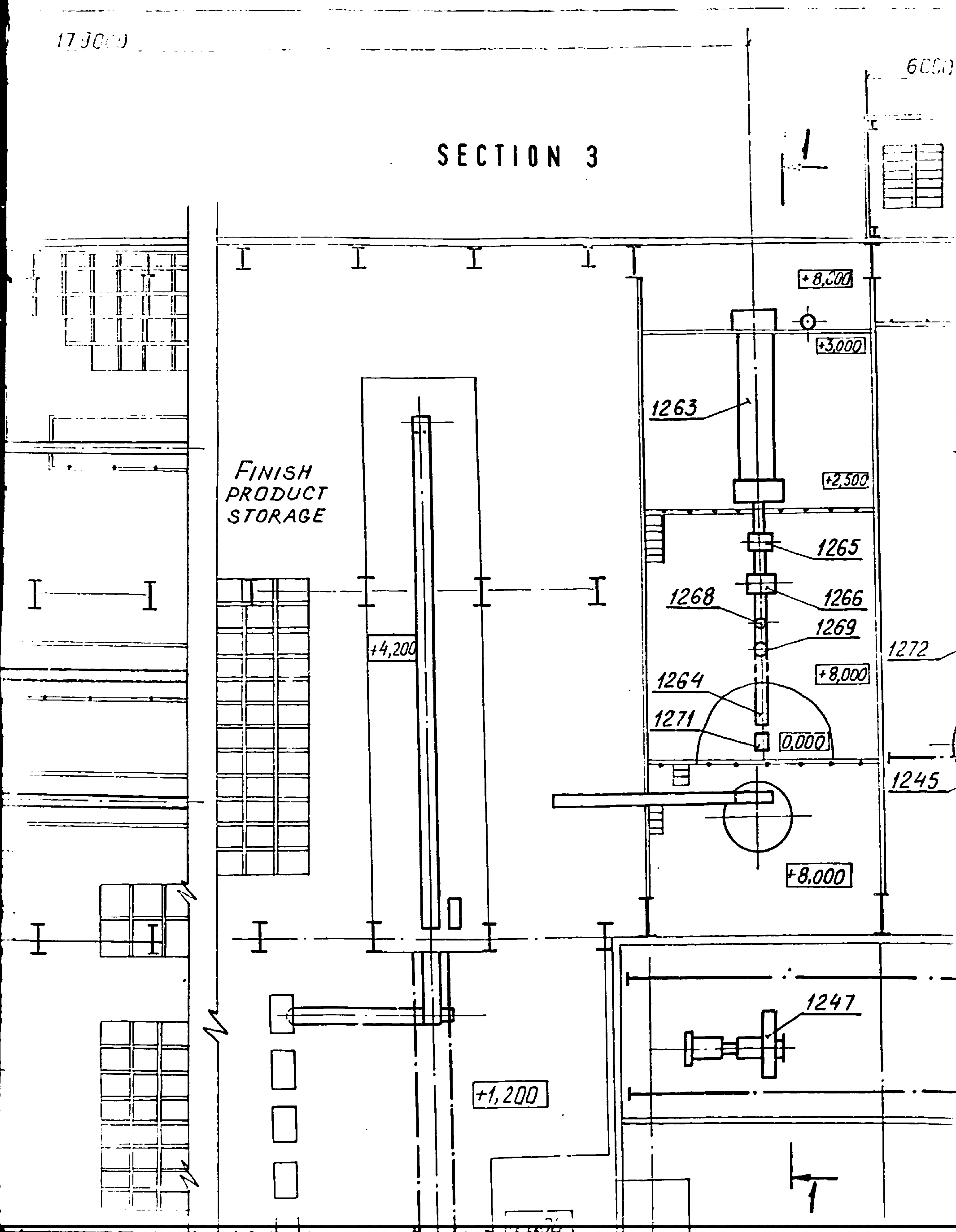
SECTION 1



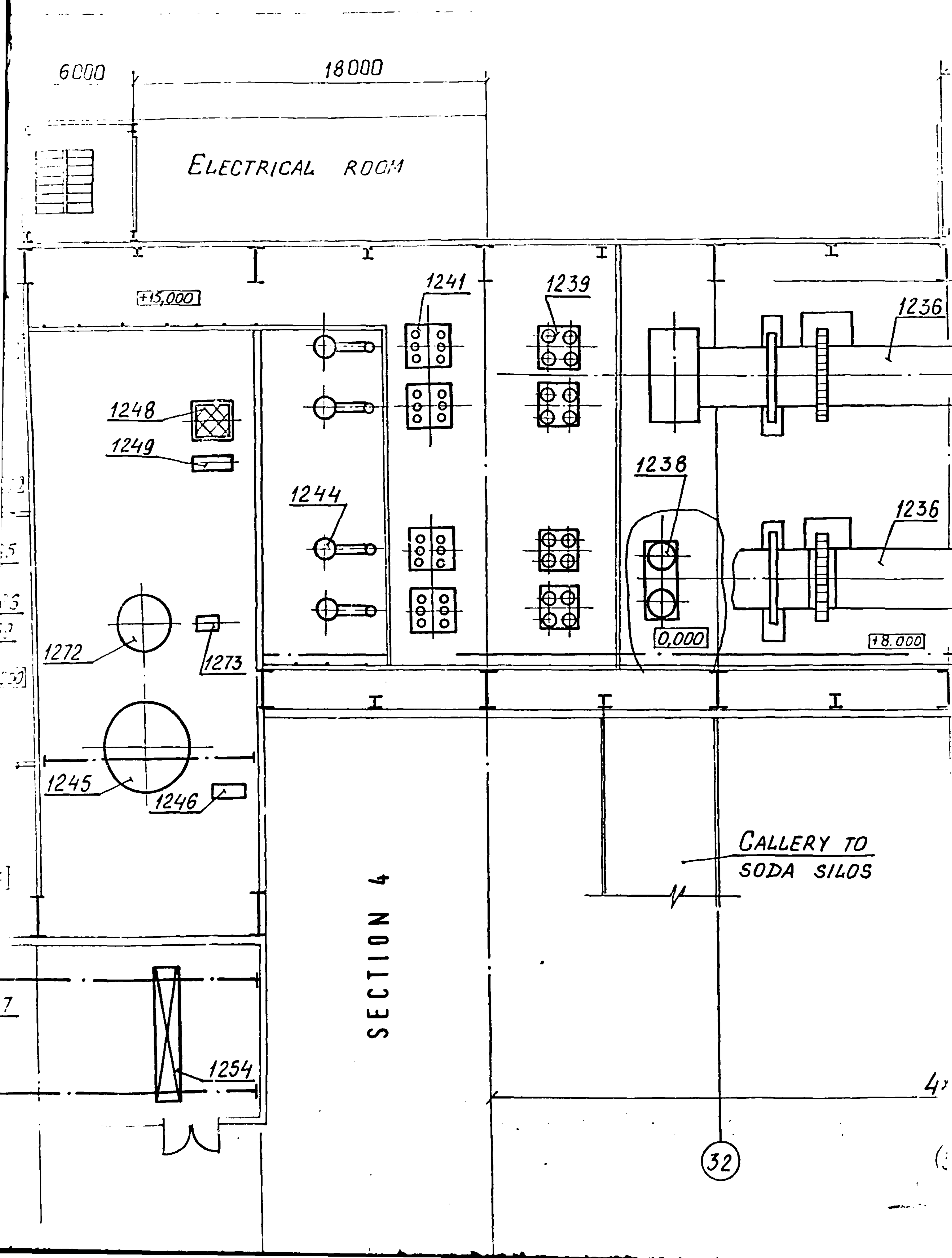
J
H
G
F
E
D
C
B
6000
36000
24000
CALLERY CENTRAL AXE
CONTROL ROOM
6000
1205
+9,600
1203
+9,600
1204
+8,000
0.000
1225
1226
1206



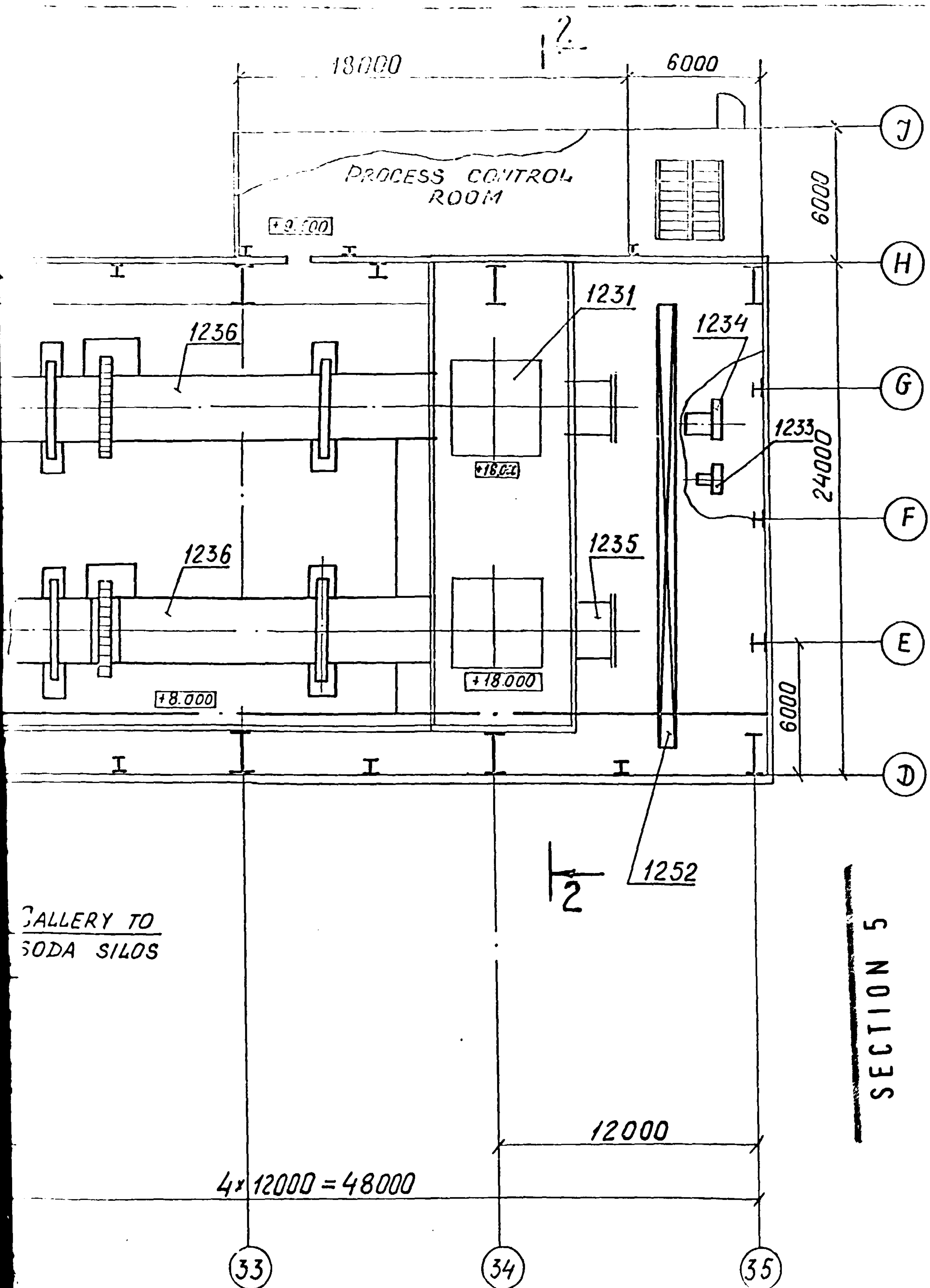
17 9000
6000
1500
ELECTRICAL ROOM
SECTION 2
+8,800
0,000
1214
1213
1217
+15.200
1220
1228



SECTION 3
FINISH PRODUCT STORAGE
1263
1265
1266
1268
1269
1264
1271
1272
1245
1247
+8,000
+3,000
+2,500
+8,000
0,000
+8,000
+4,200
+1,200

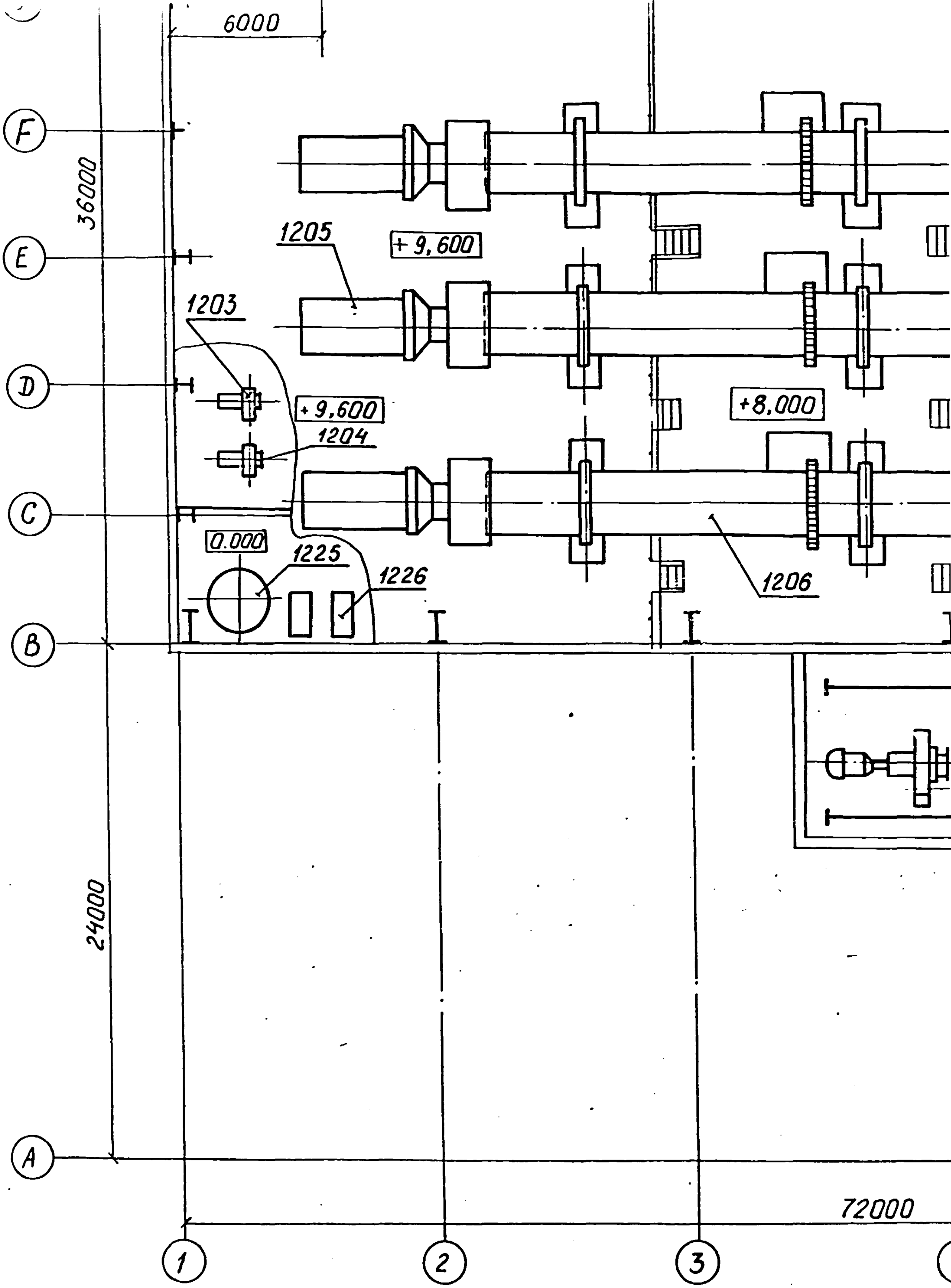


6000
18000
ELECTRICAL ROOM
+15,000
1241
1239
1236
1248
1249
1238
1244
1236
1272
1273
0,000
+8.000
1245
1246
CALLERY TO SODA SILOS
SECTION 4
1254
32

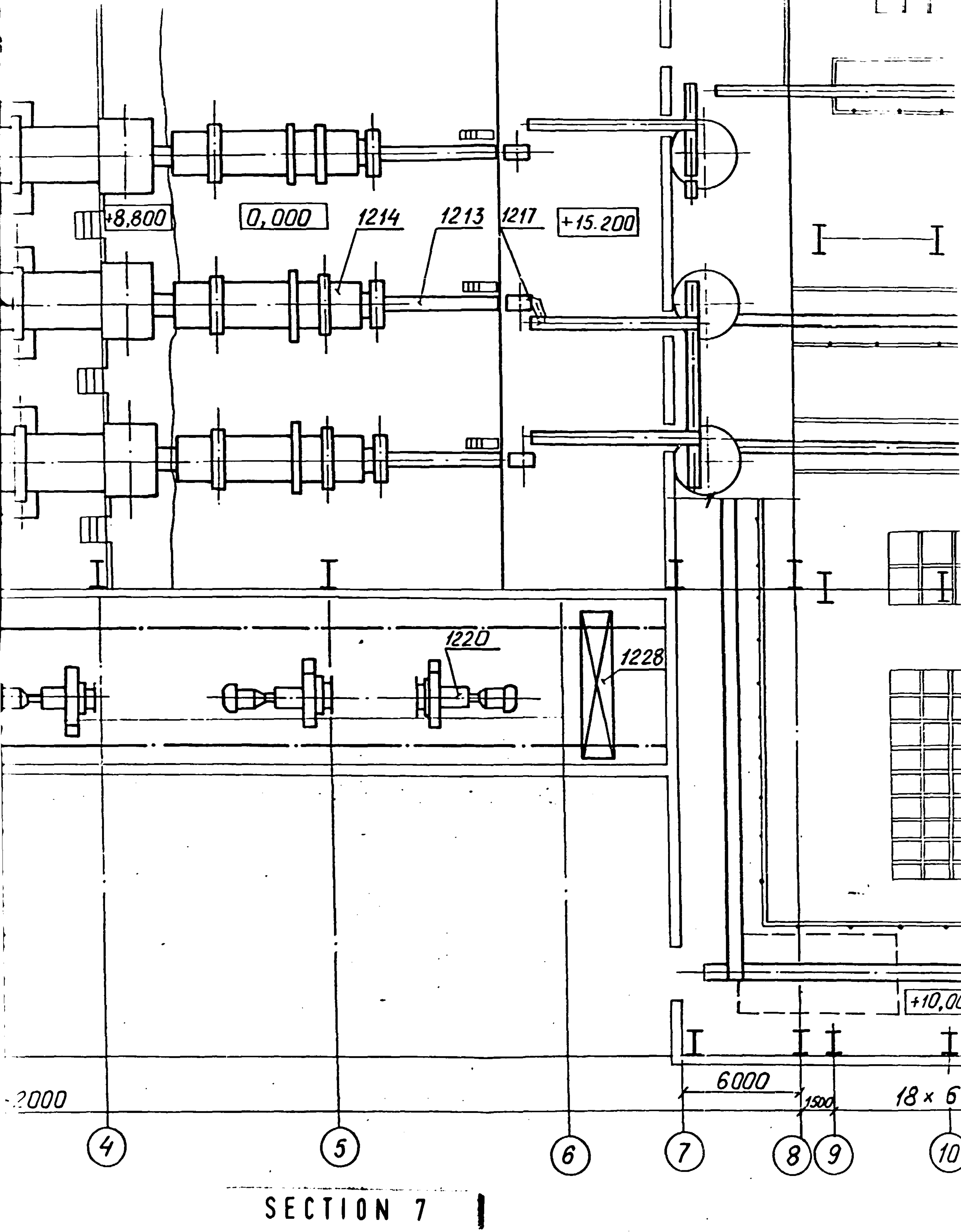


18000
6000
PROCESS CONTROL ROOM
1231
1234
1233
1236
1236
1235
+18.000
+8.000
1252
2
GALLERY TO SODA SILOS
6000
24000
6000
J
H
G
F
E
D
12000
4x12000 = 48000
33
34
35

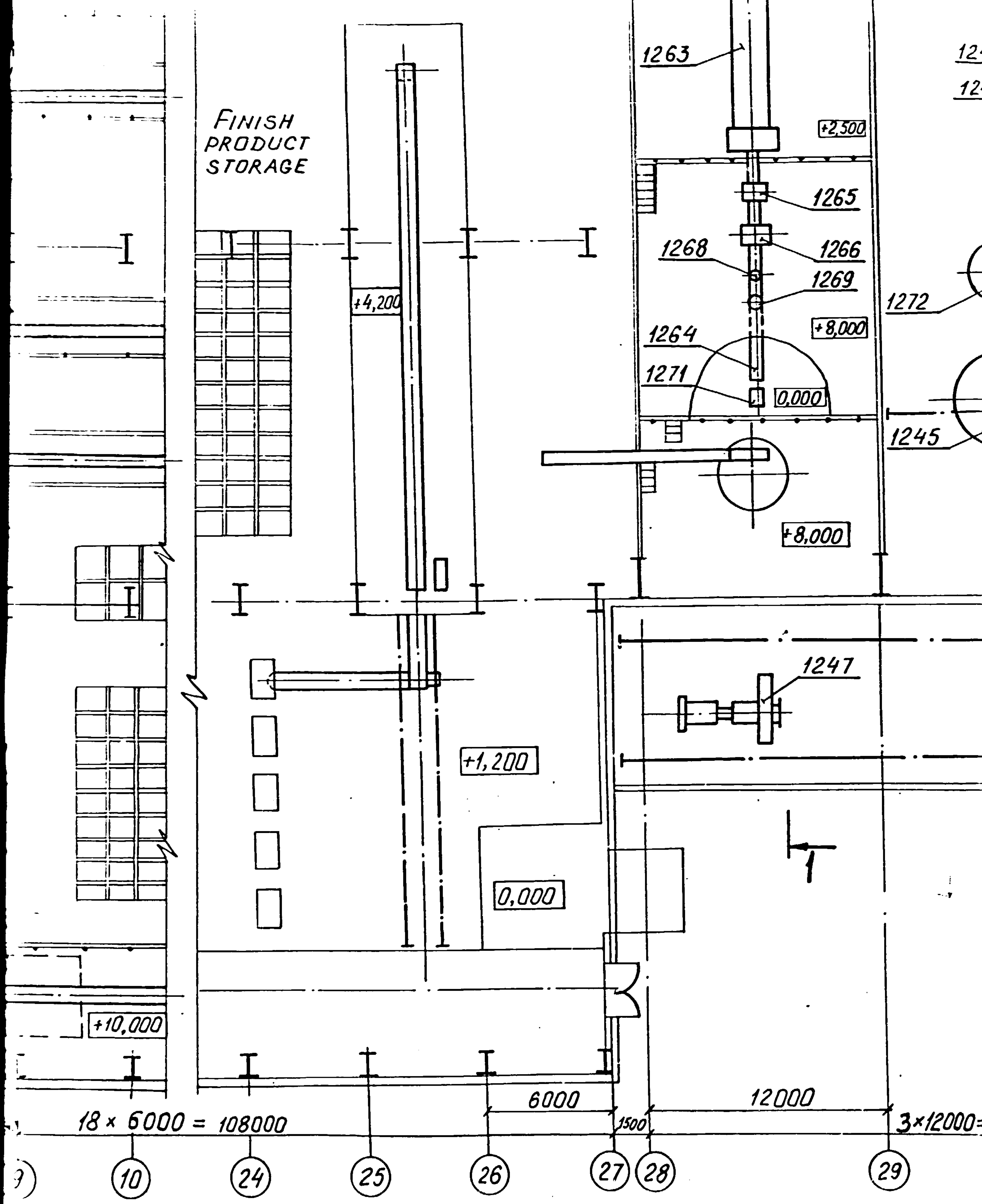
SECTION 5


6000
36000
24000
72000
F
E
D
C
B
A
1
2
3
1205
1203
1204
1225
1226
1206
+9,600
+9,600
+8,000
0.000

SECTION 6

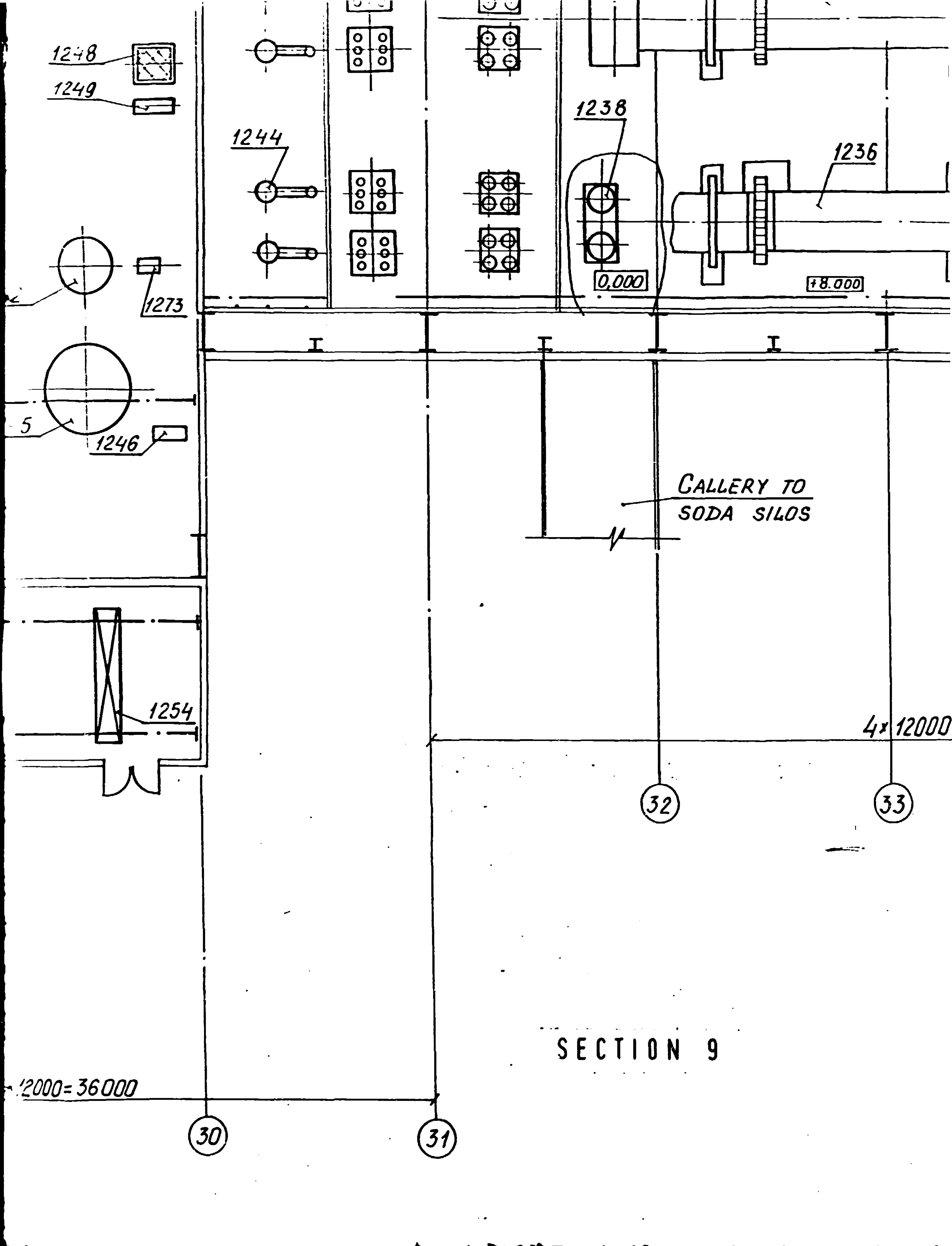

+8,800
0,000
1214
1213
1217
+15.200
1220
1228
+10,00
6000
1500
18 × 6
-2000
4
5
6
7
8
9
10

SECTION 7

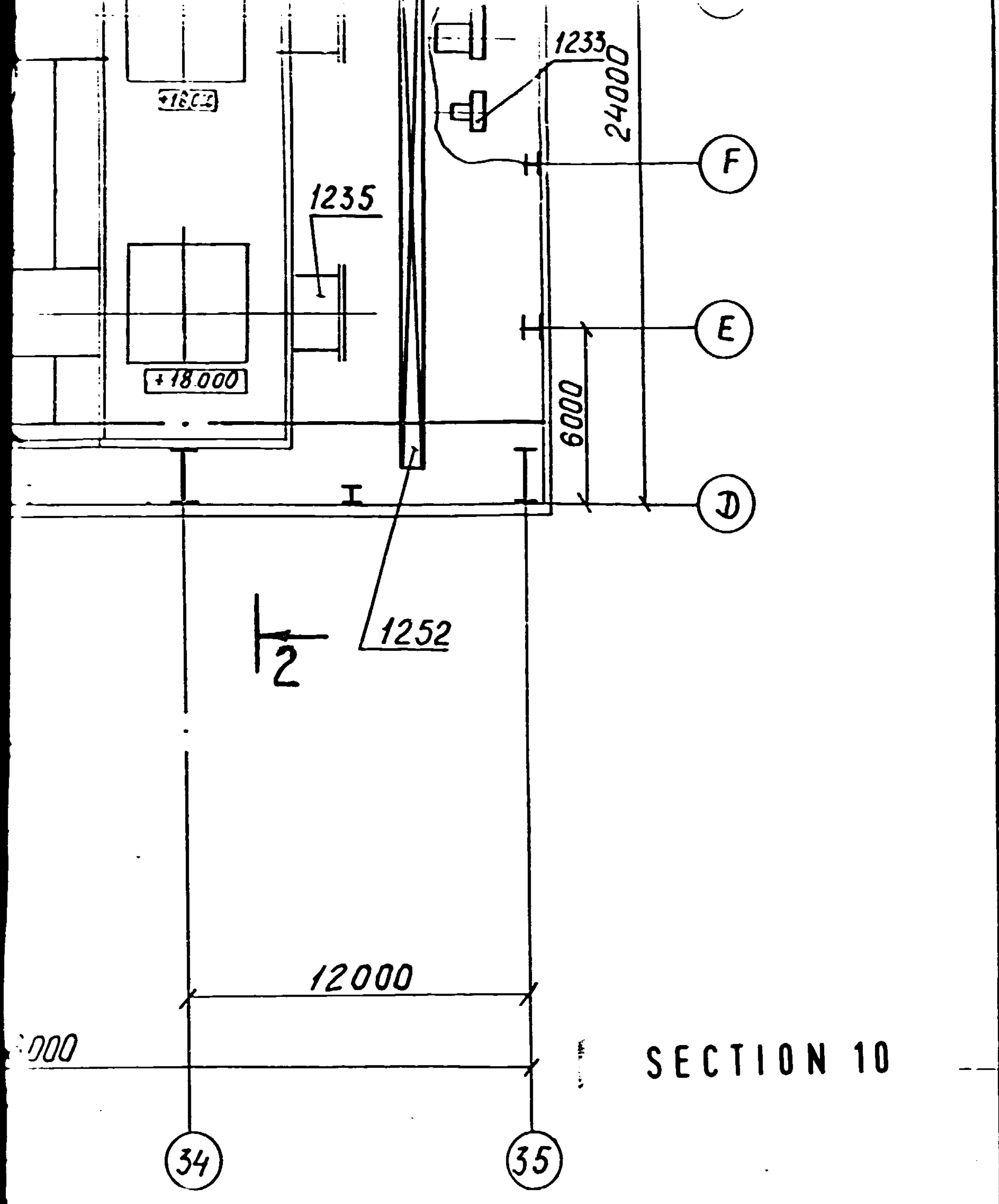


FINISH PRODUCT STORAGE
1263
+2,500
1265
1268
1266
1269
1272
1264
+8,000
1271
0,000
1245
+4,200
+8,000
1247
+1,200
0,000
+10,000
1
6000
12000
18 × 6000 = 108000
1500
3×12000=
10
24
25
26
27
28
29

