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FINAL REPORT

ACTION PROGRAMME TO SUPPORT THE BUILDING MATERIALS SUB - SECTOR IN THE COMESA COUNTRIES

21507

TF/RAF/90/902 : **FINAL REPORT:**

FEASIBILITY STUDY FOR THE OPTIMIZATION AND EXPANSION OF THE CHILANGA CEMENT PLANT

Prepared for the Chilanga Cement PLC, Zambia by the United Nations Industrial Development Organization

SUMMARY

According to Zambia Privatization Agency Status Report from 31 July, 1995, the Chilanga Cement Limited owners structure is as follows: CDC - 50.1 %, ZAMIC - 12.6 %, Public - 37.3 %.

To survive in competitive cement market abroad and to meet demands of future investment development within Zambia will require to replace obsolete wet process machinery and equipment in the Chilanga Cement Plant. On behalf of the Government of the Republic of Zambia, COMESA requested UNIDO, Vienna to provide assistance in carrying out the project entitled "Feasibility Study for the Optimization and Expansion of the Chilanga Cement Plant in Zambia". In response to the request of the Government, UNIDO with the support of the Japanese donors decided to prepare the study and selected Keramoprojekt a.s. Trenčin, Slovakia as a consulting firm.

The expansion of the Chilanga Cement plant in Zambia appears to be a profitable project for both the country and the company provided that investment means new technology, an enlarge markets base on proven geological raw material reserves.

To implement the optimization and expansion project according to UNIDO neutral advice provided in the feasibility study is the main action recommended.

KEY WORDS

Zambia, Optimization and expansion of cement plant, Privatization, CDC - Commonwealth Development Corporation, Raw material investigation

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We would like to express our thanks to those who contributed to achieve the objectives of the mission, namely to prepare a feasibility study for the optimization and expansion of the Chilanga Cement Plant in Zambia. The study will be used by the new shareholders to make the forthcoming investment decision. UNIDO with the support of the Japanese donors has been requested to provide high level advisory services on the issue.

First of all we wish to thank the representatives of COMESA - Dr. J. E. O. Mwencha, director of the division of Industry, Energy and Environment and his team - Mr. M. A. Salah, Mr. Sichilima, etc., for their support and flexible and prompt provision of necessary information.

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ABBREVIATIONS AND ACRONYMS

a.s.	- join stock company
CCL	- Chilanga Cement Limited
CDC	- Commonwealth Development Corporation Limited
COMESA	- The Common Market for Eastern and Southern Africa (formerly PTA)
d	- day
dpw	- day per weak
dpy	- day per year
E	- East
GDP	- Gross Domestic Product
GNP	- Gross National Product
GW	- gigawatt
h	- hour
hpd	- hour per day
ICL	- Irish Cement Limited
IRR	- Internal Rate of Return
kV	- kilovolt
kVA	- kilovoltamper
kW	- kilowat
km/h	- kilometers per hour
L.O.I.	- Loss of Ignition
LSF	- Lime Saturation Factor
Ma	- Alumina Modulus
Ms	- Silica Modulus
Mts.	- mountains
mil.	- million
mg/Nm^3	- milligram per normal cubic meter
mm	- millimeter
MW	- megawatt
N	- North
NCDP	- National Commission for Development and Planning
PTA	- Preferential Trade Area for Eastern and Southern Africa

p/y	- per year
Q'ty	- quantity
S	- South
SADC	- Southern African Development Community (former SADCC)
SADCC	- Southern African Development Co-ordination Conference
tpd	- tons per day
tph	- ton per hour
tpy	- ton per year
tpw	- ton per week
UNDP	- United Nations Development Programme
UNIDO	- United Nations Industrial Development Organization
USD	- US dollars
W	- West, Watt
ZAMANGLO	- Zambian Anglo American Corporation
ZCCM	- Zambian Consolidated Copper Mines
ZESCO	- Zambian Electricity Supply Company
ZIMCO	- Zambia Industrial Mining Company
ZPA	- Zambia Privatization Agency
ZRA	- Zambia Revenue Authority

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FEASIBILITY STUDY FOR THE OPTIMIZATION AND EXPANSION OF THE CHILANGA CEMENT PLANT

0. EXECUTIVE SUMMARY

0.1 THE ENTERPRISE AFTER PRIVATIZATION: INTERRELATIONS WITH THE BUSINESS ENVIRONMENT

The Chilanga Cement PLC company operates two cement factories: Chilanga Works and Ndola Works.

Chilanga Works, located 15 kilometers south of Lusaka, was commissioned in 1951 with the first kiln producing 50,000 tones per annum. The management was soon realized that this capacity would not meet local demand and a second wet kiln was installed and commissioned in May, 1956 with a capacity of 98,000 tones per annum. The third wet kiln was installed in 1965 with a capacity of 110,000 tones per annum. The original kiln has since been permanently shut down, leaving the factory with a revised capacity of 170,000 tones per annum.

In 1968 the first of two dry process kilns was commissioned at Ndola. The factory is located on a large deposit of excellent quality limestone. The rated capacity is 320,000 tones per annum.

Fully privatized as of 1994, Chilanga Cement, PLC is free to manage its own affairs. The decision making process is quicker and is based on sound commercial principles by people who understand the business. However, the same freedom does impose certain extra responsibilities on the company management and its directors, as it holds a monopoly position in Zambia. Pricing is always a sensitive issue with regard to a strategic commodity such as cement. There is a conflict between maximizing shareholders returns and raising the end product prices. According to the General Manager of the CCL, balancing these two opposed objectives will not be fully achievable over the next year. The company needs to generate adequate income to redress the past low level of refurbishment and modernization of the two factories.

According to Zambia Privatization Agency Status Report from 31 July, 1995, the Chilanga Cement Limited owners structure is as follows:

PRIVATIZED	CURRENT STATUS 31 JULY 1995
Chilanga Cement Limited CDC exercised their pre-emptive rights to purchase an additional 26 percent of the shares in Chilanga Limited for USD 5.4 million, bringing their total shareholding to 50.1 percent. A further 6.5 percent of the shares was taken up by Zamanglo Industrial Corporation Limited (ZAMIC), a subsidiary of the Anglo American Corporation Group, on the same terms and conditions. The final shareholding of the privatized company is envisaged to be as follows CDC 50.1 % ZAMIC 12.6 % Public 37.3 %	Agreement signed 5 April 1994 Privatization complete. Remaining 30 % of the ZIMCO shareholding was sold by public flotation by the Zambia. Privatization Trust Issue was fully subscribed. Number of employees retained 822 Redundancies on privatization 0

Regional issues

Geographically, the Zambian cement market comprises Zambia as a whole and the neighboring countries such as Botswana, Burundi, Malawi, Mozambique, Namibia, South Africa Tanzania, Zaire and Zimbabwe. Angola, due to the political situation and not convenient transport accessibility, cannot be yet considered as a partner for cement trading.

Actors coming into the Zambian cement market are:

- Zambian cement producer Chilanga Cement PLC
- customers of Chilanga Cement PLC, foreign and domestic

Actors coming into the supply market related to the cement industry are:

- Chilanga Cement PLC, as a customer
- suppliers of Chilanga Cement PLC inputs

Foreign customers are importers from the immediately surrounding countries. The largest export markets are Malawi, Burundi, Tanzania and Zaire which constitute some 85% of Chilanga's export sales. Exports account for approximately 22% of total cement sales up to August, 1995. The new trend with South Africa cannot have been evaluated.

0.2 GENERAL INDICATORS

Business Objectives and Corporation Strategies

The main corporate strategies can be shortly characterized as follows:

- To survive in a competitive cement market at the regional level
- To meet requirements of a future investment development at the national level

Analysis of Strengths and Weaknesses of the Firm

The strengths and weaknesses of the Chilanga Cement PLC , including Chilanga Works are as follows:

STRENGTHS

Chilanga Cement PLC

* Recognized quality of produced cement
* Monopoly position in the Zambian cement market
* Fully privatized company - clear owners' relationships
* Financially stabilized position

Chilanga Works

* Quite well trained staff
* Responsibility and accountability of the top management
* Close to major domestic market and to urban center with already developed construction base and expected high dynamics of the construction industry in the future
* Characteristics those related to the company as a whole

WEAKNESSES

Chilanga Cement PLC

* Management Information System still does not fully and satisfactorily operate
* Marketing management should be better developed

Chilanga Works

* Lack of market information to be more effective in sales
* Obsolete machinery and equipment
* Management Information System does not work sufficiently
* Dependency on Tanzanian packing paper sacks
* No clear position on industrial pollution

0.3 MARKETING CONCEPT AND PLANT CAPACITY

0.3.1 REGIONAL CEMENT MARKET CHARACTERISTICS

General characteristics: The average annual per capita cement consumption of the African continent in 1990 represents an amount of 94 kg. This proves, compared to the annual cement consumption per capita within the COMESA region in 1991 of 41 kg, a low investment and consequently construction activity of COMESA countries. The world per capita annual consumption of cement is estimated at 217 kg. Consumption has been constrained in many COMESA countries by the low purchasing power of potential consumers and production bottlenecks which cause shortages of cement. Without these constraints cement consumption would have been at a much higher level as there is enormous scope for improvement in both the housing and transport infrastructure in most COMESA countries. It is expected that cement consumption will rise when the economies recover and will continue to grow until the level of market saturation. All the per capita reviews are of course influenced by the rate of population growth which, in the case of Africa, is much higher than in industrialized regions of the world.

The COMESA cement productive countries are Kenya, Tanzania, Zambia and Zimbabwe. Capacity utilization in Kenya seems to be at its maximum level, therefore, in order to prevent shortages in the domestic market, the construction of a third plant is planned for operation before the year 2000. Tanzania and Zambia both meet the local and export demands while Zimbabwe satisfies the high demand for cement through local production and imports from South Africa

Cement prices in the region: Export prices within the region are in general negotiable and competitive, but vary considerably according to the distances and magnitude of the orders. For instance, FOB prices for Kenya range from 43 USD/ton to 50 USD/ton. In Tanzania, export prices range from 35 USD FOB in Tanga to 60 USD FOB in Dar es Salaam and in Zambia FOB prices range from 55 USD to 60 USD per ton. The high cost of cement transport within the region has rendered many quotations uncompetitive. As a result, the region is experiencing substantial imports from outside, e.g. South Korea, Romania and Poland

Infrastructure and Environment: The most common infrastructure problems in the region are the malfunctioning of railways and the poor maintenance of roads. The electric power supply is in most cases reliable. The telecommunication systems often work reasonably well for international connections, while local networks have low availability due to insufficient capacity. There is a need for rehabilitating old cement plants but this has to be done within the framework of relevant infrastructure improvement projects. Environmental protection is equally important for the region. Many cement plants are not adequately equipped with dust precipitators or dust collectors to satisfy the usual limits for dust emission.

Future development: In order to meet the challenges of the future, the cement industry in the region should consider the following aspects:

- Co-operation at the regional level to strengthen the industry whilst allowing healthy competition
- Tough competition on price, quality and delivery.
- Keep the costs of labour, fuel and power at the same level as it is at the international level.
- Stricter enforcement of environment protection and works safety regulations
- Growth of cement demand

0.3.2 ZAMBIAN CEMENT MARKET CHARACTERISTICS

General Characteristics: The political unrest in Burundi is causing concern and exports to Burundi have fallen from 60,000 tones per annum in the early '90s to a little less than 20,000 tones per annum at present. There are signs that the market in Zaire is improving and now that Zambia Railways have reached an accord with the Zairian operators there are good prospects of railing significant quantities into Zaire.

The Chilanga company is actively looking at opportunities to expand the use of cement within Zambia; generally by increasing the range of cement-based manufactured products.

The expected development of the works on the project Konkola will increase trade and money flow within the country and generate a substantial increase in cement consumption. The earnings from the copper exports will put life into the existing, stagnant economy and the spin off from it should bring the long awaited upturn in the economy of Zambia as a whole.

Chilanga Cement PLC purchases inputs for its operation in Zambia as well as abroad. The main inputs, limestone, phyllite, gypsum, coal and energy are domestic whilst paper sacks, grinding media, refractories, fuel &lubricants, explosives and spare parts are from abroad. The raw materials and other supplies sources are mentioned in detail in the Chapter IV

0..3.3 SALES CHARACTERISTICS

Domestic Sales: Chilanga Cement PLC, as mentioned above, has a monopoly in cement production in Zambia. This fact means that the Cement company owns almost a 100 % share of the Zambian market. Some rare, minor imports, possibly from Tanzania, Zimbabwe or even from South Africa are not shown in statistical figures or reports

The domestic market was picking up at the beginning of 1995. However , as can be seen from the annual sales graph below. The annual domestic sales is 261.0[illegible] tons

From the monthly reports of Chilanga Works and Ndola Works within the period January - August 1995, the annual forecast, by extrapolation, for the year 1995 is expected to be 221,000 tons

In the year 2000 following the estimation of a 38 kg per capita domestic cement consumption in Zambia should be 452 2 tons. CCL could cover the assumed demand of cement beyond the year 2000

Export Sales: The most limiting issue for the successful export of cement is the cost of transport. The prices offered by Zambian transport companies range from 72 to 100.80 Kwacha per ton km which equals 1.53 to 2.14 USD per 20 t km including 20 % V.A.T. (Exchange rate valid in September 1995 940 K/USD). These figures mean that the transport costs for exported cement double the sales price for destination which are between 542 to 758 km. About 20 % of the total cement produced is for export.

Price Analysis: The analysis has shown that the bottom ex-works prices are as follows

Local bagged cement ...	86 USD per ton
Local bulk cement ...	62 USD per ton
Exported cement ...	58 USD per ton

The maximum recommended ex-works prices are as follows

Local bulk cement ...	96 USD per ton
Local bulk cement ...	70 USD per ton
Exported cement ...	60 USD per ton

The cement price level at the domestic market is declared to be market created but at the same time is strongly influenced by the fact that Chilanga Cement PLC has a monopoly position in the Zambian cement market. The export prices are created on the basis of the high quality of produced cement along with the price pressure of potential foreign producers from the other side of the price profitability border.

Future Development: A summarizing analysis of the future development of cement consumption in Zambia plus possible export, the presumed Chilanga Cement Plant cement output will be as follows (tpy)

	1995	2000	2005	2010	2015
Chilanga Works output	115,000	250,000	315,000	315,000	450,000

0.3.4 MARKETING CONCEPT

There are two kinds of factors to be considered in the case of an investment in the expansion of cement production capacity in the Chilanga Works

SUPPORTING FACTORS

- Access to raw materials and to other supplies for production
- High quality produced cement
- Readiness to meet a rising demand for cement in case the Zambian economy improves as expected
- Working opportunities not only in the cement plant itself but in interrelated industries as well

ADVERSE FACTORS

- Chilanga Cement PLC will have to impose high cement prices in order to survive in the case of the continuing recession of the Zambian economy

* Freezing of Chilanga Cement PLC dividends or a big part of them due to repayment of loan installments - almost all retained profit is used for repayment of the loan installments

0.4 RAW MATERIAL INPUTS AND FACTORY SUPPLIES

0.4.1 RAW MATERIALS

Cement clinker processing will be carried out from the same two main components as it is at the present technology - limestone and phyllite.

Limestone : Consumption of limestone (2 % H_2O) .... 453,962 tpy

The following table depict the volume of proved reserves for the individual benches of RP3 deposit and for the deposit as a whole :

Bench (m RL)	Limestone reserves (t)	CaO (%)	MgO (%)
60	3,058,197	44,99	1.47
70	3,609,080	46,00	1.37
80	2,431,850	45,87	1.47
90	184,787	39,73	1.79
Total deposit	**9,283,914**	**45,73**	**1.49**

It was proposed to use limestones from RP3 deposit, after its depletion to develop new quarry in Outpost Hill deposit. The total amount of proved reserves in RP3 deposit is 9.3 mil tons (according to the revaluation of ZCCM ore reserves calculation by UNIDO geologists - the same methodology of revaluation should be adopted for Outpost Hill deposit.), Outpost Hill deposit 6.4 mil tons (according to the ore reserves calculation of R. K. Weller, 1968). The total amount of proved reserves is 15.7 mil tons. This amount is adequate for more than 30 years of life of the new proposed expanded Chilanga Cement Plant.

According to the information available the quality and amount of limestones of RP3 and Outpost Hill deposits as a whole correspond to a requirements of the proposed technology. Because of more sensitiveness of the new proposed dry production process technology to fluctuating of chemical, physical and technological properties of raw material and with regard to small quantity of information on Outpost Hill deposit, there will be a need of more detailed geological, chemical and technological studies on limestone properties on both deposits. More detailed information are available in the Chapter 5.2.

Phyllite : Consumption of phyllite (5 % H_2O) .... 29,852 tpy

Phyllites are used in cement production process to stabilize chemical composition of the raw materials. The main portion of phyllites for the existing Chilanga Cement Plant is quarried in Chilanga Quarry situated approximately 5 km from the plant and 4 kilometers before RP3 quarry.

The quality of phyllite used in the existing Chilanga Cement Plant will be suitable also for the proposed expanded plant.

0.4.2 PROCESSED INDUSTRIAL MATERIALS AND COMPONENTS

Gypsum will be henceforth purchased from the Nhana copper works, situated 400 km from the Chilanga Cement Plant in the Copperbelt area

Consumption of gypsum (2 % H_2O) .... 15,300 tpy

0.4.3 AUXILIARY MATERIALS AND FACTORY SUPPLIES

Auxiliary materials, e.g. paper bags, refractories, lubricants and explosives will be purchased as it is presently in the markets abroad. Grinding media, lining of the mills and spare parts will also be imported. Consumable are available mostly at the local market. The quantities of auxiliary materials are presented in the following schedule:

0.4.4 UTILITIES

Coal will be purchased mainly at the existing Maamba mine situated 350 km from the Chilanga Cement Plant

Consumption of coal (1.5 % H_2O) .... 36,798 tpy

It is coal used at present in the Chilanga and Ndola Cement Plants

The Power Supply for the new departments of the expanded part of the Chilanga Cement Plant will be supplied by electric power from the existing 33 kV overhead transmission line (ZESCO). The electric energy supply of the existing departments used by the expanded Chilanga Cement Plant will be the same as it is at present.

Specific consumption of electric energy per ton of cement........ 120 kW

Yearly consumption of electric power .... 37,800,000 kWh/y

From that: New departments .... 19,278,000 kWh/y

Existing departments .... 18,522,000 kWh/y

The Water Supply of service and potable water for the expanded Chilanga Cement Plant will be ensured by the existing water supply system by two separate branches

The capacity of the existing water system is 15 l/s. The requirements of the proposed dry process technology are approximately 8 l/s

Consumption of process water .... 207,000 m^3/y

Consumption of potable water .... 5,000 m^3/y

TABLE 4 - 18

ESTIMATE OF PRODUCTION COSTS: MATERIALS AND INPUTS

Quantity	Unit	Item descriptions	Unit cost in USD			Total costs in thousands USD		
			Foreign	Local	Total	Foreign	Local	Total
		Raw material						
15, 300	t	Gypsum		26 00	26. 00		397 80	397 80
		Auxiliary materials						
5, 191	1, 000 pcs	Paper bags 3PLY (local)	266 17		266 17	1,381 70		1,381 70
1 298	1, 000 pcs	Paper bags 6PLY (export)	527.66		527.66	684.90		684 90
350	t	Refractories, insulation	899.70		899.70	314 90		314 90
133	t	Grinding media	720.30		720.30	95 80		95 80
60	t	Lining (cement mills)	123.33		123.33	7 40		7.40
18, 000	l	Lubricants-oil		1.60	1.60		28 80	28 80
5, 000	kg	Lubricants-grease		2 08	2 08		10 40	10 40
		Works maintenance				1, 580	400	1, 980
60	t	Explosives	986.67		986.67	59.20		59 20
18, 000	pcs	Primers	1 07		1.07	19 30		19 30
20, 000	m	Detonating fuse	0.36		0.36	7 20		7 20
		Utilities						
35, 854	t	Coal		42.60	42.60		1,527.40	1,527 40
37, 800	MWh	Electric power (tax 3%)		9.860	9.860		372 80	372 80
		MD level					202.20	202 20
207, 000	cu. m	Industrial water						
5, 000	cu. m	Potable water						
250, 000	l	Diesel oil		0 49	0.49		123 00	123 00
		Overhead materials					150.00	150 00
		Total				**4, 150.40**	**3, 212.40**	**7, 362.80**

0.5 LOCATION, SITE AND ENVIRONMENT

0.5.1 LOCATION AND SITE

Three alternatives of locations of the future plant could be considered in the Chilanga area

- Site No 1 - the area of the existing Chilanga Cement Plant

- Site No 2 - the area of the RP3 limestone quarry

- Site No 3 - partly in the area of the RP3 quarry (clinker production with all necessary production and auxiliary departments), partly in the Chilanga Cement Plant area (clinker storing, cement grinding, cement storing and loading utilizing existing departments)

On the basis of the process of selection (see Table 5-1, Chapter 5) the most suitable site for the expansion of the Chilanga Cement Plant seems to be Site No 1

The location of limestone deposit is 9 km from the Chilanga Cement Plant - RP3 deposit. After its depletion, it is possible to use limestone from Outpost Hill deposit, located 3 km from RP3 deposit.

The location of phyllite deposit is 5 km from the plant nearby the road to RP3 deposit.

0.5.2 ASSESSMENT OF ENVIRONMENTAL IMPACTS

The proposed dry cement production process environmental impacts are evaluated from the point of view of the air pollution, water pollution, noise, waste and landscape impacts.

Air pollution: The existing Chilanga Cement Plant and also the proposed expanded plant are the source of solid and gaseous pollutants, emitted into the ambient air. The solid pollutants are represented mainly by limestone, clinker, slag and cement dust. The sources of the dust are primarily - stacks from the separatory machines and secondary - areal sources (roads, disposals, floors etc.). Gaseous pollutants are mainly oxides - NO_2, SO_2, CO. The main components of solid emissions are limestone and calcium compounds - clinker minerals, calcium oxide and insoluble raw materials. The reduction of the emissions will be achieved by the dedusting of all the dust emitting machines and equipment.

Water pollution: There will be no toxic and hazardous substances produced by the new technology with possibility of the water pollution. The consumption and also the production of waste water, in comparison with the present technology, will be much lower. This means that there will be the possibility to use the existing sewage system nearby the present site of the Chilanga Cement Plant

Waste management: The present system of waste management is suitable also for the proposed expanded plant. The recyclable (paper, iron, oil waste) and municipal waste will be collected and hand over to authorized companies

The proposed technology of the production of clinker is without any waste. The materials, potentially considered as waste - the dust in the cloth filters - will be recycled back into the production process and used in the burning of clinker. The dust from the clinker cooler and from the clinker conveyers will be put back into the last chain of the clinker transportation and processed into cement

Noise impact: The technology of the expanded Chilanga Cement Plant is proposed to respect the usual noise emission standards - 85 dB in the outdoor departments, 70 dB in the indoor departments and 50 dB (40dB in the nights) in the outdoor residential areas

Landscape impacts: This category includes environmental impacts such as the impact in the landscape scenery. This kind of negative, environmental impact of a permanent character will be the abandoned quarries after the end of quarrying. The area of RP3 quarry and the Outpost Hill deposit area (proposed for future quarrying), however, are not in an environmental protected area.

0.6 ENGINEERING SITUATION AND TECHNOLOGY

0.6.1 OUTLINE PRODUCTION PROGRAM AND PLANT CAPACITY

The study evaluates "Expansion of Chilanga Cement Plant" with a capacity of 1,000 tones of clinker per day.

Estimation of annual production capacity is as follows:

Clinker .... 300,000 tpy

Cement .... 315,000 tpy

The proposed cement plant will produce Portland cement of normal and high early strength according to the Zambian standard, ZS 001 : 1972.

Recommended composition of raw mix (dry):

Limestone + phyllite .... 98.6 %

Coal ash .... 1.4 %

Recommended raw material composition (98.6 %) is as follows:

Limestone .... 94% = 92.7 % of raw mix

Phyllite .... 6 % = 5.9 % of raw mix

Cement will be grinded from clinker (95 %) and gypsum (5 %).

The energy consumption will be as follows (specific consumption).

Heat .... 780 kcal/kg of clinker (3,266 kJ/kg)

Electric power .... 120 kWh/ton of cement

0.6.2 DESCRIPTION OF THE TECHNOLOGY SELECTED

The proposed technology works on the basis of a modern dry clinker production process in a short rotary kiln with a preheater and grate cooler.

This production process is more convenient in comparison with the existing wet process from the point of view of economy and environmental impacts.

The expansion of the Chilanga Cement Plant will consist of the following new departments - preblending storage of limestone, raw material grinding plant, blending silo, rotary kiln line, coal grinding plant, part of electrical equipment and central control room with instrumentation. Raw mill and consequently burn clinker will be prepared in these departments.

The expanded Chilanga Cement Plant will utilize the existing limestone and phyllite extraction, primary crushing plant, secondary crushing plant, clinker storage, coal and gypsum storage, cement grinding plant, cement silos, packing plant with loading, electrical and all the existing auxiliary and service departments.

0.6.3 SUMMARIZING OF THE MAIN PLANT ITEMS

ESTIMATE OF INVESTMENT COSTS: EQUIPMENT

No	Item description	Costs in USD		
		Foreign	Local	Total
1	Production equipment			
01	Limestone extraction	1,300,000	-	1,300,000
02	Phyllite extraction	-	-	-
03	Primary crushing plant	-	20,000	20,000
04	Secondary crushing plant	-	40,000	40,000
05	Preblending storage of limestone	2,500,000	-	2,500,000
06	Storage of phyllite	-	20,000	20,000
07	Raw material grinding plant	5,800,000	-	5,800,000
08	Blending silo	1,000,000	-	1,000,000
09	Rotary kiln line	6,300,000	-	6,300,000
10	Clinker storage	-	-	-
11	Gypsum storage	-	-	-
12	Coal storage	-	-	-
13	Coal grinding plant	1,700,000	-	1,700,000
14	Cement grinding plant	350,000	-	350,000
15	Cement silo and dispatch			
	of bulk cement	300,000	-	300,000
16	Packing plant and bag loading	800,000	-	800,000
17	Electrical equipment	700,000	-	700,000
18	Central control room	500,000	-	500,000
2	Auxiliary equipment			
20	Main switching station	200,000	-	200,000
21	Diesel power plant	120,000	-	120,000
22	Compressed air plant	-	-	-
23	Water supply and distribution			
	system	50,000	-	50,000
24	Laboratory	350,000	-	350,000
25	Workshops	150,000	-	150,000
26	Stores	-	-	-
27	Diesel oil tank	-	-	-
28	Lubricants store	-	-	-
29	Garage	-	-	-
3	Service equipment	-	-	-

4	Spare parts	800,000	-	800,000
	Subtotal	**22,920,000**	**80,000**	**23,000,000**
5	Project planning	500,000	-	500,000
6	CIF - Dar es Salaam (IF)	1,146,000	-	1,146,000
7	Transport Dar es Salaam -			
	Chilanga	550,000	-	550,000
8	Erection		1,600,000	1,600,000
9	Contingencies	502,320	33,600	535,920
	Subtotal	25,618,320	1,713,600	27,331,920
10	Customs, taxes, charges			
	(on CIF value mimis project)			
	Custom duty - free		-	-
	V.A.T. - free		-	-
	Import license fee 5%		1,230,800	1,230,800
	Custom clearance fee 4%		984,640	984,640
	Total	**25,618,320**	**3,929,040**	**29,547,360**
	of that - fixed assets	**24,741,940**	**3,851,710**	**28,593,650**
	- current assets	**876,380**	**77,330**	**953,710**

Note : According to Investment Act, Zambia 1993, Part V, par 30A and 31, the imports of machinery and equipment for selective industries are custom & tax free Chilanga Cement PLC is benefiting of these incentives for the time being.

0.6.4 LAYOUT AND SCOPE OF THE PROJECT

The layout of the expanded Chilanga Cement plant is presented in the No.1 and No.2 drawings - General Layout.