SECTION 8


1248
1249
1244
1238
1236
1273
0,000
+8.000
5
1246
CALLERY TO SODA SILOS
1254
4x12000
12000=36000
30
31
32
33

SECTION 9



CONTRACT N 90/204/205

1398865-T

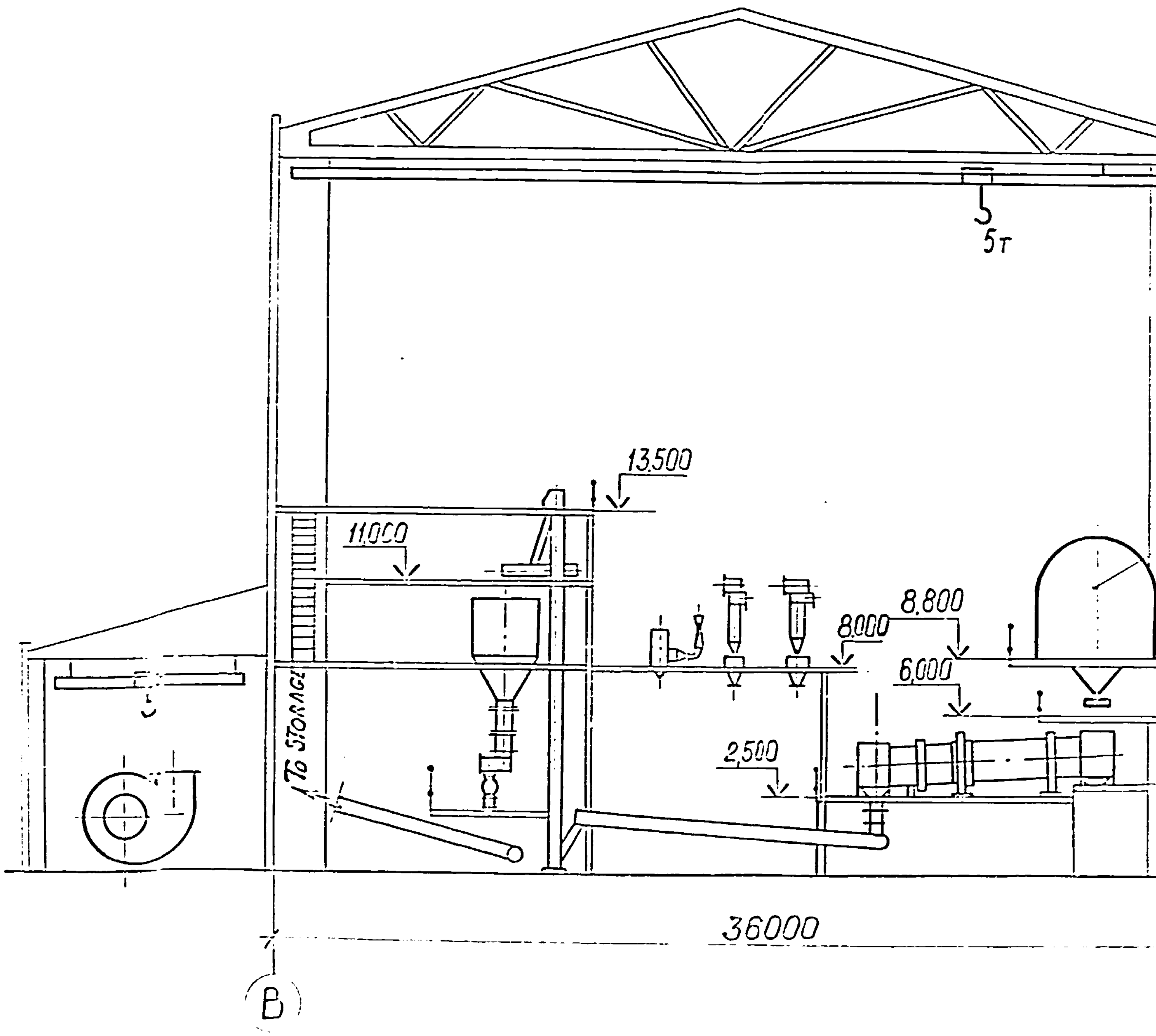
RAZGAH NEPHELINES PROCESSING PLANT (IRAN)

SODA CARBANATE AND POTASH PRODUCTION	PHASE	SHEET	SHEETS
	POS	4	4
PLAN	VAMI LENINGRAD		

Инв. № подл.	Подп. и дата	Взам. инв. №

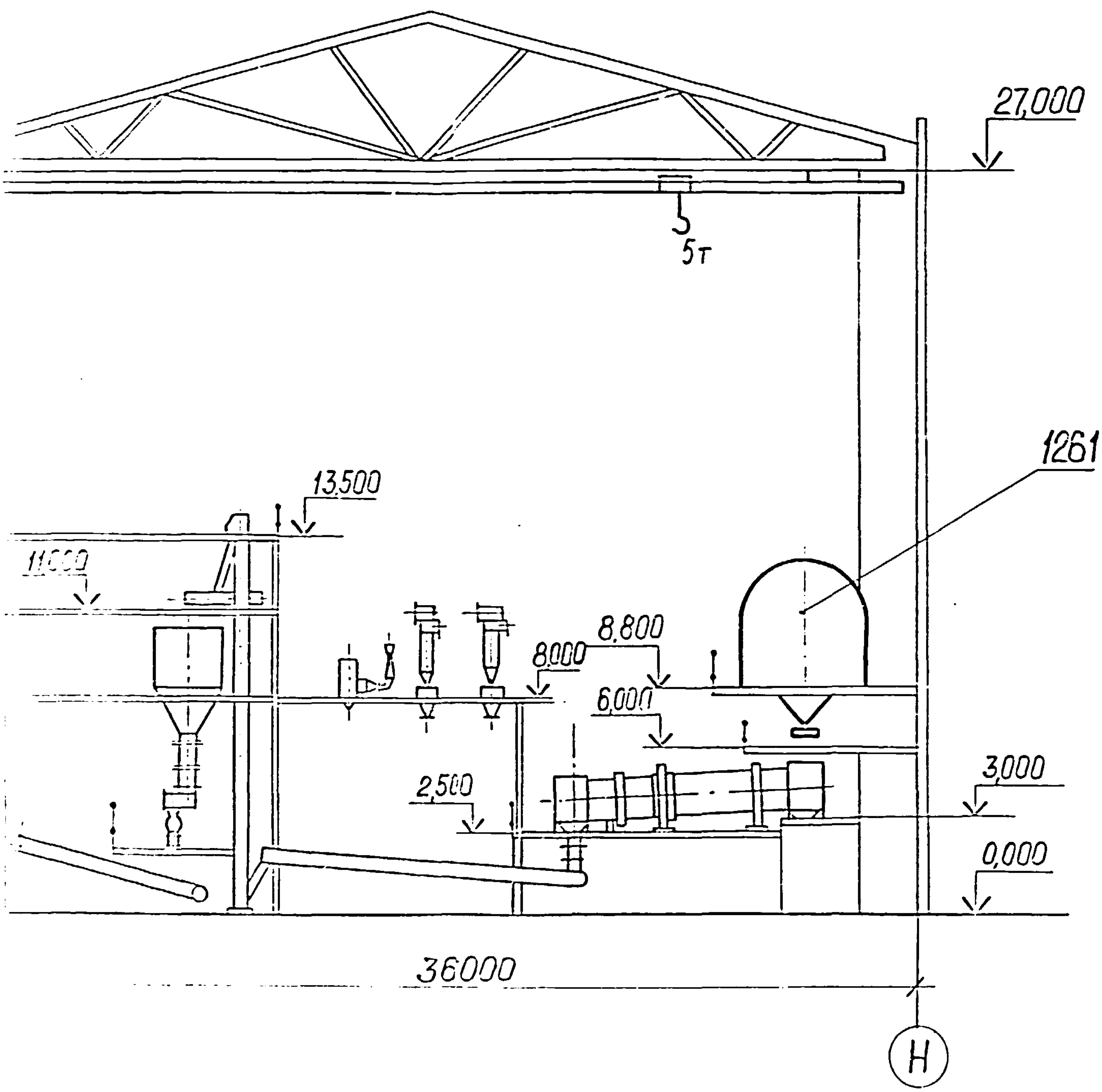
1398865-Т			
Завод по переработке нефелиновых руд месторождения Разгах (Иран)			
Содопоташное производство Сушка содопродуктов	Стадия	Лист	Листов
	ИВП	4	
План	ВАМИ Ленинград		

1 - 1

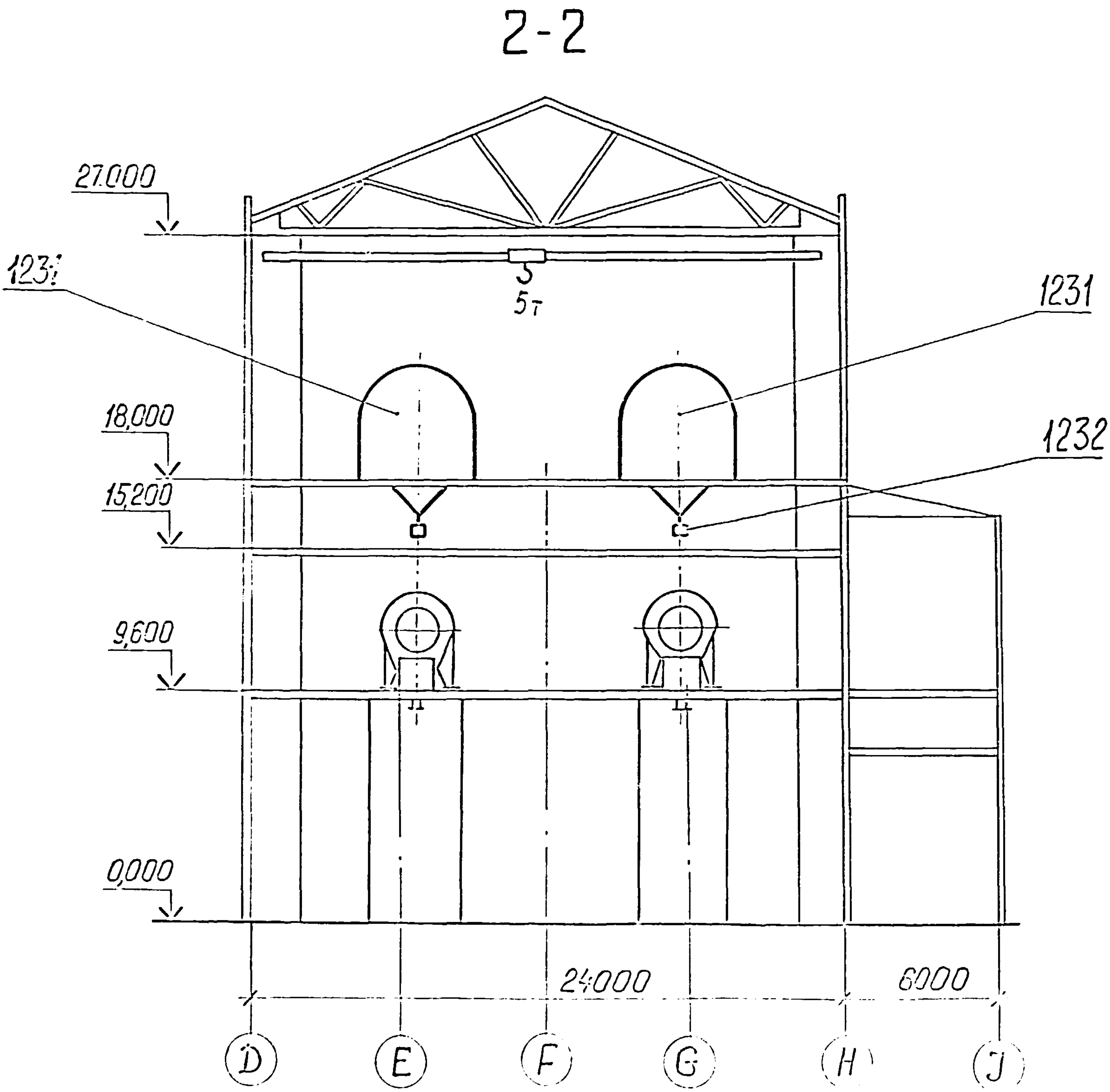


SECTION 1

1 - 1


27,000
5т
1261
13,500
11,000
8,800
8,000
6,000
3,000
2,500
0,000
36000
H

SECTION


2-2
27.000
1231
5т
1231
18,000
1232
15,200
9,600
0,000
24000
6000
D
E
F
G
H
J

SECTION 3

SECTION 4

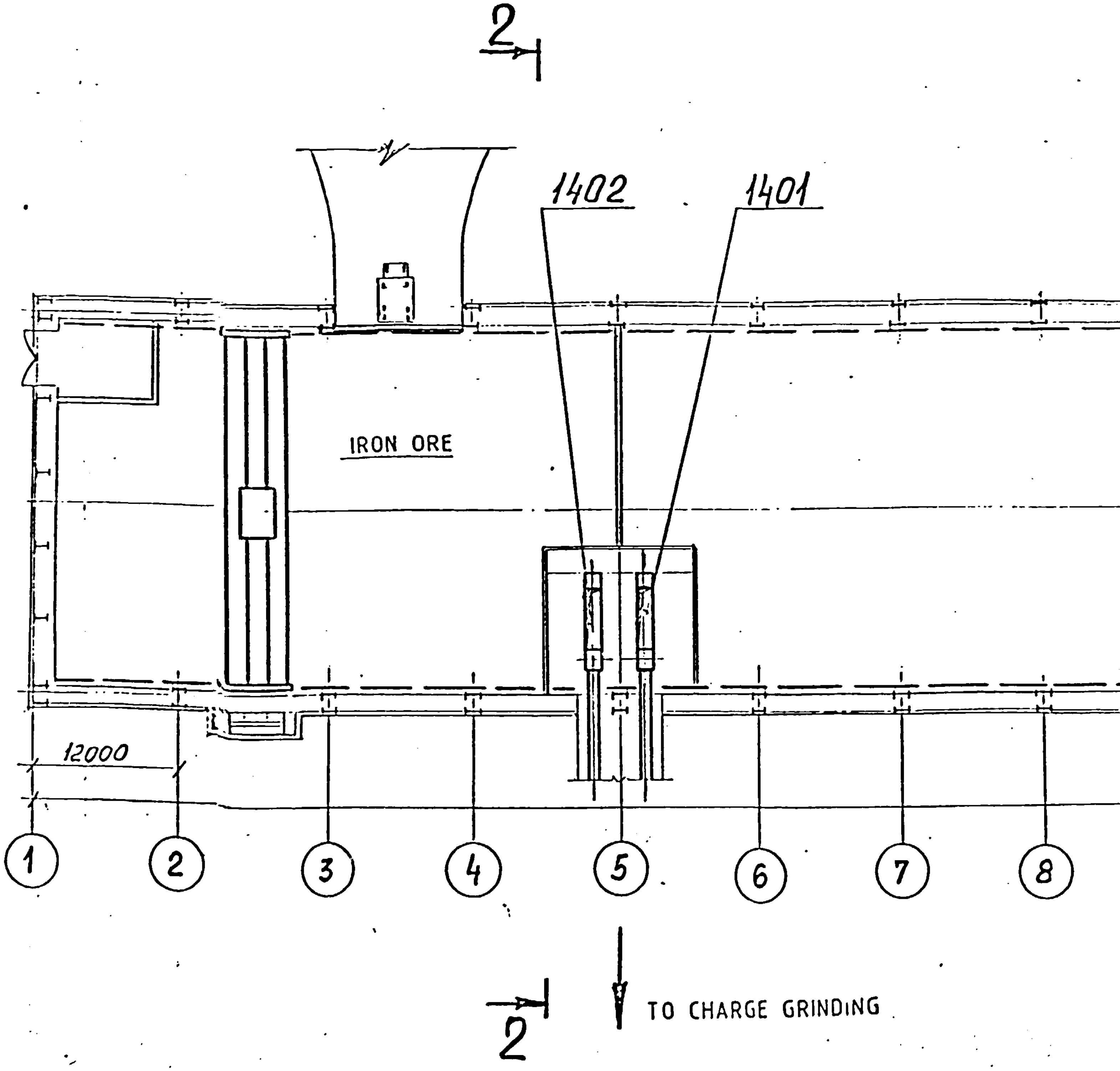
CONTRACT N 90/204/205

1398865-T			
RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
SODA CARBONATE AND POTASH PRODUCTION	PHASE	SHEET	SHEETS
	POS	5	
SECTIONS 1-1; 2-2	VAMI Leningrad		

1398865-Т			
ЗАВОД ПО ПЕРЕРАБОТКЕ НЕФЕЛИНОВЫХ РУД МЕСТОРОЖДЕНИЯ РАЗГАХ (ИРАН)			
Содопоташное производство. Сушка содопродуктов	Стадия	Лист	Листов
	ИВП	5	
Разрезы 1-1; 2-2.	ВАМИ Ленинград		

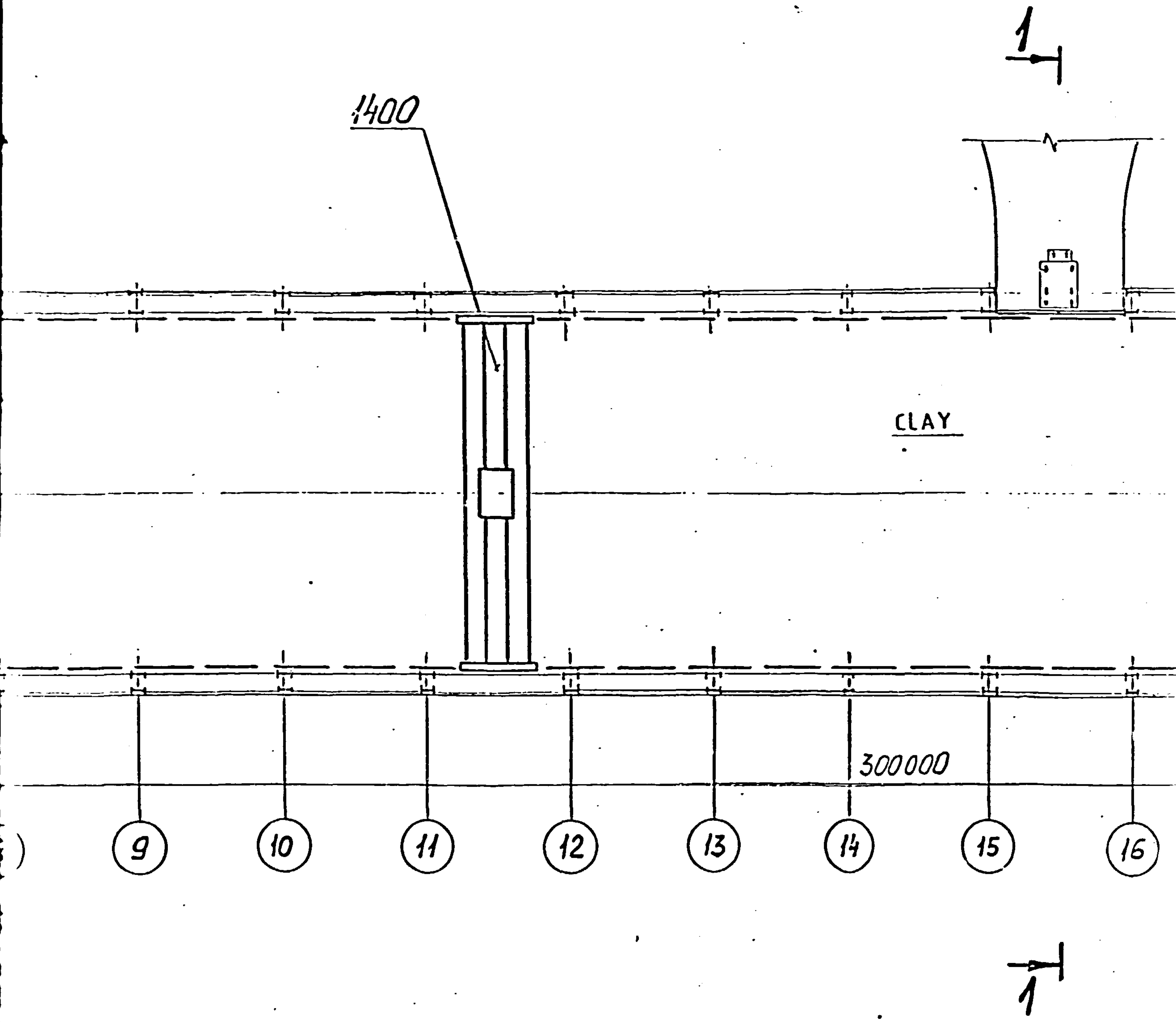
Инв. № подл. | Подп. и дата | Взам. инв. №

Формат А4х4

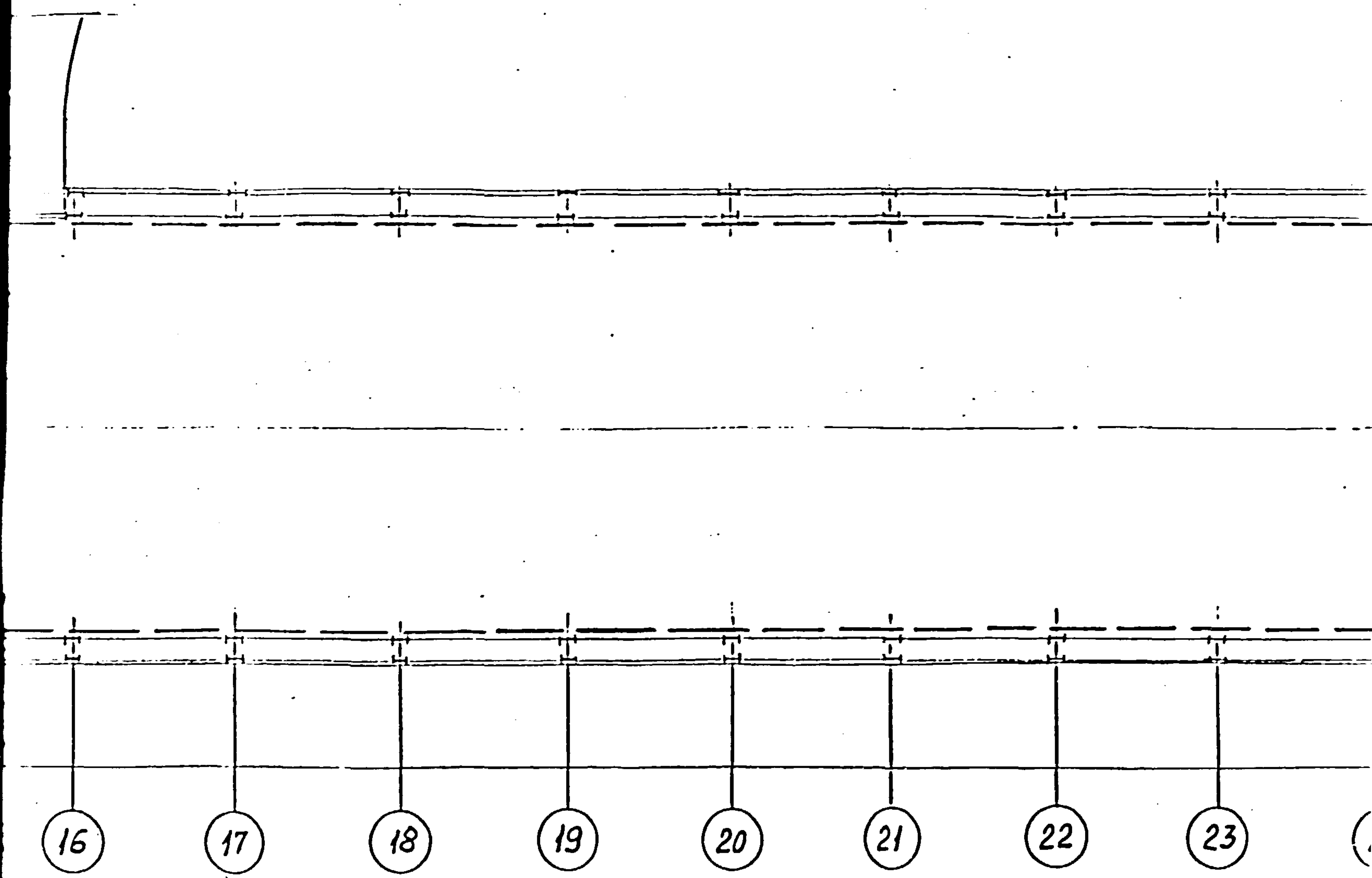


SECTION 1

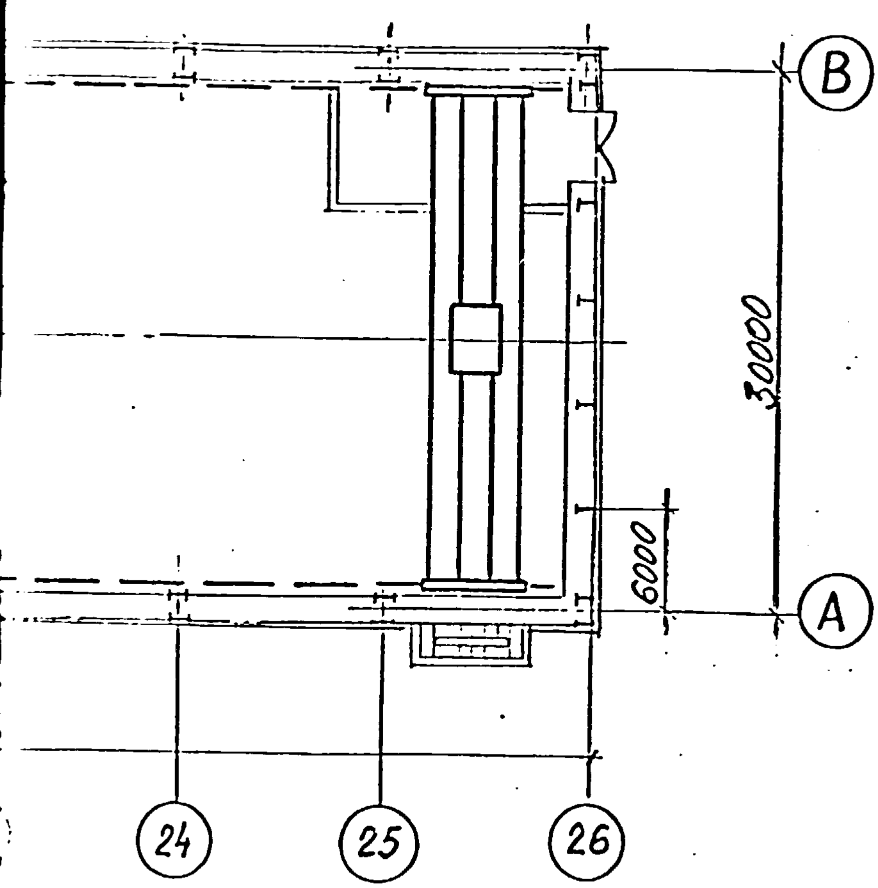
PLAN

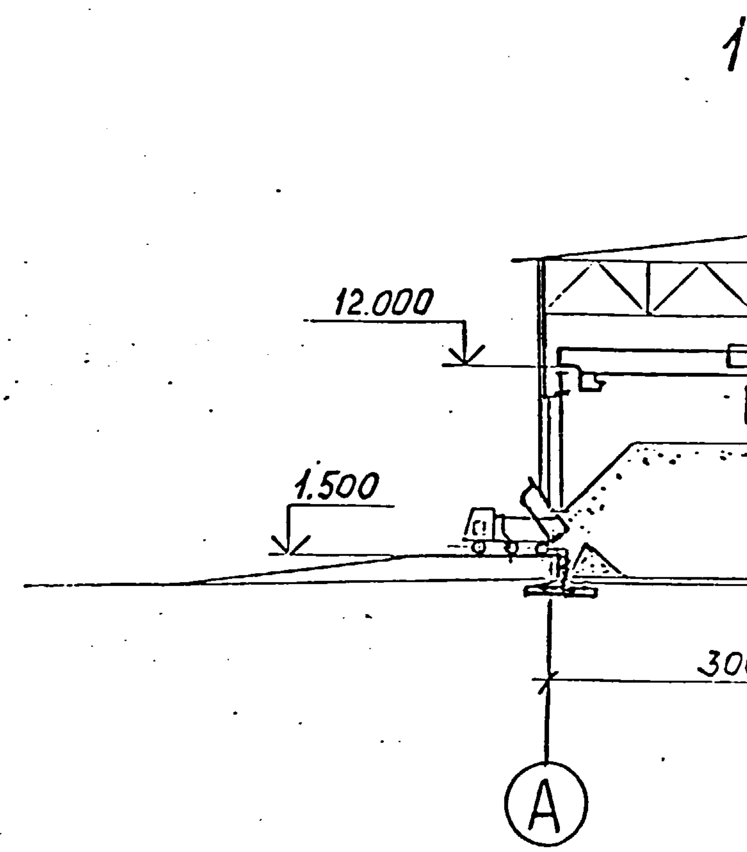


SECTION 2



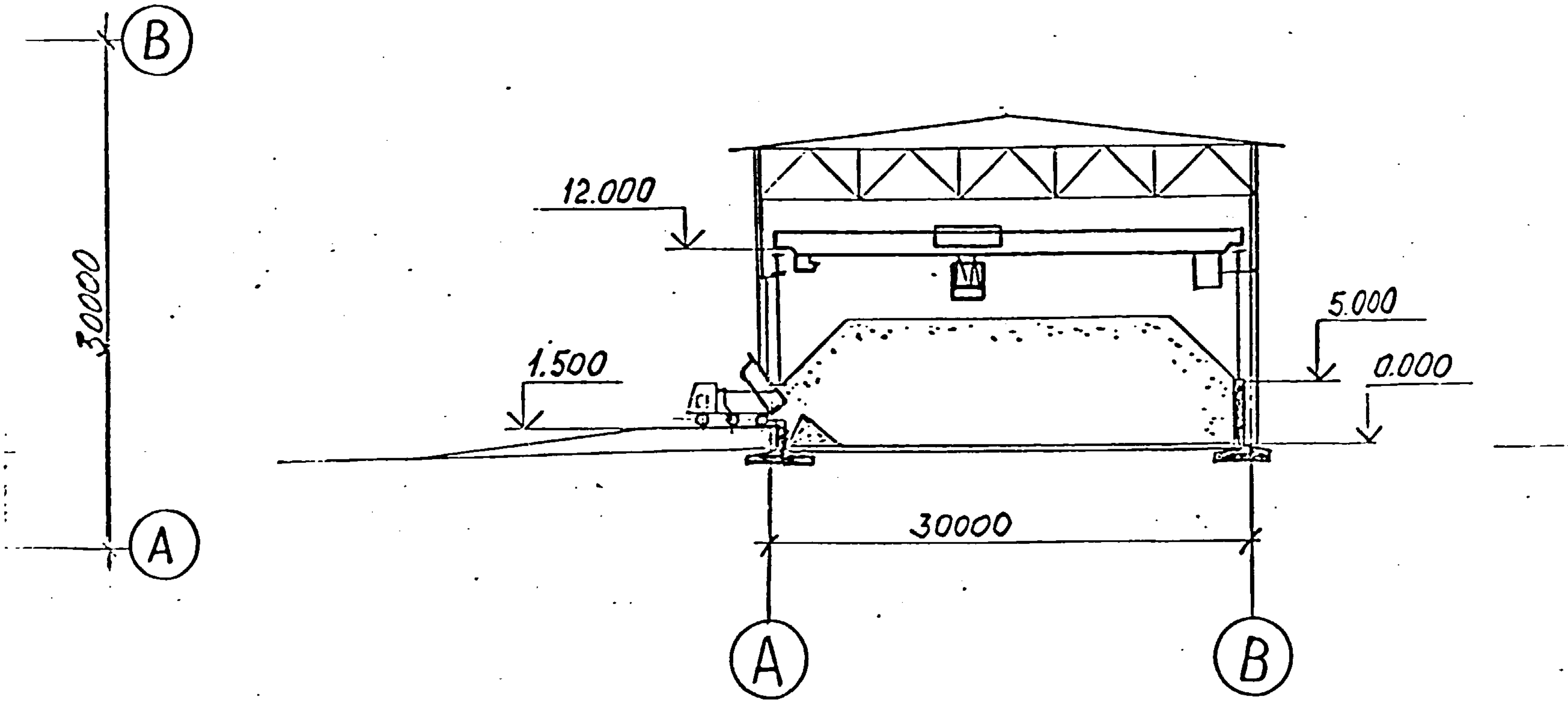
SECTION 3





SECTION 4

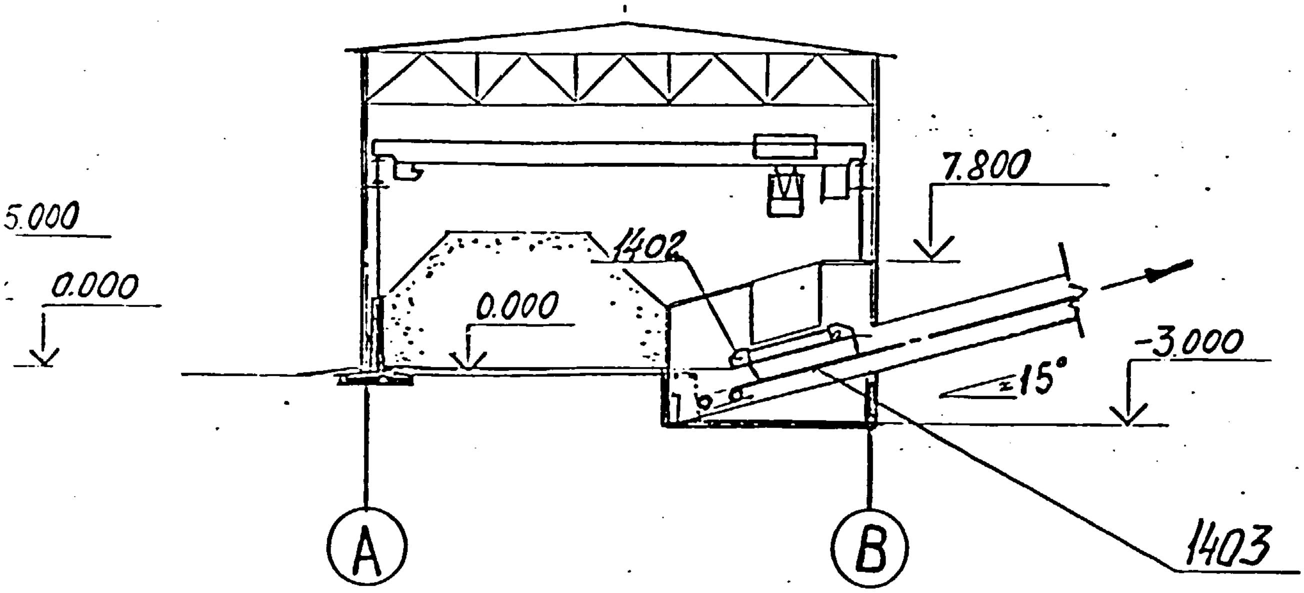
1-10



SECTION 5

2-20

SECTION 6



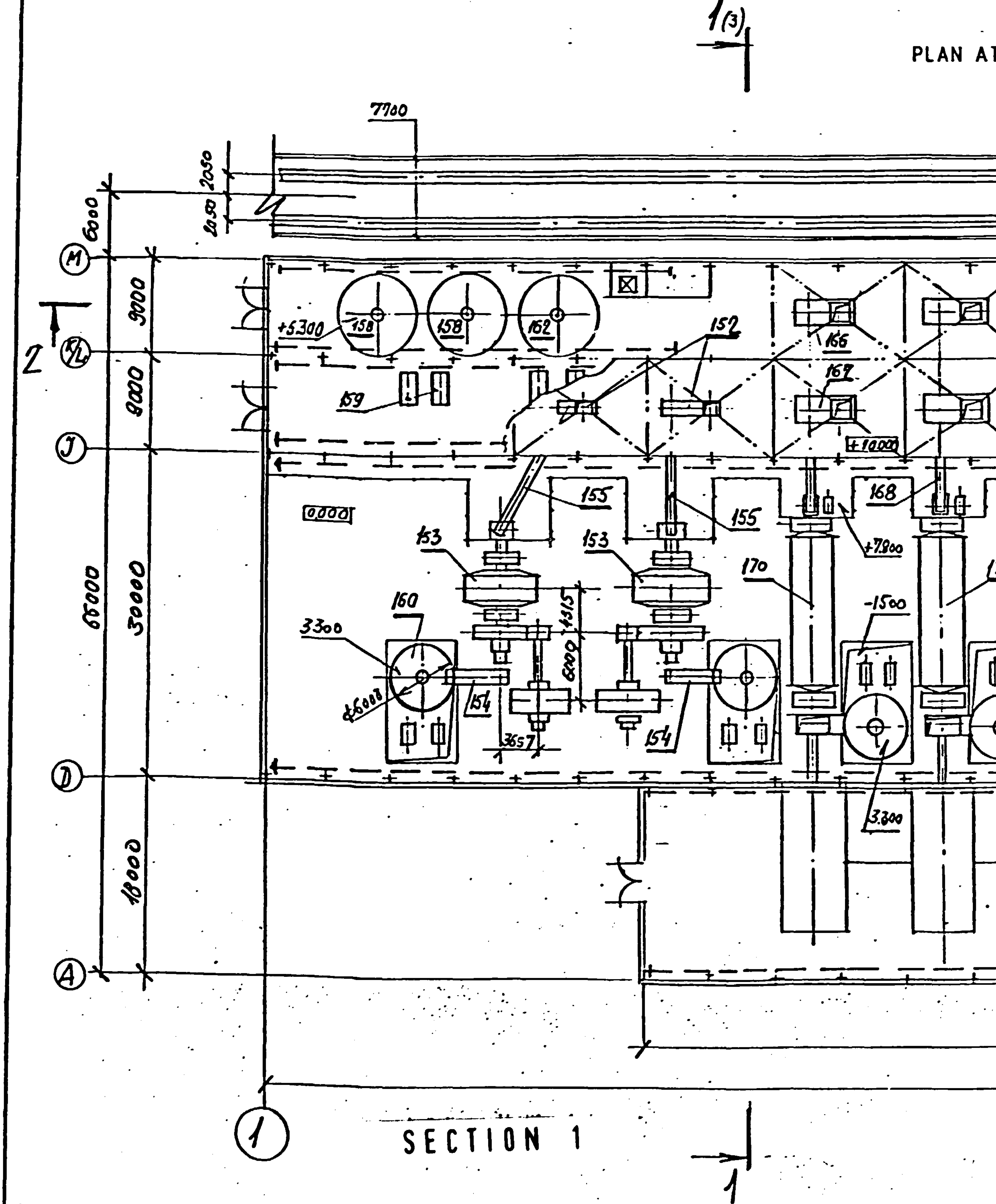
THE VIEWS ARE SHOWN IN SCALE 1:400.