The scope of the project for the new departments includes the following deliveries and services:

- Machinery and equipment complete with erection
- Complete electrical equipment, instrumentation and controls, complete with erection
- Construction materials complete with building and civil works
- Soil tests of the site
- Training of personnel
- Management of start-up, guarantee tests

0.6.5 REQUIRED MAJOR CIVIL ENGINEERING WORKS

The description of the major engineering works is presented in Chapter 6

ESTIMATE OF INVESTMENT COSTS: CIVIL ENGINEERING WORKS

No	Item description	Costs in US dollars		
		Foreign	Local	Total
1	Site preparation	-	500,000	500,000
2	Buildings and special civil works	2,000,000	6,000,000	8,000,000
	Subtotal	2,000,000	6,500,000	8,500,000
3	Project planning	-	250,000	250,000
4	CIF Dar es Salaam	100,000	-	100,000
5	Transport Dar es Salaam-Chilanga	60 000	-	60 000
6	Contingencies	108,000	337,500	445,500
	Subtotal	2,268,000	7,087,500	9,355,500
7	Custom, taxes, charges			
	(on CIF value)			
	20% Custom duty		432,000	432,000
	20% V.A.T. (from CIF + cust.duty)		518,400	518,400
	5% Import fee (from CIF)		108,000	108,000
	4% clearing agent fee (from CIF)		86,400	86,400
Total		**2,268,000**	**8,232,300**	**10,500,300**

0.7 PLANT ORGANIZATION AND OVERHEAD COSTS

0.7.1 PLANT ORGANIZATION

The general organizational outline is based on the organizational outline of the existing Chilanga Cement Plant

Horizontally, the cement works organization comprises the following departments:

- Head
- Production
- Engineering
- Materials

- Human
- Sales
- Accounts
- Technical

0.7.2 OVERHEAD COSTS

The Table "OVERHEAD COSTS" indicates the overhead costs generated within the operation of Chilanga Works excluding those stated in Chapters IV "MATERIALS AND INPUTS" and Chapter VIII "HUMAN RESOURCE".

in USD

No	Item description	Factory	Administrative	Marketing	Finance	Depreciation
1	Traveling	64,000				
2	Safety, protective clothing, welfare	49,000				
3	Training, publications	41,700				
4	Rent & Rates	10,400				
5	Social & Health expenses	95,300				
6	Mining licenses	10,000				
7	Chemicals & water reticulation	27,270				
8	Security charges	9,100				
9	Insurance premium	105,700				
10	Telephone, fax, postage		4,700			
11	Computer services		2,300			
12	Consultancy fees		20,500			
13	Recruitment		1,000			
14	Bank charges				3,200,000	
15	Depreciation					
	- civil engineering works 2%					210,000
	- equipment 4%					1,479,160
	- mobile equipment 10%					59,800
	- quarry depletion					305,100
16	Selling & distribution			340,000		
17	Demurrage			17,000		
18	Advertising			32,000		
Total overhead costs:		**412,470**	**28,500**	**389,000**	**3,200,000**	**2,054,060**

The finance part of overhead costs includes the interests payable on loans (project and operation) and bank overdrafts.

The total overhead costs arising from full operation capacity of Chilanga Works are 6,084,030 USD.

The estimate of contribution paid to the Head Office of Chilanga Cement PLC in the year 1995 amounted to 4,300,000 USD. This amount should be as an additional part of administration overhead costs. Thereby the grand total of the overhead costs estimate per annum excluding personnel costs amount to 10,384,030 USD.

0.8 HUMAN RESOURCES

Personnel necessary for the proposed expansion of the Chilanga Cement Plant will be recruited beforehand from the existing cement plants in Chilanga and Ndola.

Training of personnel will be carried out in the Contractor's facilities, Ndola Cement Plant or Chilanga Cement Plant during the erection and start-up.

0.8.1 SELECTED SIZE AND STRUCTURE OF LABOUR AND STAFF

The number of personnel required for the expanded Chilanga Cement Plant - 282 persons, is categorized from the following points of view:

Head department 3

Production department:

- Overhead 7
- Quarry 20
- Crushers 6
- Storage 8
- Raw grinding 4
- Homogenizing 4
- Clinker burning 4
- Coal grinding 6
- Control room 8
- Crane storage 8
- Cement grinding 9
- Cement storage 3
- Packing plant 20
- Quality control 17

Engineering department

- Overhead 5
- Mechanical engineering 24
- Electrical engineering 17
- Transport 16
- General engineering 20

Materials department

- Stores 6
- Purchasing 2

Human resources department.

- Overhead 2
- Personnel office 4
- Security 23
- Canteen 4
- Clinic 2
- Estates (clubs) 8

Sales department 8

Account department 9

Technical department 5

Total 282

0.9 PLANT IMPLEMENTATION SCHEDULE

0.9.1 DURATION OF PLANT ERECTION AND INSTALLATION OF EQUIPMENT

The period of preparatory works including decision, setting up a project implementation management, tendering, evaluation of bids and contracting will take approximately 12 months.

The project implementation phase will embrace the period of 27 months from the awarding of the contract to the start of production.

The construction period will include the following activities:

Site preparation and soil tests .... 3 months

Project planning .... 6 months

Civil works .... 12 months

Delivery of machinery and equipment .... 6 months

Erection .... 12 months

Final building and civil works .... 9 months

Testing, trial runs .... 3 months

Training .... 6 months

0.9.2 DURATION OF THE PRODUCTION START-UP AND RUNNING-IN PERIOD

Start-up, including trial runs, will take 3 months and the running-in of the plant until the normal production capacity will be reached can be estimated at 9 months.

Production during running-in will be as follows:

1-st quarter	50 %
2-nd quarter	70 %
3-rd quarter	90 %
4-th quarter	100 %

0.9.3 PROJECT IMPLEMENTATION PROGRAMME

The Project implementation programme is detailed in chapter 9 PLANT IMPLEMENTATION

0.10 FINANCIAL ANALYSIS AND STANDING OF THE ENTERPRISE

0.10. 1 REPUTATION

The Chilanga Cement PLC is a well-known cement producing company because of its monopoly position in the Zambian cement market and its high quality of cement production.

More information about the company are as follows:

Corporate information

Board of directors consists of four representatives of major shareholders: CDC (50.1 %), two representatives of ZPTF (Zambia Privatization Trust Fund -37.3 %) and one representative of ZAMIC (Zamanglo Industrial Corporation Ltd. - 12.6 %). Two additional persons - the Alternate directors - represent CDC.

Management of the company consists of the General Manager, Finance & Administration Manager, Company Technical Manager, Chief Marketing Manager, Works Manager - Chilanga Works and Works Manager - Ndola Works.

Institutions and companies co-operating with Chilanga Cement PLC are as follows:

Lead merchant bank - Stanbic Bank Zambia Limited, Lusaka, Zambia

Advisers and sponsoring brokers - Standard Corporate and Merchant Bank Limited, Johannesburg, South Africa,
- Cavmont Securities Limited, Lusaka, Zambia
- Meridian Financial Services Limited, Lusaka, Zambia
- Meridian Securities Limited, Lusaka, Zambia

Adviser to Chilanga Cement - Standard Chartered Merchant Bank Zimbabwe Limited, Harare, Zimbabwe

Auditors of Chilanga Cement - KPMG Peat Marwick Certified Accountants , Lusaka, Zambia

Reporting accountants - Price Waterhouse Certified Accountants, Lusaka, Zambia

Commercial bankers - Barclays Bank of Zambia Limited, Lusaka, Zambia
- Meridian Bank Zambia Limited, Lusaka, Zambia
- Standard Chartered Bank Zambia Limited, Lusaka, Zambia
- Zambia National Commercial Bank Limited, Lusaka, Zambia

The Chilanga Cement PLC is also a well-known company because of its financial stability. At present (December 1995), it is the only company quoted at LuSE (Lusaka Stock Exchange). Profit history underlines this fact

0.10.2 CAPITAL STRUCTURE

The summarized Balance sheets of Chilanga Cement Plant at 31March 1994 (the end of an old fiscal year) and at 31 December,1994 (the end of a new fiscal year), based on the audited accounts, show the capital structure of the company

The Summarized Balance Sheets of Chilanga Cement Plant

	New fiscal year system	Old fiscal year system
	31 December 1994	**31 March 1994**
	K millions	**K millions**
1. Fixed assets	17,419	1,180
2. Current assets	7,431	5,577
2.1 Stocks	6,072	4,145
2.2 Debtors	972	911
2.3 Cash and bank balances	387	521
3. Current liabilities	3,843	3,521
3.1 Bank overdrafts	165	129
3.2 Creditors	2,154	1,882
3.3 Short term loans	86	57
3.4 Dividends payable	1,100	955
3.5 Taxation	338	498
4. Net current assets (2. - 3.)	3,588	2,056
5. Total assets - Current liabilities (1. + 2. - 3)	21,007	3,236
Financed by:		
6. Share capital	103	103
7. Reserves	19,358	2,099
8. Total shareholders' funds	19,461	2,202
9. Long term indebtedness	342	370
10. Deferred liabilities	1 ,204	664
11. Equity + Long term liabilities (8 + 9 + 10.)	21,007	3,236

Liquidity ratios:	Current ratio:	7,431/3,843 = 1.93	5,577/3,521 = 1.58
	Quick ratio:	1,359/3,843 = 0.35	1,432/3,521 = 0.41
	Cash ratio:	387/3,843 = 0.10	521/3,521 = 0.15

The revaluation of fixed assets in the new fiscal year system is commented further on.

0.11 INVESTMENT PLAN

0.11.1 MARKETING COSTS

The marketing costs assessed in Chapter 7 [illegible] costs are arising from

a Chilanga Cement Plant Sales department [illegible] office supplies, postage, etc

b Sales promotion, costs of transport, rents of Zambia Railway facilities in Lusaka and Kabwe, etc Applied more then less at export sales

c Department for purchasing at Chilanga plant and Marketing department at Head Office of Chilanga Cement PLC as a part of contribution amount paid monthly by the plant (included in the administration overheads)

0.11.2 PRODUCTION COSTS

Computing of annual production costs takes into account the full production capacity of the plant 315,000 tons of cement an all items of cost structure included in Chapters 4,7 and 8.

The unit costs per ton of cement on annual basis are listed below

Item No	Item description	Costs in USD	%
1	Materials and inputs	23.37	38.91
2	Personnel overhead costs	3.73	6.21
3	Factory overheads	1.31	2.18
4	Factory costs (1+ 2+ 3)	28.41	47.30
5	Administrative overheads	13.74	22.88
6	Sales & distribution costs	1.23	2.05
7	Operating costs (4+ 5+ 6)	43.38	72.23
8	Depreciation	6.52	10.85
9	Financial costs	10.16	16.92
10	Production costs (7+ 8+ 9)	60.06	100.00

The item 5 "Administrative overheads" includes ones from Table „OVERHEAD COSTS" in Chapter 0.7 as well as the contribution to Head office

There is an effective functioning of material management considered in the stock with as low as possible level of inventories, semi-products and finished products (see Chapter 11, part "Working capital") For the weighted prices (80% local bagged and 20% exported cement) of the variants A, B and C the percentage of the production costs is as follows

A 60.06/80.40 = 74.70 %
B 60.06/88.80 = 67.64 %
C 60.06/84.60 = 70.99 %

0.11.3 SUMMARY OF THE INVESTMENT COSTS (in USD)

Item	Costs		
	Foreign	Local	Total
Fixed Assets			
* Fixed Investment Costs	27.009.940	12.084.010	39.093.950
* Pre-production Capital Expenditure	1.004,600	1,493.900	2,498,500
Current Assets			
Working Capital	876.380	77.330	957.710
Total Investment Costs	28.890.920	13.655.240	42.546.160
Percentage	67.90	32.10	100

0.11.4 FINANCIAL APPRAISAL

The Feasibility study for the Optimization and Expansion of the Chilanga Cement Plant has as objective to assess the production capacity of 1.000 tons of clinker per day (corresponding to 315.000 tons of cement per year).

Income Statement Analysis (in USD)

Variant	A	B	C
Local bagged price	86.00	96.00	91.00
Export price	58.00	60.00	59.00
Weighted price (20% export)	80.40	88.80	84.60
Production costs	60.06	60.06	60.06
Gross profit per ton	20.34	28.74	24.54
Full capacity gross profit estimate	6,407,100	9,053,100	7.730.100

Cash Flow Analysis (in USD)

	Year 2000			Year 2001-2011		
	A	B	C	A	B	C
Cash sales	20,100	22,200	21,150	25,326	27,972	26,649
Production costs	17,947	17,947	17,947	18.919	18,919	18.919
Profit taxable	2,153	4,253	3,203	6.407	9,053	7.730
Tax (weighted)	667	1,318	993	1,986	2,806	2,396
Profit after taxation	1,486	2,935	2,210	4,421	6,247	5,334
Depreciation	2,054	2,054	2,054	2,054	2,054	2,054
Net cash flow	3,540	4,989	4,264	6,475	8,301	7.388

The weighted tax is computed from 80% of 35% and 20% from 15%. (See Chapter 11.6 TAX POSITION).

In the year 2000 the capacity utilization is estimated at 250,000 tons of cement It means 79 37 % utilization of full production capacity 315,000 tons

In this case the production costs are changed due to variable costs (most of material and inputs) and in total they are relatively higher due to fixed costs

The Net cash flow is computed without considering of interests arising from bank deposits This simplified computing of net cash flow shows that there is needed another source of project financing in the year 2000 unless the price reaches level B

The foreign part of Total Investment Costs is assumed as being a loan which will be requested from foreign investor

This item presents an amount of 28,890,920 USD (see Chapter 11 8 1)

Basic loan amount:	28,890,920 USD
Payback period	12 years
Internal rate of return	9 0 %
Grace period	2.5 years for the 1st part of the loan

According to the suggested schedule of implementation of the project (Chapter 9), installment will be done as follows:

The first part of the loan 5,800,000 USD will be deposited 2 5 years before the end of the pre-production period. Interests due within the grace period are of 1,394,378 USD being paid out during the production period.

Second part of the loan 23,090,920 USD will be deposited at the beginning of the production period. The cash annual installments as payback amounts are 4 035 million USD The inflation rate (discounting rate) is not considered

$$NPV = -28.890.920 + \sum_{t=1}^{12} \frac{4,035,000}{(1+0,09)^t} = +2,606.49 \text{ USD}$$

* **NOTE:** Break-even point and Sensitivity analysis will be computed by the COMFAR facilities

12. ECONOMIC ANALYSIS NATIONAL AND REGIONAL LEVEL
12. 1 EMPLOYMENT EFFECTS

One of the advantages of Chilanga Cement PLC, company as a whole is the trained and skilled staff keeping operation of the company running.

The company takes use of every opportunity to employ women and place them to position convenient for women though character of cement production industry does not allow many opportunities for women because of safety reasons.

The increased production of cement as a consequence of new machinery and equipment implementation press more to decrease the number of employees, especially the unskilled ones. Therefore, the results of project will not be the increase of employee number in Chilanga Cement Plant. Nevertheless, the development of construction industry will offer employment opportunities through the increased activities of construction companies processing Chilanga cement in the region.

The cement plant alone has limited opportunities for employing large number of people from outside.

There are several limitations, as follows:
- additional costs for training (effective operation, safety)
- economical operation to reach a maximal profit

12. 2 FOREIGN EXCHANGE EFFECTS

The stability of Chilanga Cement Plant export sales contributes to the collection of hard currency for Zambian economy, which can be used for alternative investment. Thus, Chilanga Cement PLC ensures the multiply effect for Zambian economy.

0.12. 3 ECONOMIC INDUSTRIAL DIVERSIFICATION

The economic industrial diversification will be developed if Chilanga Cement Plant expands and makes use of national subcontracting industries performing in the same sector.

0.12.4 INSTITUTIONAL SUPPORT INCENTIVES

Provided that the tax advantage given to CDC by the government of Zambia are transferred to Chilanga Cement PLC for at least 30 additional years the financial figures provided in this report confirm the profitability of an investment in the optimization and expansion of CCL.

0.13 CONCLUSIONS

* The expansion of the Chilanga Cement plant in Zambia appears to be a profitable project for both the country and the company provided that investment means new technology, an enlarge markets base on proven geological raw material reserves

* The forecast of consumption of cement in Zambia (including export) is supposed as follow

- after year 2000 approximately 530,000 to 600,000 tpy cement
- after year 2015 approximately 750,000 to 800,000 tpy cement

* Maximal quantity of the production of the expanded Chilanga Cement Plant after the year 2000 will be approximately 315,000 tpy of cement.

* **The total volume of proved reserves of raw material for the expansion of the plant is adequate for more than 30 years cement production, it means 15.7 million tons.**

* Because of the vicinity of the capital Lusaka (18 km) and southern part of the country, where presumably the main future consumption of cement will be, the actual location of Chilanga Cement Plant is very convenient.

* **From the two alternatives of the expansion of Chilanga Cement Plant, Alternative No.2 (dry process of clinker production with capacity of 1,000 tpd clinker - annual output 315,000 tpy cement), has been selected**

* One of the advantages of the alternative chosen is to make use of some existing departments.

* **Chilanga Cement Plant after expansion will still produce the two types of final products: <u>normal Portland cement</u> and <u>high early strength cement</u> according to Zambia Standard ZS 001 : 1972.**

* Regarding predicted consumption of cement in Lusaka Province. Southern Province as well as in Malawi and Tanzania the share of local and export is as follows:

Local sales (bagged and bulk)	80 %
Export	20 %

* **The export sales require a specific approach in terms of sales promotion and a strong improvement of the company marketing activity.**

* The local sales are to be increased particularly in Lusaka region due to expected boom in construction sector.

* The support from the Government underlines this idea.

* The expansion of cement production in Chilanga requires foreign capital as well as Chilanga Cement PLC owns financial sources

* Repaying the foreign loan (annual installments of 4 million USD) along with the operation running effectively requires that profit generated in Ndola Cement Plant be used to support the overall debts.

* The final decision to carry out the project of Chilanga Cement Plant by expanding production capacity is supposed to be made by the Board of Directors. or in fact by CDC. the major shareholder

* **The decision obviously will influence the dividend policy of the company because major part of retained profit should be used for payments of the loan installments. The internal sources of financing equity, profit after taxation and rationalization have to be seriously considered. A good base for the rationalization's exercise will be to switch to the dry process and to make better use of the well trained staff operating the plant.**

* **The rationalization supposed a better marketing oriented approach with the use of modern information system.**

0.14 RECOMMENDATIONS

0.14.1

Action: To implement the optimization and expansion project according to UNIDO neutral advice provided in the feasibility study. An investment decision should be taken by the shareholders.

Responsible actor: The CCL management
Deadline : Before the end of fiscal year 1996

0.14.2

Action: To clarify with the Government the duration and the level of the income tax holiday provided to CDC

Responsible actor: The CCL management
Deadline : As soon as possible

0.14.3

In order to reduce the production costs and to optimize the company, two main actions should be done

0.14.3.1

Action: To decide on the implementation of the dry process technology
Responsible actor: The CCL management and shareholders
Deadline : Before the end of the fiscal year 1996

0.14.3.2

Action: To carry out detailed geological, chemical and technological study of RP3 deposit limestones and Phyllite Quarry phyllites properties with regard to requirements of the dry cement production process.
Responsible actor: The CCL management using a geological consulting company
Deadline : After the decision implementing the dry process technology and before the start-up of the operation of the new investment

0.14.4

In order to stabilize and optimize the volumes of cement sale, two main actions should be done in the field of marketing

0.14.4.1

To strengthen the marketing department in setting up reliable market information system in Chilanga Cement PLC which should integrate national, regional and international data on a computerized system
Responsible actor: The CCL management
Deadline : As soon as possible

0.14.4.2

Action: To elaborate market concept and a marketing strategy with the objective to facilitate the shareholders and the management decisions and facilitate the identification of new markets for sale opportunities

Responsible actor: The CCL management with the support of consultant firm / UNIDO
Deadline : As soon as possible

0.14.5

In order to facilite the expansion of the company, two main actions should be performed:

0.14.5.1
Action: To undertake support technical study which should prove the availability the additional limestone reserves, especially in the lower part of RP3 deposit (under the 60m RL) and then on its north eastern continuation parts. In addition accurate determination of geomechanical properties of the rocks in deposit should be ascertain with the aim to change the final pit slope inclination more than 45° with very small additional costs.
Responsible actor: The CCL management using a geological consulting company / UNIDO.
Deadline : Recommended period should be before the end of fiscal year because of no possibility to implement new pit slope due to future no accessibility.

0.14.5.2
Action: To prove the availability of additional reserves of limestones after approximately twenty years by carrying out detailed geological investigation of Outpost Hill deposit.
Responsible actor: The CCL management and the geological consulting firm / UNIDO
Deadline : 5 years before the depletion of RP3 deposit (approximately in the year 2010)

1. INTRODUCTION

On behalf of the Government of the Republic of Zambia, COMESA requested UNIDO, Vienna to provide assistance in carrying out the project entitled "Feasibility Study for the Optimization and Expansion of the Chilanga Cement Plant in Zambia".

In response to the request of the Government, UNIDO decided to prepare the study and selected Keramoprojekt a.s. Trenčin, Slovakia as a consulting firm among twelve consulting firms which were shortlisted.

In compliance with the contract No. 95/110 signed between UNIDO and Keramoprojekt a.s., and on the supervision of the backstopping officer, Keramoprojekt a.s. sent a team to the project area on October 7, 1995.

The field team consisted of the following experts:

1. Mr. A. Mikula, Team Leader, Cement Process Engineer
2. Mr. S. Marsina, Economist, Marketing and Financial Analyst
3. Mr. S. Mikoláš, Geologist
4. Mr. K. Kandera, Geologist, Industrial Economist
5. Mr. Y.E.Amaizo, Advisory Services on Investment Matters

The team have collected the data and information necessary for the preparation of the feasibility study with assistance of the representatives of the Chilanga Cement plant and COMESA from October 7 to November 6, 1995.

During the stay in the project area the team visited the Chilanga and Ndola cement plants and obtained data on raw material deposits, alternative sites, reviewed the company strategy on inputs, checked the operating conditions and evaluated the technological equipment which was operating.

The data and documents obtained during the visit to the project area have been checked in detail and used during the preparation of the feasibility study.

The financial evaluation of the study has been prepared with the support of the UNIDO computer model for the preparation and reporting of the feasibility study COMFAR III expert and will be supplemented.

2. BACKGROUND AND HISTORY

2.1 BACKGROUND

2.1.1 NATIONAL LEVEL

In order to better understand some elements of the project formulation, relevant background information about the country and its economic development is presented at the very beginning of the feasibility study:

Official name	Republic of Zambia
Form of state	unitary republic
Area	752,614 km^2
Population	9,250,000
Density	12.3 per km^2

The Republic of Zambia is a land-locked state occupying elevated plateau country in southern Africa. The topography of Zambia is dominated by uplifted planation surfaces.

Zambia's economy is what is known as a mono - economy. For many years, copper mining has dominated, although its contribution has declined significantly since the mid-1980's. This reflects price fluctuations on the international commodity markets. The country is the world's fifth-largest copper producer.

Before independence in 1964, Zambia's formal economy was dominated by the copper sector and heavily controlled by non-Zambians. All but those few Zambians with jobs in the mines or with the government were outside the formal economy, predominantly in subsistence agriculture. The government was committed to use copper revenues to improve public services and to bring more Zambians into the formal sector. Although policies toward the private sector were relatively liberal and benign at the outset, a growth strategy based on parastatals became increasingly dominant. By the early 1970s, Zambia had become a classic case of a public sector-led economy with excessive controls, parastatal monopolies, and a pro-urban, anti-agricultural bias derived in part from a distrust of the private sector based on the colonial experience.

The result was that in the first ten years of independence - when copper prices were increasing, investment was high, and nearly all external positive - Zambia's economy grew by only 2.4 %, well below the population growth rate. Some impressive gains were made in providing public services, but the groundwork was not laid for sustainable growth. The limited flexibility inherent in a public sector led to the difficult economic situation of Zambia today (especially with low public sector management capacity).

The severe deterioration in Zambia's terms of trade in the latter half of the 1970s (together with the reduction in copper output) severely restricted the availability of foreign exchange and reduced economic growth. Necessary adjustments were not made on time. Expecting the good times to return, the reaction was to borrow heavily, to increase the share of income going to consumption, to resist exchange-rate depreciation, and to increase distortions caused by direct controls and parastatal dominance. A private sector-led economy might have been forced to make rapid and large adjustments. Unfortunately, Zambia's economy could not (and did not) adjust, and the result has been one of the world's worst economic growth performances over the past decade.

The big effect of the terms of trade shock was the striking fall in national income, more than 30 % in 1975 alone. The experience of other countries suggests that Zambia's terms of trade deterioration in the mid-1970s would have accounted for a drop of about one percent a year in output growth. In fact, the average annual GDP growth fell from 2.4 % in the first decade after independence to 0.7 % a year in the next 15 years. This greater decline seems to have been due to the inherent inflexibility in an economy dominated by the public sector, and to the refusal of the government to make the necessary adjustments. The consequences of external shocks and poor economic performance have been felt by all Zambians and by all parts of the economy. The quantity and quality of social services have also suffered both from the decline in real resources and the inadequacy of public - sector management. This includes spending too much on salaries and new capital projects and too little on the rehabilitation of existing facilities and the provision of operating supplies.

In the early 1990s an economic recovery was expected, following the establishment of a new government and the resumption of an IMF-approved austerity programme; however, signs of improvement were slow to appear.

The main turning point in the development of Zambian's political and economical system was the introduction of a multi-party political system and the holding of multi-party presidential and parliamentary elections in October, 1991.

The Structural Adjustment Program (SAP) accepted by the Government of Zambia in 1991 caused a significant decline of the Zambian economy. The guiding principles of it are the promotion of the private sector growth and establishment a more efficient and equitably focused public sector. The first requirement of both is reduction of inflation. Beyond that, the major public sector issues are privatization, public sector management (including wage policy), promotion of free and open markets, and the provision of vital public services.

As the first result, the Zambian economy entered a period of major recession. In 1994, some results from the SAP were being experienced by the Zambian economy. Interest rates were declining, inflation was significantly reduced, and there was reasonably firm control of the money supply. Zambia, therefore, can look forward to the start of a period of sustained growth in domestic economic activity.

The latest available figures on economic structure of Zambia are on the **Table 2 - 1**.

2.1.2 REGIONAL LEVEL

The Common Market for Eastern and Southern Africa (COMESA), formerly The Preferential Trade Area (PTA), is the largest subregional intergovernmental economic organization in Africa associated with all Zambia's neighboring countries and countries to be potential markets for cement export. COMESA was established to promote intra-African trade within the subregion, to foster economic co-operation among the Member States and to assist these countries in their efforts to transform the productive structures of their economies, with a view to develop a more self-reliant and self-sustained subregional economy.

COMESA (with 23 members) has a population of about 140 million with an annual growth of 2.6 % (please refer to Table 3 - 4(The Gross Domestic Product (GDP) is about USD 65.0 billion (1991) at a growth rate 1.2 % p.a.

The export to the markets of the neighboring countries, using the advantages of the economic structures of the COMESA organization, besides the growth of domestic consumption of cement, is the future of the cement industry in Zambia.