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339646-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	CLAY AND IRON ORE STORAGE	PHASE	SHEET	SHEETS
		POS	2	
	PLAN. SECTIONS.	VAMI LENINGRAD		

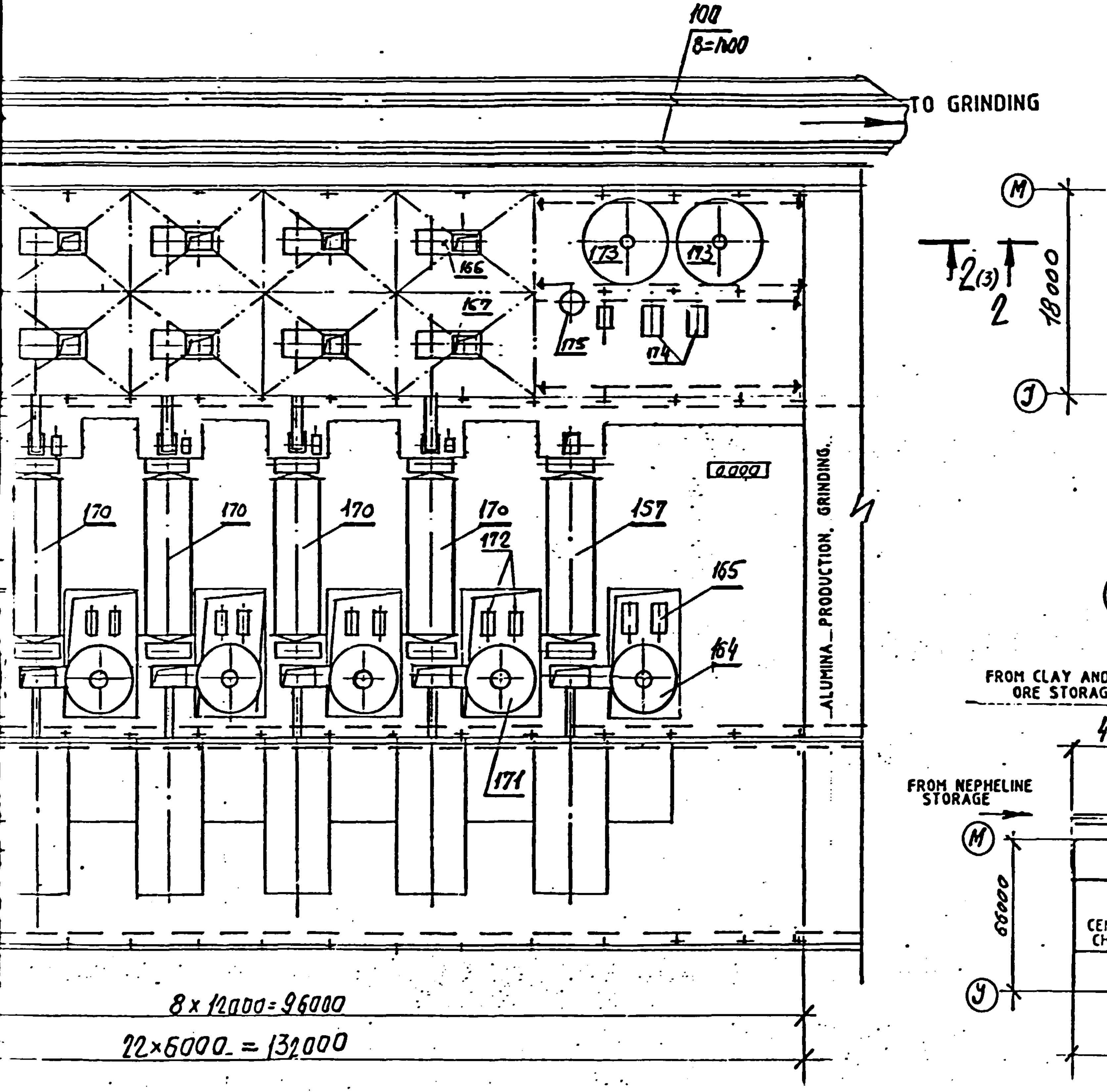
SIZE A4x6

PLAN AT



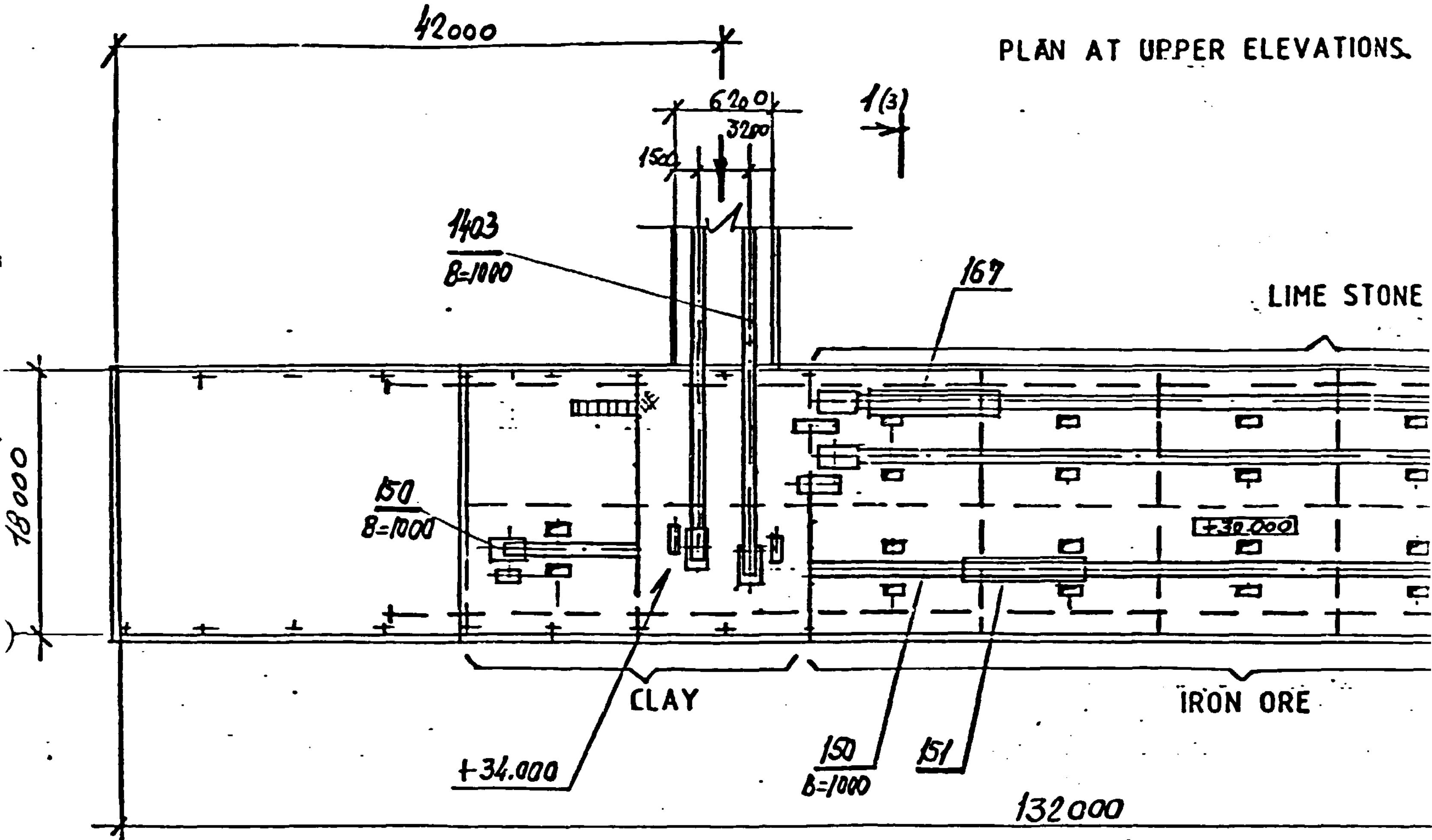
SECTION 1

'LAN AT MIDDLE ELEVATIONS.



SECTION 2

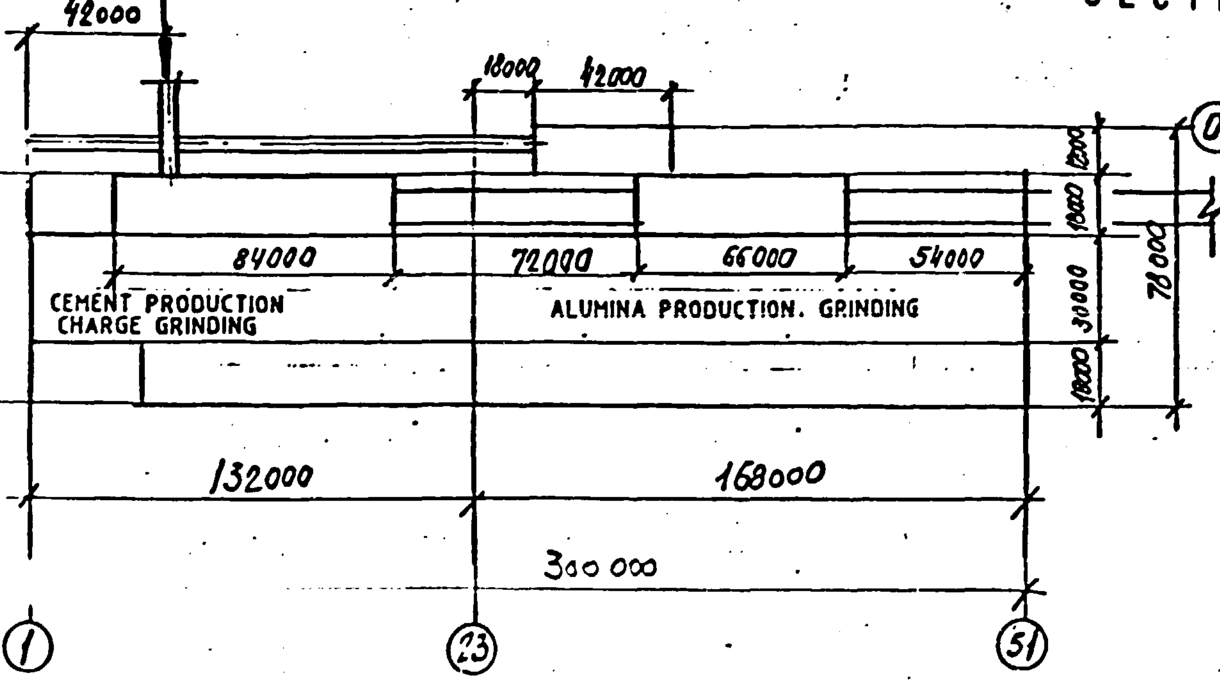
PLAN AT UPPER ELEVATIONS.



LOCATION LAY-OUT.
(1:2000)

SECTION 3

THE

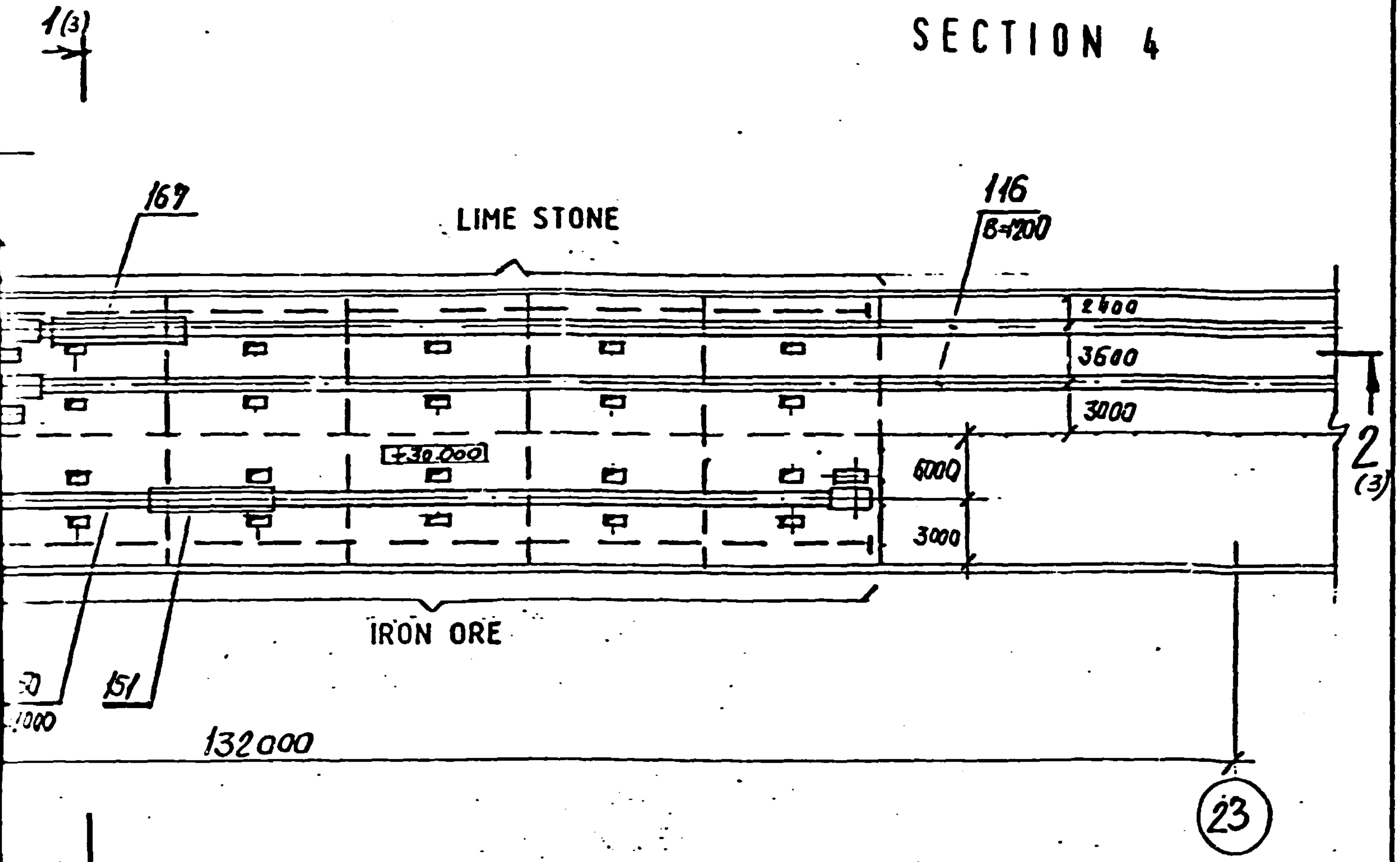


C

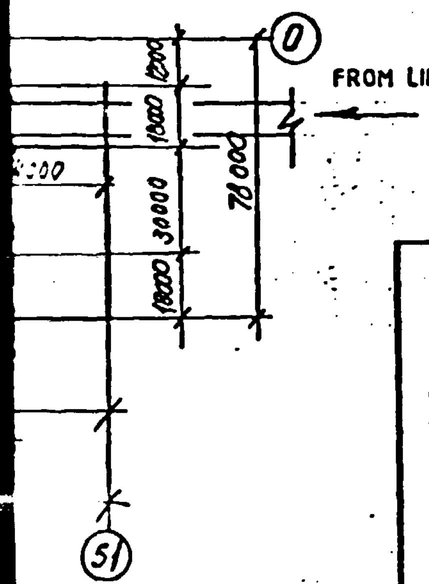
THIS DRAWING IS NOT
REPRODUCED OR TRAN
RED TO OTHER ORGANIZAT
OR PERSONS WITHOUT

PLAN AT UPPER ELEVATIONS.

SECTION 4



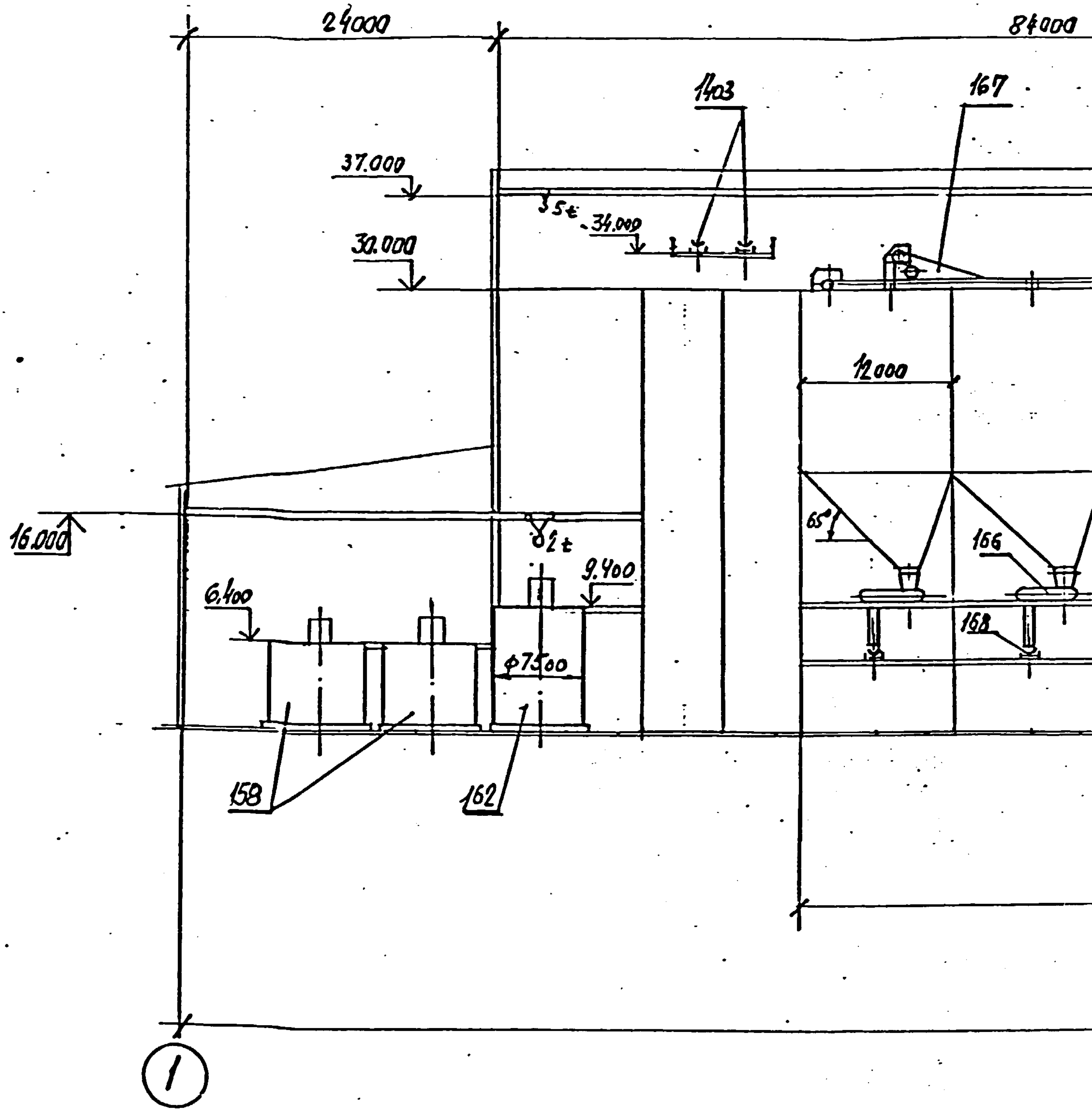
THE VIEWS ARE SHOWN IN SCALE 1:400



CONTRACT N 90/204/205

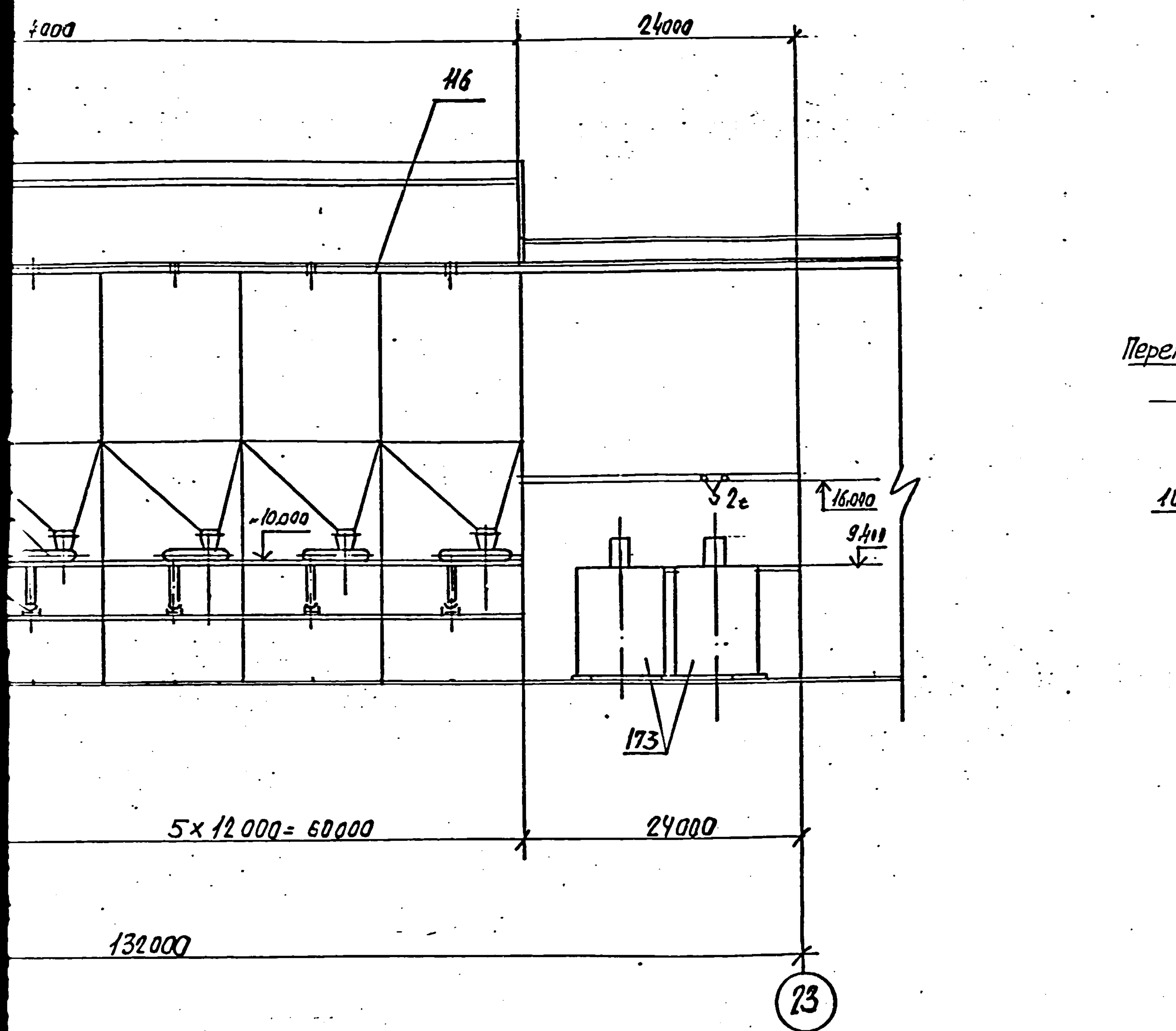
THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339647-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	CEMENT PRODUCTION CHARGE GRINDING	PHASE	SHEET	SHEETS
		POS	2	
	PLANS	VAMI LENINGRAD		

SIZE A4/4


24000
84000
1403
167
37.000
30.000
5t
34.000
12000
65°
166
16.000
6.400
9.400
2t
φ7500
168
158
162
1

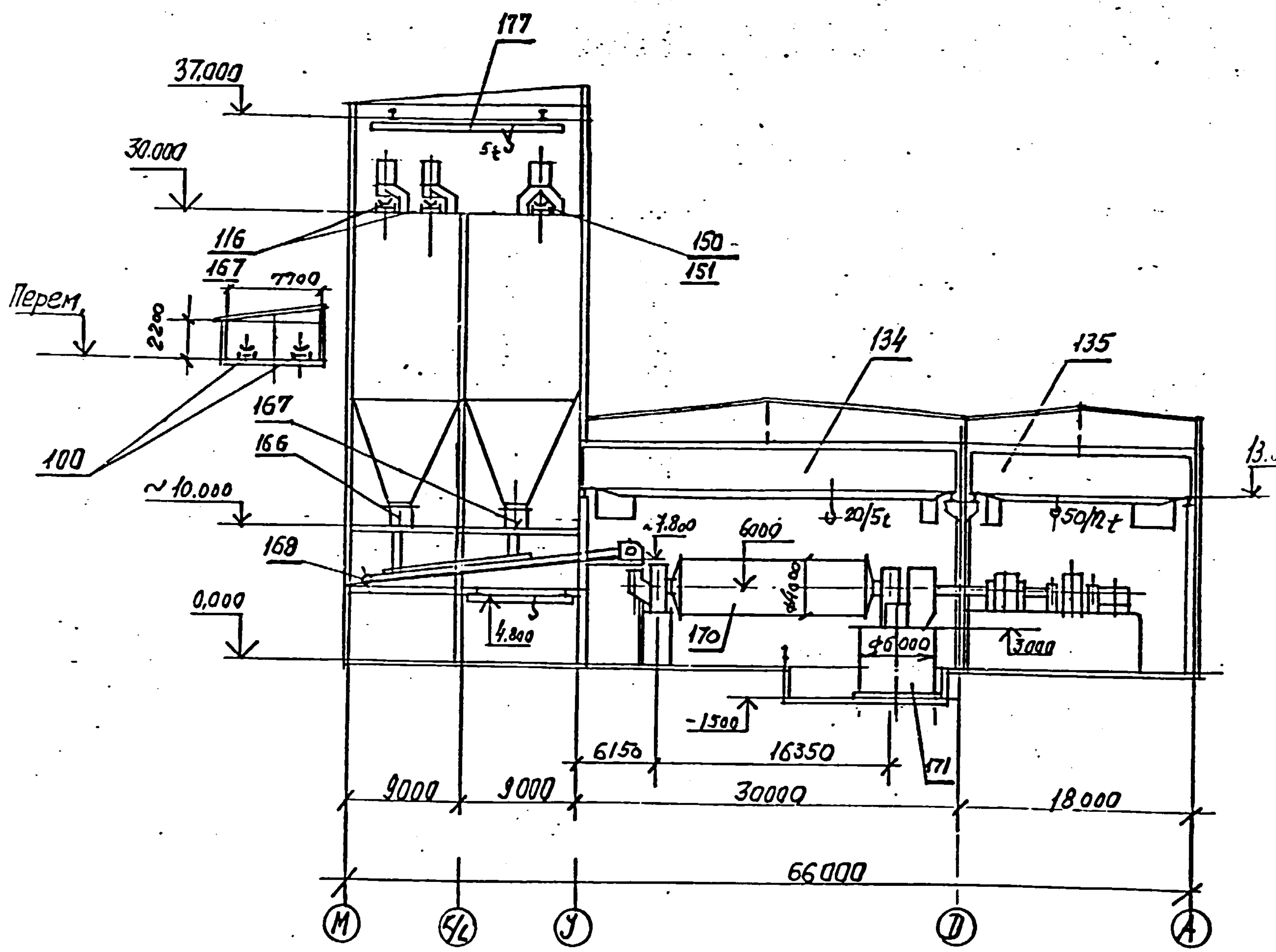
SECTION 1

2-2 (2)



SECTION 2

1-10 (2)

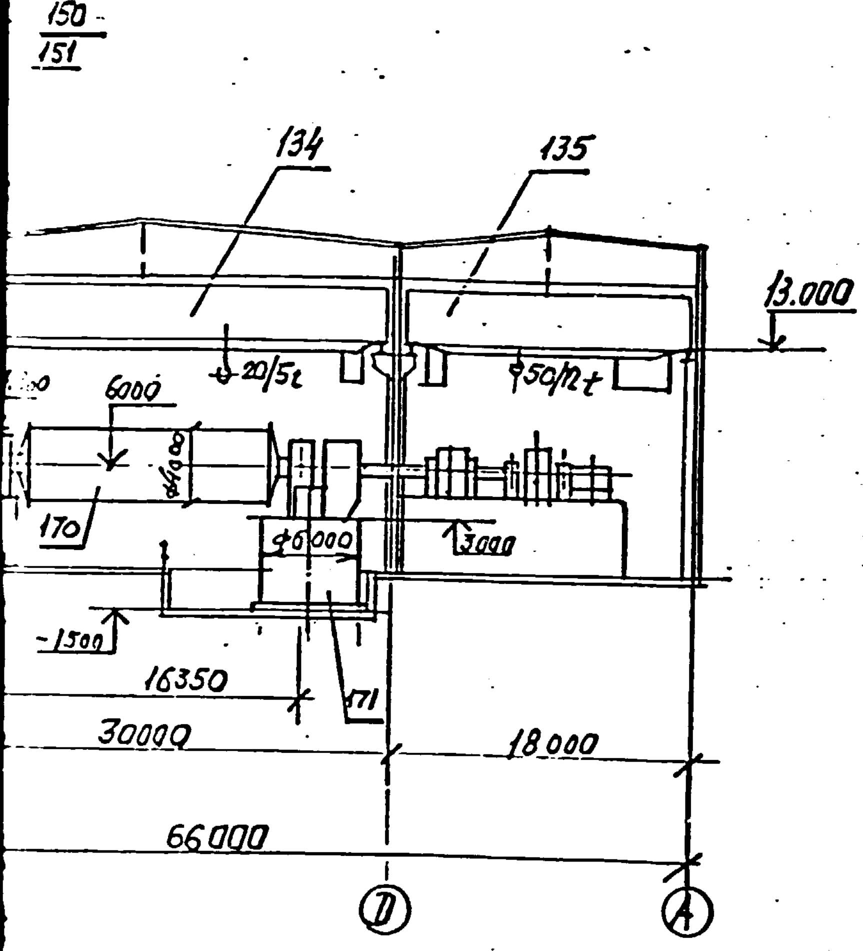


CONT.

SECTION 3

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI

1-10 (2)



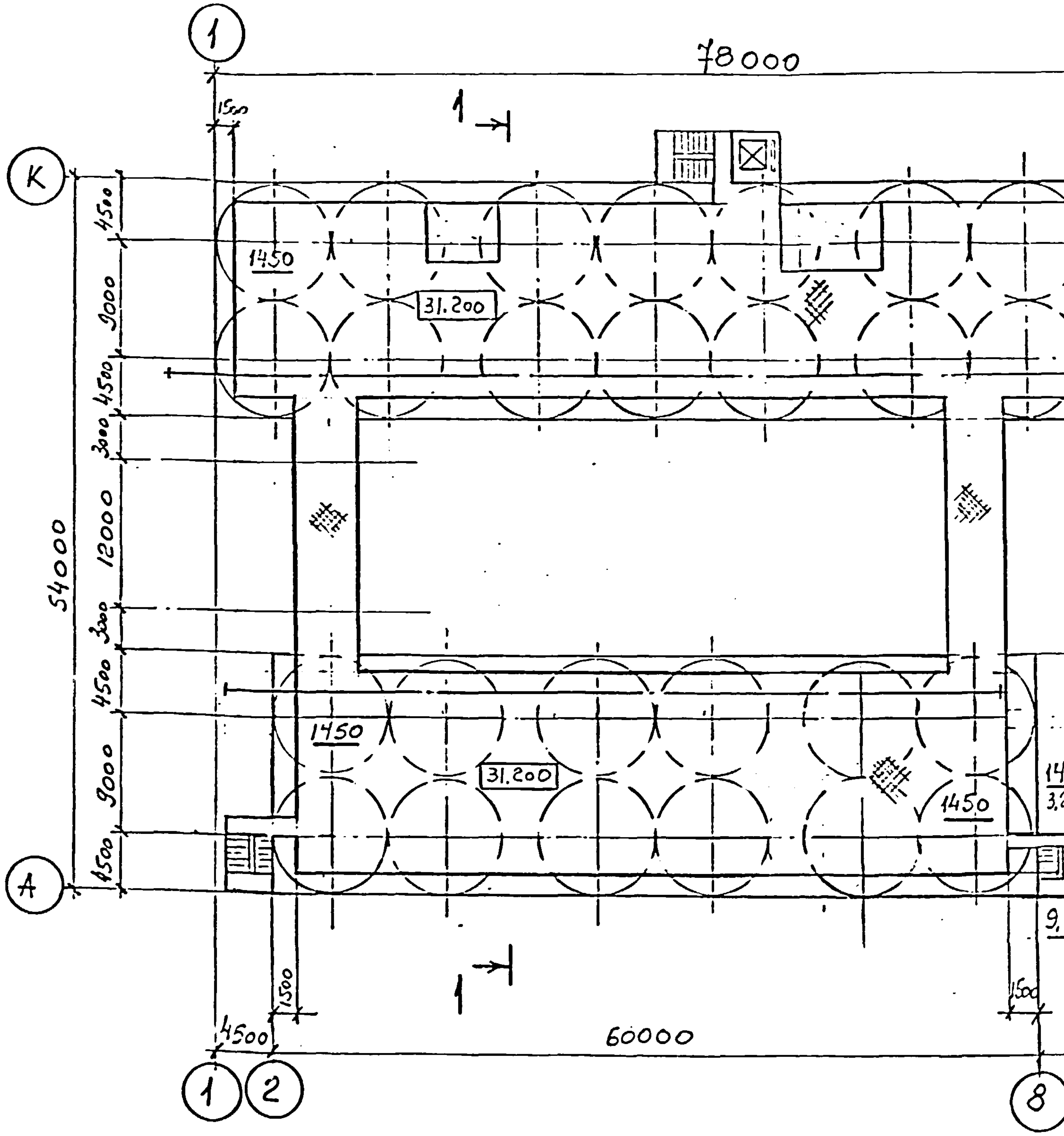
SECTION 4

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339647-T		
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)		
	CEMENT PRODUCTION CHARGE GRINDING	PHASE: POS	SHEET: 3 / SHEETS:
	SECTIONS.	VAMI LENINGRAD	

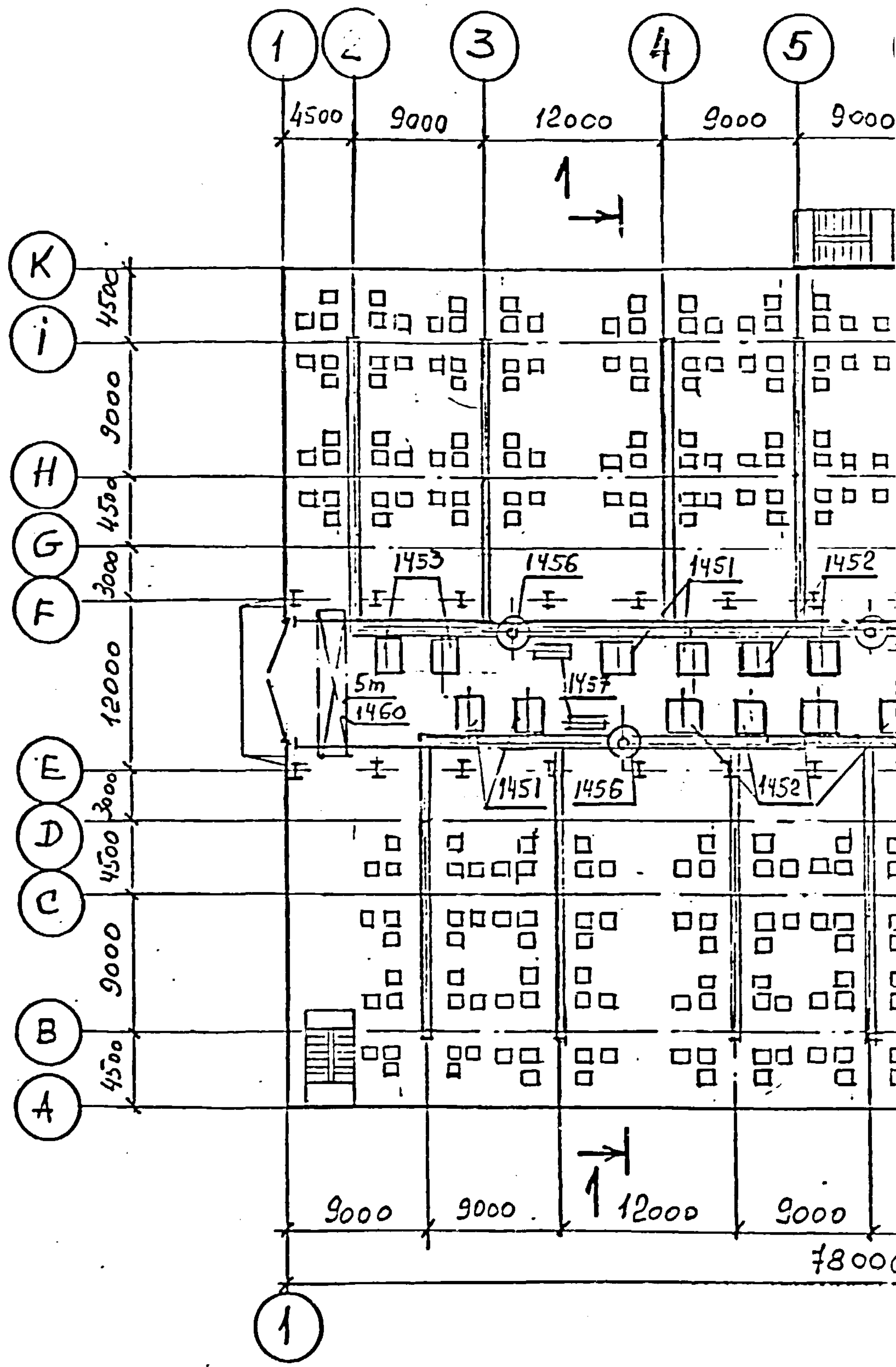
SIZE A4x4

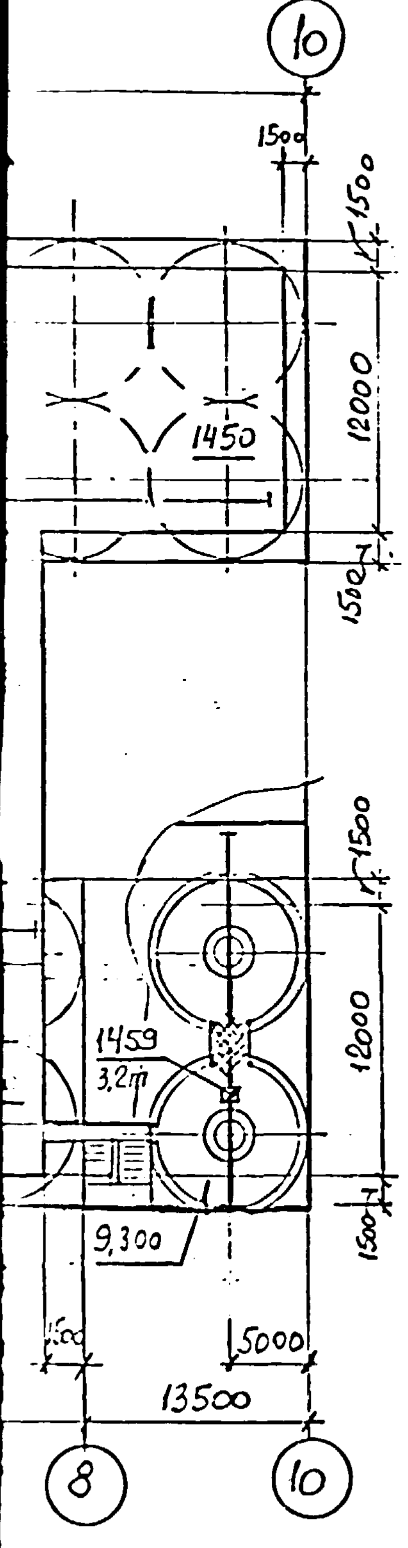
PLAN AT EL. 31.200



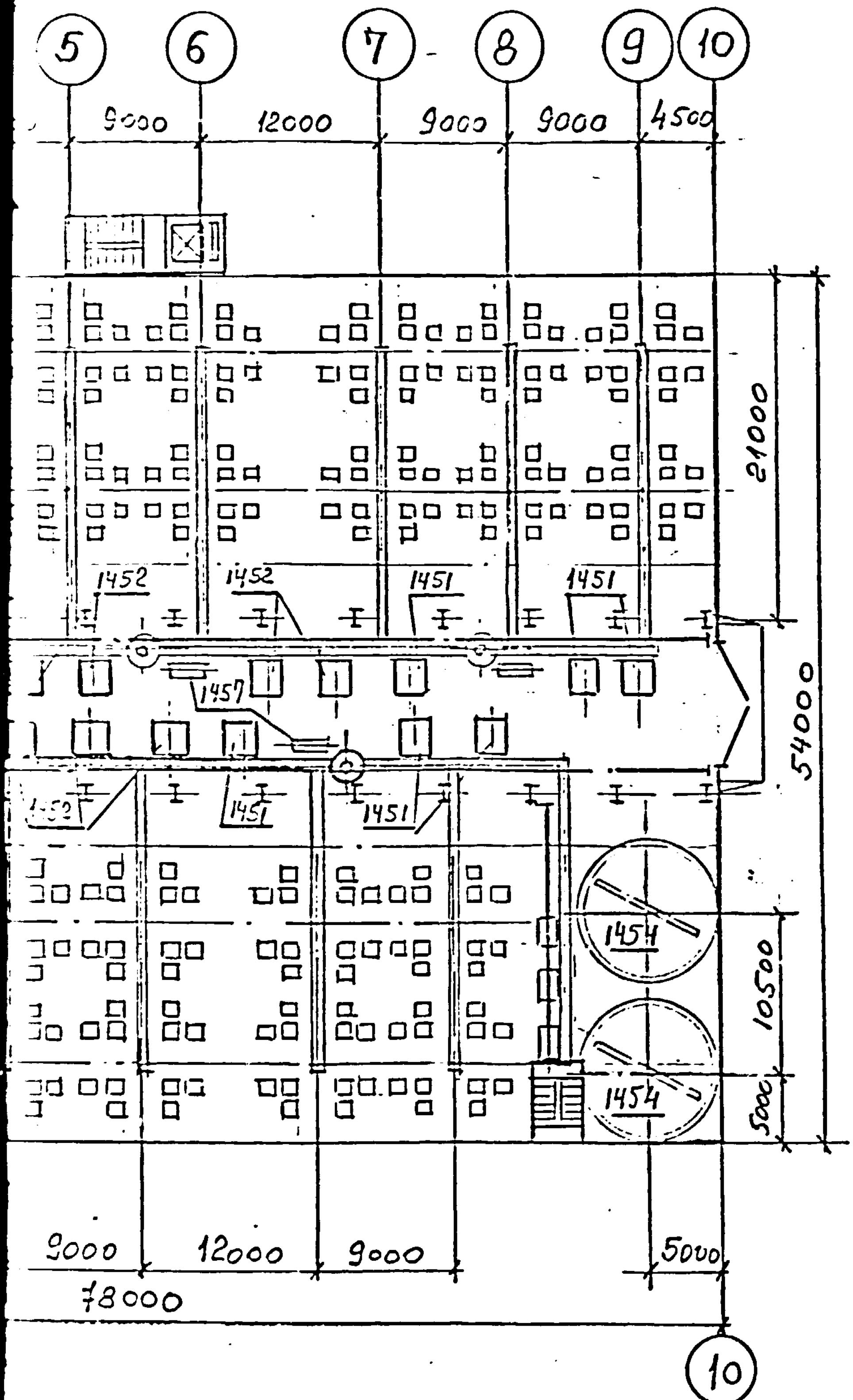
SECTION 1

PLAN AT EL. 0.000

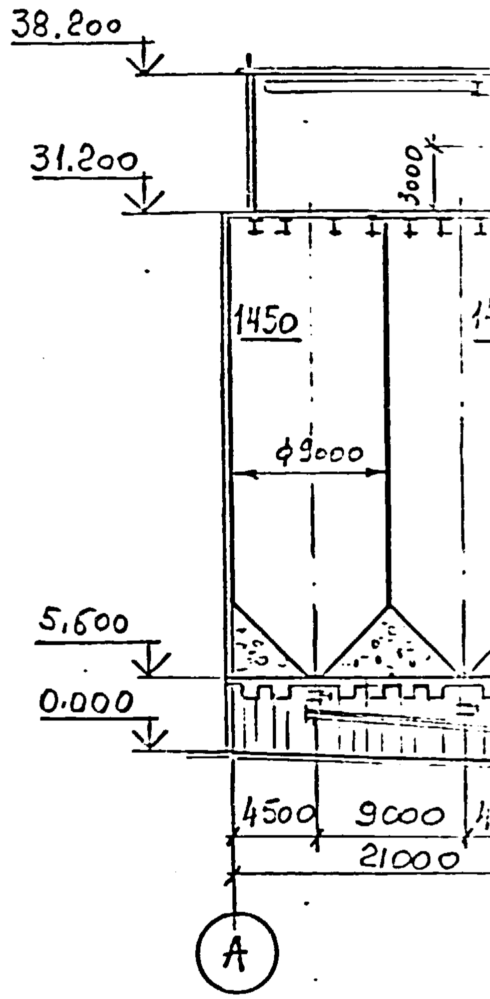




SECTION 2



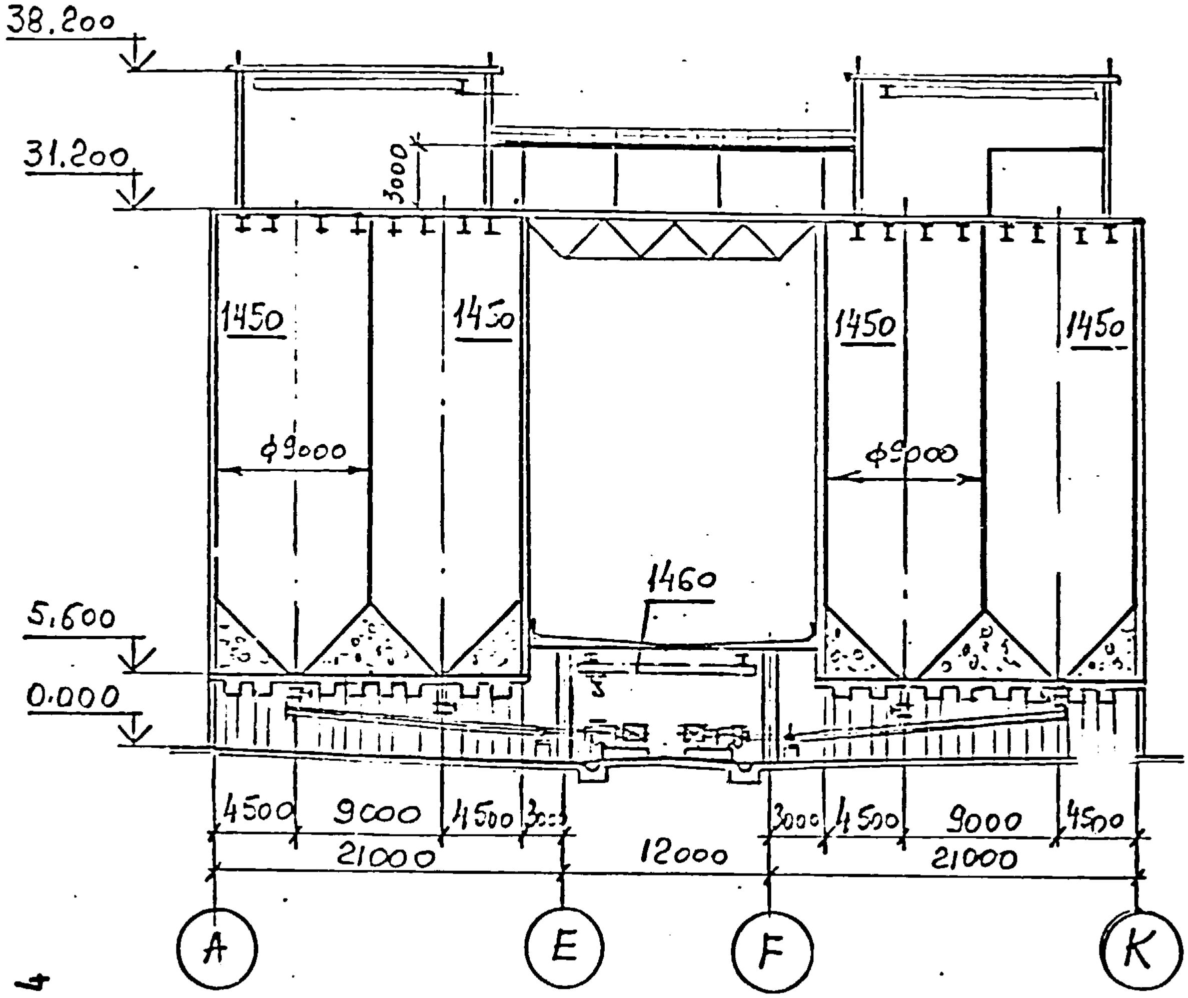
SECTION 3



THE VIEWS

THIS DRAWING IS NOT
REPRODUCED OR TRA
RED TO OTHER ORGANIZA
OR PERSONS WITHOUT
MENT WITH VAMI

1-1



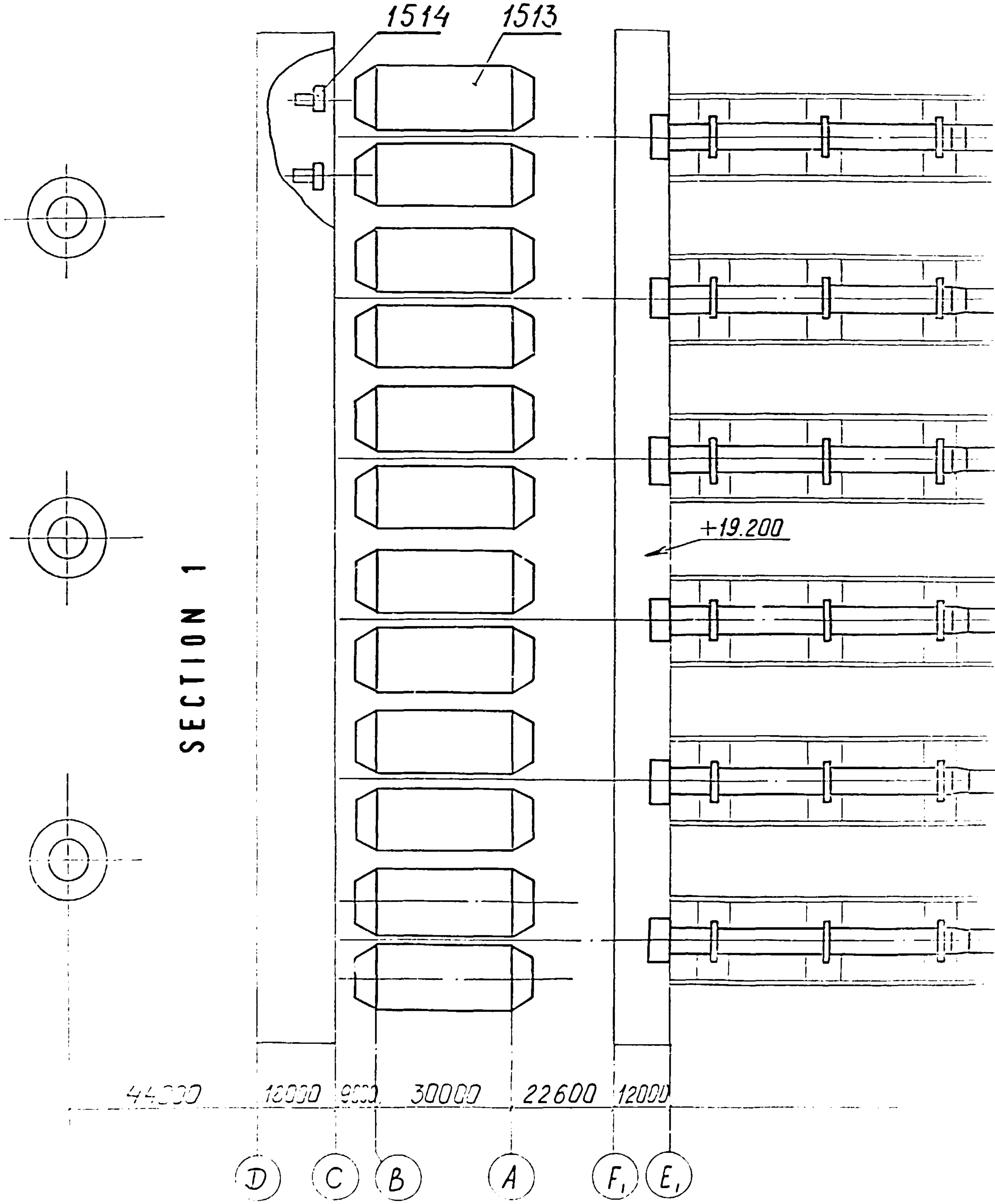
SECTION 4

THE VIEWS ARE SHOWN IN SCALE 1:400

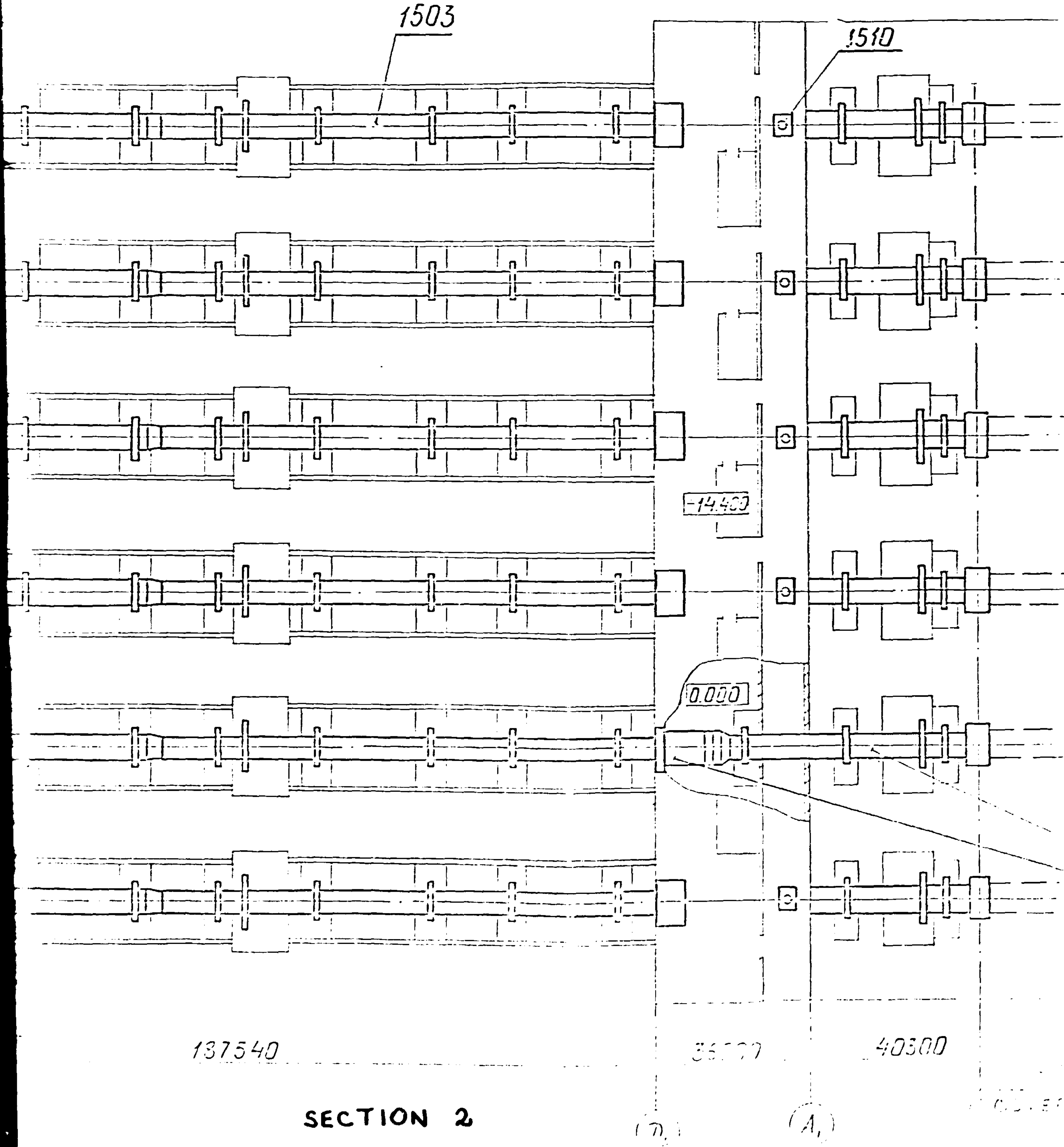
CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE P[illegible]DUCED OR TRANSFER-[illegible] TO OTHER ORGANIZATIONS OR [illegible]RSONS WITHOUT AGREEMENT WITH VAMI	1339648-T		
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)		
	CEMENT PRODUCTION CORRECTION BASINS	PHASE	SHEET	SHEETS
		POS	2	
	PLANS AT EL. 0.000;31.200 SECTION 1-1.	VAMI LENINGRAD		

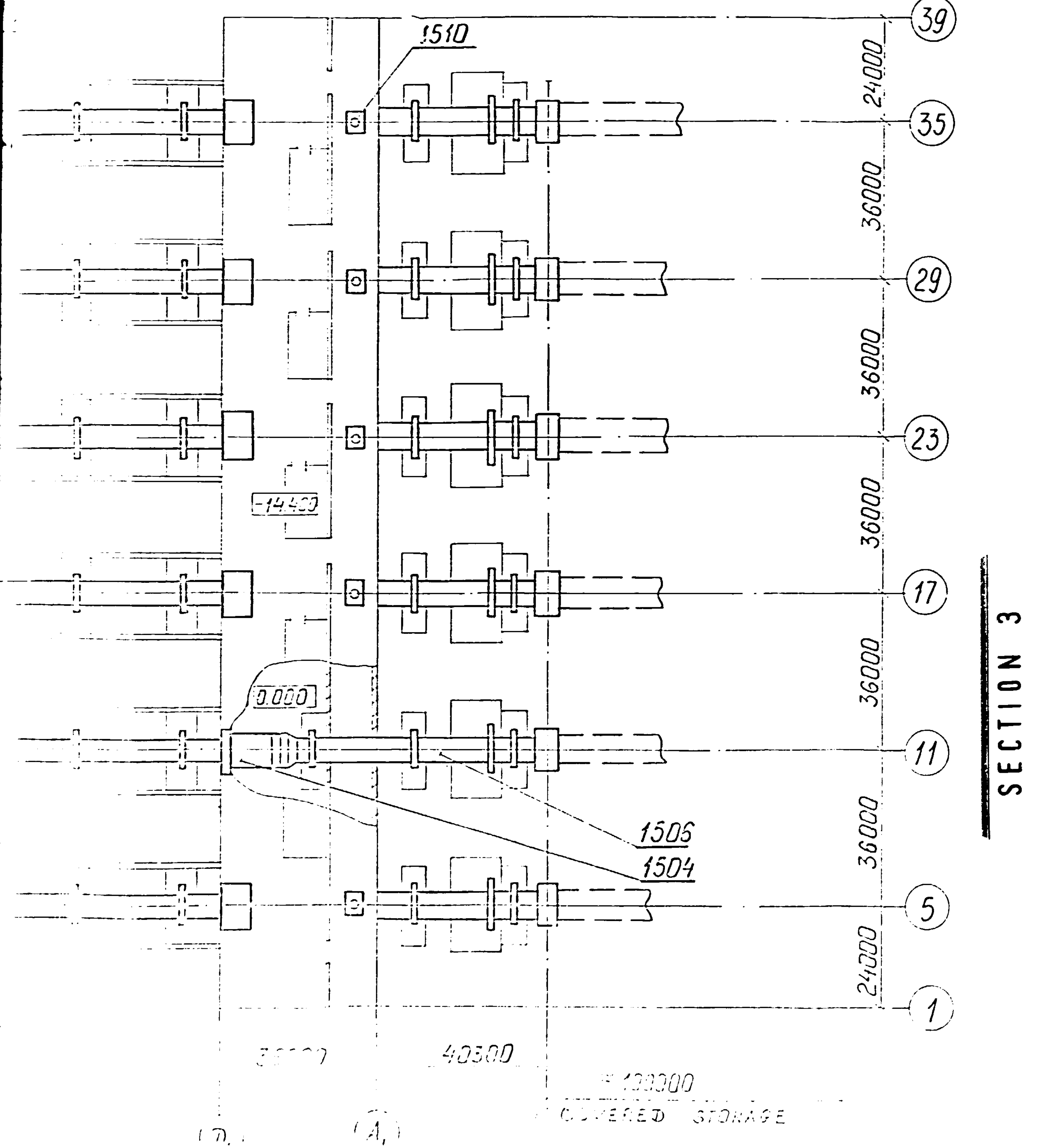
SIZE A4x4



1514
1513
SECTION 1
+19.200
44000
16000
9000
30000
22600
12000
D
C
B
A
F1
E1



SECTION 2



1510
39
35
29
23
17
11
5
1
24000
36000
36000
36000
36000
36000
24000
-14.400
0.000
1506
1504
40300
COVERED STORAGE
D
A
SECTION 3