Table 2-1: Economic structure of Zambia

Economic indicators	1990	1991	1992	1993	1994
GDP at market prices ZK m	113,34	218,276	469,564	1,640,748	2,318,287[a]
Real GDP growth %	0,5	-0,4	-0,6	5,1	-5,4
Consumer price inflation[b] %	117,4	92,6	197,4	189	55[a]
Population m	8,07	8,39	8,64	8,94	9,25[c]
Exports fob $ m	1,254	1,172	1,177	1,013	1,075[c]
Imports fob $ m	1,511	752	829	803	845[c]
Current account $ m	-596	-307	-288	-258	-200
Reserves excl gold $ m	193,1	184,6	150	192,3	297
Total external debt $ bn	7,24	7,29	6,94	6,79	n/a
External debt-service ratio %	15,1	51,1	29,5	32,8	n/a
Copper output[d] '000 tons	422	387	432	392	350
Exchange rate (av) ZK:$	30,29	64,64	172,21	452,76	669,37

August 4, 1995 ZK941.6:$1

Origins of gross domestic product 1994[a]	% of total	Components of gross domestic pro	% of total
Agriculture	32	Private consumtion	97
Minig	6	Government consumption	10
Manufacturing	22	Gross fixed capital formation	11
Construction	5	Change in stocks	-1
Commerce	22	Exports of goods & services	24
Government & other services	13	Imports of goods & services	-41
GDP at market prices	**100**	**GDP at market prices**	**100**

Principal exports 1993	$m	Principal imports 1993	$m
Copper	830	Crude oil	144
Cobalt	74	Fertiliser	30
Zinc	3	Electricity	1

Main destinations of exports 1993[e]	% of total	Main origins of imports 1993[e]	% of total
Japan	18	South Africa	22
Thailand	12	UK	12
France	10	Zimbabwe	6
Malaysia	8	Japan	6

[a]Provisional. [b]Low-income index, urban areas. [c]EIU estimate. [d]ZCCM financial years starting April 1.
[e]Based on partners' trade returns, subject to a wide margin of error.

2.2 THE ENTERPRISE

Chilanga Cement was incorporated in Zambia on 29 July 1949 The company was formed by the Northern Rhodesia government and the Colonial Development Corporation Chilanga was selected as an appropriate site for the factory due to the substantial limestone deposits in the area The first kiln was completed in 1951 and, with an output of 150 tons per day, it was capable of producing all the cement required for the construction of the Kariba dam wall.

Although the original kiln has since been shut down, two additional kilns installed at Chilanga in 1956 and 1965 are still in operation. In 1968 a manufacturing operation (now comprising two kilns) was established in Ndola.

During the early 1950s the company's shareholder base was broadened to include Rhodesian Anglo American Limited and Premier Cement Company Limited. In 1957 the Northern Rhodesia governments remaining shareholding was offered for sale to the public as a result of which over 400 individuals subscribed for shares. In 1973, as a part of an economic restructuring that had the aim of indigenising and placing the economy under state control, the Government nationalized Chilanga Cement by acquiring a majority stake in the company. When the Movement for Multiparty Democracy was elected to power in 1991, it commenced a programme of economic liberalization and growth through private investment As a part of this process, the Government established the Zambia privatization Agency in 1992 Chilanga Cement was one of the first significant State - owned companies to be chosen for privatization. In October 1994, the Government, through the Zambia Privatization Agency, sold a 25.9 % interest to CDC which together with its existing shareholding gave CDC a controlling interest of 50.1 % Subsequent to the acquisition of control CDC assumed management responsibility under a management services agreement Shortly thereafter, the Government transferred the bulk of its remaining shareholding in Chilanga Cement to ZPTF in preparation for an offer for sale restricted to Zambian citizens and Eligible Institutions The second largest shareholder with 12.6 % is Zamanglo Industrial Corporation (ZAMICO), a subsidiary of South Africa's Anglo American Corporation. According to Zambia Privatization Agency Status Report from 31 July, 1995, the Chilanga Cement Limited status is as following:

PRIVATIZED	CURRENT STATUS 31 JULY 1995
Chilanga Cement Limited CDC exercised their pre-emptive rights to purchase an additional 26 percent of the shares in Chilanga Limited for USD 5.4 million, bringing their total shareholding to 50.1 percent. A further 6.5 percent of the shares was taken up by Zamanglo Industrial Corporation Limited (ZAMIC), a subsidiary of the Anglo American Corporation Group, on the same terms and conditions The final shareholding of the privatized company is envisaged to be as follows CDC 50.1 % ZAMIC 12.6 % Public 37.3 %	Agreement signed 5 April 1994 Privatization complete Remaining 30 % of the ZIMCO shareholding was sold by public flotation by the Zambia Privatization Trust Issue was fully subscribed. Number of employees retained 822 Redundancies on privatization 0

2.3 HISTORY

2.3.1 PROJECT PROMOTER

The Feasibility Study for the Optimization and Expansion of the Chilanga Cement Plant is financed by the Government of Japan and supported by UNIDO, COMESA and the Government of Zambia.

2.3.2. PROJECT HISTORY

Within the overall framework of PTA's (change to COMESA) objective and work programme and UNIDO's technical co-operation programme for industrial development in Africa, UNIDO technical assistance delivery over the years cover inter-alia policy issues, strategic management of industrial development process, rehabilitation of industries, technology development and information exchange, human resources development and strengthening capacities in selected industrial subsectors

One of the UNIDO's funded / extended projects is **Action Programme to Support the Dynamic Development of the Building Materials Industry with Particular Reference to the Cement Industry in the PTA subregion 1 - TF/RAF/90/902.** The overall objective of the project is to determine an action-oriented, prospective programme for the future development of the building materials industrial subsector (with particular reference to cement) in the PTA subregion. The project also assisted promoters faced with increased projected demand with the complete techno - economic analysis and direct technical assistance with a view to increasing the profitability of the subsector and the capacities of PTA subregion to produce building materials locally

One of the designed UNIDO's funded projects was the Feasibility Study for the expansion of the Chilanga Cement Plant. After its privatization the new management confirmed they are interested in the study. According to the facsimile from 30 January, 1995 (COMESA Secretariat, Lusaka to UNIDO, Feasibility Studies Branch) the company had expressed interest that the study should include the location of suitable limestone reserves in the Lusaka region in relation to changing the present outmoded wet process at the Chilanga works to a dry process

As to the UNIDO Request for Proposal No. P95/101 - Project No. TF/RAF/90/902 - Feasibility Study for the Optimization and Expansion of the Chilanga Cement Plant dated 7 June 1995, UNIDO and COMESA Secretariat have invited (out of 11 consulting companies) Keramoprojekt Trenčin j.s.c., Slovakia, to submit a written proposal for the subject services as described in Appendix. The closing date to send of written proposal was 12 July, 1995.

Keramoprojekt Trenčin j.s.c. submitted The Proposal for Project Services dated 7 July, 1995. According to the proposal, Keramoprojekt's subcontractor for geological works is PROGEO Ltd., Slovakia. The proposed team for the project area consisted of four experts - a technologist, economist and two geologists.

Keramoprojekt j.s.c. was awarded the contract as to the fax dated 9 August, 1995, according to the UNIDO's Terms of Reference dated 24 April 1995, UNIDO's Request for Proposal No. P95/101 dated 7 June 1995 and Keramoprojekt's proposal dated 7 July 1995.

3. MARKET ANALYSIS AND MARKETING CONCEPT

3.1 MARKET STRUCTURE AND CHARACTERISTICS

3.1.1 REGIONAL CHARACTERISTICS

Supply/demand situation in the COMESA region

The average annual per capita cement consumption of the African continent in 1990 represents an amount of 94 kg as shown in **Table 3 - 1**. This proves, compared to the annual cement consumption per capita within the COMESA region in 1991 of 41 kg (**Table 3 - 7**), a low investment and consequently construction activity of COMESA countries. The **Tables 3 - 2, 3 - 3, 3 - 4 and 3 - 5** display the productive power of the COMESA countries' economies. The **Table 3 - 4** embraces a 21 year development of GNP and thereby enables the macroeconomics phenomena "economic cycles" to be seen, helping analysts to forecast forthcoming development. All these per capita reviews are of course influenced by the rate of population growth which, in the case of Africa, is much higher than in economically developed regions of the world.

Taking information from the COMESA Industrial Department, the construction industry contributes about 3 % to the gross domestic product of COMESA countries, whilst the demand for cement is expected to rise at a rate of 3-10 % annually until the year 2000. For some countries the demand for cement will be greater under the prevailing economic climate. It is expected that the potential market for cement in the COMESA importing countries, namely Comoros, Djibouti, Lesotho, Mauritius, Somalia, Sudan, Swaziland and Uganda will be considerable with total consumption exceeding 3 million tons by the year 2000.

The COMESA productive countries are Kenya, Tanzania, Zambia and Zimbabwe. Capacity utilization in Kenya is at a maximum level, therefore, in order to prevent shortages in the domestic market, the construction of a third plant is planned for operation before the year 2000. Tanzania and Zambia both meet the local and export demands while Zimbabwe satisfies the high demand for cement through local production and imports from South Africa.

The per capita consumption of cement in the region is about 41 kg per a year (see **Table 3 - 7**), which is very low compared to the world average per capita consumption. The world per capita annual consumption of cement is estimated at 217 kg (see **Table 3 - 1**). Consumption has been constrained in many COMESA countries by the low purchasing power of potential consumers and production bottlenecks which cause shortages of cement. Without these constraints cement consumption would have been at a much higher level as there is enormous scope for improvement in both the housing and transport infrastructure in most COMESA countries. It is expected that cement consumption will rise when the economies recover and will continue to grow until the level of market saturation.

Cement prices in the region

Export prices within the region are in general negotiable and competitive, but vary considerably according to the distances and magnitude of the orders. For instance, FOB prices for Kenya range from 43 USD ton to 50 USD ton. In Tanzania, export prices range from 55 USD FOB in Tanga to 60 USD FOB in Dar es Salaam and in Zambia FOB prices range from 55 USD to 60 USD per ton. The high cost of cement transport within the region has rendered many quotations uncompetitive. As a result, the region is experiencing substantial imports from outside, e.g. South Korea, Romania and Poland.

CEMENT CONSUMPTION 1966 - 1990 **Table 3-1**

FIGURES IN KG PER CAPITA

YEAR	EUROPE	USSR	AFRICA	AMERICA	ASIA	OCEANIA	WORLD
1966	385	335	44	211	49	278	137
1967	410	351	44	206	52	278	140
1968	433	358	45	220	54	271	147
1969	452	362	51	219	64	295	152
1970	452	381	59	218	67	306	158
1971	467	399	59	233	70	310	164
1972	492	415	63	235	82	318	176
1973	511	427	67	249	789	396	188
1974	500	444	74	241	76	382	182
1975	480	470	78	223	86	368	180
1976	492	474	82	232	91	363	184
1977	498	480	90	240	99	352	189
1978	504	484	82	257	101	350	193
1979	503	457	83	256	107	360	201
1980	501	460	85	252	109	370	203
1981	472	466	98	243	111	320	189
1982	456	452	104	225	120	373	188
1983	447	462	106	219	131	269	196
1984	434	460	100	228	133	294	193
1985	417	466	101	232	139	312	199
1986	436	476	97	243	143	304	204
1987	454	480	96	250	150	302	209
1988	478	485	91	248	162	349	217
1989	491	486	91	240	164	342	218
1990	469	472	94	242	170	303	217

Source: World Statistics, 1990

GROSS DOMESTIC PRODUCT IN CURRENT US DOLLARS
(Millions of US Dollars)

Table 3-2

COUNTRY	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Forecast 1994
ANGOLA	6,141	6,043	5,535	5,823	5,437	6,354	6,815	7,668	7,614	7,579	7,822	8,073	8,331
BURUNDI	1,013	1,083	987	1,150	1,202	1,132	1,082	1,114	1,132	1,167	1,087	948	967
COMOROS	107	112	108	115	163	196	208	199	244	242	261	248	268
DJIBOUTI	394	405	406	420	440	371	394	411	422	425	427	430	433
ETHIOPIA	4,429	4,846	4,831	4,778	5,268	5,507	5,725	5,995	6,009	6,602	6,723	6,993	7,294
KENYA	6,437	5,984	6,192	6,131	7,241	7,972	8,519	8,341	8,533	8,043	7,939	5,539	5,694
LESOTHO	343	351	309	247	276	370	452	495	604	643	747	759	796
MADAGASCAR	3,526	3,512	2,939	2,858	3,258	2,566	2,442	2,498	3,081	2,677	2,995	3,352	3,221
MALAWI	1,180	1,223	1,208	1,131	1,181	1,184	1,334	1,522	1,803	2,178	1,858	1,974	2,030
MAURITIUS	1,078	1,090	1,041	1,076	1,463	1,831	2,071	2,108	2,559	2,724	3,062	3,280	3,569
MOZAMBIQUE	2,078	1,862	1,939	2,564	3,015	1,336	1,203	1,330	1,443	1,434	1,285	1,468	1,451
NAMIBIA	1,712	1,762	1,488	1,281	1,462	1,726	1,970	1,999	2,129	2,264	2,549	2,508	2,545
RWANDA	1,411	1,507	1,588	1,715	1,944	2,152	2,396	2,410	2,305	1,687	1,638	1,494	1,612
SEYCHELES	148	147	151	169	208	249	284	308	373	375	425	444	486
SOMALIA	774	734	788	876	930	1,010	1,038	1,092	917	971	1,027	1,067	1,130
SUDAN	7,835	7,589	8,731	10,284	8,740	9,921	11,575	13,006	14,425	15,775	17,199	18,312	19,389
SWAZILAND	538	555	495	361	449	587	692	696	904	946	1,036	1,038	1,081
TANZANIA	6,274	6,329	5,814	6,905	4,882	3,524	3,336	2,839	2,590	2,857	2,572	2,373	2,195
UGANDA	2,178	2,240	3,432	3,468	3,857	6,299	6,530	5,318	4,365	3,306	2,830	3,236	3,891
ZAIRE	13,649	11,004	7,856	7,193	8,094	7,660	8,859	8,769	8,487	8,214	7,950	7,734	7,485
ZAMBIA	3,871	3,321	2,720	2,252	1,664	2,078	3,632	3,995	3,288	3,377	3,181	3,685	3,826
ZIMBABWE	6,846	6,225	5,093	4,520	4,974	5,380	6,336	6,552	6,779	6,279	5,035	5,635	5,688
TOTAL	71,962	67,924	63,651	65,317	66,148	69,405	76,893	78,664	80,006	79,765	79,648	80,591	83,382

Source: COMESA, Statistics Dept.

POPULATION

(Millions Inhabitants)

Table 3-3

COUNTRY	1988	1989	1990	1991	1992	1993	Forecast 94
ANGOLA	8,9	9,2	9,5	9,8	10,0	10,3	10,7
BURUNDI	5,2	5,3	5,5	5,7	5,8	6,0	6,2
COMOROS	0,4	0,5	0,5	0,5	0,5	0,5	0,5
DJIBOUTI	0,5	0,5	0,5	0,5	0,6	0,6	0,6
ETHIOPIA	44,8	46,1	47,4	48,9	50,3	51,9	53,4
KENYA	22,0	22,7	23,4	24,0	24,7	25,3	26,0
LESOTHO	1,7	1,7	1,8	1,8	1,9	1,9	1,9
MADAGASCAR	11,8	12,2	12,6	13,0	13,4	13,9	14,4
MALAWI	8,5	8,9	9,4	9,7	10,0	10,5	11,0
MAURITIUS	1,1	1,1	1,1	1,1	1,1	1,1	1,0
MOZAMBIQUE	13,9	14,1	14,2	14,5	14,9	15,1	15,4
NAMIBIA	1,3	1,3	1,3	1,4	1,4	1,5	1,5
RWANDA	6,5	6,7	7,0	7,2	7,4	7,6	7,8
SEYCHELLES	0,1	0,1	0,1	0,1	0,1	0,1	0,1
SOMALIA	8,3	8,5	8,7	8,8	8,9	9,0	9,1
SUDAN	23,3	23,9	24,6	25,3	25,9	26,6	27,3
SWAZILAND	0,7	0,8	0,8	0,8	0,9	0,9	0,9
TANZANIA	23,1	23,8	24,5	26,4	27,2	28,0	29,1
UGANDA	15,3	15,8	16,3	17,2	17,6	18,0	18,6
ZAIRE	35,0	36,2	37,4	38,6	39,9	41,2	42,6
ZAMBIA	7,3	7,6	7,8	8,4	8,6	8,9	9,3
ZIMBABWE	9,2	9,6	9,9	10,2	10,4	10,7	11,0
TOTAL	**248,9**	**256,6**	**264,1**	**273,8**	**281,5**	**289,6**	**298,6**

Source: COMESA, Statistics Dept.

GROSS NATIONAL PRODUCT PER CAPITA

Table 3-4

(US Dollars)

COUNTRY	1972	1973	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
ANGOLA					..		..		..	..	..	..	..	..	..	..	..	..		..
BOTSWANA	180	240	360	450	480	560	670	870	1,160	1,200	1,170	1,110	1,040	1,060	1,110	1,380	1,810	2,230	2,580	2,790
BURUNDI	70	80	100	120	140	150	170	200	250	240	240	230	250	240	240	230	220	210	220	210
COMOROS	110	140	170	190	200	220	260	350	380	360	330	310	300	320	370	450	460	470	490	510
DJIBOUTI							..	..	..	..	..	..	..	..		..	..	..	..	..
ERITREA								..	..		..		..	..		..	..			
ETHIOPIA	70	70	80	90	90	100	110	120	120	120	120	120	110	110	120	120	120	120	120	110
KENYA	180	180	230	240	270	310	370	420	430	400	350	330	310	330	340	370	370	360	330	310
LESOTHO	110	150	230	260	300	330	370	420	490	550	510	480	390	340	350	420	520	560	580	590
MADAGASCAR	180	190	280	280	300	310	380	430	410	400	380	340	310	290	260	240	220	230	210	230
MALAWI	80	90	120	120	130	160	170	180	180	190	180	180	170	160	150	160	170	200	230	210
MAURITIUS	340	430	710	860	930	1,030	1,200	1,190	1,260	1,210	1,120	1,080	1,110	1,230	1,500	1,830	2,150	2,240	2,380	2,700
MOZAMBIQUE					..	..	..	..	..	190	160	180	190	220	150	110	80	80	80	60
NAMIBIA					..	..	..	..	..	1,500	1,440	1,310	1,070	980	1,020	1,220	1,360	1,470	1,520	1,610
RWANDA	60	70	90	120	160	180	210	240	260	260	270	270	280	300	310	350	590	320	290	250
SEYCHELLES	470	580	800	870	950	1,120	1,610	2,020	2,300	2,350	2,370	2,370	2,580	2,720	3,100	3,720	4,550	5,110	5,070	5,460
SOMALIA	90	90	140	150	140	130	110	110	120	120	120	120	120	130	130	130	130	120	..	
SOUTH AFRICA	830	960	1,460	1,610	1,740	1,180	1,290	1,710	2,790	3,040	2,460	2,330	2,010	1,760	1,830	2,150	2,370	2,420	2,540	2,670
SUDAN	230	150	250	310	370	390	390	400	410	410	390	360	370	..	..	..	..	..	..	..
SWAZILAND	330	370	590	580	590	600	720	830	930	980	1,020	960	810	760	730	870	930	990	1,030	1,090
TANZANIA	110	130	170	190	210	230	260	290	310	310	310	290	290	250	190	150	120	110	100	110
UGANDA		..	..	..	..	..	..	..	..	..	120	170	170	200	240	240	210	180	170	170
ZAIRE	270	320	410	420	450	490	560	590	540	490	420	330	250	240	230	230	230	..	..	..
ZAMBIA	430	440	560	550	490	510	520	610	720	650	570	470	350	260	260	290	390	490	450	..
ZIMBABWE	350	400	550	570	540	530	590	710	870	900	850	740	640	570	550	630	670	690	670	570

Source COMESA, Statistics Dept

BASIC INDICATORS

Table 3-5

COUNTRY	TOTAL AREA (km2)	POPULATION (Millions inhab.) 1993	DENSITY 1993 (Inhab. per km2)	GDP AT CURRENT MARKET PRICES (Millions USD) 1993	PER CAPITA GDP 1993 AT CURRENT MARKET PRICES (USD)	PER CAPITA GNP 1993 (USD)	TOTAL EXPORTS 1993 (Mns USD)	TOTAL IMPORTS 1993 (Mns USD)	INTRA-COMESA EXPORTS 1993 (Mns USD)	INTRA-COMESA IMPORTS 1993 (Mns USD)
ANGOLA	1,246,700	10,3	8	8,073	781	..	3,182	2,046	0,00	6,00
BURUNDI	27,834	6,0	216	948	158	180	125	220	16,00	20,00
COMOROS	2,171	0,5	230	248	496	560	54	90	0,00	4,00
DJIBOUTI	22,000	0,6	27	430	717	..	87	412	56,00	14,91
ERITREA	..	..	..	..	..	..	..	..	.	
ETHIOPIA	1,221,900	51,9	42	6,993	135	100	246	1,158	10,00	39,00
KENYA	582,646	25,3	43	5,539	219	270	1,264	2,597	234,00	90,00
LESOTHO	30,355	1,9	63	759	399	650	76	64	0,00	1,00
MADAGASCAR	581,041	13,9	24	3,352	241	220	253	441	13,00	16,64
MALAWI	118,484	10,5	89	1,974	188	200	350	519	30,00	68,91
MAURITIUS	2,045	1,1	538	3,280	2,982	3,030	1,303	1,718	30,64	37,73
MOZAMBIQUE	801,590	15,1	19	1,468	97	90	217	751	13,91	71,00
NAMIBIA	825,000	1,5	2	2,508	1,672	1,820	272	158	1,82	11,00
RWANDA	26,338	7,6	289	1,494	197	210	94	286	0,00	64,00
SEYCHELLES	280	0,1	357	444	4,440	6,280	75	234	0,00	8,00
SOMALIA	637,657	9,0	14	1,067	119	..	117	205	1,00	44,91
SUDAN	2,505,813	26,6	11	18,312	688	..	350	1,145	0,00	27,00
SWAZILAND	17,363	0,9	52	1,038	1,153	1,190	261	103	24,55	1,00
TANZANIA	945,087	28,0	30	2,373	85	90	454	1,304	54,45	67,00
UGANDA	236,036	18,0	76	3,236	180	180	134	380	4,00	64,00
ZAIRE	2,345,409	41,2	18	7,734	188	..	1,027	782	14,00	20,64
ZAMBIA	752,614	8,9	12	3,685	414	380	1,043	1,119	109,00	82,45
ZIMBABWE	390,580	10,7	27	5,635	527	520	1,374	2,022	205,00	58,18
COMESA AS A WHOLE (1)	**13,318,943**	**289,6**	**22**	**80,591**	**278**	**..**	**11,068**	**15,063**	**817,36**	**817,36**

<u>**Note:**</u>

(1): Eritrea not included because no data available for the Country

Source: COMESA, Statistics Dept.

PROCESSES & TECHNOLOGY USED IN CEMENT PLANTS IN THE COMESA REGION **Table 3-6**

COUNTRY	PLANT	NO. OF KILNS IN THE PLANT TPD	CLINKER CAPACITY	TYPE OF PROCESS	YEAR IN SERVICE	MAKE
ANGOLA	CIMANGOLA	3	1900	WET	1955, 1959, 1969	FLS
	LOBITO	1	300	WET	1950	FLS
BOTSWANA	-	-	-	-	-	-
BURUNDI	-	-	-	-	-	-
COMOROS	-	-	-	-	-	-
DJIBOUTI	-	-	-	-	-	-
ERITREA	-	-	-	-	-	-
ETHIOPIA	DIRE DAWA	1	150	SEMI DRY	1938	BREDE
	ADDIS ABABA	1	300	DRY	1964	INGRA
	MUGHER	2	2000	DRY	1984	SKET
KENYA	BAMBURI	8	3980	DRY	1954	POLYSIUS
	ATHI RIVER	1	1300	WET	1958	FLS
LESOTHO	-	-	-	-	-	-
MADAGASCAR	AMBOANIO	n.a.	n.a.	n.a.	n.a.	n.a
	IBITY	n.a	n.a	n.a.	n.a.	n.a.
MALAWI	BLANTYRE	2	540	DRY	1956	POLYSIUS
MAURITIUS	-	-	-	-	-	-
MOZAMBIQU	DONDO	1	1000	WET	1951	FIVES-LILLE
	MATOLA	1	2000	DRY	1974	FIVES-LILLE
	NACALA	1	300	SEMI DRY	1963	POLYSIUS
NAMIBIA	-	-	-	-	-	-
RWANDA	MASHYUZA	1	210	WET	1985	CHINESE
SEYCHELLES	-	-	-	-	-	-
SOMALIA	BERBERA	n.a.	n.a.	n.a.	n.a.	n.a
SOUTH AFRIC	-	-	-	-	-	-
SUDAN	NILE	n.a	n.a	n.a	1949	n.a
	ATBARA	n.a.	n.a	n.a	1947	n.a
	WAZO HILL	3	1650	DRY	1966, 1972, 1979	KHD/FLS
SWAZILAND	-	-	-	-	-	-
TANZANIA	TANGA	1	1600	DRY	1980	FLS
	MBEYA	1	800	DRY	1983	FLS
UGANDA	TORORO	2	450	DRY	1953	POLYSIUS
	HIMA	2	900	DRY	1970	VICKERS
ZAIRE	MAHAJANGA	n.a	n.a.	n.a.	n.a	n.a
ZAMBIA	CHILANGA	3	600	WET	1950, 1955, 1967	VICKERS/
	NDOLA	2	1000	DRY	1969, 1974	POLYSIUS
ZIMBABWE	CIRCLE	2	1350	DRY/SEMI DRY	1957, 1927	POLYSIUS
	BULAWAYO	2	500	n.a.	1915, 1928	n.a
	COLEEN BAWIN	3	720	DRY	1949, 1951, 1954	n.a
TOTAL		44	23550			

Sources: Unofficial compiled information by the Industry and Energy Division of the COMESA Secretariat

CEMENT CONSUMPTION IN THE COMESA REGION — Table 3-7

COUNTRY	CONSUMPTION (1000 TONNES/YEAR)								PER CAPITA CONSUMPTION (KG/PERSON/YEAR)	
	1980	1981	1982	1983	1984	1985	1991	2000	1991	2000
ANGOLA	254	229	199	131	140	207	250	400	27	31
BOTSWANA	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
BURUNDI	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	60	75	11	10
ISLES	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	300	370	185	175
DJIBOUTI	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	50	65	90	93
ERITREA	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ETHIOPIA	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	600	1000	12	15
KENYA	691	652	579	517	546	649	1000	1400	42	44
LESOTHO	71	70	81	158	102	70	90	110	53	53
MADAGASCAR	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
MALAWI	123	92	80	84	76	77	113	215	11,6	13
MOZAMBIQUE	163	170	214	163	87	159	120	500	8	23
NAMIBIA	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
RWANDA	16	36	43	-	14	29	75	90	10	9
SOMALIA	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	50	250	8	19
SOUTH AFRICA	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
SWAZILAND	70	61	53	55	61	60	75	90	75	75
SUDAN	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
TANZANIA	344	326	448	346	321	342	650	800	25	23
UGANDA	n.a.	n.a.	n.a.	n.a.	n.a.	n.a	60	250	3,5	11
ZAIRE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ZAMBIA	268	266	256	260	255	270	350	420	42	38
ZIMBABWE	511	535	537	536	492	590	600	750	62	60
TOTALS	2511	2437	2490	2250	2094	2453	4342	6583	41	50

ISLES: COMOROS, MAURITIUS, SEYCHELLES

Sources: Unofficial compiled information by the Industry and Energy Division of the Comesa Secretariat

STATUS OF CEMENT PLANTS IN THE COMESA REGION Table 3-8

COUNTRY	PLANT	INSTALLED CAPACITY	1992 PROJECTED PRODUCTION	1993 PROJECTED PRODUCTION	CAPACITY UTILIZATION	PLANT AVAILABILITY
		t'000/yr	t'000/yr	t'000/yr	%	%
ANGOLA	CIMANGOLA	750	n a	n a	n a	n a
	LOBITO	120	n a	n a	n a	n a
BOTSWANA	-	-	-	-	-	-
BURUNDI	-	-	-	-	-	-
COMOROS	-	-	-	-	-	-
DJIBOUTI	-	-	-	-	-	-
ERITREA	MASAWA	n a	n a	n a	n a	n a
ETHIOPIA	MUGHER	600	305	345	51	33
	ADDIS ABABA	70	23	45	30	15
	DIRE DAWA	120	n.a	n a	n a	n a
KENYA	BAMBURI	1200	1215	1200	101	96
	ATHI RIVER	340	311	325	91	86
LESOTHO	-	-	-	-	-	-
MADAGASCAR	AMBOANIO	n.a.	n.a.	n.a.	n a	n a
	IBITY	n.a.	n.a.	n.a.	n a	n a
MALAWI	BLANTYRE	140	130	137	93	90
MAURITIUS	-	-	-	-	-	-
MOZAMBIQUE	MATOLA	600	48	70	8	n a
	DONDO	300	13	30	4	n a
	NACALA	90	17	20	19	n a
NAMIBIA	-	-	-	-	-	-
SEYCHELES	-	-	-	-	-	-
RWANDA	CIMERWA	70	63	53	90	85
SOMALIA	BERBERA	200	n.a.	n.a.	n a	n a
SOUTH AFRIC	-	-	-	-	-	-
SUDAN	ATBARA	375	121	300	32	75
	NILE	100	65	80	65	80
	TWIGA	500	380	420	76	83
SWAZILAND	-	-	-	-	-	-
TANZANIA	TANGA	500	230	250	46	80
	MBEYA	250	75	75	30	50
UGANDA	HIMA	300	34	60	11	44
	TORORO	165	10	15	6	10
ZAIRE	MAHAJANGA	n.a.	n a	n.a.	n a	n a
ZAMBIA	CHILANGA	193	149	153	77	76
	NDOLA	339	218	223	64	72
ZIMBABWE	UNICEM	768	593	519	75	95
	CIRCLE CEMENT	n.a.	n a	n.a.	n a	n a
TOTAL		8090	4000	4320	51	66 9

Key:

-	:	Cement plants do not exist
n.a.	:	Information is not available
Plant availability	:	Number of net working days divided by capacity
Installed capacity	:	Capacity at which the plant is supposed to produce

Sources: Unofficial compiled information by the Industry and Energy Division of the COMESA Secretariat

Ways of Shipment

Cement is normally shipped in 50 kg bags, except for Mauritius where cement is bought in bulk and bagged by the importers. The modes of transport are by rail, road and lake.