SECTION 4

CONTRACT N 90/204/205

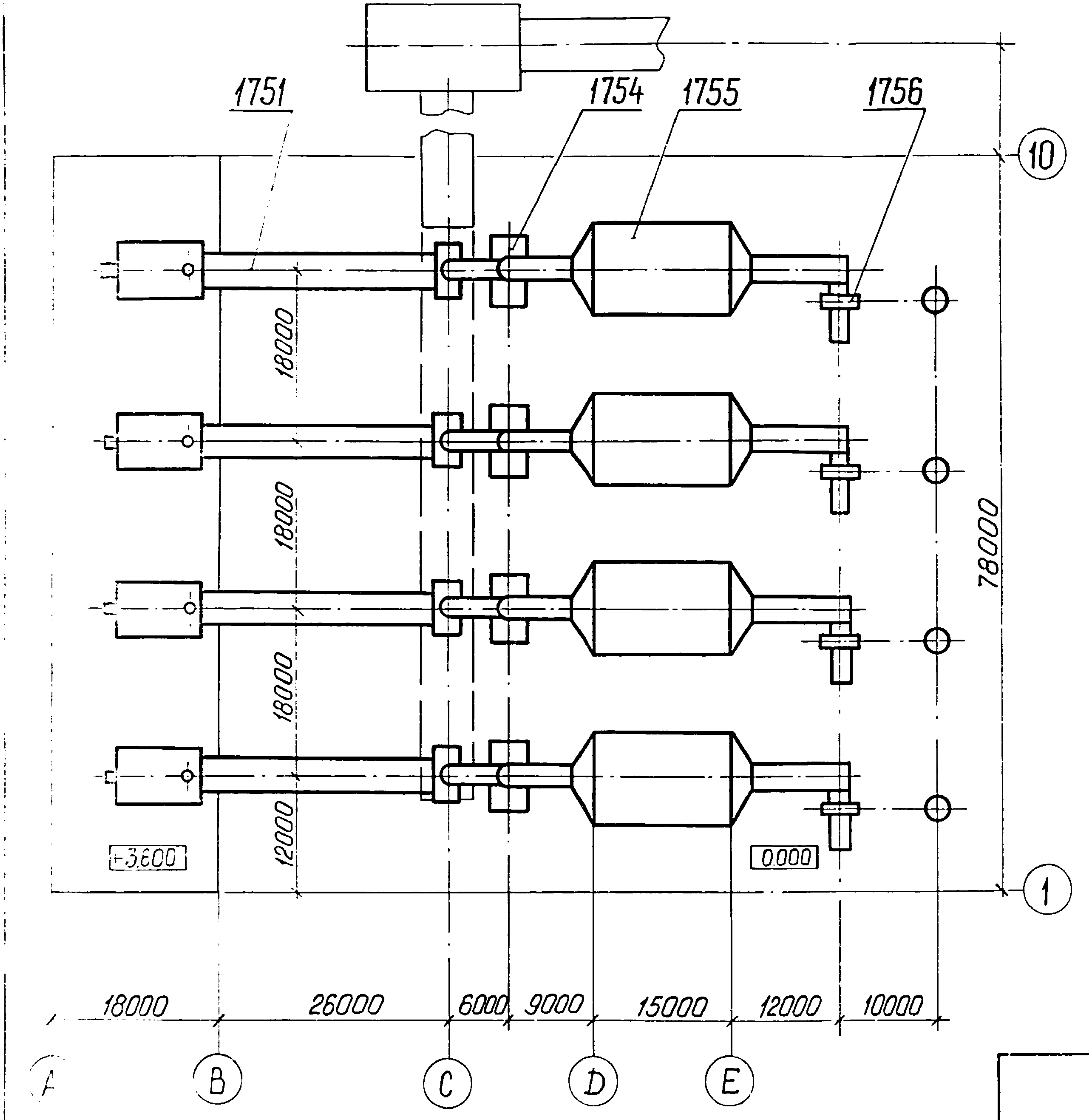
This drawing is not to be [illegible] or transferred to other organizations or persons without agreement with VAMI	1398866-T		
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)		
	CEMENT PRODUCTION CLINKER BURNING	PHASE	SHEET	SHEETS
		PDS	2	
	PLAN	VAMI Leningrad		

SIZE A4x4

Инв.№подл.	Подп. и дата	Взам.инв.№

1398866-Т			
Завод по переработке нефелиновых руд месторождения Разгах (Иран)			
Цементное производство Обжиг клинкера	Стадия	Лист	Листов
	ИВП	2	
План	ВАМИ Ленинград		

Формат А4х4



SECTION 1

THIS DRA
REPRODU
RED TO
OR PER

SECTION 2

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1398867-T		
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)		
	CEMENT PRODUCTION DRYING OF BELLITE MUD	PHASE / POS	SHEET / 2
	PLAN	VAMI LENINGRAD	

SIZE A3

Инв. N° подл.	Подп. и дата	Взам. инв. N°

Констр.	Горшкова		
Провер.	Мершалов		
Провер.	Зверев		
Рук. гр.	Лакисов		10.31
Гл. констр.	Ягуд		08.9
Наусект.	Голиков		
Нач. отд.	Беляков		
Перевод	Корчагин		
Н. контр.	Родионов		
ГИП	Каим		

1398867-Т

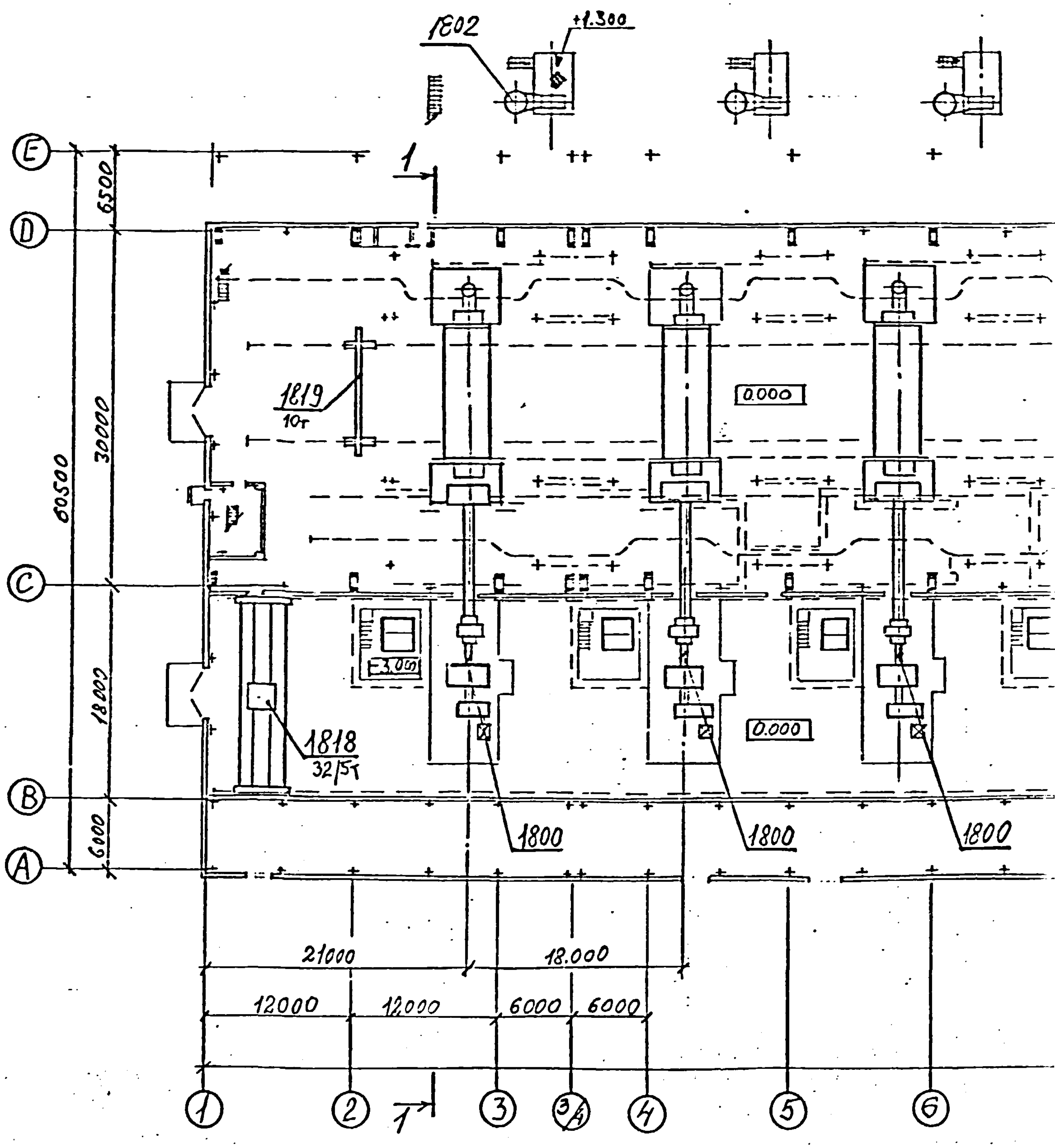
Завод по переработке нефелиновых руд месторождения Разгах (Иран)

Цементное производство
Сушка белитового шлама

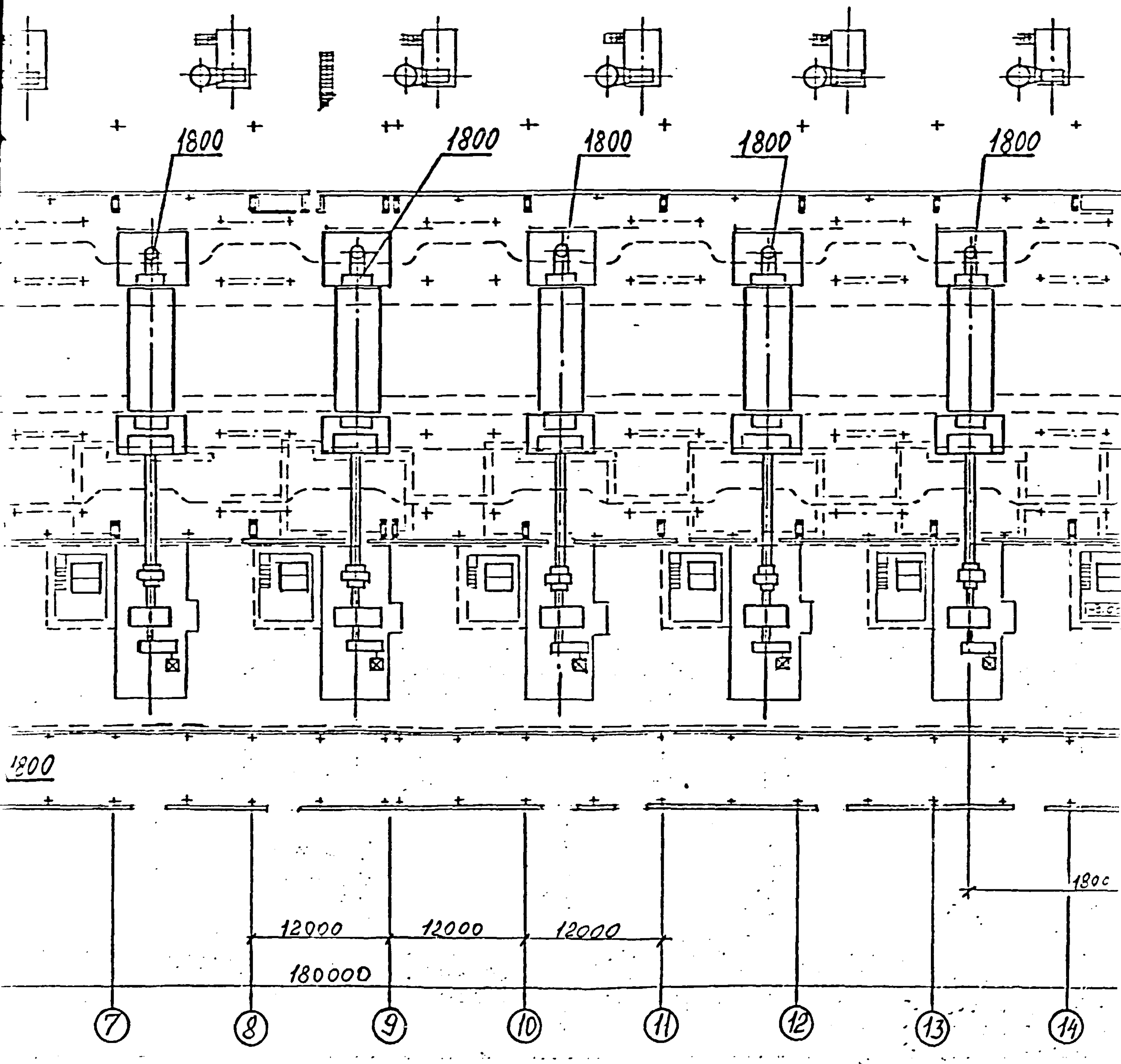
Стадия	Лист	Листов
ИВП	2	

План

ВАМИ
Ленинград


1802
+1.300
1
6500
30000
60500
18000
6000
1819
10т
0.000
1818
32/5т
3.000
0.000
1800
1800
1800
21000
18.000
12000
12000
6000
6000
E
D
C
B
A
1
2
3
3/A
4
5
6

SECTION 1



1800
1800
1800
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1800
1800
12000
12000
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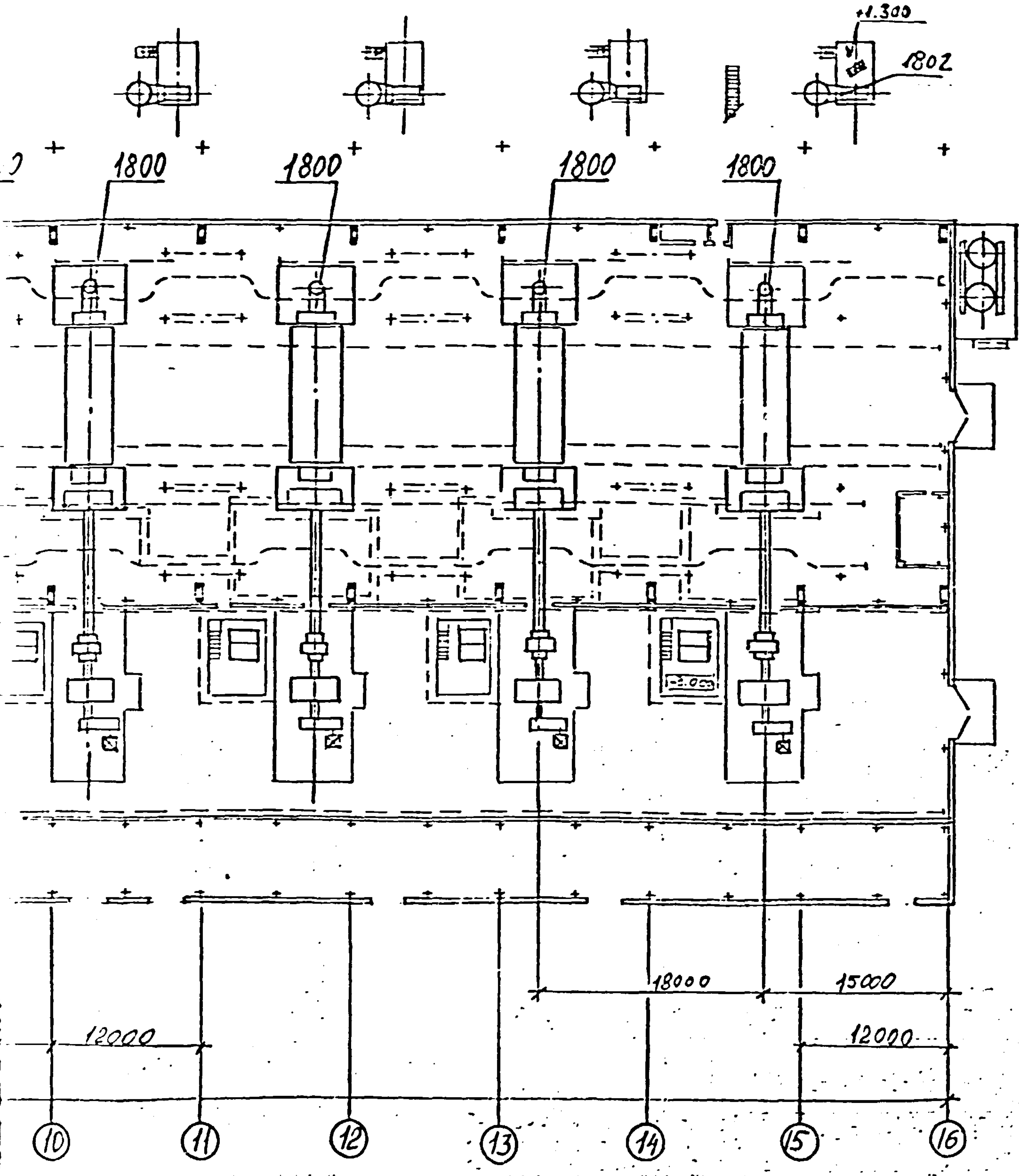
180000
180c
7
8
9
10
11
12
13
14

SECTION 2



+1.300
1802
1800
1800
1800
1800
18000
15000
12000
12000
10
11
12
13
14
15
16

SECTION 3

SECTION 4

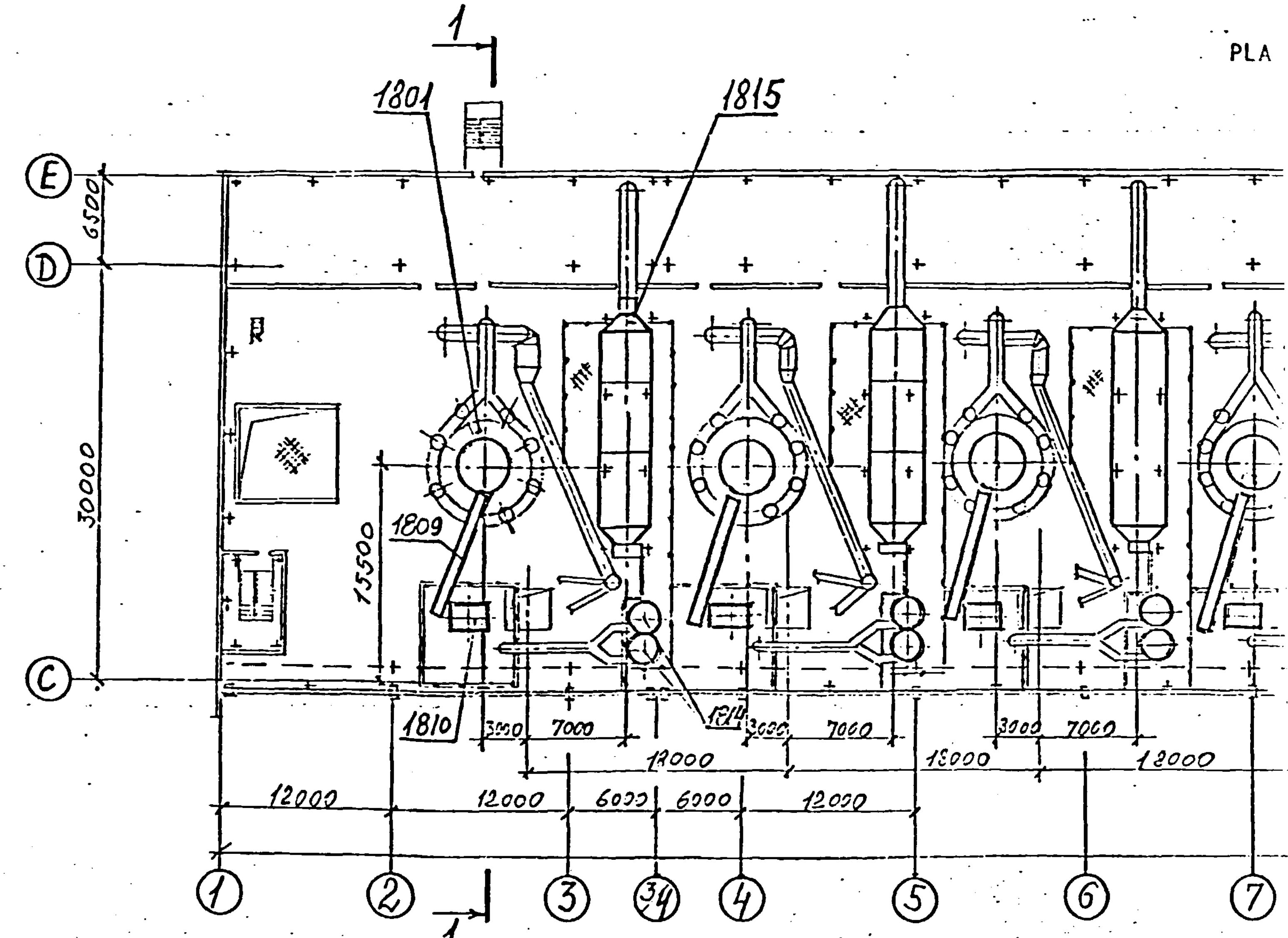
THE VIEWS ARE SHOWN IN SCALE 1:400

CONTRACT N 90/204/205

	1339649-T			
	RAZGAH NEPHELINES PROCESSING PLANT (IRAN)			
	CEMENT PRODUCTION. CEMENT GRINDING.	PHASE	SHEET	SHEETS
		POS	2	
	PLAN AT MIDDLE ELEVATIONS.	VAMI LENINGRAD		

SIZE A 4x4

PLA



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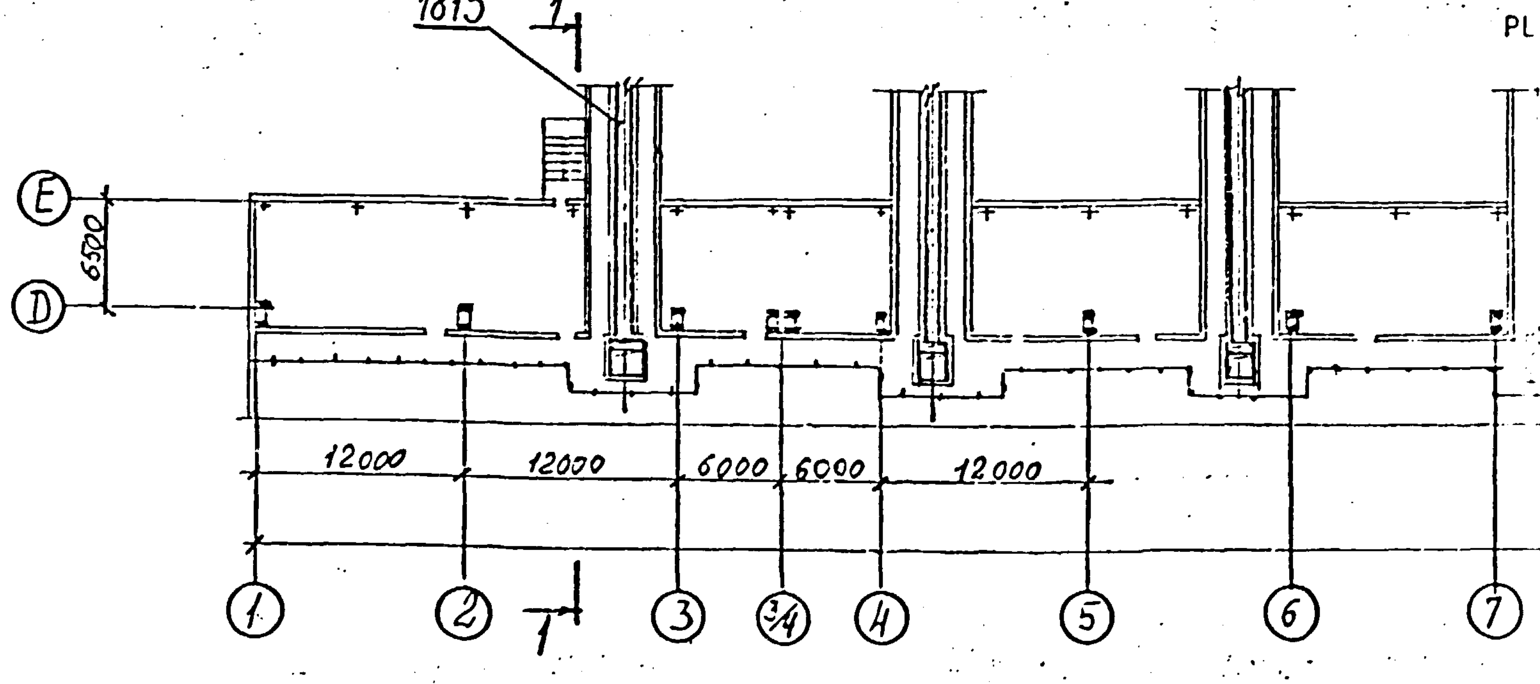
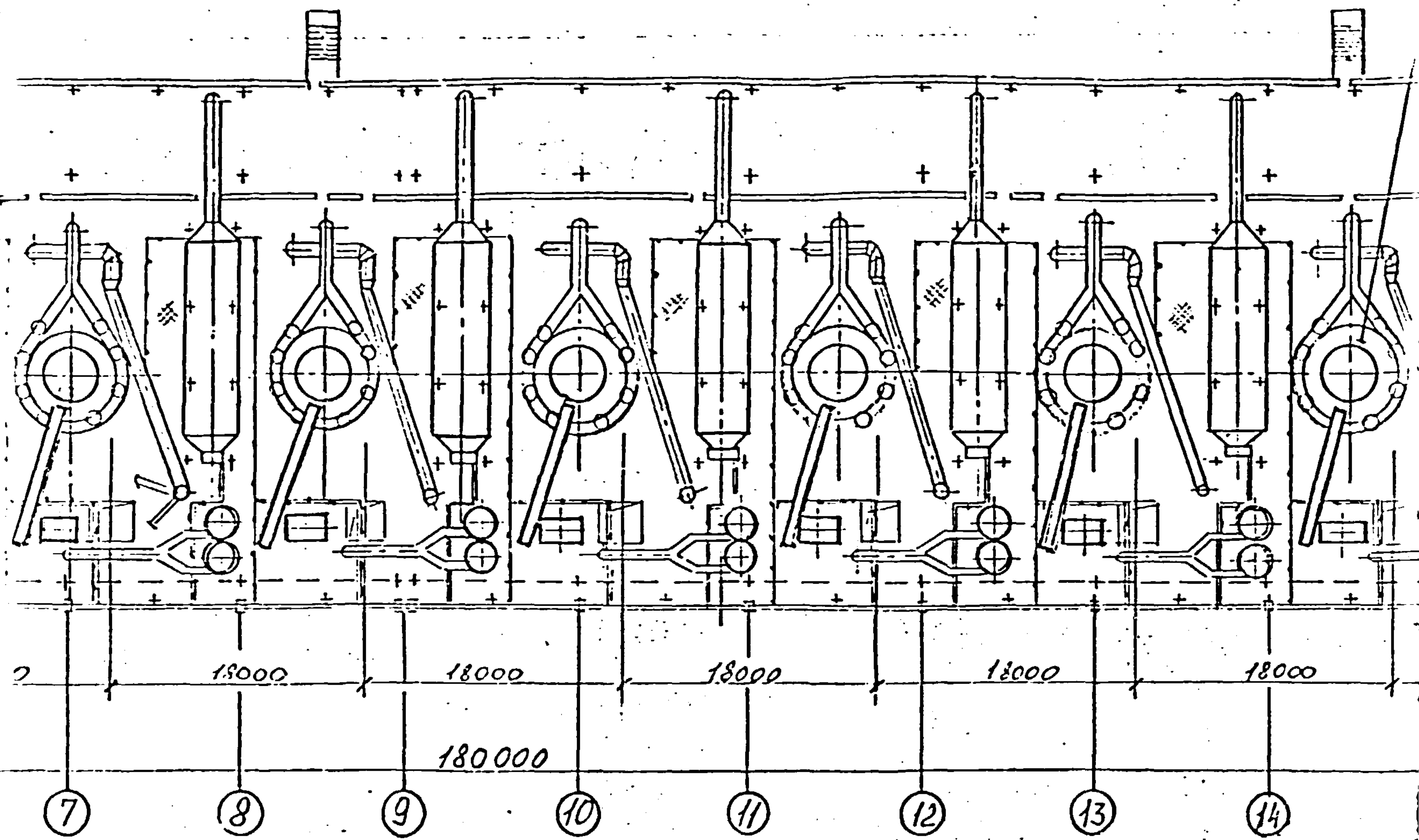
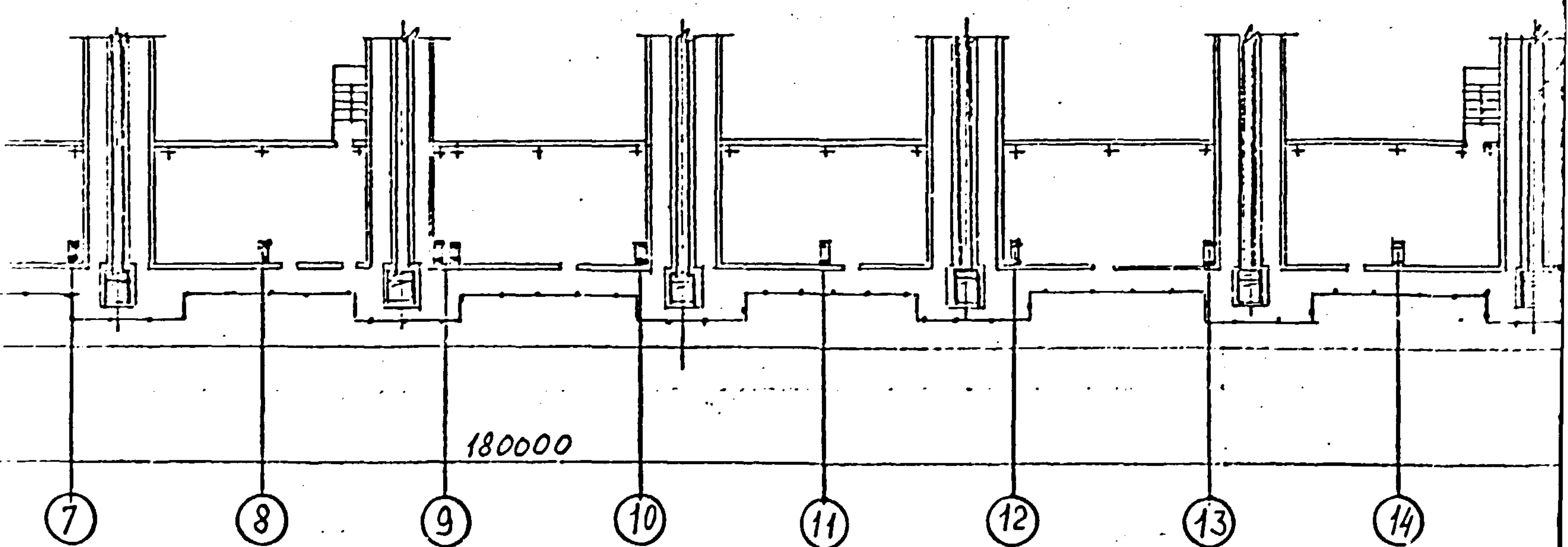


SECTION 1

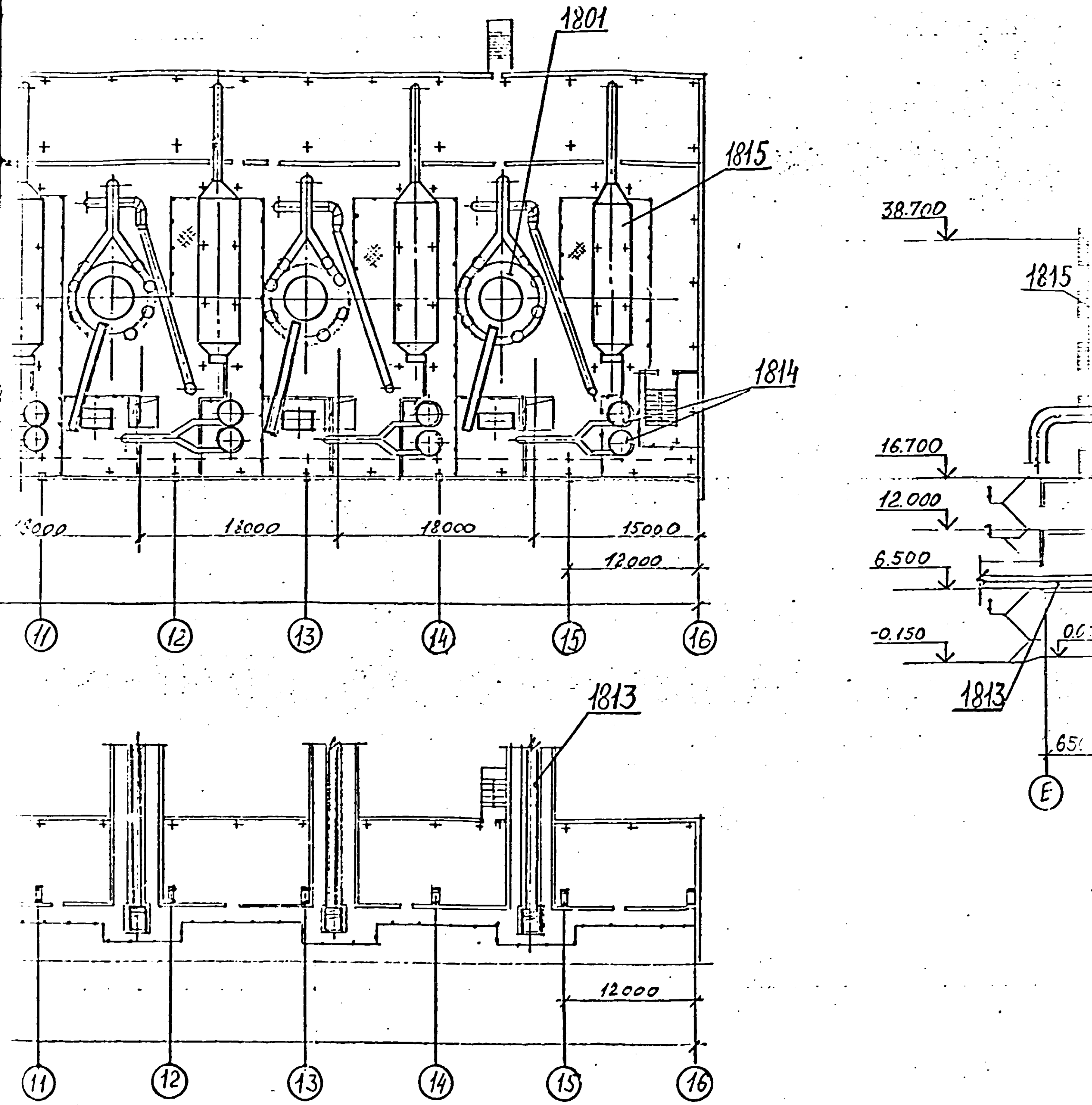
PLAN AT UPPER ELEVATIONS..



PLAN AT ELEVATION 6.500.



SECTION 2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SECTION 3

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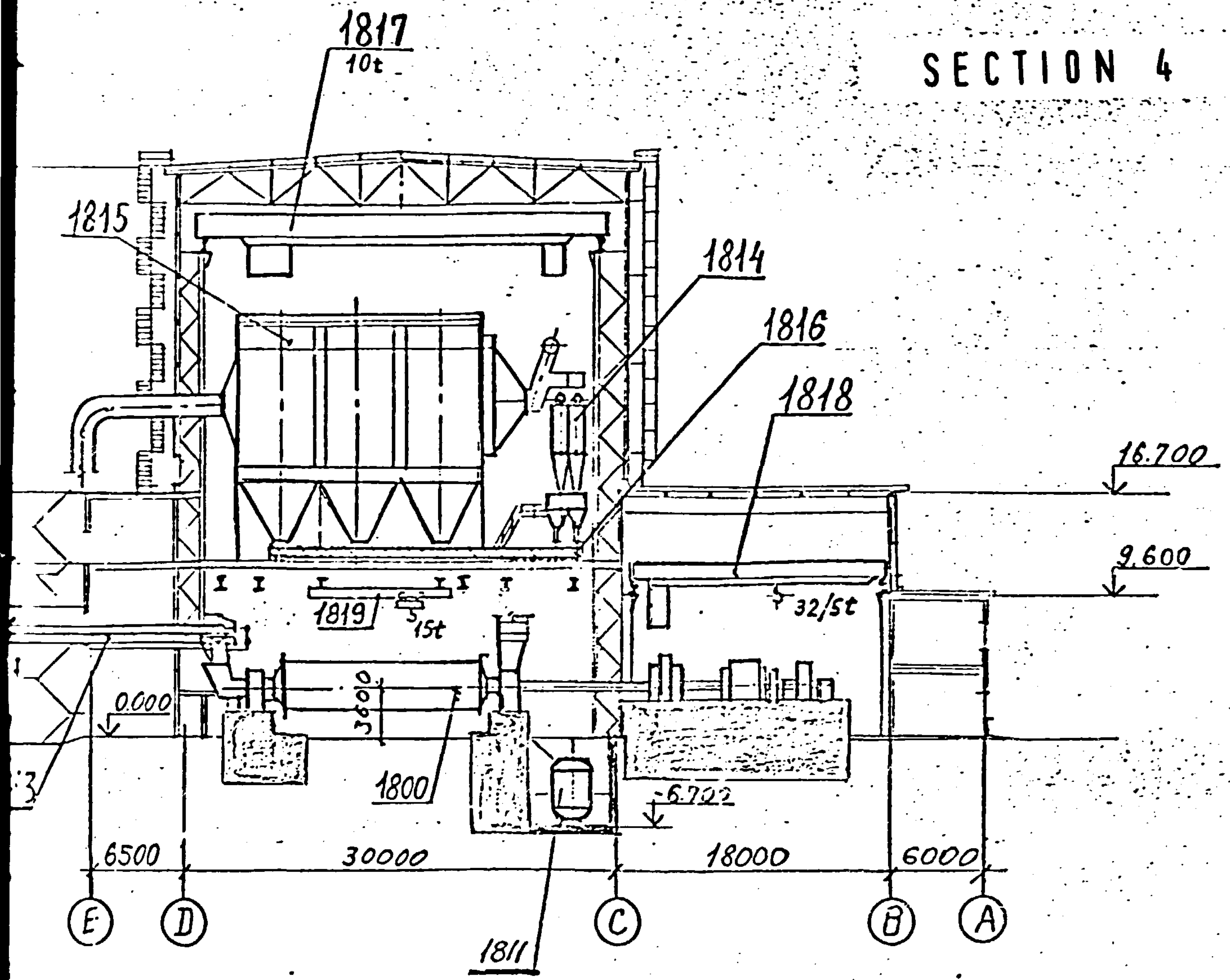

CONTRACT N 90/204/205

THIS DRAWING IS NOT TO BE REPRODUCED OR TRANSFERRED TO OTHER ORGANIZATIONS OR PERSONS WITHOUT AGREEMENT WITH VAMI	1339649-T			
	NEPHELINES PROCESSING PLANT (IRAN)			
	CEMENT PRODUCTION. CEMENT GRINDING.	PHASE	SHEET	SHEETS
		POS	3	
	PLANS. SECTION.	VAMI LENINGRAD		

Contract № 90/204/205
UNIDO Project № US/IRA/90/251

PROJECT OPPORTUNITY STUDY ON INTEGRATED USE OF THE RAZGAH NEPHELINE ORES, IRAN BY METALLURGICAL PROCESSING INTO ALUMINA, CEMENT, SODIUM CARBONATE AND POTASH

Final Report

Volume III
SPECIFICATIONS OF EQUIPMENT

NPO „VAMI"

VVO „TECHNOEXPORT"

ST.-PETERSBURG
1992

COMPOSITION
OF THE FINAL REPORT

Volume I. General Explanatory note.

Volume II. Drawings.

Volume III. Specifications of equipment.

CONTENT

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3. Carbonated soda and potash production 73

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5. Storage facilities 120

6. Utility facilities 126

7. Water supply, sewage and mud disposal units 144

1. EXPLANATORY NOTE

The Specification of Main Technological Equipment is given in this volume. This Equipment is voreseen for the Installation on the Alumina, Soda-Potash and Cement Production of Nepheline plant.

The Main Electrical Equipment and Materials of the External Power Supply are also given.

2. ALUMINA PRODUCTION

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		ALUMINA PRODUCTION						
		Process part						
		Receiving unit for nepheline ore with wagen tilter						
		Part I. Equipment						
		Handling equipment						
1		Stationary rotery wagon tilter for discharge of 134 t wagons complete with car pushers and installation for collection of empty wagons, 75 kW motors		pce	1	231000	231000	
2		Heavy duty apron feeder, apron width - 2400 mm Productivity - 900 t/h 100 kW motor		"	1	147970	147970	
3		Electric overhead crane, l/c 32/5 t Motor 50 kW		"	1	28000	28000	
4		Movable hand-operated hoist, l/c 8 t		pcs	2	300	600	
5		Movable hand-operated hoist, l/c = 5000 kg		pce	1	150	150	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
6		Movable hand-operated hoist l/c 3200 kg		pce	1	90	90	
7		Movable hand-operated hoist l/c 1000 kg		pcs	2	45	90	
		Total:					407900	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Nepheline ore storage						
		Process design						
		Section I. Equipment						
		Handling equipment (conveyors, discharging cars, feeders, cranes, hoists)						
1		Stationary belt conveyor, length 145 m, belt speed 1.6 m/s, belt width 1200 mm, gear ratio - 40 Electric motor power 160 kW		pc	1	46560	46560	
2		Reversible belt conveyor, length 50 m, belt speed 1.6 m/s, belt width 1200 mm, gear ratio - 40, Electric motor power 22 kW		pc	1	15200	15200	
3		Stationary belt conveyor, length 150 m, belt speed 1.6 m/s, belt width 1200 mm, gear ratio - 40, Electric motor power 55 kW		pcs	2	47700	95400	
4		Stationary belt conveyor, length 150 mm, belt speed 1.25 m/s, belt width 1000 mm, gear ratio - 50 Electric motor power 22 kW		"	2	35000	70000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
						of one piece	total	
5		Movable apron feeder, apron width 1000 mm Capacity 200 t/hr Electric motor power 15 kW		pc	2	15000	3000	
6		Discharging car for conveyor with belt 1200 mm wide. Motor power 8 kW		pc	2	10253	20506	
7		Caterpillar bucket excavator. Bucket capacity 5.0 m3 Motor power 250 kW Voltage 6000 V		pc	2	175000	350000	
8		Portable electric hoist, capacity 5 t		pc	1	1150	1150	
9		Portable electric hoist, capacity 2 t		pc	4	65	260	
10		Suspended single girder bridge crane, capacity 5 t Motor power 10 kW		pc	2	10000	20000	
		Total:					649076	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		FINE CRASHING ON NEPHELINE PROCESS						
		Part I. Equipment						
		Crashing milling and dressing equipment						
1		Inertial based screen with cover 1750 x 4100 Motor 18.5 kW		pc	4	-640	39560	
2		Fine-crushing conical machine Productivity 260 t/h ø 2200mm2 Motor 250 kW Voltage 6000 V		pc	2	88000	176000	
3		Oiling set Productivity 125 l/min Motor 8.55 kW		pc	2	1300	2600	
4		Hydraulic unit motors total power 14 kW		pc	2	470	940	
		Total:					218100	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
4		Stationary belt conveyer L = 150 m B = 1000 mm V = 1,25 Gear ratio 40 Motor 110 kW		pc	2	60500	121000	
5		Stationary belt conveyer L = 175 m B = 800 mm Gear ratio 40 Motor 30 kW		pc	2	27000	54000	
6		Stationary belt conveyer L = 35 m B = 800 mm V = 1,25 m/sec Gear ratio 40 Motor 11 kW		pc	2	8600	17200	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
7		Stationary belt conveyer L = 20 m B = 1200 mm V = 1,25 m/sec Gear ratio 40 Motor 7,5 kW		pc	4	6600	26400	
8		1200 mm - belt automatic conveyer weigher		pc	4	450	1800	
9		Discharge trolley for 1000 mm - belt conveyer Motors 7,5 kW		pc	2	9100	18200	
10		Apron feeder B = 1200 mm Productivity 100 t/h Motor 26 kW		pc	4	20600	82400	
11		Overhead electric crane, l/c 20/5 t Motors 40 kW		pc	1	20000	20000	
12		Suspended overhead 1-beam electric crane l/c = 5000 kg		pc	1	1800	1800	
13		Hand-operated movable hoist l/c = 2000 kg		pc	6	65	390	
14		Hand-operated movable hoist l/c = 1000 kg		pc	6	45	270	
		Total:					343460	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
						of one piece	total	
		Limestone intaking and primary crushing						
		Technology						
		Part I. Equipment						
		Crush-milling and dressing equipment						
1		Jaw crasher 2100 x 1500 Productivity 600 m^3/h Head drive motor 250 kW		pc	2	120000	240000	
		Thick oiling station Productivity 0,075 l/min Motor 0,4 kW		pc	2	115	230	
		Oiling station Productivity 70 l/min Motor 2,2 kW		pc	2	1153	2306	
		Total:					242536	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Whom to be supplied by
		Handling equipment						
2		Heavy type apron feeder B = 2400 m L = 18 m P_{max} = 75 kW		pc	2	120000	240000	
3		Overhead crane l/c 50/12,5 t		pc	1	44600	44600	
4		Movable hoist l/c = 2 t		pc	2	65	130	
		Total:					284730	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Whom to be supplied by
		Secondary limestone crushing						
		Technology						
		Part I. Equipment						
		Crashing, milling and dressing equipment						
1		Inertial screen ГИТ-7IM 2500 x 5000 engine power 30 kW		pc	2	12500	25000	
2		Secondary crushing machine Ø 2200 mm engine power 250 kW Voltage 6000 V		"	2	86800	173600	
		Oiling set productivity 125 l/min engines power 8,55 kW		"	2	1300	2600	
		Hydro unit engines power -.14 kW		"	2	470	940	
							202140	
		Handling Equipment						
3		Stationary belt conveyer L = 220 m B = 1200 mm V = 1,6 m/sec engine power 315 kW gear ratio - 50		"	2	71000	142000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
4		Electric overhead crane, l/c - 20/5 t Engines power - 65 kW		"	1	35000	35000	
5		Electric hoist, movable l/c = 2000 kg		"	2	65	130	
		Total:					177130	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
						of one piece	total	
		FINE LIMESTONE CRUSHING WITH SCREENING TECHNOLOGY						
		Part I. Equipment						
		Crushing, milling and dressing equipment						
1		Inertial based screen with cover 1750 x 4100 Engine power 18,5 kW		pc	8	9640	77120	
2		2-layer inertial screen 1750 x 4000 Electric engine power 18,5 kW		"	2	8000	16000	
3		Hammer crusher $\varnothing_r$ = 1300 mm Productivity - 200 m/h Engines power 200 kW Voltage - 6000 V		"	8	13000	104000	
		Total:					197120	
		Handling equipment						
4		Belt stationary conveyer B = 1200 mm; V = 1,6 m/sec Gear ratio - 50 L = 240 m; engine P = 250 kW		"	2	76000	152000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
5		Discharging trolley for 1200 mm - belt conveyer Engine p = 8 kW		pc	2	10253	20506	
6		Stationary belt conveyer B = 1200 mm; V = 1,25 m/sec Gear ratio - 40 Engine P = 7,5 kW L = 20 m		"	10	6600	66000	
7		Movable belt conveyer B = 800 mm; V = 1,25 m/sec Engines power - 26 kW		"	10	14000	140000	
8		Apron feeder B = 1200 mm Productivity - 200 m/h Engine power max. - 26 kW		"	10	20600	206000	
9		Belt conveyer weigher, automatic for 1200 m - belt		"	10	450	4500	
10		Vertical chain elevator Productivity 15 m/h H = 30 m Engine P = 7,5 kW		"	2	4700	9400	
11		One-beam overhead suspended crane l/c = 5000 kg; H = 36 m Engine P = 9,7 kW		"	1	1800	1800	

NOS	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
No according to technological flowsheet						of one piece	total	
12		Electric overhead crane l/c - 10000 kg Engines P = 32 k"		pc	1	22600	22600	
13		Hand-operated movable hoist l/c = 2000 kg		pc	10	65	650	
		Total:					623456	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Limestone storehouse						
		Technology						
		Part I. Equipment						
		Handling equipment						
1		Stationary belt conveyer L = 480 m B = 1200 mm V = 1.6 m/sec Engine power 315 kW Gear ratio - 50 Steel structures Conveyor frames		pc	2	133000	266000	
2		Reversive belt conveyer B = 1200 mm; L = 50 m V = 1.6 m/sec Engine power 45 kW Gear ratio - 40		"	2	16500	33000	
3		Stationary belt conveyer L = 400 m B = 1200 mm; V = 1.6 m/sec Gear ratio - 40 Engine power - 200 kW		"	2	84000	168000	
4		Stationary belt conveyer L = 450 m; B = 1200 mm V = 1.6 m/sec Gear ratio - 40 Engine power 200 kW Steel structures and conveyer frames		"	2	90000	180000	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
6		Movable belt conveyer B= 1200 mm L = 15 m V = 1,6 m/sec Engines P = 26 kW		pc	2	10000	20000	
7		Discharging trolley for 1200 mm - belt conveyer Engines P = 8 kW		"	2	10253	20506	
8		One-beam suspended overhead electric crane l/c = 5000 kg		"	1	1800	1800	
9		Front-end loader Bucket cap. - 7.65 m^3 Engine power - 405 kW		"	2	7300	14600	
10		Movable electric hoist l/c = 5000 kg		"	1	1150	1150	
11		Movable hand-operated hoist l/c = 2000 kg		"	4	65	260	
		Total:					705316	
		Special cars						
12		Wheel excavator Productivity 320 m^3/h Engines P = 150 kW		"	1	75000	75000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Milling Technology						
		Part 1. Equipment						
		Crushing, milling and dressing equipment						
1		Pipe mill Ø 3200 mm L = 15000 mm Main engine power 2000 kW Voltage 6000 V		pc	12	462000	5544000	
		Complete with:						
		- mill bearings oiling station Q = 50 l/min Engines power 7 kW		"	12	1600	19200	
		- Main (head) year oiling station Q = 125 l/min Engines P = 17 kW		"	12	2600	31200	
		Total:					5594400	
		Chemistry Equipment						
2		Chain mixer Ø 4.5 m H = 3 m Engine P = 15 kW		"	12	6900	82800	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
3		Chain mixer Ø 7500 mm H = 9000 mm P = 18,5 kW		pc	8	25500	204000	
4		SumpF mixer Ø 2000 mm H = 2500 mm P = 5.5 kW		"	6	1950	11700	
		Total:					298500	
		Pumps						
5		Centrifugal pump Productivity 85 m^3/h pressure 40 m, P = 45 kW		"	12	1270	15240	
6		Centrifugal pump Productivity 170 m^3/h Pressure 40 m P = 75 kW		"	4	1660	6640	
7		Centrifugal pump Productivity 70 m^3/h Pressure 27 m P = 22 kW		"	8	1155	9240	
8		Centrifugal pump productivity 112 m3/h. Pressure - 17 m P = 18.5 kW		"	24	1260	30240	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
9		Centrifugal pump, productivity 350 m^3/h Pressure 40 m P = 132 kW		pc	2	2825	5650	
10		Centrifugal pump, productivity 170 m^3/h, Pressure 40 m, P = 37 kW		"	6	1430	8580	
		Total:					75590	
		Handling Equipment						
11		Stationary belt conveyer B = 1000 mm L = 140 m V = 1,25 m/sec P = 75 kW Gear ratio - 50		"	2	29700	59400	
12		Automatic weigher for 1000 mm - belt conveyer		"	2	400	800	
13		Stationary belt conveyer B = 1000 mm, B = 80 m V = 1,25 m/sec P = 15 kW, gear ratio 31.5		"	2	16200	32400	
14		Electric gravitation feeder, productivity 160 m3/h, P = 4 kW		"	3	3220	9660	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
15		Discharging trolley for 1000 mm belt conveyer P = 8 kW		pc	2	5174	10348	
16		Stationary belt conveyer B = 650 mm, L = 20 m, V = 1 m/sec, P = 7,5 kW Gear ratio 25		"	7	2200	15400	
17		Automatic weigher for 650 mm belt conveyer		"	7	150	1050	
18		Stationary belt conveyer B = 1250 mm, L = 180 m, V = 1.6 m/sec, P = 200 kW Gear ratio - 40		"	3	50000	150000	
19		Electric overhead crane l/c 20/5 t; P = 76 kW		"	2	23800	47600	
20		Electric overhead crane l/c 50/12 t; P = 180 kW		"	1	58000	58000	
21		Automatic weigher for 1200 mm belt conveyer		"	3	450	1350	
22		Stationary belt conveyer B = 1200 mm; L = 180 m with discharging trolley P = 90 kW gear ratio 40 V = 1.6 m/sec		"	3	44300	132900	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
23		Discharging trolley for 1200 mm belt conveyer P = 8 kW		pc	3	10253	30759	
24		Disk feeder, Ø 2000 mm Max.productivity 112 m3/h P = 11 kW		"	4	3350	13400	
25		Electric overhead crane l/c = 5000 kg P = 30 kW		"	1	15000	15000	
26		Suspended electric overhead crane l/c = 5,0 t P = 10,0 kW		"	2	2000	4000	
27		Overhead electric suspended crane l/c 2.5 t P = 6.8 kW		"	2	1800	3600	
28		Overhead electric suspended crane l/c = 1.6 t P = 4.2 kW		"	2	1600	3200	
29		Passenger lift l/c = 320 kg		"	1	500	500	
		Total:					589367	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied
		Correction and retention basins						
		Process design						
		Section I. Equipment						
		Chemical equipment						
1		Chain agitator dia. 2 x 2.5 m Electric motor 3 kW		pc	6	2318	13908	
2		Chain agitator dia. 4500 x 4500 Electric motor 15 kW		pc	2	8023	16046	
		Total:					29954	
		Tanks						
3		Distribution box, Drive electric motor 0.55 kW - 6 pcs Tank, ø 12 m, H=22.6 m, V=2.000 m3		pc	3	10700	32100	
		Pumps Total:					1328100	
4		Centrifugal pump, 335 m3/h, 37.5 m, electric motor 79 kW		pc	4	4030	16120	
5		Centrifugal pump, 335 m3/h, 37.5 m, electric motor 79 kW		"	6	4030	24180	
6		Centrifugal pump, 390 m3/h, 50 m, electric motor 120 kW		pc	2	4030	8060	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied
7		Centrifugal pump, 170 m3/h, 40 m, electric motor 75 kW		pc	4	1660	6640	
8		Centrifugal pump, 350 m3/h, 40 m, electric motor 132 kW		pc	6	2825	16950	
		Total:					71950	
		Handling equipment (cranes, elevators, hoists)						
9		Suspended single-girder electric crane, capacity 2.5 t, span 3 m, lift height 6 m, total power of motors 6.8 kW		pce	1	1060	1060	
10		Suspended single-girder electric crane, capacity 5 t, span 6 m, lift height 6 m, total power of motors 8.7 kW		"	1	1980	1980	
11		Passenger lift capacity 320 kg, lift height-22.4 m		"	1		6000	
12		Electric hoist, capacity 3.2 t, height - 6 m		"	1	1895	1895	
13		Suspended E.O.T. crane, capacity 2.5 t, span 6 m, lift height 36 m, total power of motors 6.8 kW		"	2	1360	2720	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
14		Suspended E.O.T. crane, capacity 2.5 t, span 9 m, lift height 36 m, total power of motors 6.3 kW		pc	2	1790	3580	
		Total;					11235	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied
		Sintering						
		Process design						
		Section I. Equipment						
		Chemical equipment						
1		Electrostatic precipitator, F = 129.8 m2, ЭГАI -40-12-6-5		pc	6	390000	2340000	
2		Pneumatic screw pump, flowrate 36 t/hr		"	3	980	2940	
3		Pneumatic chamber pump		"	3	14550	43650	
4		Pneumatic screw pump		"	3	800	2400	
5		Double-chamber pump dia. 1800 mm		"	3	7760	23280	
6		Moisture and oil separator, capacity 50 m3/min		"	6	190	1140	
7		Vortex moisture and oil separator		"	6	195	1170	
		Total:					2414580	
		Tanks, furnace equipment						
8		Rotary kiln, dia. 6.4/5.8x190 m		pc	3	3300000	9900000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied
9		Grate cooler, Fgr. = 68 m^2		pc	3	700000	2100000	
10		Drum aftercooler, dia. 6.4/5.8 x 60 m		pc	3	880000	2640000	
11		Discharging cyclone dia. 1200		kg	3	900	2700	
		Total:					14642700	
		I.D.Fans, fans						
12		I.D.fan, flowrate 417000 m^3/h Head - 600 kgf/m2		pc	9	23700	213300	
13		Centrifugal fan, Q = 2500÷4500 m3/hr, H = 90 kgf/m2		"	3	55	165	
14		Centrifugal fan, Q = 25000÷45000 m3/hr, H = 250÷300 kgf/m2		"	24	645	15470	
15		Fan, Q = 33000 m3/hr, H = 512 kgf/m2 (mill fan)		"	3	5000	15000	
16		Fan, Q = 58000 m3/hr H = 920 kgf/m2		"	9	4000	36000	
		Total:					279935	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Whom to be supplied
		Sanitary-engineering equipment						
17		Airheating unit, power - 0.37 kW, h = 1370 rpm		pc	12	131	1577	
18		Bimetallic air heater with spiral F = 83.12 m2		"	3	176	528	
19		Throttle valve, Dnom. 1200 mm		pc	33	1200	64000	
20		Pippet valve, $D_{nom.}$ 4420 mm		"	3	40000	120000	
		Total:					186105	
		Handling equipment						
21		Rod conveyor, capacity 30 t/h		pc	6	1500	9000	
22		Belt conveyor, b = 1200 mm, Q = 60 t/h		"	2	62000	124000	
23		Suspended-flight conveyor capacity 500 t/h, length 21 m		"	6	6270	37560	
24		Suspended flight conveyor Q = 500 t/h, L = 32 m		"	12	8630	103560	
25		Screw feeder, Q = 14 t/h		"	6	800	4800	
26		Screw feeder, Q = 42 t/h		"	6	1700	10200	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
27		Sluice feeder, Q = 6.28÷60 m3/h		pc	3	400	1200	
28		Sluice feeder, Q = 6.28÷60 m3/h		"	3	400	1200	
29		Travelling gantry crane, capacity 100/10 t, $L_{sp.}$ = 32 m, H = 32 m		"	1	201700	201700	
30		E.O.T.crane, capacity 5 t, height - 36 m		"	1	26300	26300	
31		Suspended electric crane, capacity 5 t		"	1	1030	1030	
32		Bridge crane, capacity-1 t, span 4.2 m		"	3	720	2160	
33		Electric hoist,2 t, H = 30 m		"	1	625	625	
34		Electric hoist,3.2 t, H = 30 m		"	1	700	700	
35		Electric hoist,3.2 t, H = 12 m		"	3	515	1545	
36		Electric hoist,5 t, H = 12 m		"	1	830	830	
37		Electric hoist,1 t, H = 24 m		"	6	350	1050	
38		Electric hoist,0.5 t, H = 18 m		"	30	115	4450	
39		Electric hoist,1 t, H = 12 m		"	6	200	1200	
40		Slurry proportioner		pc	6	128	768	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Whom to be supplied by
41		Weighing proportioners		pc	3	2100	6900	
42		Disk gate dia. 300 mm with pneumatic drive		pc	24	133	3192	
43		Double-rack gate 500x500 mm		pc	72	167	12024	
44		Flap valve, $D_{nom.}$ = 300 mm		pc	72	90	6480	
45		Elevator, capacity 500 kg, height = 48 m		pc	1	2000	2000	
		Total:					563474	
		Power equipment						
46		Flap valve, $D_{nom.}$ = 300 mm		pc	72	90	6480	
47		Fireclay A		set	3	3300	9900	
48		Mineral wool		m^3	3600		720000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied
		Sinter line						
		Process design						
		Section I. Equipment						
		Crushing, grinding and beneficiation						
1		Inertia screen, 1750 x 3500 mm		pc	2	6200	12400	
		Handling equipment						
2		Stationary belt conveyor, belt speed 125 m/s, belt width 1200 mm, gear ratio - 50 Electric motor power 132 kW		pc	2	52000	104000	
3		Stationary belt conveyor, length abt.27 m, belt speed 1.25 m/s, belt width 1200 mm, gear ratio - 31.5 Electric motor power 11 kW		"	2	11000	22000	
4		Continuous belt weigher		pc	6	5360	32160	
		Stationary belt conveyor, length abt.46 m, belt speed 1.25 m/s, belt width 800 mm, gear ratio - 40 Electric motor power 22 kW		"	3	14000	42000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
5		Stationary belt conveyor, length abt. 68 m, belt speed 1.25 m/s, belt width 800 mm, gear ratio - 31.5 Electric motor power 11 kW		pc	3	18500	55500	
		Total:					255660	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	total	Manufactured indigenously
		Cake leaching						
		Technology						
		Part I. Equipment						
		Crushing, milling and dressing equipment						
1		Hydraulic vertical classificator Ø 1,4 m H = 8,6 m		pc	3	4054	12162	
2		Ball mill with combined feeding, expanded axle, cooled bearings and drive, ø 3.2x4.5 mm		"	3	152560	457680	
		Head grive engine P 900 kW complete with:		"	3	15900	47700	
		1) Individual bearings oiling station		"	3	1373	4119	
		2) Thick grafit oiling station for gears and drives		"	1	528	528	
		3) Head drive bearings oiling station		"	3	772	2316	
		4) Drum-lifting machine		"	3	1500	4500	

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NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
3		Rod mill Ø 3.6 x 5.5 m with combined feeding, expanded axle, cooled bearings, drive complete with:		pc	3	244200	732600	
		- head drive engine P = 1250 kW 6000 V		"	3	19795	59385	
		- bearings oiling station		"	3	900	2700	
		- drive thick oiling station		"	3	528	1584	
✓		**Total:**					1325274	
		Chemistry equipment						
4		Chain mixer Ø 4.5 x 3 m Engine 15 kW			6	7190	43140	
5		Chain mixer Ø 4.5 x 6 m			2	3440	6880	
6		Vertical leacher Ø 2 m		pc	6	25000	150000	
7		Mixer Ø 800 mm		"	9	720	6480	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
8		Thickening filter Ø 5.75 m Engines of: - rotating drive - rake 15 kW - distribution drive - head 3 kW		pc	4	30200	120800	
9		Chain mixer Ø 3.0x3.0 m Engine 5.5 kW		"	3	3780	11340	
10		Chain mixer Ø 6 x 9 m Engine 15 kW		"	8	18800	150400	
11		Chain mixer Ø 6 x 6 m Engine 15 kW		"	2	14300	28600	
12		Mixing condensator Ø 800 mm		"	1	1050	1050	
13		Vacuum-cooler cyclon Ø 2,2 m		"	2	6500	13000	
14		Vacuum receiver V = 2.5 m3		"	3	600	1800	
15		Trap, V = 1 m^3		"	3	450	1350	
16		Barometric condensator Ø 1.6 x 6.5		"	2	3400	6800	
17		Flocculant production machine		"	2	2340	4680	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
18		Vacuum receiver, ø 1.2 m		pc	2	680	1360	
19		SumpF mixer Ø 2 x 2.5 Engine 5.5 kW		pc	5	2340	11700	
		Total:					559380	
		Tanks						
20		Thickener Ø 8 m Engines: - rotating mechanism 3.0 kW - lifting mechanism 2,2 kW		"	9	18660	167940	
21		Section washing tank		"	2	2200	4400	
22		Tank		"	2	750	1500	
23		Mixer		"	2	720	1440	
24		Distribution box		"	10	500	5000	
25		Hydrogate		"	8	420	3360	
26		Tank Ø 6-9 m		"	2	12320	24640	
		Total:					208280	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Pumps						
27		Centrifugal pump 700 m3/h, 40 m Engine 250 kW		pc	6	4630	27780	
28		Centrifugal pump 350 cm^3/h, 40 m Engine 132 kW		"	16	2825	45200	
29		Centrifugal pump 300 m3/h, 30 m Engine 48.6 kW		"	6	2640	15840	
30		Centrifugal pump 265 m^3/h, 22.5 m Engine 55 kW		"	16	2090	33440	
31		Centrifugal pump 520 m^3/h, 12.5 m		"	12	3460	41520	
32		Vacuum pump BBH-50 Engine 100 kW		"	4	4000	16000	
33		Centrifugal pump 85 m^3/h 40 m		"	6	2615	15690	
34		Centrifugal pump 500 m3/h, 37.2 m		"	3	2100	6300	
35		Centrifugal pump 170 m3/h, 40 m		"	5	1660	8300	
36		Pumping weigher, engine 5 kW		"	2	300	600	
		Total:					210670	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Exhausters, fans, air blowers						
37		Air blower, 500 m3/h Engine 125 kW		pc	2	615	1230	
		Handling equipment						
38		Overhead electric crane, l/c 32500 kg, H = 18 m Total engines P = 79 kW		"	1	41600	41600	
39		Overhead electric crane, l/c = 2000 kg, H = 18 m Total engines power 3.6 kW		"	3	1000	3000	
40		Overhead electric crane l/c = 5000 kg, H = 18 m Total engines P = 9.2 kW		"	1	2000	2000	
41		Overhead electric crane, l/c 3200 kg Total engines P = 5.7 kW		"	2	1500	3000	
42		Electric hoist l/c = 1000 kg		"	3	220	660	
		Total:					50260	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Desilication						
		1. Autoclave desilication						
		Process						
		Section I. Equipment						
		Chemical equipment						
1		Contact heater, dia.1,200 mm		pcs	6	2000	12000	
2		Chain agitator, dia.9x9 m, with 18.5 kW electric motor		"	5	31370	156850	
3		Do, dia.2x2.5 m, with 5.5 kW electric motor		pce	1	2340	2340	
4		Jet heater, dia. 530 mm		pcs	6	1000	6000	
5		Desilicator, dia.3,600 mm; H = 18 m		"	21	20000	420000	
6		Heating chamber, dia.2,000 mm; surface area - 800 m2, length of tubes - 9 m		"	3	18000	54000	
7		Flash tank, dia.1,000 mm		pcs	9	800	7200	
8		1-st stage separator, dia. 2,600 mm		"	3	12000	36000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
9		2-nd stage separator, dia. 3,600 mm		"	3	24000	72000	
		Total:					766390	
		Tanks, vessels						
10		Tank dia.4.5x4.5 m		"	2	5280	10560	
		Total:					11800	
		Pumps						
13		Centrifugal pump 350 m3/hr,40 m 132 kW electric motor		pcs	7	2825	11300	
14		Centrifugal pump 50 m3/hr, 55 m 11.0 kW electric motor		"	2	200	400	
15		Centrifugal pump 200 m3/h4, 32 m, 90 kW electric motor		pce	2	427	854	
16		Centrifugal pump 170 m3/hr, 40 m 75 kW electric motor		"	1	1660	1660	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
17		Centrifugal pump 450 m3/hr, 67 m 250 kW electric motor		pcs	8	5085	40680	
18		Vacuum pump 3.3 m3/min. 7.5 kW electric motor		"	1	290	290	
		Total:					55184	
		Material handling equipment						
19		3.2 t overhead electric crane. Total capacity of electric motors 5.7 kW		pce	1	1000	1000	
20		1 t electric hoist		"	1	220	220	
		Total:					1220	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Whom to be supplied by
		White slime thickening and filtration Technology Part I. Equipment Chemistry Equipment						
1		Hydro-cyclor Ø 710 mm 200÷300 m3/h		pc	3	1500	4500	
2		Chain mixer Ø 7.5 x 6 m Engine P = 18.5 kW		"	13	18870	245310	
3		Chain mixer Ø 4.5 x 3 m Engine 15 kW		"	18	7190	129420	
4		Vertical leaf filter, filtration surface 250 m^2 Engine 1 kW		"	5	18760	93800	
5		Chain mixer Ø 3 x 3 m Motor 5.5 kW		"	3	3780	11340	
6		Vacuum drum filter, filtration surface 40 m2 El. Motor = 5.5 kW		"	3	19500	58500	
7		Vacuum-receiver V = 4 m^3		"	3	900	2700	
8		Chain mixer Ø 7.5 x 7.5 m Motor 18.5 kW		"	10	20870	20870	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
99		Equipment for the synthesis of calcium hydrocarboaluminate, ø 1.7 m		pc	2	5200	10400	
10		Chain mixer Ø 6 x 9 m Motor 15 kW		pc	3	18800	56400	
11		Barometric condenser Ø 1,6 m x 6.5 m		"	2	3400	6800	
12		SumpF-mixer Ø 2 x 2.5 m Motor 5.5 kW		"	8	2340	18720	
		Total:					846590	
		Tanks						
13		1-chamber thickener, motors 2.2 + 4 = 6.2 kW		"	8	47000	376000	
14		Hydraulic gate ø 1.2x3.5 m		"	3	860	2580	
15		Hydraulic gate Ø 1.2 x 2.0		"	2	490	980	
		Total:					379560	
		Pumps						
16		Centrifugal pump 300 m^3/h; 30 m Motor 90 kW		"	13	2640	34320	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
17		Centrifugal pump 56 m3/h; 17 m Motor 15 kW		"	19	1123	21337	
18		Centrifugal pump 350 m^3/h; 40 m Motor 132 kW		"	8	2825	22600	
19		Centrifugal pump 185 m3/h, 45 m, Motor 90 kW		"	4	2235	8940	
20		Centrifugal pump 85 m3/h, 40 m, Motor 45 kW		"	12	1270	15240	
21		Centrifugal pump 140 m3/h, 27 m Motor 37 kW		"	4	1430	5720	
22		Centrifugal pump 225 m3/h, 67 m Motor 160 kW		"	2	2615	5230	
23		Centrifugal pump 70 m3/h, 27 m Motor 22 kW		"	10	1155	11550	
24		Centrifugal pump 170 m3/h, 40 m Motor 75 kW		"	9	1660	14940	
25		Centrifugal pump 265 m3/h, 22.5 m Motor 55 kW		"	2	2090	4180	
26		Vacuum pump 50 m3/min Motor 100 kW		"	4	4000	16000	
		Total:					160057	