Landlocked countries like Uganda and Burundi use a combination of rail, road and lake transport facilities for their cement imports. Transport costs for these countries are high and in many cases exceed the FOB value of the shipment.

Trends in the Cement Industry

During the last 50 years the cement industry expanded its capacity by a factor of 10 world-wide in order to meet the growth of cement consumption. In most of the industrialized countries the trend has been to increase the size of the production lines rather than to increase the number of production plants. The new plants of the 1990s are built with capacities up to 5,000, or in some cases, 10,000 tones per day.

The main reason for the trend towards the installation of bigger capacity plants is that bigger plants have a lower cost of installation and operation per unit of capacity, due to the economies of scale.

In theory, the optimum size of a new cement plant may be calculated by comparing the cost of production and the cost of distribution of the cement for different plant capacities.

Exceptions to this rule are the construction of small capacity plants in special cases where the local conditions of raw materials, market density and infrastructure are in favor of small scale production. Such small capacity plants with capacities in the range of 100-300 tones per day are referred to as Mini Cement Plants or Small Scale Cement Plants. These are successfully operated in countries such as China and India. Some of the cement plants in the COMESA region are in the above range as well (see **Table 3 - 8**).

Raw Materials and Other Supplies

The basic raw materials for the production of Portland cement are normally limestone, clay, gypsum and other corrective materials such as iron ore, coal ash, etc. Limestone, clay and gypsum are available in the form of natural resources in many COMESA countries.

Although there are many important deposits of cement raw materials in the region, it is often difficult to identify adequate reserves of good quality limestone for the production of cement in desired locations near the major markets. Therefore, it is important to carry out comprehensive exploration on the quality of limestone for future plants or expansion projects.

Fuel, paper sacks, spare parts, refractories and grinding media are imported by most cement plants in the region. Zimbabwe, however, produces its own refractories, grinding media and some of the spare parts for cement production. Tanzania has a paper sacks factory which can supply all the cement plants in the region.

The Energy Situation in the COMESA Subregion

Energy resources in the COMESA subregion are abundant as they have not been fully exploited as yet. For instance, wood and other agricultural wastes such as crop residues, can provide an estimated one billion cubic meters per year, whilst consumption is only 200 million cubic meters In the power subsector, generation can be increased as the untapped, hydro resources are estimated at over 150,000 MW. Power is also available from coal resources estimated at 50 billion tones and natural gas resources estimated at 1,192 billion m^3. Petroleum reserves are 2.5 billion barrels but there is potential to increase these reserves through on-going and planned exploration programmes

Renewable energy resources for providing power to remote rural areas are available and daily solar isolations are estimated at between 800-1000 W/m^2 for almost all the countries of this region. This is the highest in the world

The potential to raise the current energy consumption per capita from the present 3-10 GJ per capita per year, to about 22 GJ as in the developed regions of the world, is enormous Therefore enhanced participation by the private sector in the energy sector investment is urgent

The subregion is also overloaded by high imports of petroleum products which average 25 % of the total energy demand. This demand is growing at 4-8 % per annum, which is higher than the registered economic growth rate. The petroleum import bills now average 333 million USD per year for member states and they have become a serious drain of scarce foreign exchange resources. This level of consumption cannot be sustained indefinitely. Countries need to examine procurement and distribution practices and pricing mechanisms in order to effect savings in foreign exchange expenditures.

Given this energy scenario, the subregion needs to exploit hydro, coal and gas resources jointly where possible to reduce the huge capital investment. Power system planning and management need to be enhanced to increase the reliability of supplies whilst grind interconnections should be explored where they are economic ones. Energy issues of major concern include energy conservation and management in the economic industrial sectors of the member states. Rural electrification for instance merits special attention, as it will ensure improvements in the economic development of rural communities. Regional co-operation in research and development, trade and training need special emphasis to enhance opportunities that have been established to develop the subregion in a mutually beneficial manner. (Source: Journal of Industry and Energy in COMESA, The Energy Situation in the COMESA Subregion, 1995).

Technical Aspects

Many of the cement companies in the region have operated cement plants for the financing of major rehabilitation or modernization projects. For some of the cement plants, the problems are aggravated by a lack of adequate maintenance systems and difficulties in obtaining spare parts for obsolete equipment. In some cases the equipment has deteriorated to such a state that it may not be possible to revive the operation without a major input of funds from outside sources. This problem has in part been solved in some companies recently by easing price control policies.

Except for Zimbabwe, all the cement plants in COMESA, produce Ordinary Portland Cement (BS 1278). Zimbabwe's major cement products are clinker and PC-15 which contain 15 per cent blast furnace slag. Zambia and Tanzania also produce rapid hardening cement (BS1276). Masonry cement (BS 5224) is produced in Tanzania while Kenya produces Sulphate Resisting Cement (BS 4027180), Low Heat Cement and the Ordinary Portland Cement. The quality of the cement produced in the region meets international standards and is routinely tested within plant laboratories. In the cases of Tanzania, Kenya, Zambia and Zimbabwe, periodical tests are carried out by the Société Général de Surveillance (SGS) in Geneva

There is wide scope for technical co-operation within COMESA in the field of manpower development, quality control, purchasing or production of spare parts, rehabilitation programmes and production planning to improve the operations of cement companies. The potential is, however, not being fully utilized. There is a need for cement producers to establish a forum within the region to enable them to meet and exchange views and ideas. An association of cement producers in COMESA is being proposed by the Secretariat.

Human Resources and Training

Most of the cement companies in the region have qualified engineers and technicians who have received additional training in other cement plants, but there is still a need for additional training, especially of personnel at the intermediate level of the organization. This training must be organized according to an overall plan, taking into consideration the special needs of all plants and the possible installation of new types of equipment and technology.

Infrastructure and Environment

The most common infrastructure problems in the region are the malfunctioning of railways and the poor maintenance of roads. The electric power supply is in most cases reliable. The telecommunication systems often work reasonably well for international connections, while local networks have low availability due to insufficient capacity.

There is a need for rehabilitating old cement plants but this has to be done within the framework of relevant infrastructure improvement projects.

Environmental protection is equally important for the region. Many cement plants are not adequately equipped with dust precipitators or dust collectors to satisfy the usual limits for dust emission

However, some cement plants located near cities or recreational areas have installed up to date dust collecting equipment and some plants have successfully reclaimed their old quarries for recreational purposes.

Future development

In order to meet the challenges of the future, the cement industry in the region should consider the following aspects:

- Co-operation at the regional level to strengthen the industry whilst allowing healthy competition.

- Tough competition on price, quality and delivery among themselves and against imports from outside the region as the economies of the region open up.

- Increasing the costs of labour, fuel and power

- Stricter enforcement of environment protection and works safety regulations

- Growth of cement demand

A number of projects have been identified for the development of the cement industry in COMESA. These include a pre-feasibility study on production capacity expansion for Zambia, strategic development of the cement industry in Kenya, a plan of action for the cement industry in Uganda as well as a technical assistance project for the Mbeya cement plant in Tanzania.

Importation of bulk cement and bagging plants in countries where the consumption of cement is low are under consideration. If these projects and the rehabilitation programmes are fully implemented, the present installed capacity can meet the estimated demand for cement up to the year 2000.

Conclusion

In most of the industrialized countries with a market economy, the cement industry has been through periods of expansion and recession. Sometimes the industry was forced to adjust to harsh business conditions and changing ownership and structure in order to support viable cement plants and to close down non-competitive ones.

In some of the COMESA countries, economic liberalization and deregulation of cement prices helped the industry to earn new funds for financing operations and maintaining cement plants. However, the extra income is often not enough for rehabilitating some of the plants which are becoming obsolete or are badly in need of major overhauls. In order to assist the industry with the rehabilitation of their production lines, it is necessary to look for other sources of financing such as the participation of new investors in the rehabilitation projects.

As a result of the privatization policies which are being pursued by a number of COMESA countries, the majority of the cement plants are earmarked for privatization.

For some of the cement companies in the region, liberalization has created better opportunities for capacity utilization and expansion, whereas for others, liberalization may lead to the closure of national production lines making the countries totally dependent on imports. This may be difficult to accept for countries which have endeavored to become self-sufficient in basic products such as cement. A possible solution may be to take up ownership in some of the cement companies of neighboring countries.

Opportunities exist for the strategic location of clinker plants near sources of good raw materials with clinker grinding and packing facilities located near the markets. Where the consumption of cement is low, mini-cement plants can be considered, provided the local condition of raw materials, market density and infrastructure are in favour of small scale production.

3.1.2 ZAMBIAN CEMENT MARKET CHARACTERISTICS

Obviously the political unrest in Burundi is causing concern and exports to Burundi have fallen from 60,000 tones per annum in the early '90s to a little less than 20,000 tones per annum at present. There are signs that the market in Zaire is improving and now that Zambia Railways have reached an accord with the Zairian operators there are good prospects of railing significant quantities into Zaire.

The Chilanga company is actively looking at opportunities to expand the use of cement within Zambia; generally by increasing the range of cement-based manufactured products. It is also actively promoting the use of bulk cement. The price differential between bagged and bulk cement is considerably more than the cost saving arising from the paper sacks used in bagged cement.

The big question is when will Konkola get going. The development work on the project alone will increase trade and money flow within the country and generate a substantial increase in cement consumption. The forex earnings from the copper exports will put life into the existing, stagnant economy and the spin off from it will bring the long awaited upturn in the economy of Zambia as a whole.

Chilanga Cement PLC purchases inputs for its operation in Zambia as well as abroad. The main inputs, limestone, phyllite, gypsum, coal and energy are domestic whilst paper sacks, grinding media, refractories, fuel &lubricants, explosives and spare parts are from abroad. The raw materials and other supplies sources are mentioned above.

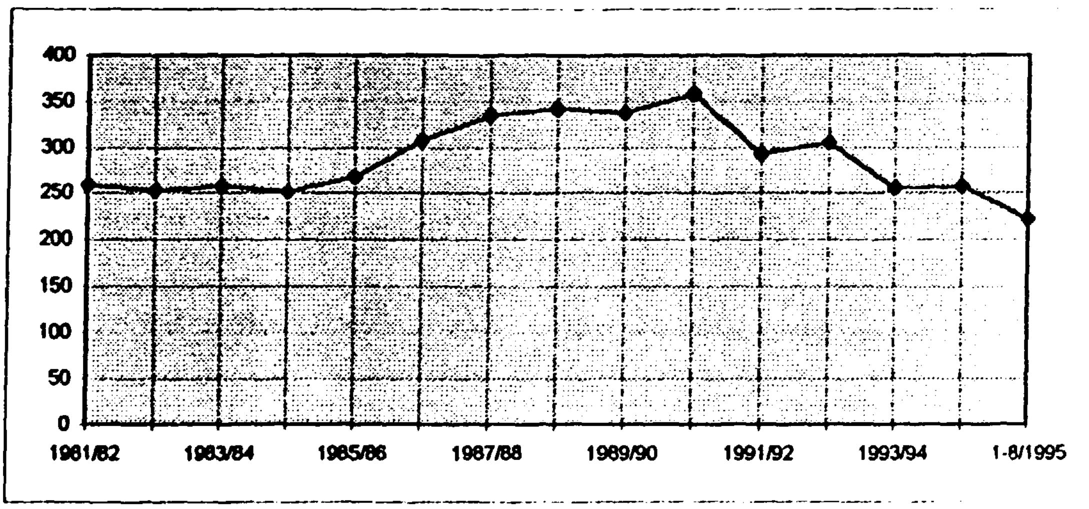
3.2 SALES OF PRODUCTS AND BY-PRODUCTS

Domestic Sales

Chilanga Cement PLC, as mentioned above, has a monopoly in cement production in Zambia. This fact means that the Cement company owns approximately a 100% share of the Zambian market. Some rare, minor imports, possibly from Tanzania, Zimbabwe or even from South Africa are not available from statistical reviews or reports.

The domestic market was picking up at the beginning of 1995. However , as can be seen from the annual sales graph below, the annualised level of sales is still only at 261,000 tonnes per annum.

From the monthly reports of Chilanga Works and Ndola Works within the period January - August 1995, the annualised forecast, by extrapolation, for the year 1995 is expected to be 221,000 tonnes sold on the domestic market (Table 3 - 9).



Source: Technical Audit of Chilanga Cement PLC, 1995

Table 3 - 9 : Domestic market cement sale

Despite being at such a low sales level, there is a danger that a further major reduction in sales could occur due to the level of industrial activity in Zambia, caused largely by the wide availability of cheap imported goods, particularly from South Africa (cement is not yet included). In these circumstances a sudden sales drop is not an impossibility and will have serious consequences in terms of cash-flow for Chilanga Cement, PLC.

The following review (**Table 3 - 10**) shows the final destinations of the local sales geographically by provinces within the period January - August, 1995.

Province	Ndola	Works	Chilanga	Works	Chilanga	Cement PLC
	(t)	(%)	(t)	(%)	(t)	(%)
LUSAKA	34,601.30	38.67	50,158.18	86.55	84,759.48	57.49
CENTRAL	5,794.30	6.48	63.85	0.11	5,858.15	3.97
EASTERN	960.55	1.07	1,614.15	2.78	2,574.70	1.75
COPPPERBELT	38,963.43	43.55	-	-	38,963.43	26.43
NORTHERN	2,904.55	3.25	166.05	0.29	3,070.60	2.08
NORTH WESTERN	1,735.30	1.94	-	-	1,735.30	1.18
WESTERN	159.90	0.18	752.85	1.30	912.75	0.62
LUAPULA	2,236.60	2.50	24.00	0.04	2,260.60	1.53
SOUTHERN	2,114.50	2.36	5,175.55	8.93	7,290.05	4.95
TOTAL	**89,470.43**	**100.00**	**57,954.63**	**100.00**	**147,425.06**	**100.00**

Table 3 - 10 : Zambia regional sale of cement

(Source: Monthly Reports, Ndola Works and Chilanga Works, August 1995)

The review above shows the Lusaka and Copperbelt regions to be the main domestic markets, while other provincial markets are not so developed. There are two major reasons. The first is the decline of investment activity, which results in a recession in the construction industry, and second is the long distances to reach the final destination using rail or roads of poor quality. Both reasons are interrelated because investment activity in the construction of a transport infrastructure consumes a lot of cement.

The structure of customer groups who purchased cement from Chilanga Works from January to August, 1995 are as follows (**Table 3 - 11**):

Customer group	Tons	%
Concrete products manufactures	12,278.86	21
Contractors	10,403.56	18
Government	1,140.85	2
Local Government/Municipal	57.70	0
Merchants	23,686.60	41
Mines	0	0
General users	10,387.06	18
Total sales	**57,954.63**	**100**

Table 3 - 11 : The structure of customers groups

The customer groups, excluding merchants, are the final users. Government and Municipal customers create, in total, a poor 2% of Chilanga Works domestic sales during the first eight months of 1995. This underlines the fact of low government supported investment activity in Zambia.

Another situation will occur since the plan produced by ZCCM for mine backfilling will have been realized. A new kiln line will be required by about the year 2000, as ZCCM alone will be taking in the order of 200,000 tpy at that stage. However, such plan proved to be over-optimistic in the past. Should the plan be implemented, the company would be challenged to erect a new kiln line as soon as possible.

The major consuming mine is projected to be that at Konkola, with over 100,000 tpy required for it alone in the year 2002. The total off-take over six mines is projected to rise to nearly 300,000 tpy by 2003. Therefore it is not only one major project that will determine its future. Chilanga Cement, PLC will have to keep a close eye on developments and to be prepared for such a demand. This assumption strongly predetermines the proposed expansion of Chilanga Works' cement production capacity. In the case the capacity will stay at its present status, a new situation of increased demand would cause pressure to import cement from abroad at much higher prices than it is supposed in this feasibility study.

According to the COMESA Statistics Department (see **Table 3 - 3)** the increasing population trend in Zambia will continue. The following numbers of inhabitants (in millions) are expected in the forthcoming years **(Table 3 - 12)**:

1995	1996	1997	1998	1999	2000	2005*	2010*	2015*
9.7	10.1	10.5	10.9	11.4	11.9	14.7	18.1	22.3

* Rough estimate according to tendency of population increase development

Table 3 - 12 : Expected population in Zambia

In the year 2000 following the estimation of a 38 kg per capita cement consumption (see Table 3 - 7, source: COMESA Secretariat, Lusaka, Zambia), the domestic consumption in Zambia should be 452.2 tonnes. It could cover the assumed demand of cement beyond the year 2000. The consumption of 420,000 tons in the year 2000 suggested in the same table seems to be too cautious.

Export Sales

Chilanga Cement PLC, while being a successful exporter, has to regard the conditions of running cement plants in neighbouring countries which can be the potential competitors. The installed capacity for clinker and cement production and its utilization, used type of process as well as the cement consumption of COMESA countries are shown in the Tables 3 - 6, 3 - 7 and 3 - 8.

The most limiting issue for the successful export of cement is the cost of transport. The prices offered by Zambian transport companies range from 72 to 100.80 Kwacha per ton/km which equals 1.53 to 2.14 USD per 20 t/km including 20 % V.A.T. (Exchange rate valid in September 1995 940 K/USD). These figures mean that the transport costs for exported cement double the price when the destination is from 542 to 758 km.

The company has been reasonably successful in exporting for many years as shown by the following graph of exports in thousand of tonnes annually (Table 3 - 13):

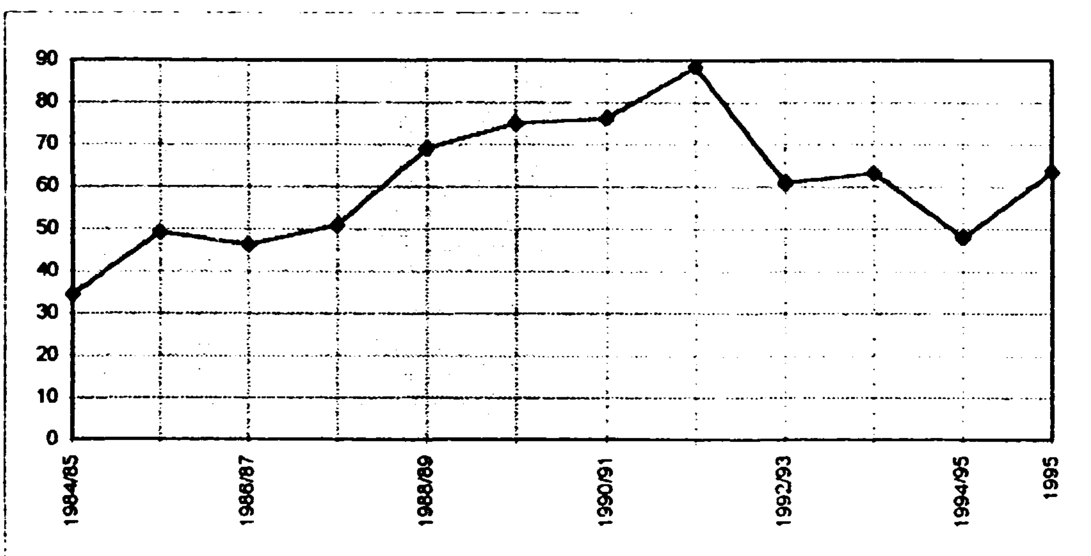


Table 3 - 13 : Chilanga Cement PLC export

While the 1994/95 figure shows a downturn, this is only a projection based on a year to date performance (source: Technical Audit of Chilanga Cement PLC 1995 up to 1994/95). The 1995 amount is given by projection based on the performance results of 1-8/95 taken from the monthly reports of Ndola Works and Chilanga Works. The total amount in 1995 is anticipated to be 63,600 tonnes.

For the continued viability of the Chilanga Cement, PLC, one of the main requirements is to get the market to move upwards. In this regard exports are regarded as a quick fix. Significant export opportunities in Tanzania appear to be a possibility for all of 1995 while continued exports to

Malawi, Burundi and Namibia will assist in this regard The review below shows the situation of Chilanga Cement PLC exports in the period from January to August, 1995 **(Table 3 - 14)**

	Export Ndola Works		Export Chilanga Works		Export Chilanga Cement PLC	
Country	(t)	(%)	(t)	(%)	(t)	(%)
Botswana	94.90	0.39	35.00	0.19	129.90	0.31
Burundi	14,179.50	58.45	0	0	14,179.50	33.45
Malawi	479.00	1.97	13,922.40	76.77	14,401.40	33.97
Mozambique	300.90	1.24	150.00	0.83	450.90	1.06
Namibia	0	0	1,141.55	6.29	1,141.55	2.69
S/Africa	0	0	0		0	0
Tanzania	1,960.40	8.08	2,604.05	14.36	4,564.45	10.77
Zaire	7,246.05	29.87	0	0	7,246.05	7.09
Zimbabwe	0	0	282.00	1.56	282.00	0.66
Total	**24,260.75**	**100.00**	**8,135.00**	**100.00**	**42,395.75**	**100.00**

Table 3 - 14 : Chilanga Cement PLC export according to countries

The review above displays that Ndola Works aims its export to Burundi, Zaire and Tanzania, whilst Chilanga Works to Malawi and Tanzania. These largest export markets constitute more than 85% of Chilanga export sales, as was mentioned before.

The brief characteristics of countries mentioned above in terms of Zambian cement import:

Botswana - very low imports caused by low population density in reachable territory

Burundi and Malawi - good prospects even possible improved by market research and promotion

Mozambique - good prospects until local cement plants are of higher utilization of their capacity

Namibia - low prospects because of remote market

South Africa - no prospects, potential competitor

Tanzania - good prospects until the Mbeya cement plant rehabilitates and expands its capacity

Zaire - according to limited information the good prospects due to the high population density in south-east region. It could be very interesting area for Zambian export but after getting more information about forthcoming construction activities.

Zimbabwe - most probably strongly influenced market by South African exporters; evaluation needs more closer information obtained on primary sources.

Price Analysis

Due to inflation waves and the devaluation of the Zambian Kwacha during the last several years, the all analysis of prices has been performed in USD.

The price level at the local, respectively foreign market is accounted in following review **(Table 3 -15)**

EX-WORKS PRICE ANALYSIS (without VAT)

	Sales in tons	Sales value '000 K	Price in K per a ton	Price in USD per a ton	Sales in tons	Sales value '000 K	Price in K per a ton	Price in USD per a ton
Mode of sale	July 1995	Exchange rate 941 K USD			January - July 1995	Exchange rate 838 K USD		
Local bagged	4,573.25	369,862	80,875.00	85.95	44,301.25	3,243,294	73,209.98	87.36
Local bulk	1,068.30	62,978	58,951.91	62.65	7,506.55	410,656	54,706.39	65.28
Export	1,216.60	65,365	53,727.74	57.10	16,738.85	805,578.75	48,126.29	57.43
Mode of sale	August 1995	Exchange rate 940 K USD			January - August 1995	Exchange rate 850.75 K USD		
Local bagged	5,224.65	422,544	80,875	86.04	49,525.90	3,673,206	74,167.25	87.18
Local bulk	922.18	54,404	58,995.37	62.76	8,428.73	465,621	55,242.17	64.93
Export	1,396.15	76,539	54,821.47	58.32	18,135.00	887,947.90	48,963.22	57.55
Mode of sale	September 1995	Exchange rate 940 K USD			January - September 1995	Exchange rate 860.67 K USD		
Local bagged	6,541.65	523,886	80,084.64	85.20	56,067.55	4,195,240	74,824.74	86.94
Local bulk	2,440.62	134,621	55,158.40	58.68	10,869.35	600,345	55,232.86	64.17
Export	3,008.20	167,643	55,728.69	59.29	21,143.20	1,051,132.90	49,714.94	57.76

Table 3 -15 : Ex - works prices analysis

Explanation: The exchange rates for the months July, August and September are computed, average monthly mid-rates from available sources in Zambian banks. The cumulative amounts are computed, average rates for a given period from average monthly mid-rates of the months concerned.

According to analysis above the prices used for the feasibility study are as follows:

	minimum	maximum	medium
* Local bagged cement	86 USD per ton	96 USD per ton	91 USD per ton
* Local bulk cement	62 USD per ton	70 USD per ton	66 USD per ton
* Exported cement	58 USD per ton	60 USD per ton	59 USD per ton

The cement price level at the domestic market is based on market price to be market created but at the same time is strongly influenced by the fact that Chilanga Cement PLC has a monopoly position in the Zambian cement market. The export prices are created on the basis of the high quality of produced cement along with the price pressure of potential foreign producers from the other side of the price profitability border mentioned above (see Tables 3.6,3.7 and 3.8)

Future Development

A summarizing analysis above the future development of cement consumption in Zambia plus possible export (in tons per year) are seen as follows **(Table 3 -16)** :

		1995	2000	2005	2010	2015
Total	Base case	285,000	530,000	615,000	615,000	750,000
	Upper case	-	600,000	700,000	800,000	800,000
Ndola Works output		170,000	280,000	300,000	300,000	300,000
Chilanga Works output		115,000	250,000	315,000	315,000	450,000*
From these - export		64,000	80,000	123,000	123,000	150,000
	- domestic	221,000	450,000	492,000	492,000	600,000

* There will be supposed an additional investment for the increase of production. The technology design is prepared for this opportunity (see Chapter VI).

Table 3 - 16 : Presumed future regional need of cement

According to the above mentioned information, the estimate of sales revenues is as follows.

Year 2000			**Years 2001-20.1**			
Variant	**Mode**	**Unit**	**Quantity**	**Sales**	**Quantity**	**Sales**
	of sales	**price**		**revenues**		**revenues**
			in 1000 tons	in 1000 USD	in 1000 tons	in 1000 USD
	Local bagged	86	200	17, 200	252	21, 672
A	Export	58	50	2, 900	63	3, 654
	Total		250	20, 100	315	25, 326
	Local bagged	91	200	18, 200	252	22, 932
B	Export	59	50	2, 950	63	3, 717
	Total		300	21, 150	315	26, 649

	Local bagged	96	200	19, 200	252	24, 192
C	Export	60	50	3, 000	63	3, 780
	Total		250	22, 200	315	27, 972

Note: Unit price is in US dollars per ton

Table 3 - 17 : Sales Revenues Estimate for the Expanded Production of Chilanga Cement plant

3.3 SALES ORGANIZATION

The sales of bagged cement is organized through the depot, the special center for sales management. The cement is bagged into color distinguished paper sacks. The exported cement is blue colored. The bulk cement is sold from the silo.

3.4 VALUE OF STOCK OF SEMI-FINISHED AND FINISHED PRODUCTS

The value of the stock of semi-finished and finished products is equal to 7 days of cement production.

3.5 ANALYSIS OF MARKETING COSTS (DIRECT AND OVERHEAD COSTS)

The marketing costs are those that deal with the sale of produced cement and the purchasing of firm inputs. They are tracked and evaluated in monthly reports (technical and accounts) as selling and distribution costs.

The other part of marketing costs a. .es from the travel of marketing people and purchasers of various inputs needed for the operation of the firm.

The marketing costs are specified in Schedules III-2 and III-3.

3.6 ANALYSIS OF THE MAIN COMPETITORS

Cement plants operating in surrounding countries are the potential competitors to Chilanga Cement PLC. As seen from **Tables 3 - 6, 3 - 7 and 3 -8** the installed cement production capacity and its utilization on one side and cement demand on other side are decisive factors in determining the possible allocation of Chilanga exported cement. Because of a strong position of Chilanga Cement PLC in the Zambian market, this study does not consider, with the exception of negligible amounts, any significant imports of Portland Cement to Zambia from abroad. That is why the next analysis is focused only on the placement the Chilanga cement in foreign markets **(Table 3 - 18)** :

Parameter	1	2	3	4	5	6
Country						
Botswana	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Burundi	-	-	60	11	75	10
Malawi	140	97.9	113	11.6	215	12.8
Mozambique	990	12.1	120	8.3	500	26.7
Namibia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Tanzania	750	43.3	650	25	800	23
Zaire	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Zambia	532	68.0	350	41.7	450	37.8

Explanations: 1 - Total cement plants capacity (tpy)

2 - Total cement plants capacity utilization in the year 1993 (%)

3 - Cement consumption in 1991 (1,000 tpy)

4 - Cement consumption per capita in 1991 (kg/person)

5 - Cement consumption, estimate for the year 2000 (1,000 tpy)

6 - Cement consumption per capita, estimate for the year 2000 (kg/person)

Table 3 - 18 : Foreign markets possibilities

3.7 ANALYSIS OF STRENGTHS AND WEAKNESSES OF THE FIRM

The strengths and weaknesses of the Chilanga Cement PLC and separately Chilanga Works are as follows:

STRENGTHS

Chilanga Cement PLC

* Recognized quality of produced cement
* Monopoly position in the Zambian cement market
* Fully privatized company - clear owners' relationships
* Financially stabilize position

Chilanga Works

* Quite well trained staff
* Responsibility and accountability of the top management
* Close to major domestic market and to urban center with already developed construction base and expected high dynamics of the construction industry in the future

* Characteristics those related to the company as a whole

WEAKNESSES

Chilanga Cement PLC

* Management Information System still does not fully and satisfactorily operate
* Marketing management should be better developed

Chilanga Works

* Lack of market information to be more effective in sales
* Obsolete machinery and equipment
* Management Information System does not work sufficiently
* Dependency on Tanzanian packing paper sacks

3.8 EVALUATION OF THE MARKETING CONCEPT; CONCLUSIONS AND RECOMMENDATIONS

There are two kinds of factors to be considered in the case of investment in the Chilanga Works expansion of cement production capacity:

SUPPORTING FACTORS:

* Access to raw materials and to other supplies for production
* High quality produced cement
* Readiness to meet a rising demand for cement in the case the Zambian economy will have rehabilitated
* Working opportunities not only in the cement plant itself but in interrelated industries as well

ADVERSE FACTORS:

* Chilanga Cement PLC will have to impose high cement prices in order to survive in the case of the continuing recession of the Zambian economy
* Abandonment of Chilanga Cement PLC dividends or a big part of them due to repayment of loan installments - almost all retained profit is used for repayment of the loan installments

RECOMMENDATIONS:

* There is a bad need to set up and maintain an accurate, reliable market information system within the Head Office of Chilanga Cement PLC and being available to Chilanga Works

* A market study elaborated by the marketing department, eventually with the assistance of a marketing consulting company could help to plan export and local sales much more accurately and to identify some sales opportunities in real time.

4. RAW MATERIALS AND FACTORY SUPPLIES

4.1 CHARACTERISTICS OF RAW MATERIALS AND FACTORY SUPPLIES

Cement clinker will be processed from two essential raw material components - **limestone** and **phyllite**. Black **coal** will be used for clinker burning. As a retarder of cement harden there will be used **gypsum**.

The proposed expansion of Chilanga Cement Plant will be supplied with:

- **Limestone** from the present used RP3 Quarry (mining license No.93) and from the deposit Outpost Hill (mining license No.34). RP3 Quarry is situated approximately 9 km south-west from the proposed expanded cement plant. After depletion of the raw materials from RP3 Quarry there is proposed to open new quarry in Outpost Hill deposit, situated 3 km south-west from RP3 Quarry.

- **Phyllite** from Chilanga Quarry (mining license BL29).

- **Coal** from Maamba Collieries (situated 350 km from the proposed plant), as alternative source it is possible to use imported coal from Hwange in Zimbabwe

- **Gypsum** from Nbana - it will be purchased from Nbana Copper Works, situated about 400 km from the proposed plant.

Chilanga Cement Plant raw materials and factory supplies are depicted on the **Drawing 4 - 1**

4.1.1 LIMESTONE

4.1.1.1 HISTORICAL SUMMARY OF LIMESTONE INVESTIGATIONS

The limestone resources in the Chilanga area were investigated by Brazier (1949 - 1953), Pooley (1951), Colegrave (1952), Eadon (1952), Hitchen (1953), Mazurczak (1954), Threader (1955), Weller (1968). The latest geological investigations (Humphrey, 1981 - 1983; Siddiqui, Molak, 1991; Ngoma, Molak 1992) were the following:

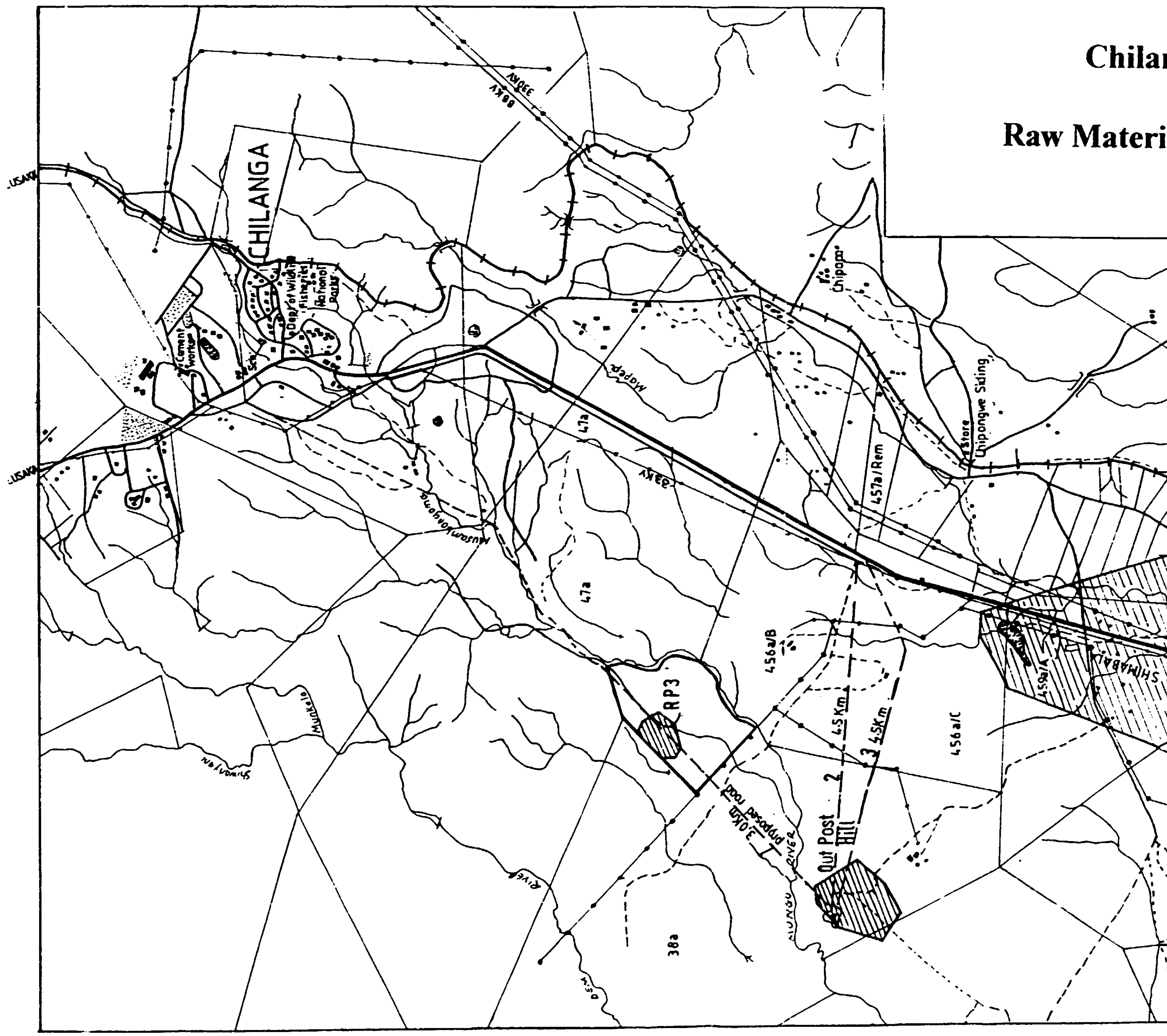
Irish Cement Ltd. made drilling investigations in 1981 and 1987. Humphrey report (1983) comprises the observations on the results of the 1981 drilling programme and recommendations for opening a quarry at the RP3 deposit. As in the 1981 drilling, another drilling program of Irish Cement in 1987 were also not accompanied by any form of geological information. It was a result of poor management of drilling and sampling programs including a disregard for core security and information storage/retrieval procedures. Only total CO_3 and $MgCO_3$ analyses have been undertaken.

In 1991 Chilanga Cement Limited through ZAL, Technical and Management Services engaged Zambia Consolidated Copper Mines Limited (ZCCM) in a project aimed at rationally designing and developing the RP3 quarry by reviewing existing information and to prepare a plan for further core drilling. The results are three reports - Geology of RP3 Limestone Quarry Phase I., 1991 (F. A. Siddiqui, B. Molak), Geology of RP3 Limestone Quarry, Phase II., 1991, (F. A. Siddiqui, B. Molak), and , finally, Pit Design Report, 1992 (ZCCM team work). Field mapping and sampling, mineralogical and chemical analysis were made. Five main geological formations were identified: limestone, dolomitic limestone and dolomite with limestone admixture, limestone breccia and lamprophyre. Structurally the limestone body is a tight synform with steeply dipping limbs with

Drawing No. 4 - 1

Chilanga Cement Plant

Raw Materials and Factory Supplies



Legend:

- Motorable tracks or farm roads
- other track
- rivers, streams, dams
- farm boundaries
- limestone quarries
- powerline
- huts, villages
- regulary maintained with bridge
- railway line
- roads tarred
- 1 dam - source of technological water

the fold axis trending NE - SW and plunging towards the SW. Along the southern flank the limestone body is tectonically truncated against schists. According to the reports, the RP3 Quarry contains, in average, 10.3 million tons of limestone at 84.9 weight percent $CaCO_3$ and at 3.45 weight percent $MgCO_3$. It has been ascertained that the $MgCO_3$ content is generally low throughout the deposit and it has an inverse relationship with the $CaCO_3$ content. The low values of silica (Ms=1.69) and alumina (Ma=1.21) are mostly due to a relatively high content of Fe_2O_3 in the limestone. Grade control procedures and a schedule of operations, final pit geometry and design, progress of drilling and blasting, a way of transportation, waste disposal and a drainage system were proposed.

4.1.1.2 REGIONAL GEOLOGY

The Chilanga area is underlain by metasediments of the Katanga System, specifically the limestone and metasiltstones of the Cheta Formation which is overlain by the Lusaka Dolomite and underlain by Lower Katanga schists and quartzites. The regional dip is northwards, with the result that the Lusaka Dolomite occurs in the extreme north and north-west of the area and the Lower Katanga beds underlie the southern and south-eastern sectors. Six miles south-west of Chilanga the Katanga beds disappear beneath the alluvial cover of the Kafue Flats. These Flats cover extensive areas to the west but are sharply bounded in the north by a low escarpment of Katanga rocks.

The limestone facies of the Cheat Formation have been designated the Mampompo Limestone by the Geological Survey of Zambia. It is described as dominantly calcareous but including dolomite facies. This limestone forms a broad belt running west-north-west along the Kafue escarpment, and appearing from beneath the alluvial cover at the eastern termination of the Kafue Flats where it includes inliers of metasiltstones and quartzite. Eastwards, the limestone swings towards the northwest with Chilanga itself lying on a relatively narrow band of east-west striking limestone which possibly represents a fold limb. To the east of Chilanga the Mampompo limestone continues as a narrow band in close proximity to the Lusaka Dolomite which underlies extensive areas to the north.

The Katanga beds have been folded along generally east-west axes, and these folds have been affected in the east and south-east by the Mpande Dome of Basement gneiss which lies to the southeast of the area under consideration. The effect of this Dome has been to superimpose folding along northeast-southwest axes.

Although considerable areas in the vicinity of Chilanga are underlain by carbonate rocks, these generally contain too high a percentage of magnesia to be suitable as a raw material for cement manufacturing. The low magnesia limestones form relatively thin bands, usually of blue-grey stone, within the succession of low-grade limestones and dolomites. It is only where such a band is thicker than normal, and has been concentrated by tectonic activity, that a deposit of reasonable dimensions and tonnage exists. An economic sized deposit of high-grade limestone is therefore a comparative rarity, and generally occurs as a complicated fold core.

4.1.1.3 MINING LICENSES OF THE CHILANGA CEMENT PLANT

License No.	Date of issue	Expire date	Location	Area (Ha)	Raw material
BL 29	1. Febr. 1994	1. Oct. 2001	Chilanga	36,26	Phyllite
BL 34	21. Sept. 1994	21.Sept. 2009	Outpost Hill	17,00	Limestone
BL 35	2. Febr. 1994	1. Aug. 2009	Makulu Ext.	43,25	Limestone
BL 88	1. Febr. 1994	1. Aug. 2001	Shimabala	68,11	Limestone
BL 93	2. Febr. 1994	13. July 2006	RP- 3	15,83	Limestone

Table 4 - 1 : Mining rights of in the Chilanga area

These rights are granted for periods of fifteen years at a time and have expire dates ranging from August, 2001 to September, 2009. Historically, there has been no difficulty in renewing these licenses and there is no indication of any change in Government policy in this regard. If, however, a license renewal was not granted it could be damaging to the business.

4.1.1.4 RP3 DEPOSIT

Geology

The sources for evaluation of the physical, chemical, mineralogical and petrological properties and for ore reserves calculation of limestones were the following:

A. Chemical analyses of the material from 1968, 1981 and 1987 drilling investigations

B./ Chemical analyses of the material from blasting holes (made in Chilanga Cement Plant)

C./ Chemical analyses of the material from crusher (made in Chilanga Cement Plant)

D./ Brief field geological maping and sampling (UNIDO geologists)

E./ Chemical analyses of the samples taken by UNIDO geologists (made in Chilanga Cement Plant)

F./ Chemical analyses of the samples taken by UNIDO geologists (made in UNIDO team laboratory)

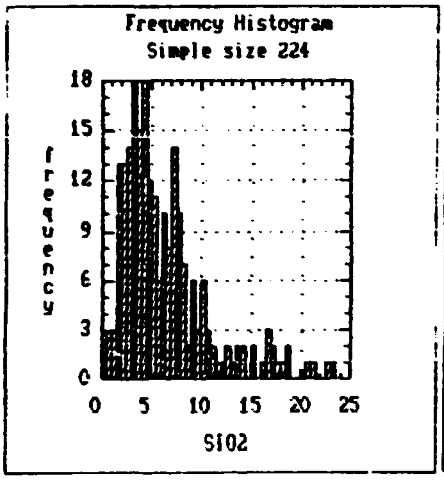
G./ Physical analyses of the samples taken by UNIDO geologists (made in UNIDO team laboratory)

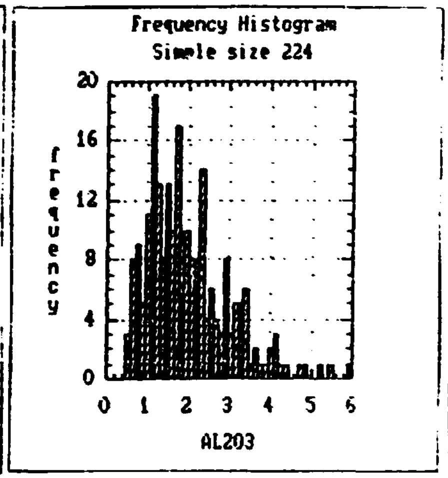
H./ Mineralogical and petrological analyses of the samples taken by UNIDO geologists (made in UNIDO team laboratory)

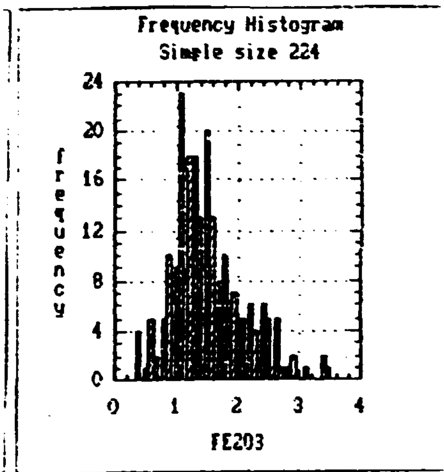
The quality of archives information on RP3 geology is variable. Drilling investigations results of R. K. Weller (1968) contain a well compiled text, interpretative mapping, geological logs of all the 30 holes and a complete $CaCO_3$ and $MgCO_3$ analysis. The analysis of SiO_2, Fe_2O_3 and Al_2O_3 has not been done for complete holes; usually those with an unusual characteristic. Both the 1981 and 1987 drilling results are not accompanied by any form geological information and include only $CaCO_3$ and $MgCO_3$ analysis.

The average content (the whole group of 921 samples) of CaO is 45.73 % and MgO 1.49 %. The average contents of other compounds are as follows (group of 224 samples): SiO_2 6.55 %, Al_2O_3 2.06 % and Fe_2O_3 1.66 %.

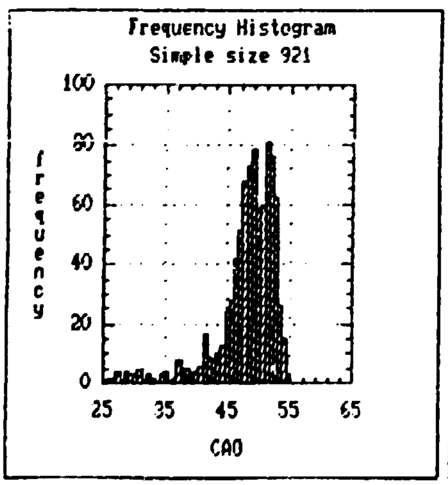
The chemical composition of raw material from RP3 deposit is shown on the **Figures 4 - 1, 4 -2, 4 - 3** and **Table 4 - 2**.

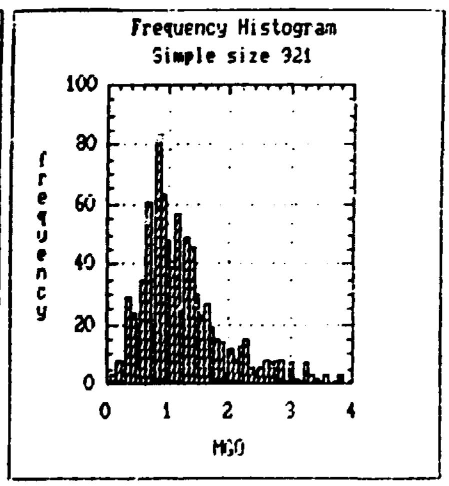






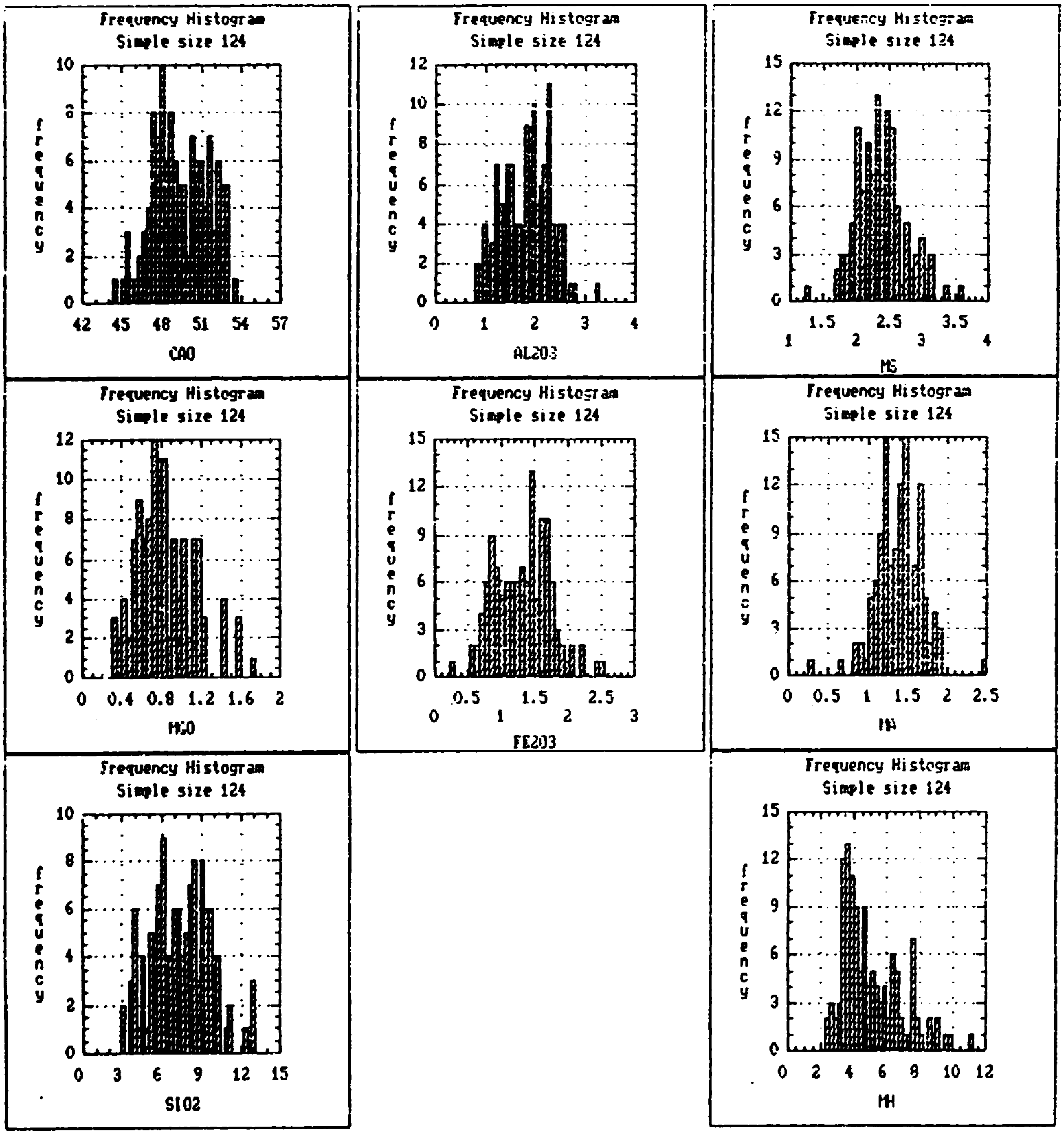
Sample size 224	SIO2	AL2O3	FE2O3
Average	6,68	2,10	1,69
Geometric mean	5,27	1,81	1,43
Variance	26,67	1,73	1,13
Standard deviation	5,16	1,32	1,06
Coeff. of variation (%)	77,25	62,86	62,72
Maximum	40,70	12,30	8,80
Minimum	0,60	0,50	0,10





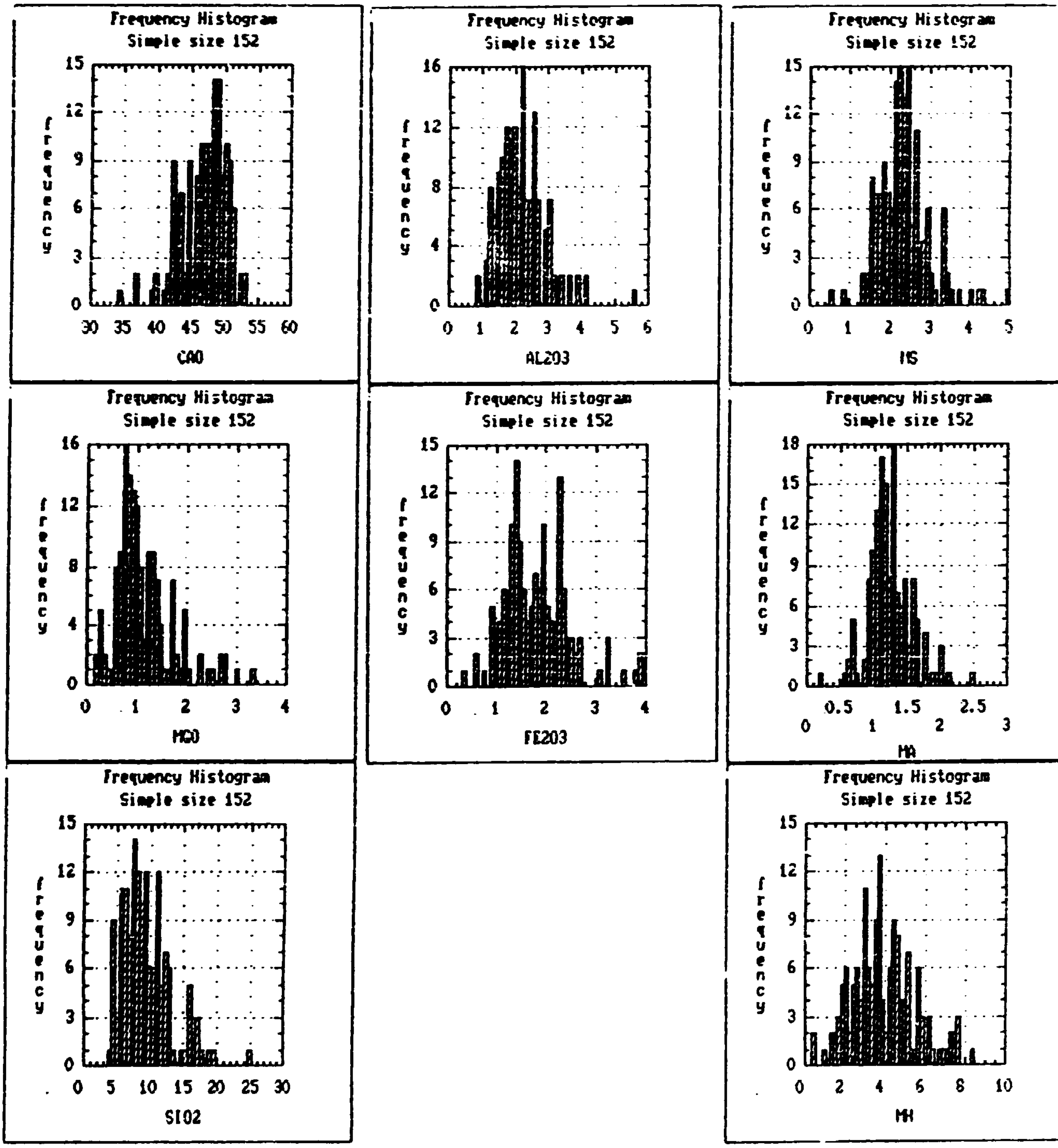
Sample size 921	CAO	MGO
Average	46,10	1,41
Geometric mean	43,65	1,20
Variance	89,63	1,30
Standard deviation	9,47	1,14
Coeff. of variation (%)	20,54	80,85
Maximum	54,85	10,85
Minimum	0,75	0,10

Figure 4-1 RP3 Quarry - Statistical analysis of blasting holes samples



Simple size 124	SIO2	AL2O3	FE2O3	CAO	MGO	MS	MA	MH
Average	7,48	1,87	1,38	49,30	0,85	2,35	1,46	5,09
Geometric mean	7,13	1,77	1,28	49,24	0,80	2,31	1,39	4,80
Variance	4,93	0,51	0,46	5,75	0,10	0,17	0,40	3,29
Standard deviation	2,22	0,71	0,68	2,40	0,31	0,41	0,63	1,81
Coeff. of variation (%)	29,70	38,10	49,15	4,87	36,92	17,57	43,45	35,64
Maximum	12,99	7,72	7,37	53,52	2,30	3,62	6,83	11,08
Minimum	3,02	0,83	0,30	35,99	0,31	0,81	0,29	2,48

Figure 4-2 : Chilanga Cement Plant - Statistical analysis of crush stone



Sample size 152	SIO2	AL2O3	FE2O3	CAO	MGO	MS	MA	MH
Average	9,73	2,36	1,93	46,79	1,18	2,34	1,31	3,90
Geometric mean	8,97	2,16	1,76	46,34	1,02	2,26	1,23	3,55
Variance	19,69	1,74	0,87	36,48	0,53	0,38	0,54	2,49
Standard deviation	4,44	1,32	0,93	6,04	0,725	0,62	0,73	1,58
Coeff. of variation (%)	45,60	55,95	48,32	12,91	61,70	26,50	55,91	40,43
Maximum	34,40	13,02	6,63	76,37	6,60	4,95	9,18	8,43
Minimum	3,91	0,91	0,34	20,26	0,21	0,59	0,19	0,43

Figure 4-3 RP3 Quarry - Statistical analysis of drilling investigations samples

	CaO	MgO	SiO2	Al2O3	Fe2O3	Ms	Ma
1	45.73	1.49	6.55	2.06	1.66	1.76	1.24
2	46.14	1.26	5.76	1.93	1.71	1.58	1.13
3	43.68	1.42	6.27	2.08	1.32	1.84	1.58

1 - all analyzed samples - weigh averages

2 - samples from the worked-out part of deposit

3 - samples from the part of deposit beneath the bench 60 m

Table 4 - 2 : Average chemical composition of RP3 deposit limestones

The statistical analysis of the material from 1968, 1981 and 1987 drilling investigations, material from blasting holes and from crusher (Figures 4 - 1, 4 - 2, 4 - 3) shows its great variability (as to standard deviation of CaO). Frequency histograms show it is possible to distinguish 4 -5 types of the carbonate raw material types according to their chemical composition. The average values of silica and alumina module are higher than those calculated in the 1991 ZCCM report. CaO and MgO average contents of the material from blasting holes are very close to that calculated from the drilling investigations from the parts worked-out at present.