NOS		Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
No according to technological flowsheet	Trans. No					of one piece	total	
		Exhausters, fans, air blowers						
27		Air blower, capacity - 5,000 m/h motor 125 kW		pc	2	615	1230	
		Handling Equipment						
28		Overhead electric crane l/c = 3.2 t Motors - 4.5 kW		"	1	1270	1270	
29		Electric overhead crane, l/c = 2 t Motors 4 kW		"	8	940	7520	
30		Overhead electric crane, l/c = 1 t Motors 3 kW		"	1	770	770	
		Total:					9560	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Hydrate machining and carbonizing						
		Technology						
		Part I. Equipment						
		Chemistry equipment						
1		Chain mixer ø 3x3 m Motor 5.5 kW		pc	6	3780	22680	
2		Chain mixer ø 7.5x7.5 m Motor 18.5 kW		"	6	20870	12520	
3		SumpF-mixer ø 2x2.5 m Motor 5.5 kW		"	5	2340	11700	
4		Cyclon separator ø 2400 mm H=4.5 m		"	2	6500	13000	
5		Barometric condenser ø 1,600 mm, H=6,500 mm		"	2	3400	6800	
6		Vertical leaf filter S_{fil}= 250 m2 Motor 0.8 kW		"	3	18760	56280	
7		Chain mixer ø 4.5x3.0 m Motor 15 kW		"	9	7190	64710	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
8		Drum filter $S_{Fil} = 40\ m^2$ Motor 5.5 kW		pc	6	19500	117000	
9		Receiver, $V = 4\ m^3$		"	6	900	5600	
10		**Trap** $V = 2.5\ m^3$		"	2	600	1200	
11		Direct-contact condensator Ø 1000 mm		"	2	2500	5000	
		Total:					429190	
		Tanks						
12		Carbonizing machine Ø 7.5 x 12 m Motor 22 kW		pc	18	30500	549000	
13		Decomposer Ø 7.5 x 12 m Motor 22 kW		pc	6	30500	183000	
14		Thickener Ø 15 m Motor 6.2 kW		"	5	47000	235000	
15		Hydraulic gate Ø 0.7 x 15 m		"	2	442	884	
16		Hydraulic gate Ø 0.5 x 4 m		"	4	300	1200	
17		Hydraulic gate Ø 1.0 x 2.5 m		"	1	500	500	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
18		Tank Ø 4.5 x 4.5 m		pc	2	4000	8000	
19		Hydraulic gate Ø 0.5 x 1 m		"	2	80	160	
		Total:					977744	
		Pumps						
20		Centrifugal pump 350 m^3/h, 40 m Motor 132 kW		"	17	2825	48025	
21		Centrifugal pump 85 m^3/h, 40 m Motor 45 kW		"	22	1270	27940	
22		Centrifugal pump 56 m^3/h, 17 m Motor 17 kW		"	13	1123	14599	
23		Centrifugal pump 170 m^3/h, 40 m Motor 75 kW		"	9	1660	14940	
24		Vacuum pump 50 m^3/min Motor 110 kW		"	6	4000	24000	
		Total:					129504	
		Exhausters, blowers, fans						
25		Blower 80 m^3/min Motor 160 kW		pc	2	615	1230	

№ No according to technological flows	№ ...ling ...gical ...et	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
			Handling Equipment						
26			Electric overhead crane, l/c 2000 kg Motor 4 kW		pc	1	2470	2470	
27			Overhead electric crane l/c = 2000 kg Motors 4 kW		"	2	810	1620	
28			Overhead electric crane, l/c = 2000 kg		"	3	1300	3900	
29			Belt mobile conveyer B = 8000; Motor 7.5 kW		"	2	18000	36000	
30			Belt mobile conveyer B = 1400 mm; Motor 11 kW		"	2	26000	52000	
31			Apron feeder; motor 10 kW		"	1	2500	2500	
32			Clamshell crane, l/c = 10000 kg Motors, total power 18 kW		"	1	53000	53000	
33			Overhead electric crane, l/c = 5000 kg Motors = 9.2 kW		"	3	1550	4650	
34			Overhead electric crane, l/c = 2000 kg Motors = 4 kW		"	1	720	720	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
3..		Overhead electric crane, l/c 3.2 t Motors 6 kW		pc	4	920	2680	
		Total:					160540	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		HYDRATE STOREHOUSE TECHNOLOGY Part 1. Equipment Handling Equipment						
1		Apron Feeder B=800 mm L=6 m Motor 5.5 kW		pc	1	3800	3800	
2		Stationary belt conveyor B=800 mm S=1 m/sec L=58.5 m Gear ratio 31.5 Motor 18.5 kW		"	1	5000	5000	
3		Diagonal plough with electric drive for 800 m belt Motor 2.2 kW		"	2	635	1770	
4		Automatic conveyer seales for 800 mm belt		"	1	345	345	
5		Belt stationary conveyor B=800 mm V=1 m/sec L=31 m Drive: gear with ratio 31.5 Motor 13 kW		"	1	6650	6650	
6		800 mm - belt automatic conveyer weigher		"	1	345	345	
7		Belt stationary conveyor, B=800 mm V=1 m/sec L=100 m Drive: gear ratio: 31à5 motor 13 kW		"	2	19840	39680	

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NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
8		Diagonal plough B = 800 mm with el.drive motor 2.2 kW		pc	2	635	1270	
9		Automatic belt weigher for the belt width - 800 mm		"	1	345	345	
10		Electric overhead crane, clamshell l/c = 10000 kg, span - 34.5 m H = 12 tm Ladle - 3.2 m^2 Total motors P = 139 kW		pc	1	53700	53700	
11		Hand-operated worm movable hoist, l/c = 1000 kg H = 3 m		"	4	45	180	
12		Hand operated movable worm hoist l/c = 1000 kg H = 6 m		"	3	50	150	
13		Hand operated movable worm hoist, l/c = 1000 kg; H = 12 m		"	3	60	180	
		Total:					112915	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		CALCINATION Part I. Equipment Process Chemistry equipment						
1		Drier "Ventury" Ø 2500 mm		pc	1	4500	4500	
2		Drier "Ventury" Ø 3000 mm		pc	1	10000	10000	
3		Electric filter for high ash-laden gas F = 41.4 m^2		pc	1	54850	54850	
4		Air filter V = 40000 m^3/h, ФP-5A		pc	2	300	600	
		Total:					95450	
		Tanks and furnaces						
5		Discharge hopper 2.5x2.5 m		pc	1	900	900	
6		Compensation tank		pc	1	300	300	
7		Furnace KC		pc	1	43600	43600	
8		Cyclonic exchanger ø 4,000		pc	1	22000	22000	
9		Recirculation cyclon Ø 4000		pc	1	30000	30000	
10		Heat exchanging column Ø 950		pc	1	1000	1000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
11		Cyclonic heat exchanger ∅ 2,800		pc	1	11000	11000	
12		Refrigirator KC F = 33.3 m2		pc	1	45500	45500	
13		Exchangers		pc	2	2500	5000	
14		Cyclon ∅ 1800 mm V = 130,000 m3/h		pc	1	1670	1670	
		Total:					160970	
		Pumps						
15		Water pump Q = 90 m^3/h H = 35 m		pc	2	800	1600	
		Exhausters, fand, air turbo-blowers						
16		Exchauster Q = 40000 m^3/h H = 350 kgp/m2		pc	1	1500	1500	
17		Fan centrifugal Q = 2000÷4000 m3/h H = 200 kgP/m2		pc	1	48	48	
18		Centrifugal fan Q = 4000÷7000 m3/h H = 80 kgP/m2		pc	2	115	230	
19		Centrifugal fan Q = 2500 m3/h H = 600 kgp/m^2		pc	2	100	200	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
20		Centrifugal fan Q = 10000 m3/h H = 200 kgs/m2		pc	1	300	300	
21		Air turbo-blower TB-175, Q = 10000 m3/h H = 6000 kgp/m2		pc	2	5600	11200	
22		Air turbo-blower TB-50 Q = 3600 m3/h H = 6000 kg /m2		pc	1	4200	4200	
23		Air turbo-blower TB-175 Q = 10000 m3/h; H = 6300 kg /m^2		pc	5	6300	31500	
		Total:					49178	
		Sanitary-engineering equipment						
24		Bag filter F = 360 m2		pc	1	3000	3000	
		Handling equipment						
25		Belt conveyer B = 800, L = 70 m		pc	1	14000	14000	
26		Belt conveyer B = 800 m, L = 12 m		pc	1	3000	3000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
						of one piece	total	
27		Overhead electric crane Q = 5 t, L = 3 m		pc	1	1470	1470	
28		Suspended electric crane Q = 1000 kg; H = 4.5 m		pc	1	1500	1500	
29		Suspended electric crane Q = 2000 kg; span - 4.5 m		pc	1	1600	1600	
30		Electric hoist Q = 3,2 t H = 24 m		pc	1	650	650	
31		Electric hoist Q = 2000 kg		pc	2	690	1380	
32		Hand-operated hoist Q = 3.2 t		pc	1	178	178	
33		Hand-operated hoist Q = 1 t		pc	1	100	100	
34		Electric hoist Q = 1000 kg		pc	2	220	220	
35		Electric hoist l/c = 1000 kg, H = 24 m		pc	1	350	350	
36		Electric hoist l/c 500 kg, H = 12 m		pc	3	100	300	
37		Remote controled pneumodischarger		pc	4	550	2200	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
38		Continious action weigher Q = 100 t/h		pc	1	2086	2086	
39		2-screw feeder ø 400 mm		"	1	2750	2750	
40		Air chute B=200 mm		"	1	1500	1500	
41		Sluice feeder Q=6.28÷60 m3		"	5	400	2000	
42		Sluice valve		"	2	1000	2000	
43		Transfer KC		"	1	5700	5700	
44		Furnace discharging machine KC with gears		"	1	2100	2100	
45		Air chute B=250 mm		"	2	500	500	
46		Air lift Q=160 t/h		"	1	6050	6050	
		Total:					52634	
		Energetic and compressor equipment						
47		Compressor Q=260 m3/h H=3000 kgp/m2		pc	32	20000	40000	
48		Compressor Q=640 m3/h H=5000 kgp/m2		"	2	30000	60000	
		Total:					100000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
						of one piece	total	
		Part II. Materials						
49		Mineral wool		m2		200	40000	
50		Chamotte					800000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
ι t		Alumina storehouse						
		Technology						
		Part I. Equipment						
		Chemistry equipment						
1		Sluice feeder Ш 5-15		pc	12	300	3600	
		Exhausters, fans, air blowers						
2		Fan ЦП 6-45-6,3		"	4	500	2000	
		Sanitary technical equipment						
3		Bag Filter F = 90 m^2		"	4	2850	11400	
		Handling equipment						
4		Automatic wagons charging machine C-926A		"	4	18900	75600	
5		Bottom pneumodis-charger ПЦЦ -101-00		"	8	600	4800	
6		Belt conveyer B = 800 m L = 300m		"	2	3500	7000	
VQ 7		Cargo lift Q = 500 kg		"	1	2000	2000	
8		Electric suspended crane, g=1 t		"	1	720	720	
		Total					90120	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
						of one piece	total	
8		Electric suspended crane, g = 1 t		pc	1	720	720	
		Total:					90120	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		LIMESTONE BURNING						
		Process						
		Section I. Equipment						
		Tanks, vessels, furnaces						
1		Lime kiln, dia.5500 mm, H=25 m with charging and discharging units		pce	1	81060	81060	
2		Group of 4 cyclones, dia.1,200 mm		pcs	2	8800	17600	
		Total:					98660	
		I.D.fans, fans, air blowers						
3		-15 air blower		pce	1	3600	3600	
4		-10 fan		"	1	1100	1100	
		Total:					8300	
		Material handling equipment						
5		Skip hoist with bucket and winch		pce	1	13500	13500	
6		Belt conveyor		"	1	22000	22000	
7		Scraper conveyor	K C(M) -320	"	1	20000	20000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
8		Continuous apron conveyor		pcs	2	600	1200	
9		Swinging feeder B=500 mm		"	2	750	1500	
10		3.2 t electric hoist		"	4	560	2240	
11		Electric hoist, Q=2 t		"	4	560	2240	
12		Charge lift		1	1	2000	2000	
		Total:					46080	
		Section II. Materials						
13		Mineral wool		kg			24000	
14		Fireclay bricks		"			400000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Lime milk preparation						
		Process						
		Section I. Equipment						
		Chemical equipment						
1		Lime slaker Dia.2.2 m 10 m long 20/22/30 kW electric motor Reduction gear with a gear ratio 40		pcs	2	27045	54090	
2		Single-spiral classifier, with partially-submerged spiral		"	2	12610	25220	
		Spiral dia.1.5 m Trough is 8.2 m long Spiral drive electric motor is 7.5 kW Electric motor of a spiral lifting mechanism is 1.5 kW		"	2	4400	8800	
3		Ball mill ø 900/1800 Elm.otor 18.5 kW						
4		Chain agitator, dia.4.5x4.5 15 kW electric motor		"	2	8023	16046	
5		Chain agitator, dia.7.5x9 m, V=400 m3, 22 kW electric motor		pce	1	23344	23344	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
6		Chain agitator, ø 4.5x3 m, V=50 m3 El.motor - 15 kW			2	6910	13820	
7		Chain agitator, ø 2x2.5 m, El.motor 3 kW			1	2318	2318	
		Total:					143638	
		<u>Material handling equipment</u>						
8		Apron conveyor Apron width B=400 mm Conveyor length L=55 m 11 kW electric motor Reduction gear with a gear ratio 180		pos	2	64518	129036	
9		Belt conveyor, stationary Belt width 500 mm Belt speed 0.8 m/s Conveyor length 42 m Reduction gear with a gear ratio 31.5		"	2	5700	11400	
10		Automatic belt weigher, type 1954AB50-5, for a belt B=500 mm		"	2	192	384	
11		Disk feeder Disk dia. 1200 mm 1.9 kW electric motor		"	2	730	1460	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
12		Double-sector gate with a pneumatic drive, 630x630		pcs	2	220	440	
13		12.5 t general purpose overhead electric crane, L_{max} = 19.5 t, H=16 m Total capacity of electric motors 25.2 kW		"	1	13000	13000	
14		1 t manual travelling worm hoist		pce	1		45	
15		3.2 t electric hoist H=36 m		pcs	4	1895	7580	
		Total capacity of electric motors 5.4 kW						
		Total:					163345	
		<u>Pumps</u>						
16		85 m3/hr, 40 m centrifugal pump Electric motor 45 kW		"	3	1270	3810	
17		Centrifugal pjmp Q=225 m3/h H= 67 m El.motor - 160 kW		-	2	1660	3320	
18		56 m3/hr, 17 m centrifugal pump 15 kW electric motor		"	1	1123	1123	
19		Centrifugal pump Q=170 m3/h H=40 m El.motor - 75 kW		-	2	1660	3320	
		Total:					[illegible]	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	total	Manufactured indigenously
		Causticization						
		Process						
		Section I. Equipment						
		Chemical equipment						
1		Agitator-causticizer, dia.4.5x4.5m 15 kW electric motor		pcs	3	7790	23370	
2		Chain agitator, dia.4.5 x 3 m 15 kW electric motor		"	6	7190	43140	
3		20 m2 drum filter 3 kW electric motor		"	2	12955	25910	
4		1 m3 receiver		"	2	350	700	
5		Trap, dia. 0.5 m		pce	1	90	90	
6		Shell-and-tube exchanger, heat exchange area - 61 m2		pcs	2	2150	4300	
7		Barometric condensor, dia. 0.8 m		pce	1	1000	1000	
8		Sump agitator, dia. 2 x 2.5 m		"	1	1930	1930	
		Total:					100440	

NOS: No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg: of one piece	Net weight, kg: total	Manufactured indigenously
		Tanks, vessels, furnaces						
9		Tank, dia. 6 x 6 m		pcs	5	10200	51000	
10		Thickener, dia. 15 m, filtration area - 176 m2 El.motor - 4 kW		"	2	13000	26000	
11		Hydroseal, dia. 1.2 x 2.0 m		"	2	420	840	
		Total:					77840	
		Pumps						
12		Centrifugal pump, 70 m3/hr, R = 27 m El.motor - 22 kW		pcs	8	1155	9240	
13		Do, 56 m3/hr, P = 17 m 15 kW electric motor		"	9	1123	10107	
14		Do, 85 m3/hr; P = 40 m 45 kW electric motor		"	4	1270	5080	
15		25 m3/min vacuum pump 75 kW electric motor		"	2	2065	4130	
		Total:					28557	

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NOS	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg		Manufactured indigenously
No according to process flowsheet						of one piece	total	
		Material handling equipment						
16		2 t overhead electric crane. 4 kW electric motor		pce	1	1170	1170	
17		3.2 t overhead electric crane. 6 kW electric motor		"	1	1650	1650	
		Total:					2820	

3. CARBONATED SODA AND POTASH PRODUCTION

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		CARBONATED SODA AND POTASH PRODUCTION						
		Process design						
		<u>Evaporation, crystallisation and centrifugation</u>						
		Section I. Equipment						
		<u>Chemical equipment</u>						
1		Agitation unit, dia 9x9 m, V=630 m3 Electric motor 22 kW		pc	2	31370	62740	
2		Agitation unit, dia.6.0x9.0 m, V=160 m3, electric motor 15 kW		"	2	18800	37600	
3		Agitation unit, dia 6x4.5 m, V=125 m3, electric motor 15 kW		"	8	11800	94400	
4		Agitation unit, dia.6.0x7.5 m, V=200 m3, electric motor 15.0 m3		"	2	16800	33600	
5		Agitation unit dia.4.5x6 m, V=100 m2, electric motor 15 kW		"	12	9440	113280	
6		Film-type evaporator, F=800 m2		"	10	35800	358000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Whom to be supplied by
7		Evaporator with forced circulation, F=500 m2, including axial chemical pump with electric motor of 315 kW		"	8	39000	312000	
8		Evaporator with forced circulation, F=1250 m2 with electric motor of 125 kW		"	2	21000	42000	
9		Evaporator with forced circulation, F=315 m2 with axial chemical pump and electric motor of kW		"	3	29800	89400	
10		Agitation unit dia.3x3 m, V=20 m3, electric motor 5.5 kW		"	4	3780	3780	
11		Agitation unit dia.4.5x4.5 m V=0.3 m3, electric motor 15.0 kW		"	5	2340	11700	
12		Repulper with agitator, ø 2x2.5 kW V=8 m3, electric motor 5.5 kW		"	5	2340	11700	
13		Heat dxchanger, F=370 m2, D_{shell} - 1600 mm, D_{pipe} = 57x3 mm, l_{pipe} = 6000 mm, n = 344 pcs		"	10	14000	140000	
14		Lefa vertical filter, F=125 m2, electric motor 0.8 kW		"	2	9270	18540	
15		Condenser D=1600 Q=18 t/h		"	7	3400	23800	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
16		Vacuum-crystallizer, $D_{ex.}$ = 3800 mm, $D_{cr.}$ =5000/3400 mm, $V_{op.}$ = 116.8 m2, with electric chemical pump, rate 250 m3/hr, head 20 m, electric motor 55 kW		"	4	35000	210000	
17		Direct-contact condenser, D=2000 mm, head 10000 mm, flowrate 26-30 t/hr		pc	7	5300	37100	
18		Centrifuge, D_{rotor} - 2000 mm with main electric motor 75 kW, oil station - 2.2 kW, vibrator - 0.75 kW		"	9	17770	159930	
19		Centrifuge, D_{rotor} - 900 mm El.motor - 30 kW		"	2	10560	21120	
20		Cooling machine, of the MKT 350-2-1 type, capacity - 580000 kkcal/h		"	4	9230	36910	
		<u>Tanks, reservoirs</u>						
21		Steel tanks ø 4.5x6 m, V=100 m3		"	5	7180	35900	
22		Steel tank ø 7.5x9 m		"	3	17000	51000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
23		Hydrogate ø 2.5x2.0 m, V=8 m3		pc	9	1190	10710	
24		Flash evaporator, V=1.25 m3		"	27	430	11610	
25		Settling tank ø 12 m El.motor: shaft 3 kW, rake 3 kW		"	1	40000	40000	
		Total:					149220	
		<u>Pumps</u>						
26		Centrifugal pump Q=50 m3/h, H=16 m, motor 10 kW		"	10	700	7000	
27		Centrifugal pump Q=90 m3/hr, H=85 m, motor 45 kW		"	2	1010	2020	
28		Ditto, Q=320 m3/hr, H=50 m, motor 55 kW		"	4	2200	8800	
29		Ditto, Q=20 m3/hr, H=50 m motor 7.5 kW		"	4	320	1280	
30		Centrifugal pump Q=90 m3/hr,. H=30 m, motor 22 kW		"	2	1100	2200	
31		Centrifugal pump Q=25 m3/hr, H=32 m, motor 1.5 kW		"	42	1000	42000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
32		Centrifugal pump Q=12 m3/hr, H=50 m, motor 5.5 kW		"	6	170	1020	
33		Centrifugal pump, Q=100 m, H=40 m, Elmotor R=45 kW		"	8	1300	10400	
34		Centrifugal pump Q=170 m3/min, H=40 m, motor 75 kW		"	14	1600	23240	
35		Vacuum pump Q=25 m3/min motor 75 kW		"	34	2075	70550	
36		Vacuum pump, Q=12 m3/min, motor 30 kW		"	1	885	885	
37		Vacuum water-steam pump, Q=250 m3/h P oper. 40 mm.m		"	2	3266	6532	
		Total					117827	
		Handling equipment						
38		Electric travelling crene l/c 20/5 t, motor 55 kW		"	1	38000	38000	
39		Electric travelling crane l/c 5 t, motor 9.2 kW		"	1	2000	2000	
40		Electric travelling crane l/c 3.2 t, motor 5.7 kW		"	2	1500	3000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Whom to be supplied by
41		Belt conveyor B=800 mm, L=80 m, motor 15 kW		"	2	23800	47600	
		Total:					90600	

NOS No according to process flowsheet	[illegible]s. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		Soda product drying with sulfate and potash storage						
		Process						
		Part I. Equipment						
		<u>Chemical equipment</u>						
1		Drum drier Ø 2,5 m, l = 20 m		pc	5	95000	475000	
2		Drum drier Ø 1.2 m, l = 6 m		"	1	10000	10000	
3		Drum cooler Ø 2.2 m, l = 16 m		"	3	46000	138000	
4		Bag filter F = 30 m2		"	3	1109	3327	
5		Shell and tube heat exchanger F = 40 m2		"	1	1360	1360	
		Total:					627687	
		<u>Tanks, furnaces</u>						
6		Group of 4 cyclones Ø 900 mm		"	10	3610	36100	
7		Group of 6 cyclones Ø 700 mm		"	10	3430	34300	
8		Group of 2 cyclones Ø 400 mm		"	1	456	456	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Manufactured indigenously
9		Cyclone ЦН-I5 Ø 500 mm		po	1	385	385	
10		Venturi tube ГВПВ-0,06		"	4	522	2088	
11		Venturi tube ГВПВ-0,045		"	6	396	2376	
12		Venturi tube ГВПВ-0,006		"	1	74	74	
13		Moisture trap КЦТ-I200		"	4	707	2828	
14		Moisture trap КЦТ-400		"	1	91	91	
15		Ditto, КЦТ-400		"	6	922	5532	
		Total:					84230	
		Pumps						
16		Suction dredge Q = 160 m3/h H = 60 m		"	2	1523	3046	
17 17		Ditto, Q = 60 m3/h, H = 16 m		"	2	335	670	
18		Pump Q = 12,5 m3/h, H = 50 m		"	1	311	311	
19		Pump Q = 320 m3/h, H = 50 m		"	2	1223	2446	
20		Ditto, Q = 100 m3/h, H = 40 m		"	2	925	1850	
		Total:					8323	

NOS	Trans.	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg		Manufactured indigenously
No according to process flowsheet	No					of one piece	total	
		Smoke exhausters, fans air blowers						
21		Centrifugal fan, capacity up to 16600 m/h, pressure 230-680 kgf/m2		pc	2	535	1070	
22		Centrifugal fan, productivity up to 39000 m3/h, pressure 552 kgf/m2		"	5	1354	6770	
23		Centrifugal fans, 19600 m3/h P = 346 kgf/m2		"	3	723	2169	
24		Ditto, 150000 m3/h, P = 1290kgf/m2		"	5	4170	20850	
25		Ditto, 6700 m3/h, P = 230 kgf/m2		"	3	48	144	
26		Ditto, 3200 m3/h, P = 185 kgf/m2		"	1	24	24	
		Total:					31027	
		Handling equipment						
27		Belt conveyor B = 800 mm L = 80 mm		"	3	11900	35700	
28		Ditto, B = 800 mm, L = 4 m		"	3	1400	4200	
29		Scraper conveyor Q = 4 t/h, L = 15 m		"	2	3000	6000	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg		Manufactured indigenously
						of one piece	total	
30		Ditto, Q = 1 t/h, L = 14 m		pc	1	3000	3000	
31		Ditto, Q = 15 t/h, L = 10 m		"	3	3382	10146	
32		Ditto, Q = 3 t/h, L = 8 m		"	3	3000	9000	
33		Air lock feeder 6,28÷59,68 m3/h 5-45		"	5	386	1930	
34		Ditto, 0,57÷5,48 m3/h, 5-20		"	26	130	3380	
35		Plate feeder 0,245÷1,62 m3/h		"	1	212	212	
36		Pneumatic pump Q = 60 t/h (TA-29A)		"	2	7760	15520	
37		Elevator Q = 1 t/h		"	1	1670	1670	
38		Ditto, Q = 15 t/h		"	3	3185	9555	
39		Electric overhead crane Q = 5 t, H = 24 m		"	2	3920	7840	
40		Ditto, Q = 3,2 t		"	4	1270	5080	
41		Electric hoist 1 t		"	6	204	1224	
42		Weighing device, 20 m3/h (25 t/h)		"	2	475	950	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
43		Automatic weigher		pc	4	480	1920	
44		Bag sewing machine 500 bags/h		"	3	465	1395	
45		Winding unit, 30 packs/h		"	1	720	720	
46		General purpose vibrator HB-104A		"	32	29,5	944	
47		Conveyor with immerged scrapers Q = 15 t/h, L = 8 m		"	3	2190	6570	
48		Weighing feeder Q = 50 kg/min		"	4	445	1780	
49		Telescopic hoist, lifting capacity 100 kg		"	1	1000	1000	
50		Immerged scrapers conveyer Q = 15 m/h, L = 30 m		"	1	7660	7660	
51		– " – Q = 15 m/h, L = 22,5 m		"	1	5690	5690	
52		Reversible screw conveyer, Q = 15 m/h, L = 11 m		"	1	1170	1170	
53		Screw conveyer Q = 1 m/h, L = 6m		"	1	523	523	
✓ 54		Incline belt conveyer B = 650 mm, L = 24 m		"	3	4530	13590	
55		– " – B = 650 mm, L = 18 m		"	1	2900	2900	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
56		Reversible belt conveyer, B = 650 mm, L = 27 m		pc	1	4000	4000	
57		Diagonal plough conveyer B = 650 mm, L = 23 m		"	1	3100	3100	
58		Movable belt conveyer B = 500 mm, L = 14 m		"	2	900	1800	
59		– " – B = 400 mm, L = 10 m		"	2	500	1000	
60		Sack-loader, 900 s/h		"	2	5800	11600	
61		Electric loader, l/c 1250 kg H = 2800		"	1	255C	2550	
62		– " – l/c 1000 kg H = 4500		"	1	4650	4650	
63		Electric hoist, l/c 1000 kg		"	6	220	1320	
64		Overhead electric crane, l/c – 5000 kg, H = 16 m		"	1	2700	2700	
65		Hand-operated trolley with lifted platform, l/c 1000 kg		"	2	64	128	
		Total:					22020217	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Section II. Materials						
67		Mineral wool					40000	
68		Fireday		set			250000	
		Total:					3899000	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		Sodium carbonate silo storage						
		Process						
		Section I. Equipment						
		Chemical equipment						
1		Air collector, D = 200 mm P = 8 kg/cm2		pce	1	3565	3565	
		Pumps						
2		Sump pump Q = 3 m3/hr H = 40 m		pcs	2	58	116	
		Material-handling equipment						
3		Shunting unit Tractive force 9000 kg Wagons movement length - 150 m max		pcs	2	3850	7700	
4		Passenger lift G = 500 kg		pce	1	2000	2000	
5		Pulley block casing, 5 t		pcs	5	35,5	177,5	
6		Tractive effort - 2000 kg, rope length		pce	2	924	1448	
7		1 t manual truck with lifting platform P=17		pce	1	95	95	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
8		450 t/hr automatic loader		pcs	2	3475	6950	
9		Screw conveyor D = 200 mm L = 18 m		pce	1	1200	1200	
10		7,5÷150 t weigher		pcs	2	15280	30560	
		Total:					50130.5	

4. CEMENT PRODUCTION

NOS	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
No according to technological flowsheet						of one piece	total	
		BURDEN MILLING						
		Technology						
		Part I. Equipment						
1		Crashing, milling and dressing equipment						
1		Raw material mill ø 4x13.5 Head drive engine P=3150 kW Rotation Fr= 500 /min Voltage 10000 V Gear ratio 30.94		pc	6	520000	312000	
		Helping drive engine P=55 kW R.Fr. = 1000 /min Gear ratio = 159.42 Complete with:						
		- oiling station 125 l/min, 5 kgs/cm2		pc	6	1560	9360	
		- oiling station 125 l/min, 12 kgs/cm2		"	6	1860	11160	
		- oiling stztion 35 l/min		"	6	590	3540	
		- oiling station 8 l/min		"	6	284	1704	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
		Hydrohead system with pump, Q=8 l/min El.engine P=7.5 kW		pc	6	75	450	
2		Wet self-milling mill L=2.3 m ø 7000 m Engine Power 16000 kW		"	2	44700	89400	
		Voltage 10000+220/380 V complete with:		"	2	195	390	
		- oiling station 125 l/min		"	2	1860	3720	
		- oiling station 50 l/min		"	2	1172	2344	
		- oiling station 8 l/min		"	2	284	568	
3		Vibration screen, engine 2.8 kW El.		"	8	2000	16000	
		Total:					1278236	
		Chemistry equipment						
4		Chain mixer ø 7.5x6 m V = 250 m3 Engine 18.5 kW		"	2	19355	38710	
5		Chain mixer ø 6x4.5 m V = 125 m3 engine 15 kW		"	3	11802	35406	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
6		Chain mixer ø 7.5x9 V V = 400 m3 Engine 18.5 kW		pc	1	23344	23344	
7		Chain mixer ø 7.5x9 V = 400 m3 Engine 28.5 kW		"	2	23344	23344	
8		Chain mixer ø 6x4.5 m V = 125 m3 Engine 15 kW		"	5	11802	59010	
9		Chain mixer ø 2x2.5 V = 8 m3 El.motor - 5.5 kW		"	5	2318	11590	
		Total:					183378	
		Pumps						
10		Centrifugal pump 225 m/h 67 m Engine 160 kW		"	10	2615	26150	
11		Centrifugal pump 170 m3/h 40 m Engine 75 kW		"	2	1660	3320	
12		Centrifugal pump 170 m3/h 40 m Engine 75 kW		"	4	1660	6640	
13		Centrifugal pump 350 m3/h, 40 m Engine 132 kW		"	2	2825	5650	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
14		Centrifugal pump 350 m3/h, 40 m Engine 132 kW		pc	4	2825	11300	
15		Centrifugal pump 350 m3/h, 40 m Engine 132 kW		"	4	2825	11300	
		Total:					63690	
		<u>Handling equipment</u>						
16		Belt chute conveyor B=1000 m, L=110 m Gear ratio 31.5 Engine 37 kW S=1.6 m/sec						
17		Discharge trolley 100-63 for 1000 m belt conveyer Total engines power 7.9 kW		"	2	5174	10348	
18		Automatic scales for 650 mm belt conveyer		"	2	198	396	
19		Belt chute conveyer B=1000 mm, L=20 m S=1 m/sec Gear ratio 31.5 Engine 7.5 kW		"	7	5000	25000	
20		Automatic scales for 1000 mm - belt conveyer		"	5	332	1660	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
						of one piece	total	
21		Belt chute conveyor Belt width B=650 mm - langth L=14 m - speed V=1 m/s Engine 7.5 kW Gear ratioi=25		pc	2	2100	4200	
22		Continious action weigher Max production limit 100 t/h Engine 4 kW		"	2	4000	8000	
23		Continious action weigher Max production limit 100 t/h Engine 4 kW		"	5	4000	2000	
24		Continious action weigher Production limit 16 t/h Engine P=2 kW		"	5	4000	20000	
25		Overhead electric suspended crane, l/c = 5000 kg; H=20 m Total engines power 9.2 kW		"	1	3280	3280	
26		Overhead electric suspended 1-beam crane; l/c-20000 kg, span - 18 m, T.e.p.=9.2 kW		"	3	810	2430	
27		Electric hoist Loading capacity - 5 t heihtit - 12 m Engine - 9.2 m		"	1	830	830	
		Total:					140144	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Correction and reserve tanks						
		Process						
		Section I. Equipment						
		Chemical equipment						
1		630 m3 chain agitator, dia.9x9 m; 18.5 kW electric motor		pcs	2	30680	61360	
2		Chain agitator, ø 2x2.5 m, V=8 m3, Engine - 5.5 kW		"	5	2318	11590	
		Total:					72950	
		Pumps						
3		170 m3/hr centrifugal pump, 40 m; 75 kW electric motor		"	5	1660	8300	
4		225 m3/hr centrifugal pump; 67 m; 160 kW electric motor		"	3	2615	67045	
		Total:					75345	
		Material handling equipment						
5		5 t overhead electric suspended crane, span - 15 m. Total capacity of electric motors - 9.2 kW		pce	1	3280	3280	