According to the results of analysis of the surface samples which have been taken by UNIDO geologists and analyzed in UNIDO team selected laboratory (Table 4 - 4), the average chemical composition of limestones is suitable for the proposed dry process technology. There is, of course, the need of very strict selection of that parts of deposits with lamprophyre and gridstone content because of the high content of that elements harmful to the proposed dry process. Of course, the surface sampling is only some kind of indicator, the real picture will be done after supplementary drilling investigation focused on the requirements of the proposed technology.

Limestone Reserves Calculation - Introductory Information

Multicclored crystalline limestone (sparite), occupying the center of the RP3 deposit, represents the main source of feed to the cement plant. The limestone body contains few intercalations of sandy and dolomitic limestone which seems to be identical with the stratification. It also contains the intrusions of a dioritic porphyry (lamprophyric dike rocks) of very irregular shape (especially in the north - eastern part of the deposit). Dolomitic limestone, dolomite with limestone, breccia and mica schist appear along the deposit borders.

The average value of bulk density we have used in reserves calculations was 2.632 kg/m^3.(see Table 4 - 3). The value of bulk density used in the previous ZCCM calculations of reserves was 2.75 kg/m^3, but there are no exact information on it.

Tab. 4 - 3 : Technological analysis of the rocks samples (UNIDO team laboratory)

Sample	Rock	Bulk density (kg/m^3)	Specific density (kg/m^3)	Porosity (%)	Relative density (%)
CHQ3-6	Lamprophyre	2,500	2,712	7.80	92.20
CHQ3-8	Limestone	2,632	2,714	3.00	97.00
CHQ3-11	Limestone	2,632	2,718	3.15	96.85

Tab. 4-4 : Chemical Analysis of the Rock Samples - RP3 Deposit (UNIDO team laboratory)

No.	Sample	Rock type	CaO (%)	MgO (%)	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	L.O.I. (%)	SO_3 (%)	K_2O (%)	Na_2O (%)	PbO (ppm)	ZnO (ppm)	CuO (ppm)	P_2O_5 (%)	Cl (%)	Sr (%)
1.	NL-1	Limestone	43.98	0.51	14.09	3.22	1.77	35.64	0.16	0.07	0.02	7	21	25	0.15	0.002	0.152
2.	CHQ3-1	Lamprophyre	10.37	7.86	45.85	12.11	11.86	6.61	0.44	0.61	1.86	st	44.82	13.47	0.22	0.010	0.020
3.	CHQ3-2	Lamprophyre	7.52	6.23	50.69	13.49	11.30	5.27	0.19	0.71	2.26	st	58.52	7.51	0.23	0.042	0.011
4.	CHQ3-4	Lamprophyre	7.51	0.86	53.60	13.66	9.06	10.76	0.01	1.23	1.57	9	72	252	0.18	0.005	0.006
5.	CHQ3-5	Limestone	51.72	0.61	3.08	0.47	1.55	41.85	0.32	0.12	0.06	5	37	141	0.08	0.023	0.049
6.	CHQ3-6	Limestone	51.43	0.81	4.25	0.43	0.89	41.60	0.63	0.05	0.21	8	18	70	0.06	0.028	0.090
7.	CHQ3-8	Limestone	53.47	1.10	1.47	0.27	0.57	42.57	0.10	0.05	0.05	st	31.13	33.80	0.07	0.010	0.054
8.	CHQ3-9	Limestone	49.30	0.72	6.90	1.22	1.17	39.89	0.09	0.10	0.02	st	47.31	46.32	0.09	0.010	0.009
9.	CHQ3-10	Limestone	47.60	4.60	1.97	0.76	1.17	42.57	0.29	0.22	0.04	st	8.72	113.90	0.22	0.040	0.026
10.	CHQ3-11	Limestone	51.84	0.61	3.49	0.92	0.77	41.25	0.59	0.13	0.09	43.09	58.52	22.54	0.11	0.010	0.033
11.	CHQ3-12	Limestone	44.99	0.75	13.34	2.05	1.04	36.60	0.78	0.62	0.21	5	13	53	0.08	0.013	0.052
12.	CHQ3-13	Limestone	48.01	4.60	2.99	0.41	0.77	42.33	0.09	0.06	0.02	st	14.94	10.02	0.23	0.020	0.028
13.	CHQ3-14	Limestone	54.68	0.31	0.33	0.03	0.67	43.61	0.22	0.01	0.01	7	24	18	0.02	0.090	0.058
14.	CHQ3-15	Limestone	49.12	0.33	7.12	1.21	2.11	39.25	0.09	0.06	0.02	2.15	94.62	32.55	0.15	0.010	0.003
15.	CHQ3-16	Gridstone	1.28	0.98	62.29	18.83	3.62	2.32	1.14	8.20	0.96	st	12.45	3.76	0.05	0.020	0.004
16.	CHQ3-17	Limestone	50.81	2.30	2.23	0.44	0.50		0.22	0.18	0.02	4.31	9.96	6.28	0.21	0.020	0.026
17.	CHQ3-19	Limestone	50.03	0.61	5.80	1.01	1.23	40.23	0.93	0.17	0.22	5	15	11	0.09	0.027	0.090
18.	CHQ3-20	Limestone	51.64	0.73	4.32	0.27	0.73	41.73	0.47	0.12	0.03	5	24	18	0.04	0.015	0.055
19.	CHQ3-21	Limestone	52.20	0.84	2.44	0.34	1.12	42.38	0.37	0.07	0.09	5	315	20	0.09	0.025	0.051

To check the analyses from Chilanga Cement Plant Laboratory there have been made control analyses in UNIDO team laboratory. The results are shown on the **Table 4 - 5**.

Table 4 - 5 : Chemical analyses and control analyses - rock samples - RP3 deposit

No.	Sample	Rock type	CaO (%)	MgO (%)	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	L.O.I. (%)
1.	CHQ3-5		50.75	0.80	3.36	0.79	1.44	40.10
2.	CHQ3-5*	Limestone	51.72	0.61	3.08	0.47	1.55	41.85
		difference (in %)	**1.90**	**-23.75**	**-8.33**	**-40.51**	**7.64**	**4.36**
3.	CHQ3-12		44.70	0.96	13.52	1.96	1.22	37.03
4.	CHQ3-12*	Limestone	44.99	0.75	13.34	2.05	1.04	36.60
		difference (in %)	**0.65**	**-21.88**	**-1.33**	**4.59**	**-14.75**	**-1.16**
5.	CHQ3-19		48.89	0.66	5.82	1.24	1.19	40.19
6.	CHQ3-19*	Limestone	50.03	0.61	5.80	1.01	1.23	40.23
		difference (in %)	**2.33**	**-7.58**	**-0.34**	**-18.55**	**3.36**	**0.01**
7.	CHQ3-20		50.51	0.72	4.36	1.00	0.63	42.64
8.	CHQ3-20*	Limestone	51.64	0.73	4.32	0.27	0.73	41.73
		difference (in %)	**2.24**	**1.39**	**-0.92**	**-0.73**	**15.87**	**-2.13**
9.	CHQ3-21		51.23	0.48	2.52	0.86	1.00	42.75
10.	CHQ3-21*	Limestone	52.20	0.84	2.44	0.34	1.12	42.38
		difference (in %)	**1.89**	**75.00**	**-3.17**	**-60.47**	**12.00**	**-0.87**

The requirements on raw material quality concerning the proposed dry production process are higher of those for the obsolete wet process. These are the main:

Technological requirements of the raw materials

1. Quantitative requirements

A./ Minimal required quantity of the raw materials is 15 millions tons of proved reserves (there is enough reserves for approximately 30 years)

2. Qualitative requirements

Quality of mixture requirements (it means mixture of limestone, phyllite and coal ash)

Silica modulus .... 2.3 - 2.6

Alumina modulus .... 1.9 - 2.1

Lime saturation factor .... 98 - 105

The average chemical composition of the proved reserves of limestone

CaO .... no limits

MgO .... max 3.0 %

SO3 .... max 1.0 %

K2O + Na2O max 1.3 %

P2O5 max 0.5 %

Cl	max 0.02 %
Cu	max 0.1 %
Pb	max 0.01 %
Zn	max 0.01 %
Sr	max 0.1 %
Ms	max 3.5
Ma	no limits

This limits have to be valid for the weighted average for each separate bench

Because of the limited data on RP3 limestones their quality and suitability should have been evaluated according to these main criteria:

1./ MgO content upon the bench max. 3.0 %

2./ Silica modulus upon the bench max. 3.5 %

Unfortunately, the number of available chemical analysis and the choice of representative samples for them were not adequate for making a responsible calculation for the whole deposit or separate benches. SiO_2, Al_2O_3 and Fe_2O_3 analysis have not been done for complete holes but rather for specific samples within the holes; usually those with an unusual characteristic. Because of this the missing data for M_S calculations for the benches were replaced by the weight averages of SiO_2, Al_2O_3 and Fe_2O_3 contents of the whole deposit. The reserves calculation was done with respect of the recent mining technology using 10 m thick benches, beginning from a 60 m RL bench. At the same time the level of 60 m RL represents a deposit and reserves calculation basis. Limestone reserves were calculated like mining reserves above the final pit slope.

Methodology of Reserves Calculation

A) Deposit Boundary Determination

The northern boundary is geometrical. It was created as a line leading through the DDH 30 bore hole bottom parallel with the connecting line of DDH 2 with DDH 4 bore holes. This line connects with limestone limits of the ZCCM 1992 report. In this way the problematic part of the RP3 quarry (frequent lamprophyric dikes, insufficient space for establishing 60, 70 and 80 m RL benches) was excluded from the reserves calculation.

In the western and south-western part the whole bore DDH 26 was excluded from the calculation of proved reserves. It is formed by unsuitable raw material - dolomitical limestone with an MgO content above 3 %. Intercalations of this material is aimed to the bottom of limestone body. Here the deposit boundary is also geometrical (there is a line of connection between DDH 27 and

DDH 18 bore hole bottom) It connects with the limestone geological limits on the surroundings of DDH 13 bore hole.

The southern deposit boundary follows limestone - schist limits.

The eastern boundary was formed on the basis of geological sections from the ZCCM 1992 report. It excludes from the limestone body the marginal and unsuitable parts of carbonate sedimentary complex, represented by dolomitic and sandy limestone and dolomite. This geometrically constructed line connects the limestone limits line northerly from the DDH 28 bore hole.

In order to keep the quality criteria, all unsuitable parts - intercalations - have to be excluded from the limestone deposit (see **Table 4 - 6**). These include:

1./ Parts with MgO contents above 3 % for the whole bench.

Such parts are found in DDH 14, DDH 9 and DDH 22 drill holes. They have the shape of geological layers aiming from the surface to the bottom of the limestone body. But DDH 9 bore hole unsuitable part is eliminated by the final pit slope.

2./ Lamprophyric dykes with high contents of SiO_2 and Fe_2O_3 (specified as dioritic porphyry).

Gridstone occur around the sampling site CHQ3 - 16 out of the eastern deposit boundary. There is a lack of the information on geological and lithological structure of the deposit. In according to our present knowledge it is supposed gridstone may form bedding intercalations aiming from the surface into the deposit bottom out of reserves calculations.

They occur especially in the north - eastern part of the deposit. Here one little body is hidden under the plane of the final pit slope, another body appears on the deposit surface southerly from the DDH 4 drill hole. The intrusions formerly assumed in the central part of the deposit have not been found during the UNIDO geologists field survey.

B) The Final Pit Slope Construction

It was constructed from the above mentioned deposit boundaries into the mining license area with an inclination of 45°. The used value is conventional, because of the absence of data on the geomechanical properties (analysis of slope stability) of the particular rock environment. The intervals for the construction of the final pit slope isohypsis have been made from 5 to 10 m.

C) Limestone Reserves Calculation

The total volumes of benches were calculated by the horizontal sections method. The isohypsis of separate mining benches 60, 70 and 80 m RL were used as the main horizontal sections. Because of the need to calculate an exact volume of limestone reserves on the part of the deposit mined at

Table 4-6: Average CaO and MgO contents calculated from benches

	B60		B70		B80		B90	
	CaO	MgO	CaO	MgO	CaO	MgO	CaO	MgO
DDH1[1]			45,17	3,57	49,09	1,51		
DDH2	50,58	1,17	52,49	0,93	50,93	0,92	49,39	0,92
DDH3	3,10	1,22	26,70	2,09	46,49	1,87		
DDH4	39,94	2,25	47,90	1,02	44,27	1,17		
DDH5	48,14	1,80	48,29	1,81	39,27	1,02		
DDH5A	51,69	1,08	49,82	1,19	48,52	1,13		
DDH6	50,74	1,15	50,13	0,91	50,66	0,66		
DDH7	37,91	0,85	51,74	0,72	59,90	1,08		
DDH8	51,08	0,75	47,69	1,01	44,68	0,82		
DDH9[2]	46,60	3,74	48,74	2,35	49,42	2,24	51,80	1,41
DDH10	44,21	2,13	49,58	0,76	50,25	0,47		
DDH11	41,32	1,14	45,14	1,61	52,30	0,78		
DDH12	47,88	1,24	46,63	0,80	47,96	0,66		
DDH13			36,86	2,65	44,65	1,95		
DDH14	45,30	0,84	50,82	1,14	31,51	[3]4,17		
DDH15	48,54	1,42	47,07	1,16	47,34	0,72		
DDH16			12,89	0,83	32,67	1,67		
DDH17	48,11	0,76	47,44	0,88	45,44	2,33		
DDH18	48,64	1,26	47,65	1,27	48,82	0,91		
DDH19	49,14	0,71	47,60	1,28	49,92	0,88		
DDH20	48,08	1,00	48,26	0,80	51,54	1,04		
DDH21	2,41	1,10	44,07	0,98	52,81	1,24		
DDH22	37,65	1,03	46,16	0,95	44,51	[3]4,74		
DDH23	48,64	0,78	41,31	1,48	46,13	1,69		
DDH24	44,76	1,63	47,22	1,21				
DDH25	47,89	1,19	49,02	1,18	51,70	0,81		
DDH26[1]	44,81	4,42	41,16	7,49	39,33	8,99		
DDH27			50,48	1,15	49,07	1,24		
DDH28			49,19	2,11	42,93	2,18	48,98	0,89
DDH29			50,88	0,44	47,44	0,97		
DDH30			45,59	0,81	53,11	0,58		
1	45,93	1,63	46,10	1,70	48,10	1,68		
2	1,77	2,65	52,62	1,65	44,97	1,98		
3	21,90	1,66	34,16	1,63	51,08	1,63		
4	41,97	1,92	27,90	2,19	20,53	2,98		
5	48,26	1,73	49,78	1,70	19,59	1,82		
6	50,81	1,82	50,68	1,79	49,44	1,86		
7	50,90	0,91	50,14	0,89	49,46	0,86		
8	46,94	2,88	45,81	2,12	46,28	1,68		
9	1,98	[3]3,26	5,66	2,74	2,57	2,60		
8131	49,68	1,18	46,02	1,85	26,96	1,21		
8132	45,62	1,36	41,26	1,48	35,54	1,01		
8133	43,84	1,81	47,66	1,57	46,96	[illegible]		
8134			48,88	1,71	[illegible]	1,37		
8135	13,60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
8136			51,19	[illegible]	[illegible]	[illegible]		
8137			48,18	[illegible]	[illegible]	1,49	[illegible]	[illegible]

1) Bore hole out of deposit
2) B60 out of deposit
3) Unsuitable part of deposit

present (upon 80 m RL bench), these main horizontal sections were completed by the auxiliary horizontal sections (identical to the isohypses of the quarry surface according to the latest topographical map from 1995)

All the areas were measured by planimeter, taking into consideration the boundary of the final pit slope. The unsuitable parts volume was calculated as a multiple of their areas and average thickness. The value of the average thickness of the unsuitable parts (1) was found out by measuring on geological and technological sections 2 - 2', 1 - 1' (see **Annex 2, Drawing 10**). The lamprophyre body thickness was ascertained by measuring of the horizontal sections on the topographical map. The final limestone reserves volume (for separate benches and for the whole deposit) was calculated as the difference between the total volume of reserves and the volume of unsuitable parts. Tonnage calculation was made by using the rock density value for limestone (2,632 kg/m^3). The final reserves values is shown in the **Table 4 - 7**.

Bench (m RL)	Limestone reserves (t)	CaO (%)	MgO (%)
60	3,058,197	44,99	1,47
70	3,609,080	46,00	1,37
80	2,431,850	45,87	1,47
90	184,787	39,73	1,79
Total deposit	**9,283,914**	**45,73**	**1,49**

Table 4 - 7 : RP3 Deposit Reserves Calculation Results

Conclusions and Recommendations

The total volume of limestone is 3,527,000 m^3, that is 9,284,000 tons of raw material suitable for cement production. The unsuitable parts represent min. 0,4 % of the limestone reserves, but we suppose this value can be higher (see **Annex 2, Drawings 9 and 10**)

It is necessary to emphasize that the above mentioned reserves calculation and its quality evaluation are considerably influenced by the methods used in the previous geological survey. With regard to the high variability of chemical and technological properties of the deposit body, the drill holes density is insufficient. Because of the missing drill holes a more exact determination of the litological boundaries in the carbonate sedimentary complex is not possible. There is also a few information on the geological structure of the marginal deposit parts. It is possible to discuss the accuracy of boring methods (slope boring) and the choice of samples for the complete chemical analysis from all the drill core segments

It is possible to secure some additional limestone reserves, especially in the lower parts of the RP3 deposit (under the 60 m RL) and also on its north - eastern continuation. The following possibility depends on determination of geomechanical properties of the deposit rocks, aiming to make an accurate mathematical analyze of final slope stability and to calculate the more exact value of its inclination. However, it is necessary to carry out a supplementary, more detailed drilling investigation and qualifiably documented and evaluated geological survey with professional management.

4.1.1.5 OUTPOST HILL DEPOSIT

GEOLOGY

The sources for evaluation of the physical, chemical, mineralogical and petrological properties and for the reserves calculation of limestones were the following:

A./ Written information of R. K. Weller, (1968), Summary report

B./ Brief field geological maping and sampling (UNIDO geologists)

C./ Chemical analysis of the samples taken by UNIDO geologists (made in Chilanga Cement plant)

D./ Chemical analysis of the samples taken by UNIDO geologists (made in UNIDO team laboratory)

E./ Physical analysis of the samples taken by UNIDO geologists (made in UNIDO team laboratory)

F./ Mineralogical and petrological analysis of the samples taken by UNIDO geologists (made in UNIDO team laboratory)

The effort of UNIDO team to gain primary information from geological investigations failed because of lack of available information. The archive Summary Report of R. K. Weller (1968) was the only information on Outpost Hill deposit.

The deposit is bounded in the north-west and west by micaceous schists, and to the south by calc- silicates and impure carbonate rock. To the Northeast and east the limestone disappears beneath thick overburden.

The structure is extremely complicated with a net of east-west striking folds, fanning out towards the west and plunging towards the east, which are superimposed on at least one earlier major fold phase. Isoclinal folding of individual color bands is frequent. In effect, the deposit represents the folding core of a relatively thin band of limestone occurring within a schist / impure carbonate succession.

The entire hill feature is underlain by grey, medium to coarse grained limestone, generally banded in grey and white, and with occasional bands of limestone carrying abundant graphitic shale and pelite fragments.

The water table rests at approximately 18 30 m below the foot of the hill

Chemical Composition

The overall grade of the deposit is high, with $MgCO_3$ values below 4 % (MgO - 1,92) and total carbonates generally over 90 %. The bands of limestone containing pelite fragments where the $CaCO_3$ values drop to 80 - 90 (CaO 44,8 - 50,4 %) and $MgCO_3$ values occasionally rise to 6 %

No.	Sample	Rock type	CaO (%)	MgO (%)	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	L.O.I. (%)	SO_3 (%)	K_2O (%)	Na_2O (%)	PbO (ppm)	ZnO (ppm)	CuO (ppm)	P_2O_5 (%)	Cl (%)	Sr (%)
1.	OH-1	Limestone	52.26	2.43	0.55	0.09	0.36	43.87	0.01	0.02	0.03	5	9.00	14.00	0.14	0.005	0.031
2.	OH-3	Limestone	53.55	1.57	0.53	0.22	0.36	43.49	0.05	0.05	0.02	st	32.37	10.02	0.07	0.010	0.019
3.	OH-4	Limestone	47.24	0.85	9.05	2.20	0.91	38.27	0.05	0.36	0.54	2.15	59.76	12.52	0.18	0.010	0.050
4.	OH-6	Breccia	4.45	0.91	75.02	7.90	3.18	4.57	0.10	2.70	0.04	st	41.09	15.02	0.10	0.010	0.003
5.	OH-7	Limestone	51.36	2.50	1.14	0.50	0.41	43.56	0.19	0.08	0.02	st	11.21	11.27	0.11	0.010	0.022
6.	OH-9	Limestone	49.21	1.88	6.53	0.62	0.36	40.88	0.09	0.24	0.01	5	4.00	13.00	0.11	0.005	0.073

Table 4-8 : Chemical analyses of the rock samples - Outpost Hill deposit - UNIDO team laboratory

(MgO - 2,88 %) are the exceptions. The analyses of the surface samples taken by UNIDO team geologists shows the following chemical composition (%) CaO 49.21 - 53.55, MgO 0.85 - 2.50

In addition a low grade lens has been broadly delineated in the center of the deposit with $MgCO_3$ values rising to 16 % (MgO - 7,68) including one dolomite band. It is estimated that by careful quarrying this material can be incorporated into stone available for cement manufacturing, but it has been omitted from R. K. Weller (1968) proven reserves estimates

The alkali content is fairly low, with mean figures of 0.24 % Na_2O and 0.28 % K_2O. Phosphate figures are rather higher with an average value of 0.17 % P_2O_5. The Pb and Zn contents are negligible

As to the analysis of the surface samples which have been taken by UNIDO team geologists, the chemical composition of limestones from Outpost Hill deposit is as seen on the **Table 4 - 8**

Reserves

Reserves have been calculated to a depth of 18 m (60 ft) and 27 m (90 ft) below the foot of the hill

Total reserves of the deposit are 6,4 million tones. Proven reserves to 18 m below the foot of the hill are 4,6 million tones. Proven reserves to 27 m below the foot of the hill are 6,4 million tones.

Table 4 - 9 : Physical analyses of the rocks samples (UNIDO team laboratory)

Sample	Rock	Bulk density (kg/m^3)	Specific density (kg/m^3)	Porosity (%)	Relative density (%)
OH-3	Limestone	2,564	2,713	5.50	94.50
OH-4	Limestone	2,500	2,710	7.75	92.25

We propose a detailed, geological revaluation of Outpost Hill deposit because of need to confirm the amount of limestone reserves calculated by R. K. Weller (1968) and a more accurate knowledge of chemical, physical (see **Table 4 - 9**) and technological properties with regard to the requirements of the new proposed dry production process and the right way of developing of the new quarry of the Outpost Hill deposit

There is proposed to use limestones from RP3 deposit, after its depletion to develop new quarry in Outpost Hill deposit. The total amount of proved reserves in RP3 deposit is 9.3 mil tons (according to revaluation of ZCCM ore reserves calculation by UNIDO geologists), in Outpost Hill deposit 6.4 mil tons (according to the limestone reserves calculation of R. K. Weller, 1968). The total amount of proved reserves is 15.7 mil tons. This amount is sufficient for more than 30 years of life of the new proposed expanded Chilanga Cement Plant.

According to the information available the average quality and total amount of limestones of RP3 and Outpost Hill deposits correspond to the requirements of the proposed technology. Because of more sensitiveness of the new proposed dry production process technology to fluctuating of chemical, physical and technological properties of raw material and with regard to small quantity of information on Outpost Hill deposit there is, of course, the need of more detailed geological, chemical and technological study of limestones properties on both the deposits.

4.1.1.6 HYDROGEOLOGY AND WATER OF LIMESTONE DEPOSITS

The most important hydrogeological property of **prequarternary rocks** building deposits is **the pore space** they incorporate. The pore space may be contemporaneous with the rock - the primary porosity or it may be due to subsequent processes, such as fracturing, solution or weathering - the secondary porosity.

Limestones in the quarry are consolidated and have been metamorphosed. They are stepped over by net of fissures and closely spaced joints.

The main source of water in quarry is mostly from surface water, the contribution of ground water is very small. The size of the sump has important part especially during the rainy seasons. The pump capacity will be designed according to the hydrologic conditions and of course the area of the open pit to be sufficient to handle a heavy down pour.

From the hydrogeological point of view the establishment of daily pumping records, amount of drainage water and hydrological data would be used and helpful in hydrogeological assessment.

Limestone resources in Chilanga area are depicted in the Annex 2, drawing No.8.

4.1.2 PHYLLITE

Phyllite is used in cement production process to stabilize chemical composition of the raw materials. The main portion of phyllite for the existing Chilanga Cement Plant is quarried in Chilanga Quarry situated approximately 5 km from the plant near the road to RP3 quarry.

The sources for evaluation of the physical, chemical, technological, mineralogical and petrological properties of phyllite and for assessment their reserves calculation were the following:

A./ Brief geological investigations of phyllite sources (UNIDO geologists)

B./ Chemical analysis of the sample taken by UNIDO geologists (made in Chilanga Cement Plant)

C./ Chemical analyses of the samples taken by UNIDO geologists (made in UNIDO team laboratory)

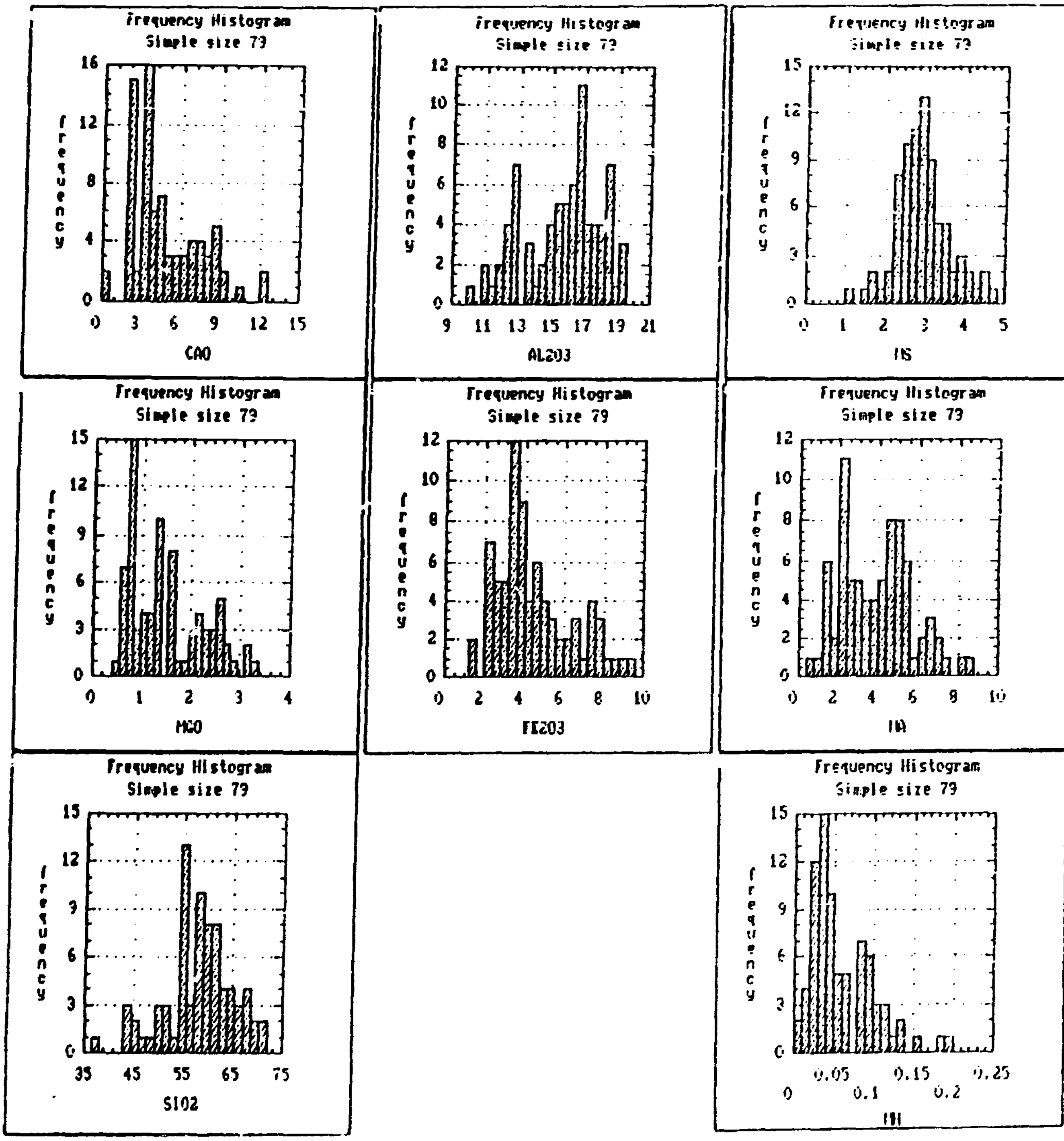
D./ Chemical analysis of phyllite used in the existing Chilanga Cement Plant (made in Chilanga Cement Plant Laboratory)

Sample	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	CaO (%)	MgO (%)	K_2O (%)	Na_2O (%)	PbO (%)	ZnO (%)	P_2O_5 (%)	Cl (%)
CHF-1	67.75	15.34	4.60	2.04	2.77						
CHF-1C	66.88	15.13	5.70	0.75	2.15	3.68	1.31	5	7	0.04	0.013

CHF-1 - chemical analyze made in Chilanga Cement Plant Laboratory

CHF-1C - check chemical analyze made in UNIDO team laboratory

Table 4 - 10: Analyses of phyllite from the quarry nearby cement plant



Sample size 79	SIO2	AL2O3	FE2O3	CAO	MGO	MS	MA	MH
Average	57,49	15,42	4,74	5,09	1,58	2,92	4,13	0,07
Geometric mean	56,69	15,11	4,24	4,26	1,38	2,84	3,56	0,06
Variance	75,23	7,39	5,31	9,94	0,74	0,44	5,08	0,00
Standard deviation	8,67	2,72	2,31	3,15	0,86	0,67	2,25	0,06
Coeff. of variation (%)	15,09	17,63	48,64	61,97	54,45	22,81	54,52	85,74
Maximum	76,19	19,53	12,89	20,40	5,41	4,80	14,56	0,47
Minimum	22,39	4,68	1,21	0,56	0,48	1,05	0,45	0,01

Figure 4-4 : Chilanga Cement Plant - Statistical analysis of phyllite

Sample	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	CaO (%)	MgO (%)	K_2O (%)	Na_2O (%)	PbO (%)	ZnO (%)	P_2O_5 (%)	Cl (%)
CHL-1	74.56	11.24	4.83	0.35	1.96	3.27	0.13				0.01
CHL-2	67.82	10.37	4.74	4.83	2.23	3.42	0.15	5	7	0.04	0.01

CHL-1 - sample of red phyllite, CHL-2 - sample of green phyllite

Table 4 - 11 : Analyses of phyllite from Chilanga quarry (UNIDO team laboratory)

The quality of phyllite used in the existing Chilanga Cement Plant will be suitable also for the proposed expanded plant (see **Tables 4 - 10, 4 - 11** and **Figure 4 - 4**). There is only a need of brief geological investigation of the phyllite quarry to know the horizontal and vertical variability of chemical composition with regard to proposed dry process technology.

4.1.3 COAL

Coal will be purchased from Maamba Collieries or import from Hwange in Zimbabwe (these two kinds of coal are used in the existing cement plants in Chilanga and Ndola)

Consumption of coal: Low calorific value (kcal/kg) 6,456

(kJ/kg) 27,030

Supposed specific heat consumption (kcal/kg clinker) 780

(kJ/kg clinker) 3,266

Consumption of coal (dry) (tpd) 120.82

Consumption of raw coal (1.5 % H_2O) (tpd) 122.7

(tpy) 36,798

	+25mm (%)	+19mm (%)	+12.7mm (%)	+4.8mm (%)	Ash (%)	Cal.val (kcal/kg)	Volat. (%)	Moist. (%)
Avg.94/95	3,11	48,3	66,0	86,70	18,20	6456	23,19	1,23
01/95	2,60	22,8	41,8	69,80	16,20	6630	25,10	1,20
02/95	4,70	90,3	36,7	49,20	21,25	6200	20,44	1,35
03/95	3,40	45,6	68,9	88,10	18,70	6410	24,00	1,60
04/95	3,50	34,9	58,3	85,60	17,60	6510	21,92	1,20
05/95	0,00	0,0	0,0	0,00	0,00	0	0,00	0,00
06/95	22,60	39,2	59,7	87,70	22,87	6060	25,66	1,20
07/95	15,90	29,8	49,6	81,00	22,30	6100	21,80	1,20
08/95	0,00	0,0	18,5	69,50	25,00	5890	22,80	1,00

Table 4 - 12 : Raw coal analysis (Chilanga Cement Plant Laboratory)

	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	CaO (%)	MgO (%)	SO_3 (%)	Total (%)
Avg.94/95	53,07	30,23	6,89	4,91	1,50	1,58	98,2
01/95	47.10	30,49	7.46	8.07	2.17	2.51	97.8
02.95	53,52	28,67	9,97	5,65	0,93	1,45	100,2
03/95	52,80	27,51	9,82	5,13	0,59	1,89	97,7
04/95	45,35	31,10	4,70	4,72	0,72	1,10	87,7
05/95	45,35	31,10	4,70	4,72	0,72	1,10	87,7
06/95	52,55	23,17	14,33	6,21	0,88	3,20	100,3
07/95	48,00	28,17	9,69	3,61	0,88	1,75	92,1
08/95	55,40	27,50	12,65	3,61	0,88	1,17	101,2

Table 4 - 13 : Coal ash analysis (Chilanga Cement Plant Laboratory)

To check coal ash quality there have been taken sample of coal from Chilanga Cement Plant coal storage (see **Table 4 - 14)**.

	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	P_2O_5 (%)	K_2O (%)	Na_2O (%)
CHC-1	**57.15**	**35.08**	**2.68**	**2.47**	**1.11**	**0.79**	**0.2**	**0.72**	**0.01**

Table 4 - 14 : Coal ash analysis (UNIDO team laboratory)

The quality of coal used in the existing Chilanga Cement Plant (see **Tables 4 -12, 4 -13** and **4 - 14)** will be suitable also for the proposed expanded plant.

4.1.4 RAW MIX COMPOSITION

The following raw mix composition of kiln feed is foreseen:

Quantity of ash from coal passing to clinker (%)	1,4
Proposed composition (dry conditions)	
Limestone + phyllite (%)	98.6
Coal ash (%)	1.4
Capacity of the kiln in clinker (tpd)	1,000
Effective working days per year	300
Annual production of clinker (tpy)	300,000

One ton of clinker produced will require 1.6 tons of kiln feed including coal ash and losses in handling.

Consumption of raw material (dry) (tpy)	480,000
Thereof: Raw components (limestone + phyllite) (tpy)	473,280
Coal ash (tpy)	6,720
Consumption of raw components (dry) (tpy)	473,280
Thereof: Limestone (94 %) (tpy)	444,883
Phyllite (6 %) (tpy)	28,397
Consumption of limestone:	
- in dry conditions (tpy)	444,883
(tpd)	1,483
- in natural conditions (2 % H_2O) (tpy)	453,962
(tpd)	1,513
Consumption of phyllite:	
- in dry conditions (tpy)	28,397
(tpd)	95
- in natural conditions (tpy)	29,892
(tpd)	100

4.1.5 GYPSUM

Gypsum will be obtained and purchased from the existing copper producing plant Nbana belonged to ZCCM. It is also used in the existing cement plants in Chilanga and Ndola. Despite to variability of the quality, chemical composition and moisture content (see Table 4 - 7) it is still acceptable for admixing to cement. To avoid problems with depletion of gypsum stock it is proposed to diversify suppliers of gypsum (import from Zimbabwe or Tanzania) or to start investigations to prove alternative sources of gypsum in Zambia

Admixing ratio of gypsum in cement is 5 % : 95 %.

Consumption of gypsum (dry) (tpy)	15,000
(in natural conditions) (tpy)	15,300

	Moist.	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	CaO (%)	MgO (%)	SO_3 (%)	Total (%)	$CaSO_4$ $.2H_2O$ (%)	Insol. resid
Avg.94/95	37.15	5.06	6.52	2.74	35.29	2.40	37.95	90.0	81.59	1.93
01/95	43.50	2.40	5.03	0.44	35.73	2.17	41.35	87.1	88.90	0.70
02/95	44.20	4.80	6.58	0.85	34.14	1.67	43.28	91.3	93.05	2.24
03/95	34,50	7,43	7,32	8,96	30,65	1,55	36,56	92,5	78,61	2,36
04/95	26,10	20,75	8,37	11,96	20,07	0,72	30,13	92,0	64,78	34,80
05/95	26,50	20,70	8,37	11,94	20,60	0,85	31,15	93,6	65,80	31,50
06/95	23,40	17,80	4,58	16,44	19,24	1,77	36,23	96,1	77,90	24,50
07/95	26,30	24,60	9,15	13,07	19,24	1,77	32,90	100,7	70,70	34,20
08/95	24,60	20,80	12,87	9,93	18,77	1,78	28,71	92,9	61,72	38,80
09/95	23,70	22,30	10,87	10,84	17,38	1,33	25,39	88,1	54,59	39,40

Table 4 - 15 : Gypsum analyses (Chilanga Cement Plant Laboratory)

To check gypsum quality there have been taken two samples of gypsum from Chilanga Cement Plant gypsum storage (see **Table 4 - 16**).

	$CaSO_4$ $.2H_2O$ (%)	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	CaO (%)	MgO (%)	SO_3 (%)	Sr (%)	Cuo (%)	PbO (%)	ZnO (%)
G-1	97	2.56	0.14	0.61	31.06	0.41	44.26	0.15	0.001	0.01	0.001
G-2	62	16.55	3.76	12.00	19.44	1.02	28.29	0.03	1.02	0.01	0.02

Table 4 - 16 : Gypsum analyses (UNIDO team laboratory)

The quality of present used gypsum is also suitable for the proposed expanded Chilanga Cement Plant.

4.1.6 POWER SUPPLY

Electric power necessary for operation of the expanded Chilanga Cement Plant will be supplied by ZESCO, by tapping from the existing 33 kV overhead transmission line, leaded along the cement plant.

The existing departments included in proposed plant will be supplied by electric power the same way as at present.

Specifications:

Voltage (kV) .... 3-phase 33 kV, 50 Hz

Source: Electric Power Corporation (ZESCO), Lusaka

4.1.6.1 POWER CONSUMPTION

Specific power consumption (kWh/t) 120

Annual power consumption (MWh/y) 37,800

Daily power consumption (MWh/d) .... approx. 126

Hourly power consumption (MWh/h) .... approx. 5.25

Estimated maximum power demand of the expanded Chilanga Cement plant is approximately 9 MW (installed power 12 MW).

4.1.7 WATER SUPPLY

Service and potable water will be supplied from the existing water system by two separate branches.

Process water demand (l/s) 8

(m^3/y) 207,000

Circulating cooling water (l/s) 20

Potable water demand (l/s) 0.2

(m^3/y) 5,000

TEST	ASSAY (mg/l)
Cu	< 0.065
Ni	< 0.0326
Zn	< 0.0097
Fe	< 0.052
Cr	< 5.14
TEST	ASSAY (mg/l)
Mn	< 0.017
Mg	51.81
K	< 0.0077
Na	16.61
Pb	< 0.266
S	0.15
Cd	< 0.0062
Co	< 0.0284

TEST	ASSAY (mg/l)
Cl	10
As	< 4.10
Ca	14.38
Al	< 4.0
P	7.47
Nitrate	Nil

Table 4 - 17 : Analysis of the technological water (old quarry dam)

Technological water used at the Chilanga Cement Plant will be also possible to use in proposed expanded plant (see **Table 4 - 17**).

4.2 SUPPLY PROGRAM

Supply program is calculated for the following production program:

Number of working days per year (dpy) 300

Annual production of clinker (tpy) 300,000

Annual production of cement (tpy) 315,000

4.2.1 RAW MATERIALS

Annual consumption of raw materials in natural conditions:

Limestone (tpy) 453,962

Phyllite (tpy) 29,892

Gypsum (tpy) 15,300

4.2.2 INPUTS - AUXILIARY MATERIALS

Paper bags (3 % break) (pcs/y) 6,489,000

Refractories, insulation (tpy) 350

Grinding media (cement) (tpy) 120

Lining (cement mills) (tpy) 60

Lining (raw mill) (tpy) 12

Lining (coal mill) (tpy) 1

Lubricants oil (l/y) 18,000

Lubricants grease (kg/y) 5,000

Spare parts (tpy)	120
Consumables (pcs/y)	3,000
Explosives (tpy)	60
Primers (pcs/y)	18,000
Detoning fuse (m/y)	20,000

4.2.3 UTILITIES

Raw coal (tpy)	36,798
Electric power (MWh/y)	37,800
Service water (m^3/y)	207,000
Potable water (m^3/y)	5,000
Diesel oil (l/y)	250,000

4.2.4 SUPPLIES

4.2.4.1 RAW MATERIALS

Limestone deposits: RP3 and Outpost Hill - situated 9, respectively 12 km from Chilanga Cement Plant (own resource).

Phyllite deposit is situated 5 km from Chilanga Cement Plant nearby the road to RP3 deposit (own resource).

Gypsum is to be purchased at Nbana (copper works), 400 km from the cement plant.

4.2.4.2 INPUTS - AUXILIARY MATERIALS

Inputs, e.g. paper bags, refractories, lubricants, explosives will be purchased in the markets abroad, partly in the local market (according to the possibilities).

Items, as are grinding media, lining of mills and spare parts will be also imported.

Consumables are available mostly in the local market.

4.2.4.3 UTILITIES

Coal necessary for burning of clinker will be purchased from Maamba coal mine and transported to the cement plant by trucks over the distance of 400 km.

Diesel oil will be purchased from Ndola Refinery by local transport corporation.

Power will be purchased and supplied from Electric Power Corporation (ZESCO) by tapping on the 33 kV overhead transmission line.

Service and potable water will be obtained from existing water system in Chilanga Cement Plant

4.2.5 SUPPLY SCHEDULE

The transport of limestone will be ensured by own company trucks using existing road (after depletion of RP3 Quarry there will be build 3 km of the new road to Outpost Hill deposit). Crushed limestone will be stored in the storage hall.

Limestone storage capacity .... 2 x 7 days

The phyllite will be transported by company trucks and stored in the existing crane storage

Phyllite storage capacity .... 20 days

Gypsum will be supplied from Nbana by the local transport companies. The road is trafficable the whole year around

Gypsum storage capacity .... 80 days

The supply of coal will be ensured from Maamba Collieries by the local transport companies. The road is trafficable all the year around.

Coal storage capacity .... 65 days

Clinker storage capacity .... 25 days

Cement storage capacity .... 8 days

Diesel oil will be supplied by the local transport companies

Diesel oil storage capacity .... 30 days

Inventory of paper bags .... 90 days

Inventory of spare parts, grinding media, linings and refractory materials ...... 1 year

Inventory of imported consumables .... 6 months

Inventory of locally available consumables .... 3 months

4.2.6 UNIT PRICES

In general, the all unit prices of materials and inputs have been stated according to current prices valid by September 1995 and used by Chilanga Works (see **Table 4 - 18**). The prices are derived from costs presented in monthly reports having been generated from the period January - September 1995.

For the computing of prices in USD there were used the average monthly middle exchange rates for the period January - September 1995. The average of this period is 860.67 K per one USD.

The prices of materials and inputs of foreign and local origin include transport costs, i.e. they equal to franco Chilanga Works prices.

Comments:

- Gypsum will be supplied from Nbana as mentioned above.
- Paper sacks are imported from Tanzania. 3Ply sacks are used for local sales and 6Ply sacks for export sales

TABLE 4 - 18

ESTIMATE OF PRODUCTION COSTS: MATERIALS AND INPUTS

Quantity	Unit	Item descriptions	Unit cost in USD			Total costs in thousands USD		
			Foreign	Local	Total	Foreign	Local	Total
		Raw material						
15, 300	t	Gypsum		26.00	26. 00		397 80	397 80
		Auxiliary materials						
5, 191	1, 000 pcs	Paper bags 3PLY (local)	266.17		266.17	1,381.70		1,381 70
1, 298	1, 000 pcs	Paper bags 6PLY (export)	527.66		527.66	684 90		684 90
350	t	Refractories, insulation	899.70		899.70	314 90		314 90
133	t	Grinding media	720.30		720.30	95.80		95 80
60	t	Lining (cement mills)	123.33		123.33	7.40		7 40
18, 000	l	Lubricants-oil		1.60	1.60		28.80	28 80
5, 000	kg	Lubricants-grease		2.08	2.08		10.40	10 40
		Works maintenance				1, 580	400	1, 980
60	t	Explosives	986.67		986.67	59.20		59.20
18, 000	pcs	Primers	1.07		1.07	19.30		19 30
20, 000	m	Detonating fuse	0.36		0.36	7.20		7.20
		Utilities						
35, 854	t	Coal		42.60	42.60		1,527.40	1,527.40
37, 800	MWh	Electric power (tax 3%)		9.860	9.860		372.80	372 80
		MD level					202.20	202.20
207, 000	cu. m	Industrial water						
5, 000	cu. m	Potable water						
250, 000	l	Diesel oil		0.49	0.49		123.00	123 00
		Overhead materials					150.00	150 00
		Total				**4, 150.40**	**3, 212.40**	**7, 362.80**

For the time being, **the production of own paper sacks is not considered.** It can arise as a forthcoming weak point in the high price as well as in permanent dependency in tough competition on the cement market

- Refractories, grinding media, explosives and maintenance materials including spare parts are delivered supplied from abroad with exemption of the pert of maintenance materials available at local market. It has been assumed that this pert is incomparable lesser than that from abroad and therefore it is considered as foreign costs

- Lubricants - oil and grease are available at Local market.

- Coal is supplied by local transporter from Maamba coal-mine.

- Electric power: There are two prices for electricity to be paid by cement plant. First, as a fixed cost given by maximum demand level of kVA and second, as variable according to consumption of MWh

- Diesel oil is available at local market and can be supplied by local transporter from the Ndola refinery plant.

- Overhead materials: Unit prices have been computed from Chilanga Works monthly reports data They refer to chemicals for cleaning, protective clothing, welfare, safety expenses and insurance premium.

5. LOCATION, SITE AND ENVIRONMENT

5.1 LOCATION OF THE CEMENT PLANT

Two existing cement plants (Chilanga and Ndola) are fully operational at present. Even though the greater part of Chilanga Cement Plant equipment is obsolete and inefficient, its location in the vicinity of the Lusaka area is ideal. The presumption is that the substantial future share of the domestic cement demands will be concentrated around Lusaka and the southern part of the country. This location would be convenient from the point of view of potential, further export expansion.

There are three potential locations in the Chilanga area taken into consideration. The main point of view is the availability of suitable limestone reserves.

Potential Site No.1 - The Present Area of Chilanga Cement Plant

It seems to be the most convenient and practical location because of the vicinity of the main north - south road (1 km) and Lusaka (18 km). The RP3 deposits and Outpost Hill will be quarried. This area can be characterized as an area suitable for the construction of the plant with convenient overall conditions. Another advantage of this site is the possibility to use the existing crushing departments, clinker storage, cement mills, cement silos, packing house and all auxiliary departments including the engineering network and railway.

Potential Site No.2 - The Area of the RP3 deposit

The second possibility has the main advantage of the vicinity of raw material deposits. The distance of this site from the main north - south road is 9 km and 25 km from Lusaka. This area for construction of a completely new cement plant can be characterized as suitable for such a construction purpose.

The disadvantage of selecting the area of RP3 deposit is the highest investment costs and the building of:

-complete production departments

- complete auxiliary departments

- complete service departments

- road connection

- water supply system

- electric power system

- construction of a new residential area

The investment costs would be approximately 100 % more than those of the first potential site.

Potential Site No.3 - Combination Site

The third potential location includes two sites. The production of clinker with all necessary production and auxiliary departments will be located in the RP3 deposit area. The produced clinker would be transported to the existing Chilanga Cement Plant by lorries. The existing grinding, storing and loading capacities would be utilized in the Chilanga Cement Plant.

The clinker production department would consist of:

- complete production departments (crushing plant, preblending storage, raw material grinding plant, blending silo, rotary kiln line, clinker silo, coal storage, coal grinding plant)

- necessary auxiliary departments
- necessary service departments
- road connection
- water supply system
- electric power system
- construction of a part of a residential area

The investment costs will be approximately 50 % more than those in the first potential site.

5.1.1 SITE SELECTION

The judgment given in Table 5.1 was prepared employing the value analysis method where each criterion is evaluated by a number of points. The selected criteria take into account geological and geographical conditions, distance to a raw material deposit, road connection and facilities, utilization of the existing production and auxiliary departments, necessary investment costs and utilization of the existing residential area.

The individual criteria are evaluated as follows: unsuitable = 0 points

less suitable = 1 point

suitable = 2 points

very good = 3 points

According to **Table 5 - 1** the most suitable site for setting up the expansion of Chilanga Cement Plant is site No 1. The evaluation of site No.1 is described in the following text.

Site criteria	Description	Points	Description	Points	Description	Points
	Site No.1		Site No.2		Site No.3	
Geographical conditions	Very good	3	Very good	3	Very good	3
Geological conditions	Good	2	Good	2	Good	2
Traffic connections: - road	2 km	3	9 km	2	2 km, 9 km	3
- railway	1 km	3	no	1	1 km	3
Utility connections: - water	existing	3	10 km	1	existing + 10 km	2
- power	existing	3	8 km	0	existing + 8 km	2

Raw material deposits : **- limestone**	9 km	2	1 km	3	1 km	3
- phyllite	1 km	3	1 km	3	1 km	3
- gypsum	400 km	2	409 km	2	400 km	2
- coal	350 km	2	359 km	2	359 km	2
Area	Sufficient including reserve for extension	3	Sufficient including reserve for extension	3	Sufficient including reserve for extension	3
Farming	No	3	Yes	2	Yes – No	2
Land preparation requirements	Moderate	3	Extensive	1	Extensive	2
Investment costs	100 %	3	200 %	1	150 %	2
Residential area	Existing	3	New	1	Limited	2
Total		41		27		35
Priority	**First**		**Third**		**Second**	

Table 5 - 1 : Site selection evaluation

5.1.2 SITE OF THE CHILANGA CEMENT PLANT

5.1.2.1 LOCATION

The expanded cement plant with a daily capacity of clinker 1,000 t will be located in the area of the existing Chilanga Cement Plant, which is situated 18 km south of Lusaka on the main north-south road.

The proposed site for the expanded part of the cement plant can be characterized as an area suitable for a new production departments construction with convenient overall conditions.

The other possible localities are not taken into account because of these requirements

- take over of additional land and consequently elevated costs of land and its preparation
- construction of all the new production departments
- construction of the new auxiliary services
- construction of a new infrastructure

The establishment of the expanded cement plant in the proposed location is supported by cement shortages mainly in the Lusaka region and the southern part of Zambia and also by the possibilities of expanding cement exports to Malawi and Zimbabwe

5.1.2.2 SITE OF THE PLANT

The new lay out is influenced by a necessity to utilize and continue the operation of some existing production departments, existing auxiliary services as well as by raw material availability and linking to the existing networks.

a) Site conditions

The following site conditions for the selected site of the expanded cement plant erection and operation are:

- Expansion site area : 200 (L) x 150 (W) m
- Altitude: 1,280 m above sea level
- Soil load-bearing capacity: 0,3 MPa
- Underground water level: > 60 m below the surface

b) Geographical and transport conditions

The existing cement plant is located in the Chilanga area, about 18 km from Lusaka.

Distance from the main north-south road: approx. 1 km

Distance to the RP3 deposit: approx. 9 km

Distance to the phyllite deposit: approx. 5 km

Coal will be obtained from the existing mine in Maamba, 350 km south of CCL

Gypsum will be obtained from the existing copper works in Nbana, 400 km north of CCL

The existing cement plant has a good connection to the main road and railway

5.2 LOCATION OF SUITABLE LIMESTONE AND PHYLLITE RESERVES AND RESOURCES IN LUSAKA AND IN THE SUBREGION

5.2.1 RP 3 DEPOSIT

Location

This deposit was located in late 1965 and lies 9 km south-west of Chilanga. RP 3 formed a low spur striking south-west from the Kafue „ Escarpment " and rising approximately 24 m above the surrounding country side.