NOS	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg	
No according to technological flowsheet						of one piece	total	Whom to be supplied by

No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg, of one piece	Net weight, kg, total	Whom to be supplied by
6		Electric hoist, Loading capacity - 3.2 m Total Power of engine - 5.4 kW		pce	1	495	495	
7		320 kg passenger lift		"	1	500	500	
		Total:					4275	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Clinker burning						
		Process						
		Section I. Equipment						
		Chemical equipment						
1		Electrostatic precipitator F = 129.2 m2		pcs	2	390000	4680000	
2		Pneumatic 2-chamber pump Q = 100 t/hr		"	6	7760	47560	
3		Pneumatic screw pump Q = 36 t/hr		"	6	800	4800	
		Total:					4732360	
		Tanks, vessels, furnace equipment						
4		Rotary kiln, dia. 6.4/5.8 x 190 m		"	6	330000	19800000	
5		Grate cooler F = 68 m2		"	6	700000	4200000	
6		Drum after-cooler dia.6.4/5.8 x 60 m		"	6	850000	5100000	
7		Cyclone-discharger dia.1200 mm		"	6	900	5400	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		I.D.fans, fans, air blowers						
8		Fan, Q=33000 m3/hr H=512 kg/m2		pcs	6	5000	30000	
9		Fan Q=58000 m3/hr H=900 kg/m2		"	12	4000	72000	
10		I.D.fan Q=417000 m3/hr H=600 kg/m2		"	12	23700	284400	
		Total:					670800	
		Power equipment						
11		Flap valve, Dnom 300		pcs	36	330	11880	
12		Material handling equipment						
12		Slurry feeder		"	12	128	1536	
13		Apron conveyor B=800 mm L=100 m		"	12			
14		Double-rack gate		"	6	167	1002	
15		Overhead electric crane Q=5 t, H=36 m		"	1	26300	26300	
16		Gantry crane Q=100/10 t B=32 m, H=32 m		"	6	201700	1210200	

NOS	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
No according to technological flowsheet						of one piece	total	
17		5 t suspended electric crane		pcs	1	10300	10300	
18		0.5 t electric hoist		"	60	104	6240	
19		1 t electric hoist, H=12 m		"	10	385	3850	
20		Electric hoist, G=2 t, H=30 m		"	1	625	625	
21		Do, G=3.2 t H=12 m		"	6	515	3090	
22		Do, G=3.2 t H=30 m		"	3	700	2100	
23		Do, G=5 t, H=12		"	3	830	2490	
24		Suspended-flight conveyor L=20 m		"	2	6270	75240	
25		Do, L=32 m		"	24	8630	207120	
26		0.5 t lift H=48 m		"	2	2000	4000	
27		Screw feeder Q=14 t/hr		"	12	800	9600	
28		Do, Q=42 t/hr		"	12	1800	21600	
29		Do, Q=6.28-60 t/hr		"	6	515	3090	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Whom to be supplied by
30		5 t suspended crane, H=36 m		pcs	1	4820	4820	
		Total:					1593203	
		Section II. Materials						
31		Mineral wool					2160000	
32		Fireclay bricks					19800000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Whom to be supplied by
		ADDITIVES AND CLINKER STORAGE						
		Technology Section						
		Part I. Equipment						
		Handling equipment						
1		Overhead crane 1/c 20 t; H=30 m		pc	6	65200	391200	
2		Apron feeder B=1200 mm L=9 m		"	6	30000	180000	
3		Belt conveyor B=800 mm L=90 m		"	2	22500	45000	
4		Belt conveyor B=800 mm L=95 m		"	2	24000	48000	
5		Belt conveyor B=800 mm L=150 m		"	2	40000	80000	
6		Belt conveyor B=1200 mm L=185 mm		"	2	74000	148000	
7		Electric hoist 1/c=2 t		"	4	625	2500	
8		Electric hoist 1/c=1 t		"	4	385	1540	
9		-"-		"	6	50	300	
		Total:					986540	

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NOS — No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg — of one piece	total	Whom to be supplied by
		GYPSUM RECEIVER						
		Technology Section						
		Part I. Equipment						
		Chemistry Equipment						
1		Bag filter F=200 m2		pc	1	2700	2700	
		<u>Pumps</u>						
2		Mud pump						
		<u>Exhausters, fans, blowers</u>						
/3		Centrifugal fan Q=10800 m3/h H=250 kgp/m2						
		<u>Handling equipment</u>						
4		Apron feeder B=1500 L=12 m		"	4	15000	60000	
5		Screw conveyor ø 320, L=8 m		"	1	860	860	
6		Belt conveyor B=1200, L=125 m		-				

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
7		Electric crane Q=3.2 t		pc	1	2140	2140	
8		Electric hoist Q=3.2 t		"	3	115	445	
9		Hand operated hoist Q=2.0 t						
		Total:					153655	

NOS	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied
No according to technological flowsheet						of one piece	total	
		Tent-roofed clinker storage						
		Process						
		Section I. Equipment						
		Chemical equipment						
1		Bag filter F = 360 m2		pcs	6	14200	85200	
2		Do, F =120 m2		"	6	4000	24000	
3		Airlock feeder 0.7 ÷ 3.6 m3/hr		"	12	167	2004	
		Total:					111204	
		I.D.fans, fans, air blowers						
4		Centrifugal fan Q = 25000 m2/hr L = 200 kgp/m2		"	6	885	5310	
5		Do, Q = 5800 m3/hr		"	12	420	5040	
6		Do, Q = 5500 m3/hr		"	12	367	4404	
		Total:					14754	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
3	.	Handling equipment						
7		Apron conveyor, 150 t/hr L=23 m		pcs	12	15000	180000	
8		Screw conveyor dia.320 mm L=4 m		"	12	204	2448	
9		Troughed belt conveyor 150 t/hr, B=1000, L=150 m		".	12	20	420	
10		Electric hoist Q=5 t H=30 m		"	12	1060	12720	
11		Manual hoist, Q=1 t, H=9 m		"	12	90	1080	
		Total:					772248	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied
		Belite slurry drying with filtration and storage						
		Process						
		Section I. Equipment						
		Chemical equipment						
1		Drum drier, dia. 3,2 x 27 m		pcs	4	215905	863620	
2		Electrostatic precipitator F=42 m^2		"	4	92500	370000	
3		Agitator dia. 6 x 9 m, with 15 kW electric motor		"	4	18800	75200	
4		Drum vacuum-filter БОУ-80 filtration area - 80 m2 Electric motor speed 480÷1420 R.P.M Electric motor capacity 4x12 kW		"	4	35500	142000	
5		4 m3 vacuum receiver		"	8	900	72000	
		Total:					1458020	
		Tanks, vessels						
6		Dust cyclone dia. 2360 mm		pcs	8	5600	44800	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied
		Pumps						
7		Centrifugal slurry pump capacity 150 m3/hr Head - 30 m Electric motor capacity - 40 m		pcs	2	1430	2860	
8		Centrifugal pump capacity 100 m3/hr Head - 30 m Electric motor capacity - 20 kW		"	2	1260	2520	
9		BBH-50 vacuum pump electric motor capacity - 100 kW		"	8	4000	32000	
		Total:					37380	
		I.D.fans, fans, air blowers						
10		Radial fan Q = 16000 m3/hr, H = 140 kg/m2		pcs	4	473	1892	
11		Centrifugal fan Q = 18000 m3/hr H = 240 kg/m2		"	4	1470	5880	
12		Do, Q = 30000 m3/hr, H = 250 kg/m2		"	4	785	3140	
13		Do, Q = 12100, H = 300 kg/m2		"	4	585	2340	
14		I.D.fan		"	4	12500	50000	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
15		Centrifugal fan, Q=6000 m3/h, H=160 kgp/m2		pcs	4	425	1700	
		Total:					.64952	
		Sanitary equipment						
16		Bag filter F=440 m2		"	4	14200	56800	
17		Do, F=200 m2		"	4	2000	8000	
18		Electric air heater N=22.5 kW		"	16	25	400	
		Total:					62500	
		Handling equipment						
19		Belt conveyor B=1000 mm L=31.5 m		pcs	4	11000	44000	
20		Reciprocating screw conveyor dia.320 mm, L=10 m		"	4	1016	4064	
21		Belt conveyor B=1000 mm L=70 m		"	4	23000	46000	
22		Screw conveyor, dia.320, L=6 m		"	4	713	2852	
23		1 t manual hoist, H=12 m		"	16	95	1520	
24		1 t manual hoist		"	8	220	1760	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
25		3.2 electric hoist		pos	4	540	2160	
26		1 t manual hoist, H=3 m		"	4	40	160	
27		2 t manual hoist, H=9 m		"	4	70	280	
28		Troughed belt conveyor, belt 800 mm wide, 40 m long Belt speed - 1.6 m/s. Reduction gear with a gear ratio 2.5 15 kW electric motor		- "	2	7700	15400	
29		10 t overhead electric crane		"	4	5370	21480	
30		Apron feeder B=1500 mm, L=12 m		"	4	15000	60000	
31		3.2 t electric hoist, H=24 m		"	4	650	2600	
32		1 t electric hoist, H=24 m		"	8	220	1760	
		Total:		-			204036	
		Section II. Materials						
33		Mineral wool		"			10600	
34		Fireclay bricks		"			350000	
				-				

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		<u>Cement grinding</u>						
		Process						
		Section I.						
		Crushing, grinding and beneficiating equipment						
		Automatic unit for grinding clinker with additives in a closed circuit		pcs	9	576000	5184000	
1.1		4x135 m cement mill 3150 kW, 10.000 V, main drive electric motor		"	9			
		Planeraty reduction gear, gear ratio 30.94		"	9			
		55 kW, 380 V auxiliary drive electric motor		"	9			
		Also including:		-				
		- 125 l/min lubricating oil station, 5 kgp/cm2		"	9			
		- lubrication oil station, Q=300 l/min		-				
		Hydrohead system		"	9			
1.2		Separator with 5 m dia. external cyclones, lined (stone castings)		- / "	9			

NOS — No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied b
						of one piece	total	
1.3		Induced draft fan for separator with 315 kW electric motor		pcs	9			
1.4		Airlock feeder. Rotor dia. - 300 mm 0.99 kW electric motor		pcs	64			
1.5		Airslide, 400 mm wide, 10 m long, complete with fan		"	9			
1.6		Do		"	18			
1.7		Airslide, 630 mm wide, 9 m long, complete with fan		"	9			
1.8		Airslide, 630 mm wide, 8 m long, complete with fan		"	9			
1.9		Airslide, 640 mm wide, 3 m long, complete with fan		"	9			
1.10		Bucket elevator, 32.5 m high		"	9			
1.11		100 m3/hr pneumatic chamber pump		"	9			
1.12		Airslide, 630 mm wide 9 m long, complete with fan		"	9			
1.13		Continuous feeder for clinker, max.capacity - 160 t/hr		"	18			
1.14		Continuous feeder max.capacity - 40 t/hr		"	9			

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied
1.15		Continuous feeder for gypsum, max.capacity - 10 t/hr		pcs	9			
1.16		Induced draft fan with 200 kW electric motor		"	9			
		Total:					5184000	
		Chemical equipment						
2		Horizontal single-section three field electrostatic precipitator, with 28.7 m2 active section area		pcs	9	81320	731880	
3		Air foam unit		"	32	225	7200	
		Total:					739080	
		Tanks, vessels						
4		Group of two cyclones, dia. 1,400 mm, type "ЦН-15"		pcs	9	4400	39600	
		Total:					39600	
		Pumps						
5		1 l/s vortex pump 16 mm W.C. 1.5 kW electric motor		pcs	19	50	950	
		Total:					950	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		Fans						
6		Centrifugal fan for feeding air to a body of main electric motor Capacity - 4800 m3/hr Pressure - 1000 mm W.C. 2.2.kW electric motor		pcs	9	50	450	
7		Dust-handling centrifugal fan. 11 kW electric motor		"	9	518	4662	
8		Do 15 kW electric motor		"	9	530	4770	
		Total:					9883	
		Material handling equipment						
9		Fixed plough tripper for 1000 mm wide belt		"	9	1140	10260	
10		Screw conveyor, dia.320 mm 21 m long		"	10	1900	19000	
11		200 t hydraulic jack		"	18	180	3240	
12		10 t overhead electric crane 1.H.-34.5 m, span - 27 m. Total power capacity - 39.7 kW		pce	1	20300	20300	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
13		32/5 t overhead electric crane, floor-operated, span - 16.5 m, hoisting height - 12.5/14 m. Light duty. Total capacity of electric motors - 43.5 kW						
14		10 t suspended single-beam electric crane, span - 8 m, 11 m long, hoisting height - 18 m. Total capacity of electric motors - 21.6 kW		"	1	5450	5450	
15		2.5 t suspended single-beam electric crane, span - 6 m, hoisting height - 36 m. Total capacity of electric motors - 6.8 kW		"	1	1330	1330	
16		3.2 t electrid travelling hoist. Hoisting height - 12 m. Total capacity of electric motors - 5.4 kW		pcs	2	495	990	
17		2 t electric travelling hoist; hoisting height - 18 m; Total capacity of electric motors - 3.4 kW		pce	1	95	95	
18		1 t manual travelling worm hoist; hoisting height - 12 m						

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	total	Whom to be supplied by
19		Lifting electromagnet complete with						
		- magnetic controller;		pce	1	60	60	
		- comand controller		"	1	3	3	
		Total:					88;86	
		Sanitary equipment						
20		Suction bag filter, filtering area - 120 m2, assembly of 4 filters		pcs	9	4000	36000	
21		Do		"	9	4000	36000	
		Total:					72000	
		Laboratory equipment						
22		Sampler for loose materials		"	9	71	639	
23		Schenk flowrate for coarse loose material, capacity - 400 t/hr		"	9			
		Total:					639	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
		<u>Cement storage with packing area</u>						
		Process design						
		Section I. Equipment						
		Sanitary equipment						
1		**Bag filter, F = 400 m2**		pc	8	11000	88000	
		Tanks, furnace equipment						
2		Cement cooler, dia.2800		"	4	24750	99000	
3		Dust cyclone, dia.700		"	4	730	2920	
		Total:					101920	
		Handling equipment						
4		Rotational packing machine		pc	4	10600	42400	
5		Elevator 900x340 mm		"	4	6000	24000	
6		Vibration acreen OB 800x2000		"	4	695	2780	
7		Feeder PK-100		"	4	366	1464	
8		Bags handling equipment		set	4	270	1080	
9		Filling and packing machine		"	2	8000	16000	
10		Screw conveyor, dia.320,length 7 m		"	12	574	6888	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Whom to be supplied by
11		Belt conveyor, B=800 mm, length=18 m		pc	4	5500	22000	
12		Belt conveyor, B=800 mm, length = 8.2 m		"	2	9000	12000	
13		Telescopic loader, capacity 100 t/h		"	4	5500	22000	
14		Bottom discharge pneumatic unloader		"	8	655	5240	
15		Suspended conveyor with load-carrying chain		"	2	2500	5000	
16		Suspended electric crane, capacity 5 t		"	2	3890	7780	
17		Electric hoist, capacity 10 t		"	2	2785	5570	
18		Electric loader, capacity 1 t		"	8	2150	17200	
		Total:					191402	
19		Mineral wool		"			60000	

NOS: No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg: of one piece	Net weight, kg: total	Whom to be supplied by
		<u>Cement silo storage</u>						
		Process design						
		Section I. Equipment						
		<u>Chemical equipment</u>						
1		Pneumatic screw pump, Q=100 t/n		pc	8	2520	20160	
2		Bag filter, F=360 m2		"	32	8800	281600	
		Total:					301760	
		<u>I.D.Fans, fens, air blowers</u>						
3		Centrifugal dust fan No.5		pc	64	400	25600	
4		Centrifugal dust pump No.8		"	32	885	28320	
5		Centrifugal fan Q=2000 m3/h head 500 kgf/m2		"	4	500	2000	
		Total:					55920	
		<u>Pumps</u>						
6		Vortex pump, capacity 1 l/s		"	16	29.4	470	
		<u>Handling equipment</u>						
7		Charging equipment		"	64	6100	390400	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
						of one piece	total	
8		Track scales, Q=150+		pc	64	15250	976000	
9		Air slide, B=400 mm, length = 12 m		"	16	1500	24000	
10		Pneumatic unloader, capacity 100 t/h		"	32	550	17600	
11		Electric hoist 0.5 t		"	10	104	1040	
12		Manual-operated hoist, Q=1 t		"	32	95	3040	
13		Freight elevator, capacity 500 kg		"	4	9500	38000	
		Total:					1450080	

5. STORAGE FACILITIES

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		STORAGE FACILITIES						
		1. Material storage No.1						
		Process						
		Part I. Equipment						
		Material storage.Crane Equipment						
1		Stacker-crane travelling cabine control OK-1.0 load capacity 1 t, span = 22.5					12780	
2		Travelling electric crane floore control load capacity 10 t, span 22.5					15100	
3		Electric loader load capacity = 1 t, H = 2.0 t					2450	
4		Electric fractor fraction power = 250 kgf					1750	
		Total:					32080	
		Material storage No.2						
1		Electric travelling crane floor control capacity 10 t L = 22.5 m			1		15100	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
2		Travelling stacker crane with telescope column l.cap.2 t, L = 22.5 m			1		24900	
3		Electric travelling crane, floor control capacity 20/5 t, L = 22.5 m					2200	
4		Electric loader capacity 1.6		pc	2	2920	5840	
		TOTAL					67840.0	
		Opened storehouse of equipment						
		Crane equipment						
1		Electric travelling gantry crane L.c. = 32/8 t; L = 32 m			1		63500	
		Total:					63500	
		Refractory storage						
1		Electric stacker crane with telescope column l.c. = 2 t; H = 7.05 m, Lcr. = 22.5 m		pc	2	29000	58000	
2		Travelling clamshell crane l.c. = 5000 kg, L = 22.5 m, H = 22 m		pc	1		21500	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
3		Electric travelling crane floor control l.c. = 10 t, L = 22.5 m, H = 16 m		pc	1		17600	
4		Electric loader l.c. = 1600 kg	1638	pc	2	3220	6440	
		Total:					103540	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		Oils, chemical and acide storage						
		Tanks and furnaces						
1		Steel horizontal cylindric tank. Capacity = 10 m3		pc	6	2000	12000	
2		Tank capacity = 2 m^3		pc	3	350	1050	
3		Settling tank capacity = 2 m3		pc	3	400	1200	
		TOTAL chemical equipment					14250	
4		Oil reclaiming aggregate	3582	pc	1		980	
		Pumps						
5		Gear pump	[illegible]I8-25 5,8/I0-5	pc	10	105	1050	
		Handling equipment						
6		Weigher	[illegible]-500 [illegible] I3	pc	3	108	324	
7		Non explosive electric loader l.c. = 1250 kg	[illegible]-I,[illegible] type 614	pc	1		2800	
		TOTAL:					3124	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		Maintenance equipment						
8		5-section rack		pc	24	1100	26400	
		Gas storage						
		Crane equipment						
1		Electrical suspended crane G = 1000 kg; L = 6 m; H = 6 m, B - 25%		pc	1	720	720	
		Maintenance equipment						
2		Bottle capacity - 40l; P = 20 MPa		pc	248	76.5	18972	

6. UTILITY FACILITIES

NOS No according to process flowsheet	Trans. No	Name and technical characteristic	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		Step-down substation 220/10 kV						
		Electrical engineering						
		Section I. Equipment						
		Electrical equipment						
1		Three-phase power double-winding transformer, power rating 10000 kVA, voltage 220/10 kV		pc	1			
2		Switching equipment for operation in 220 kV network		set	1		10200	
3		Factory-assembled distribution switch gear 10 kV, consisting of 20 cabinets		set	1		22000	
4		Assembled electrical magnet supply unit for swithing of HV circuit breakers		set	1		150	
		Total:					32350	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		Central distribution 10 kV switch gear						
		Electrical engineering						
		Section I. Equipment						
		Electrical equipment						
1		Factory-assembled switch gear 10 kV, consisting of 60 cabinets		set	1		66000	
2		Concrete reactor, current limiting, 10 kV		phase	12	2580	31000	
3		Assembled electrical magnet supply unit for switching of HV circuit breakers		set	2	150	300	
		Total:					97300	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		Transformer oil service						
		Process part						
		Part I. Equipment						
		Tanks, furnaces						
1		Tank for oil, V = 75 m^3		pc	1	4327	4327	
2		Stabilized oil tank, V = 75 m3		"	1	4327	4327	
3		Fresh oil tank, V = 75 m3		"	2	4327	8654	
4		Pressure tank for contaminated oil, V = 2 m3		"	1	400	400	
5		Contaminated oil intake tank, V = 2 m3		"	1	490	490	
6		Daily tank of fresh oil, 2 m3		"	1	400	400	
		Total:					18598.0	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		Chemical equipment						
7		Centrifuge of service oil Q = 1500 l/h		pc	1	700	700	
8		Ditto, Q = 1500 l/h for stabilized and fresh oil		"	1	700	700	
9		Filter press, Q = 3000 l/h		"	1	300	300	
10		Adsorber for 100 kg of sorbent		"	2	220	440	
11		Silicagel filter for 2 kg		"	4	10	40	
12		Silicagel filter		"	3	6	18	
13		Filter, DN = 80		"	3	94	282	
		Total:					2480	
		Pumps						
14		Rotary gear pump Q = 18 m3/h		pcs	1	148	148	
15		Rotary gear pump Q = 18 m3/h for stabilized and fresh oil		"	1	148	148	
16		Pump for oil intake from cistern, Q = 20 m3/h		"	1	195	195	

NOS	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg		Manufactured indigenously
No according to process flowsheet						of one piece	total	
17		Vacuum pump, Q = 40 m3/h		pcs	1	145	145	
		Total:					636	
		Handling equipment						
18		Electric overhead crane 100/20 t, L_{run} = 16 m		"	1	146000	146000	
19		Electric overhead crane lc. = 5 t, L_{run} = 14.5 m		"	1	12100	12100	
20		Electric hoist, 2 t		"	1	290	290	
		Total:					158390.0	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		<u>Compressor station</u>						
		Process part						
		Part I. Equipment						
		Power equipment						
1		Centrifugal compressor Q = 525 m3/min; P_{als} = 0,88 MPa complete with:		pc	8	29000	232000	
		- cylindrical pressure regulator, 1 step, turbine type with connection couplings and main oil pump		pc	8			
		- intermediate air cooler of the I step		"	16			
		- ditto, of the II step		"	8			
		- end air cooler		"	8			
		- lubrication system		"	8			
		- automation system		"	8	1800	14400	
		- electric motor, N = 3150 kW V = 6000 V or 10000 V		"	8	12300	98400	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	total	Manufactured indigenously
2		Air drying unit, 100 m3/min complete with		set	2	10520	21040	
		- heat exchanger		pc	2	3900	7800	
		- moisture trap		"	2	270	540	
		- air drying block		"	2	4450	8900	
		- air collector		"	2	1900	3800	
		Total:					386880	
		Sanitary equipment						
3		Air filter		pc	6	285	1710	
		Pumps						
4		Gear oil pump Q = 3.6 m3/h P = 0.4 MPa		pc	2	59	118	
		Handling equipment						
5		Floor operated electric overhead crane, 16/3.2 t span = 16.5 m		"	1		20800	

NOS No according to technological flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, cipher	Unit of measurement	Quantity	Net weight, kg		Whom to be supplied by
						of one piece	total	
6		Bleeding noise silencer		pc	6	110	660	
		Total:					25386	
7		Oil tank, 1.4 m3		"	2	315	630	
8		Emergency surge tank 10 m3		"	1		1000	
		Total:					1630	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	 total	Manufactured indigenously
		<u>Blowers station</u>						
		Process part						
		Part I. Equipment						
		Power equipment						
1		Centrifugal blowers Q = 740 m3/min, P = 1.84 kgf/cm2			6	16000	96000	
		complete with electric motor N = 1600 kW, U = 6000 or 10000 V				7580	45480	
		Total:					141480	
		<u>Handling equipment</u>						
2		Electric overhead crane controlled from the floor, capacity = 16/3.2 t, span 16.5 m		pc	1		20800	
		<u>Pumps</u>						
3		Oil gear pump Q = 3.6 m3/h; P = 0.4 MPa		"	2	59	116	
		Tanks						
4		Oil tank, V = 1.4 m3		"	2	315	630	
5		Security tank, V = 10 m^3		"	1		1000	
		Total:					1630	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	total	Manufactu: indigenou
		Oxygen station Process design Section I. Equipment Power and compressor equipment						
1		Air separation unit, capacity 44 m3/h, gaseous oxygen purity 99.7% O_2, including:		set	2	10400	20800	
		a) separation unit						
		b) gas expander machine						
		c) air cleaning block						
		d) preliminary cooling block						
		e) piston air compressor, flowrate 0.066 m3/s, $P_{com.}$ = 21.56 MPa with electric motor AB2101-8, power rating 75 kW, voltage 220/380 V		"	2	2900	5800	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactur… Indigenous
2		Filling oxygen header, 2 x 5 cylinders, in set with accessories, valves and fittings, control and monitoring devices		pc	1	69	69	
3		Discharging oxygen header		"	1	36	36	
		Total:					26705	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg		Manufactured indigenously
						of one piece	total	
		Tanks						
4		Oxygen bottle 40-200Y		pc	300	81	24300	
5		Oxygen bottle 1-400-20		"	28	810	22680	
		Total:					46980	
		Handling equipment						
6		Overhead electric travelling beam, l.c. 2 t, l_n = 9 m, l = 10.2 m		"	1	1300	1300	
7		Electric hoist, l.c. = 1 t		"	2	195	390	
		Total:					1690	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufacturer indigenous
		<u>Fuel oil service</u>						
		Process part						
		Part I. Equipment						
		<u>Pumps</u>						
1		Immersion pumps, Q = 150 m3/h N = 58 kW with 32 kW electric motor KO 32-4, 1450 rpm		pc	4	1630	6520	
2		Main recirculation pump of I step, Q = 70 m3/h, H = 47 m H_2O with 20 kW electric motor BAO 71-2, 2950 rpm		"	5	720	3600	
3		Main pump of II step Q = 65 m3/h, H = 500 m.H_2O with 160 kW electric motor BAO2-280M2, 3000 rpm		"	5	3150	15750	
4		Pump, Q = 360 m3/h, H = 80 m H_2O with 132 kW electric motor BAO02-2805-2, 3000 rpm		"	2	1740	3480	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufacture… indigenous…
5		Ditto, Q = 45 m3/h, H = 39 m H_2O with 11 kW electric motor AM132M2		pc	2	250	500	
6		Ditto, Q = 15 m3/h, H = 60 m H_2O with 7 kW electric motor 52-M 1000 rpm		"	2	270	540	
		Total:					30390	
		<u>Power equipment</u>						
7		Heater, Q = 120 m3/h, F = 400 m2		"	5	9201	46005	
8		Ditto, Q = 60 m3/h, F = 200 m2		"	5	7955	39775	
9		Filter, Q = 120 m3/h, 10 atm		"	5	447	2335	
10		Filter, Q = 60 m3/h, 10 atm		"	5	248	1240	
		Total:					89355	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		<u>Tanks</u>						
11		Tank V = 100 m^3		pc	2	3780	7650	
12		Expansion tank V = 75 m^3		"	2	3000	6000	
13		Metal tank, V = 10000 m^3		"	6	190000	1140000	
		Total:					1153560	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactur[e] Indigenous[ly]
		Gas service units						
		Process part						
		Part I. Equipment						
		Power equipment						
1		Gas filter, Ø 300		po	3	117	351	
2		Gas filter, Ø 700		"	12	600	7200	
		Total:					7551	
		Handling equipment						
3		Manually operated overhead crane, lifting capacity 1 t, 3 m span		"	4	320	1280	
4		Ditto, lifting capacity 1 t, 4.5 m span		"	1		350	
5		Ditto, lifting capacity 1 t, 7.5 m span		"	2	570	1140	
		Total:					2770	
6								

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		<u>Part II. Materials</u>						
		Heat insulation of mineral wool		m^3	1250		190000	

7. WATER SUPPLY, SEWAGE AND MUD DISPOSAL UNITS

NOS	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg		Manufactured indigenously
No according to process flowsheet						of one piece	total	
		Water supply sewage and mud disposal units						
		Process part						
		Part I. Equipment						
		Chemical equipment						
1		Three-chamber filter Ø 3400, Q = 270 t/h P = 6 kgs/cm2		pc	20	7500	150000	
2		Chain mixer unit Ø 4.5 x 3 m cap:50 m3 with motor 15 kW		"	2	7730	15460	
3		Clarifier Ø 11 m, H = 14.9 m Q = 400 m3/h		"	7	49500	346500	
4		Steel enameled collector cap:6.3 m3		"	4	2560	10240	
		Total:					522200	
		Fans						
5		Fan for cooling tower Q = 1100000 m3/h with motor 75 kW		"	15	9300	139500	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
6		Ditto Q = 50000 m3/h with motor 30 kW		pc	6	4960	29760	
		Total:					169260	
		<u>Pumps</u>						
7		Pump, productivity = 1200 m3/h, motor N = 315 kW pressure		pc	22	1300	28600	
8		Pump, productivity = 1000 m3/h, pressure 48, with motor P = 150 kW		"	4	1150	4600	
9		Pump, productivity = 2000 m3/h, pressure 21 m with motor P = 160 kW		"	11	3860	42460	
10		Pump, productivity = 750 m3/h, pressure 47 m.w.c. with motor 160 kW		"	6	840	5040	
11		Pump, productivity = 600 m3/h, head 70 m with motor 200 kW		"	3	730	2190	
12		Pump, productivity = 150 m3/h, head 28 m, with motor 37 kW		"	9	300	2700	
13		Centrifugal pump, feeding=500 m3/h head 65 m motor A3-315 M-4 N = 130 kW, n = 1450 rpm		"	3	1709	5127	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	total	Manufactured indigenously
14		Centrifugal pump feeding 900 m^3/h head 67 m motor DA304-450Y-6 N = 630 kW, V = 6000 V, n = 1000		"	3	9040	27120	
15		Vertical emmergency pump capacity Q = 260 m3/h H = 20 m with el.motor 4AM 180 N = 30 kW		"	2	50	170	
		Total:					119537	
		Special cars and trucks						
16		Crawler-mounted power shovel, Ladle capacity - 1.0 m3		"	1	35000	350000	
17		Crawler-mounted bulldozer with ripper head		"	2	38350	76700	
18		Dump truck Load capacity = 10 t		"	10	10.000	100.000	
		Total:					2,117,000	

NOS No according to process flowsheet	Trans. No	Name and technical characteristics	Type, brand, model, code	Unit of measurement	Quantity	Net weight, kg of one piece	Net weight, kg total	Manufactured indigenously
		<u>Tanks</u>						
19		Slime basin Ø 5500, cap. 150 m^3		"	3	23000	69000	
		<u>Handling Equipment</u>						
20		Suspended crane, l/c 10000 kg, span = 8 m, L = 11 m		"	1	5400	5400	
21		Suspended electric 1-beam crane, l/c = 2 t, span L = 9 m, L = 10.8 m		"	1	1250	1250	
		Total:					6650	
22		Cast iron Fixtures dia. 50÷400					38000	
		Total:					245000	