The deposit underlines an area of approximately 173,000 m^2, has a length of about 600 m and the width varies from 120 to 250 m.

Geological mapping and surface sampling were completed during early 1966 and a detailed drilling programmes were carried out in 1968, 1981 and 1987 to investigate the deposit to a depth of 27,5 m below the foot of the hill.

According to field survey of UNIDO team geologists and revaluation of limestone reserves their total amount is 9.3 million of tons.

5.2.2 OUTPOST HILL DEPOSIT

Location

The deposit lies 12 km south-west of Chilanga and consists of an isolated, subcircular hill some 300 m in diameter and rising 30 m above the surrounding flats. It was located, briefly mapped and sampled in late 1955 by the CDC geological team, and a mining title registered.

In 1965 the deposit was investigated in detail by mapping, surface sampling, trenching, and diamond drilling.

The total amount of limestone reserves is 6.4 million of tons (the result of R. K. Weller, 1968, proved reserves calculations).

5.2.3 PHYLLITE RESERVES AND RESOURCES

Phyllite is used as a corrective material to touch up chemical composition of raw materials. The main source (beside the sporadic quarrying in the area 1 km south of Chilanga Cement Plant) is Chilanga Phyllite Quarry some 5 km south-west of the existing plant. The amount of phyllite reserves for the proposed expansion of Cement Plant is satisfactory. Because of the great variation of chemical composition and high content of Fe_2O_3, Na_2O and K_2O (alkali content is very important for the proposed dry process) it is recommended to carry out brief geological investigation of phyllite deposit to identify the geological structure of the deposit with aim to avoid the unsuitable parts in the quarry development.

5.2.4 FOUNDATION CONDITIONS OF THE CHILANGA PLANT AREA

During survey works (trench TP - 1) a disturbed sample of soil with natural water content have been taken for determinate classificatory rock properties and engineering geological conditions of underlying soil.

The sample (eluvial horizon) was tested in UNIDO team experts' laboratory. The following methods have been used :

- granularity compose
- Atterberg's limit
- natural water content /soil moisture

The name of soil - **sandy loam with symbol SM** has been determinated from particle size distribution curve. It has the following building code characteristics:

Poisson's ratio (μ)	0.30
Soil moisture on liquid limit (w_l) (%)	20.00
Soil moisture on plastic limit (w_p) (%)	17.00
Consistency index (I_c)	2.97
Plasticity index (I_p) (%)	3.00
Soil density (γ) (kN m^{-3})	18

Modulus of deformation (E_{def}) (MPa) .... 5 - 15

Bearing capacity (R_{dt}) (kPa) .... 225 - 300

Footing bottom for new line of Cement Plant is suggested in solid rock after removing the weathering horizon The following characteristics are determinated in according to the Building code for solid rock and semisolid rock:

Solid rock (σ_c)(MPa) .... > 50

Semisolid rock (σ_c) (MPa) .... 1,50 - 50

Within the framework of the proposed new line of Cement Plant there is necessary to determinate special engineering conditions „in-situ“ to collect all engineering characteristics for foundation of structures

5.3 LOCAL CONDITIONS

5.3.1 CLIMATE

The mean annual **temperature** in ***Zambia*** is largely within the moderate range 18.0°C and 22.0°C. During December - February the daytime temperatures vary between 20.4°C and 26.3°C and the night-time temperatures vary between 17.3°C and 21.8°C. The maximum air temperature is usually below 35°C. The mean, yearly **relative humidity** varies between 55 % in the extreme southern parts of the country to 72 % around the lake shores. The winds are generally light in Zambia. The dominant direction of the winds is mostly in the East - West direction, rarely in the south-east - north-west direction. The windspeed is 12 km/h maximum, except strong winds during thunderstorms. The seasonal (October-April) minimum assured **rainfall** varies from 229 mm (Katondwe Mission) to 1103 mm (Lake Bangweulu). However many stations in Zambia have a dependable rainfall of 600 - 800 mm, corresponding to an average seasonal rainfall of about 850 - 1,000 mm.

The climatic conditions according to the data obtained from the Mt. Makulu climatic station in ***Chilanga area*** are as follows:

The hottest month is October with the mean **temperature** of 24.6°C. June, the coolest month, has the mean temperature of 15.7°C. Frost occurs, particularly in June and July and the lowest minimum temperature ever recorded is -1.6°C. The range of **relative humidity** is from 37 % (October) to 83 % (February). A major feature of the climate in the Chilanga area is the persistence and strength of the easterly **winds**. The highest mean windspeed is attained during September and the lowest in February. **Evaporation** ranges from 284 mm in October to 111 mm in February. The mean annual **rainfall**, according to data of The Meteorological Department of Zambia ,for the Chilanga area is about 850 mm. The main portion of rainfall is during the rainy season from November to March, with the maximum in December (219 mm), January (203 mm) and February (177 mm).

To characterize the local climatic conditions - see **Table 5 - 2**.

Month	Temperature		Rainfall	Wind
	max. (°C)	min. (°C)	mm	km/h
1994				
January	27,9	17,3	244,1	5,6
February	27,9	16,3	140,7	5,6
March	29,7	14,6	2,7	3,7
April	28,7	14,6	21,9	5,6
May	26,7	10,7	0,0	5,6
June	24,2	8,1	0,0	3,7
July	23,4	8,7	0,0	5,6
August	26,1	10,1	0,0	5,6
September	30,4	15,5	0,0	7,4
October	30,3	16,6	27,0	7,4
November	33,3	19,9	41,1	7,4
December	29,7	18,5	233,3	5,6
1995				
January	28,9	17,5	108,7	5,6
February	28,1	17,1	131,2	3,7
March	29,1	15,5	82,7	5,6
April	28,5	15,1	0,5	5,6
May	27,7	13,5	0,0	5,6
June	24,3	7,7	0,0	3,7
July	24,8	9,7	0,0	7,4
August	28,3	13,9	0,0	7,4
September	32,2	16,5	0,0	7,4

Mostly winds blow in the East-West direction, from time to time Southeast-Northwest.
Wind max. 12 km/h.

Table 5 - 2 : Data on Climate in the Chilanga Area

5.3.2 SEISMICITY

Zambia lies at the southern end of the East African Rift Valley System whose sesmicity has been studied in detail. The sesmicity in Zambia may be divided into five zones. The Chilanga area lies between zones No 1 and 4. The Kariba zone (No 1) has the highest seismicity. It is due to the infilling of the dam which has resulted in the reactivating of the already existing NE-SW trending fault zone. Zone No 4 is the zone of diffuse seismicity. This includes part of the Copperbelt, where some of the seismic activity is due to mining activity. The level of seismicity in both of the zones is relatively small, not requiring special anti-seismic arrangements in the Chilanga area applying to such activity as the reconstruction of the Chilanga Cement Plant.

5.3.3 UTILITIES

Water supply:

Service and potable water will be supplied by the existing water supply system

Electricity:

The existing cement plant is supplied from the overhead 33 kV line set up along the cement factory. This line will also be satisfactory for the new, expanded part of the Chilanga Cement Plant.

5.3.4 MANPOWER

Manpower for the operation of the new, expanded cement plant will be provided by the personnel of the existing Chilanga Cement Plant.

5.3.5 CONSTRUCTION, ERECTION AND MAINTENANCE FACILITIES

There are well-equipped workshops with skilled manpower, stores, offices and a laboratory in the existing cement plant. These facilities can be keep in use during the construction and operation of the next plant. The construction and erection works can be carried out by the branch offices in Lusaka.

5.4 ASSESSMENT OF ENVIRONMENTAL IMPACTS

The proposed dry cement production process environmental impacts can be evaluated from the point of view of the air pollution, water pollution, noise, waste and landscape impacts. The assessment of environmental impacts is possible to make only in general, because the type of machinery in the expanded plant is not known. In the case of requirement from the side of Environmental Council of Zambia, the complete process of an environmental impact assessment will be elaborated in the project stage.

5.4.1 AIR POLLUTION

The existing Chilanga Cement Plant and also the proposed expanded plant are the source of the pollutants, solid and gaseous, emitted into the ambient air. The solid pollutants are represented mainly by limestone, clinker, slag and cement dust. The sources of the dust are primarily - stacks from the separatory machines and secondary - areas sources (roads, disposals, floors etc.). Gaseous pollutants are mainly oxides - NO_2, SO_2, CO. The main components of solid emissions are limestone and calcium compounds - clinker minerals, calcium oxide and insoluble raw materials. Their complete volume in the form of $CaCO_3$ is 40 - 43 %. Insoluble raw materials are represented mainly by carbonates in the amount of 16 -34 %. The alkaline influence also has MgO (1.2 - 1.5%) and from the point of view of the plants nourishment, potassium in the form of K_2O (max. 2%). The main chemical compounds of the solid emissions are CaO, MgO, SiO_2, Al_2O_3, Fe_2O_3, Na_2O, K_2O, MnO, P_2O_5, TiO_2. The amounts of the solid emissions will vary from 0.0 to 30.0 $mgNm^{-3}$ (in the conveyers). The emission standard according to the usual European standards is about 50.0 $mgNm^{-3}$. The reduction of the emissions will be achieved by the dedusting of all the dust emitting machines and equipment.

The limiting values of emissions:

- The emissions concentration of dust will be under 50 mg/Nm^3
- The emissions concentration of NO_x will be under 1,300 mg/Nm^3
- The emissions concentration of SO_2 will be under 400 mg/Nm^3

5.4.2 WATER POLLUTION

There will be no toxic and hazardous substances produced by the new technology with possibility of the water pollution. The consumption and also the production of waste water, in comparison with the present technology, will be much lower. This means that there will be the possibility to use the existing sewage system nearby the present site of the Chilanga Cement Plant.

5.4.3 WASTE MANAGEMENT

The present system of waste management is suitable also for the proposed expanded plant. The recyclable (paper, iron, oil waste) and municipal waste will be collected and hand over to authorized companies.

The proposed technology of the production of clinker is without any waste. The materials, potentially considered as waste - the dust in the cloth filters- will be recycled back into the production process and used in the burning of clinker. The dust from the clinker cooler and from the clinker conveyers will be put back into the last chain of the clinker transportation and processed into cement.

5.4.4 NOISE

The technology of the expanded Chilanga Cement Plant is proposed to respect the usual noise emission standards - 85 dB in the outdoor departments, 70 dB in the indoor departments and 50 dB (40dB in the nights) in the outdoor residential areas.

5.4.5 LANDSCAPE IMPACTS

This category includes environmental impacts such as the impact in the landscape scenery. After working out the abandoned quarries will have been this kind of negative, environmental impact of a permanent character.

5.5 COST ESTIMATE

There are no costs of land.

The Head Office and Chilanga Works, Kafue road, Chilanga are located on the land held under certificate of title No. 20422 for 99 years from 1 January, 1950.

6. ENGINEERING AND TECHNOLOGY

6.1 PRODUCTION PROGRAMME

Future prognoses of the consumption of cement in Zambia (including of export), according to the market analysis (see Chapter 3) is as follows (tpy):

		1995	2000	2005	2010	2015
Total	Base case	285,000	530,000	615,000	615,000	750,000
	Upper case	-	600,000	700,000	800,000	800,000
Ndola Works output		170,000	280,000	300,000	300,000	300,000
Chilanga Works output		115,000	250,000	315,000	315,000	450,000
From these - export		64,000	106,000	123,000	123,000	150,000
	- domestic	221,000	424,000	492,000	492,000	600,000

According to the above mentioned prognoses it is supposed that Chilanga Cement Plant will produce: - after the year 2000 approx. 315,000 tpy of cement

- after year 2015 approx. 450,000 tpy of cement

The main subjects of the feasibility study are the two alternatives of the expansion of the Chilanga Cement Plant:

It should be indicated that the actual technological system operating in Chilanga Cement Plant is the wet production process, which is an obsolete technology.

Alternative 1: Semi-wet Process of Clinker Production

The conversion of the present wet process of clinker production to a semi-wet one with a possible max. output of 720 tpd of clinker (conversion of the kiln 2 and 3), would require the installation of a filter press section, dedusting unit, drying crusher unit and 1-stage preheater of the kiln for each existing kiln The aim is to achieve an improved efficiency with minimum changes in the existing plant.

Alternative 2: Dry Process of Clinker Production

The setting up a new dry process of clinker production line with an output of 1,000 tpd of clinker would consist of a preblending storage, raw mill, blending silo, short rotary kiln with 5-stage suspension preheater and grate cooler This alternative will use the crushing section, clinker storage, cement mills, cement silos, packing house and all auxiliary departments from the existing plant.

6.1.1 ALTERNATIVE 1 - SEMI-WET PROCESS OF CLINKER PRODUCTION

Kiln line No.2 and No.3 would be taken into account for the conversion from a wet to semi-wet process.

This alternative would fully exploit the existing production departments. It would be necessary to construct new departments such as a filter press plant and dryer crusher plant for each kiln There would be also a need of a small reconstruction of the existing rotary kilns which include adding one stage cyclone preheater

The present technology of Chilanga Cement Plant includes three wet process kiln lines installed in 1951, 1956 and 1967 respectively. The oldest one - kiln line No.1 from 1951 was closed down in 1981.

The Main Technical Data of the Kiln Line No.2:

Daily output: 280 tpd

3.60 / 3.05 / 3.60 m diameter x 78.1 long

Planetary cooler - 12 tubes, 1.22 m diameter x 5.4 m long

Fuel consumption: approx. 1,600 kcal / kg clinker

The Main Technical Data of the Kiln Line No.3:

Daily output: 320 tpd

3.15 m diameter x 92 m long

Planetary cooler - 10 tubes, 1.2 m diameter x 7.2 m long

Fuel consumption: approx 1,600 kcal / kg clinker

Although the main part of the production equipment (the No.3 kiln line installed in 1967 is the most modern) is very obsolete, the whole cement plant is relatively in a very good condition and probably capable of operating for the next ten or fifteen years. On the other hand the direct costs for the production per tone of cement are relatively high. It is mainly due to the high fuel consumption inherent in the wet process of cement production. The raw slurry moisture content is about 35 %.

In view of the long user period of the production equipment and the obsolete wet process it is possible to conclude that the Chilanga Cement Plant is not very suitable for operation in the distant future. It has also been observed that the Chilanga Cement Plant is not very adaptable to modification to a more efficient production plant or for expansion to a higher capacity through conversion.

The change from the existing wet to semi-wet process is not very suitable in light of the remaining life of the existing production lines, frequent output of the operations, the increasing number of maintenance and expensive alternations of the existing production equipment and buildings.

According to the market analysis (see Chapter 3) the demand of cement production after the year 2005 in Chilanga Cement Plant will be approximately 315,000 tpy. This means it would be necessary to convert both existing kiln lines (No.2 and 3).

Taken into account the age of the kiln lines and small kiln diameters, the possible increase in the production of clinker is about 20 % in comparison with present capacity. The whole capacity then would be 220,000 tpy cement {(320 + 280 x 1.2 = 720 tpd, which means approximately 220,000 tpy}.

6.1.1.1 DESCRIPTION OF SEMI-WET PROCESS OF CLINKER PRODUCTION FOR KILN LINE No.3

The semi-wet clinker production process is based on an installation of a filtration unit, dryer-crusher unit and cyclone preheater. Kiln raw slurry is prepared in the existing raw departments and it is pumped from the existing slurry basins to the filter press section, where a cake containing approximately 20 % of the moisture is produced The cake is fed from a small storage silo to a dryer-crusher and then to the kiln which will be fitted with a single stage cyclone preheater

The slurry, with about 35 % of water content, is filtered in two recessed plate filter presses The filtration is complete when the press chambers are filled with filter cake at approximately 20 % of moisture The cake parts from the filter cloths are transported by belt feeder into the storage silo of 70 m^3 capacity. The extraction is by a cutter screw mounted directly above the rotating silo base table The filter cake discharged from the silo is conveyed via a double flap into the dryer-crusher The crusher is a closed bottom hammer mil continuously filled by kiln gas with an inlet temperature of 550 ÷ 575°C, which pre-dries the cake in the mixing chamber Additional drying is effected when the material passes the hammer and descends into the whirling chamber The water content is about 1 % and the gas stream temperature is reduced to 150 - 175°C

The waste heat gas from the kiln preheater system would be just sufficient to evaporate the expected 20 % water content in the filter cake No interval heat exchange fitting is used in the kiln

The raw meal entrained in the gas stream is carried through to the dedusting cyclone The raw meal separated in this cyclone is introduced into the riser pipe at a point above the kiln inlet Here it is picked up by the gas stream from the kiln at approximately 800 - 850°C and is carried up to the riser-pipe into the preheater cyclone The preheated raw meal is discharged from the preheater cyclone hopper directly into the kiln inlet

A dust from the outlet of the dedusting cyclone hopper to the kiln inlet is provided so that part of the feed can be diverted to bypass the preheater cyclone. This helps to achieve the optimum balance of the heat exchange between the preheater cyclone and the dryer-crusher, particularly at kiln start-up.

Exhausted gas from the dedusting cyclone is carried via a variable speed ventilator to the existing electrostatic precipitator All the precipitated dust is returned into the process via the kiln raw meal feed pipe.

The same machinery is presumed in the case of the introduction of a semi-wet process for the kiln line No.2.

Flow sheet of the semi-wet process is represented on the Figure 6 - 1.

6.1.1.2 ASSUMED AND ACHIEVED OPERATIONAL RESULTS

The present production of clinker of the No.3 kiln line, operating under the wet process, is 300 ÷ 320 tpd, with a fuel consumption of 1,600 kcal/kg of clinker.

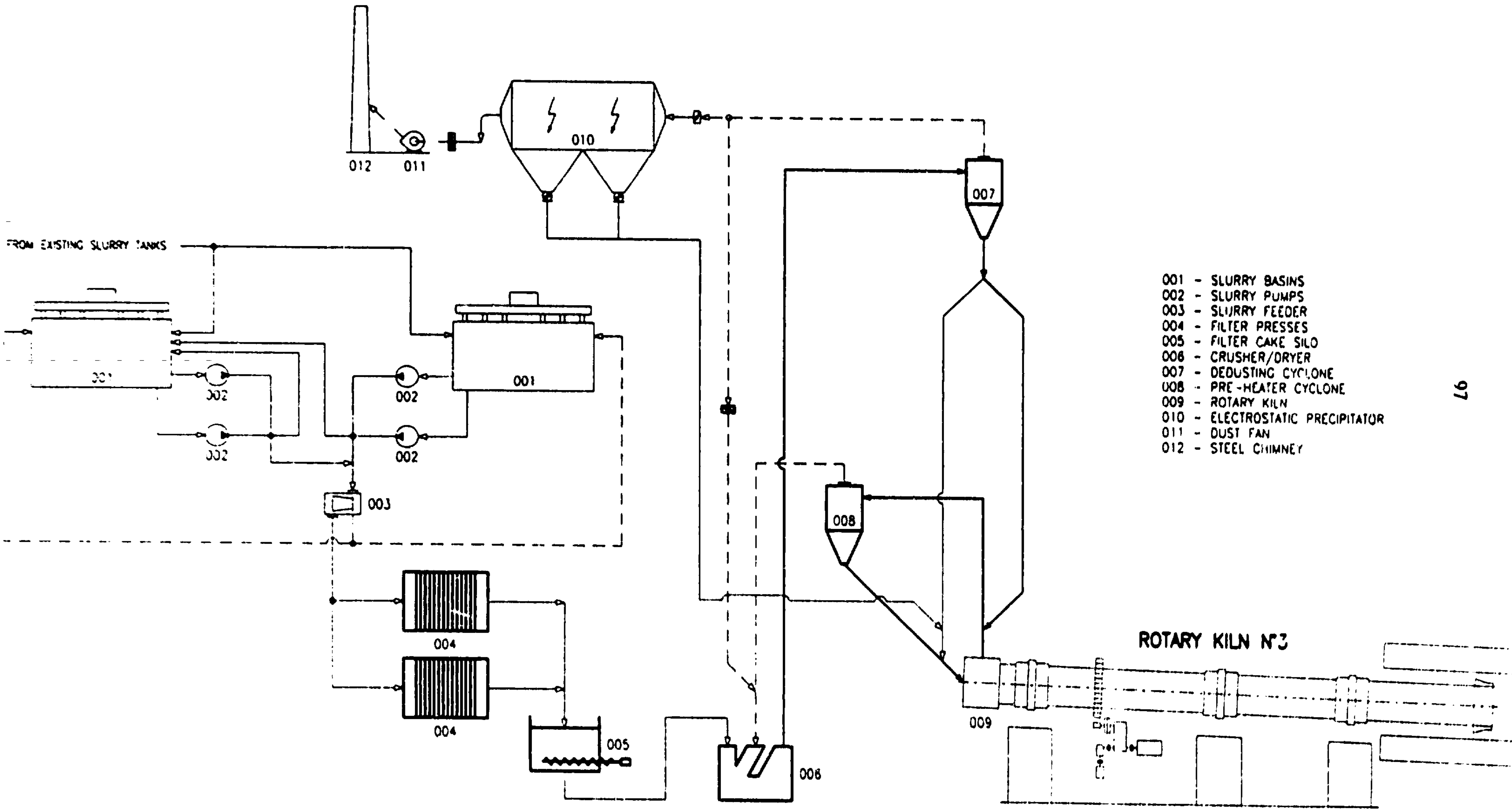
The No.3 kiln line would produce approximately 20 % more (it means 360 ÷ 380 tpd of clinker) after conversion to a semi-wet process The fuel consumption would be about 1,100 kcal/kg of clinker

During the reconstruction the kiln line. No 3 will be out of service for about 4 ÷ 5 months

Saving of coal

Heat consumption in the existing wet process	1,600 kcal/kg of clinker
Heat consumption in the semi-wet process	1,100 kcal/kg of clinker
Saving of heat	500 kcal/kg of clinker

Figure 6-1: Flow sheet of semi-wet process



Saving of heat per one tone of clinker 500,000 kcal kg of clinker

500,000 / 6,456 = 77.45 kg of coal per ton of clinker

Additional electric power consumption

There is a need for 16 kWh per ton of clinker of additional electric power altogether (about 5 kWh per ton are used in the filter press section and approximately 11 kWh per ton of clinker in the dry crusher with the preheater of the kiln)

Additional manpower

Additional manpower: 2 men per shift

Total 10 workers including 2 workers as alternative men

6.1.1.3 ESTIMATION OF THE INVESTMENT COSTS

	Production equipment (USD)	Civil works (USD)
Filter press plant	1,500,000	500,000
Dryer crusher and kiln plant	2,000,000	200,000
Total for No.3 kiln	**3,500,000**	**700,000**

Investment costs for the No.3 kiln ....4,200,000 USD

The same operational results and investment costs will be also valid for the No. 2 kiln line

6.1.1.4 ASSUMED OPERATIONAL RESULTS AND INVESTMENT COSTS FOR KILN LINES No.2 AND No.3 IN CASE OF THE SEMI-WET PROCESS

	Kiln No.3	Kiln No.2	Total
Max.daily production capacity of clinker (tpd)	384	336	720
Max yearly(300 working days per year) production capacity of clinker (tpy)	115,200	100,800	216,000
Saving of heat (kcal/kg of clinker)	500	500	-
Saving of coal (kg/t of clinker)	77.45	77.45	-
Additional electric power consumption (kWh/t of clinker)	16	16	-
Additional manpower	10	10	20
Investment costs (USD)	4,200,000	4,200,000	8,400,000

The above mentioned conversion of the existing kiln lines in the Chilanga Cement Plant into a semi-wet production process would bring an increase of cement production from the present 180.000 tpy to 220.000 tpy of cement

The marketing studies show the need for cement in Zambia plus possible export after the year 2.000, in a volume of approximately 300.000 tpy

The result is that the possible conversion would not be sufficient to fulfill future cement demands.

This result leads not to a detailed study of the variant of conversion to a semi-wet process but to detail the second possible alternative - a dry process of clinker production

6.1.2 ALTERNATIVE 2 - DRY PROCESS OF THE PRODUCTION OF CLINKER

This alternative can be solved in three versions:

- Variant No 1 - Introduction of dry production process of clinker in the area of the Chilanga Cement Plant
- Variant No 2 - Construction of a completely new cement production plant in the area of the RP3 limestone deposit
- Variant No 3 - Construction of a dry process clinker production plant in the RP3 deposit area and utilization of the existing cement grinding, storing and loading plant in the Chilanga Cement Plant.

Variant No.1 - Introduction of dry production process of clinker in the area of Chilanga Cement Plant

This version presumes the utilization of the following existing departments in the Chilanga Cement Plant

01 - Limestone extraction

02 - Phyllite extraction

03 - Primary Crushing plant

04 - Secondary Crushing Plant

10 - Clinker storage

11 - Gypsum storage

12 - Coal storage

14 - Cement grinding plant

15 - Cement silos

16 - Packing plant and loading

17 - Electrical equipment (partly)

All the existing auxiliary departments

All the existing service departments

The following new production departments would have to be built

05 - Preblending storage

07 - Raw material grinding plant

08 - Blending silo

09 - Rotary kiln line

13 - Coal grinding plant

17 - Electrical equipment (partly)

18 - Central control room and instrumentation

21 - Diesel power plant (auxiliary department)

Variant No.2 - Construction of the completely new cement production plant in the area of the RP3 limestone deposit

This version would require the highest investment costs because of the inevitable building of the following new departments.

- Complete production departments
- Complete auxiliary departments
- Complete service departments
- Road connection
- Water connection
- Electric connection
- New residential area

Variant No.3 - Construction of the dry process clinker production plant in the RP3 deposit area and utilization of the existing cement grinding, storing and loading plant in Chilanga Cement plant

Clinker would be produced in the new production departments situated in the area of the RP3 deposit. There would be a need for the construction of the following departments:

03 - Crushing plant

05 - Preblending storage of limestone

06 - Storage of phyllite

07 - Raw material grinding plant

08 - Blending silo

09 - Rotary kiln line

10 - Clinker silo

12 - Coal storage

13 - Coal grinding plant

17 - Electrical equipment

18 - Central control room and instrumentation

Necessary auxiliary departments

Necessary service departments

Road connection

Water connection

Electrical connection

Part of residential area

Clinker will be transported to the existing Chilanga Cement Plant by lorries. The following existing departments in the Chilanga Cement Plant will be utilized for grinding, storing and loading of cement:

10 - Clinker storage

11 - Gypsum storage

14 - Cement grinding plant

15 - Cement silos

16 - Packing plant and bags loading

17 - Electrical equipment

Necessary auxiliary departments

Necessary service departments

Table 6 - 1: Dry production process versions selection

Variant / Criteria	Variant No.1	Variant No.2	Variant No.3
Building site	existing	new	new - existing
Distance from limestone quarry	9 km	1 km	1 km
Distance from main road	1 km	9 km	9 km
Railway connection	1 km	10 km	10 km
Distance from coal deposit	350 km	359 km	359 km
Distance from gypsum deposit	400 km	409 km	400 km
Water supply	existing	new	new - existing
Electric power connection	existing	9 km	9 km and existing
Heat consumption (kcal kg of clinker)	760	760	760
Specific power consumption (kWh t of cement)	120	115	125
Clinker production capacity (tpd)	1,000	1,000	1,000
Number of workers	282	260	295
Production costs (Version No.1 = 100 %)	100	95	98
Investment costs (Version No.1 = 100 %)	100	200	150

The comparison of all the selected criteria shows the main decisive criterion are investment costs, because the other criteria are the same or nearly the same. The variant one has a comparative advantages, especially for the investment costs and will be by now considered as selected future variant in this report.

6.2 PLANT CAPACITY

According to the Zambian Standard, 001 1972 the expanded Chilanga Cement Plant will produce portland cement of normal and high early strength. This standard has been based on the British Standard BS 12 1958 (amended 1969), the Central African Standard CAS A 18 1964 and the South African Standard SABS 471 1959

Physical requirements

Property	Normal Portland Cement	High Early Strength Portland Cement
Specific surface (m^2/kg)	225	325
Compressive strength		
- 3 days (N/mm^2)	17.5	23.0
- 7 days (N/mm^2)	26.5	31.0
MgO content (%)	max 5	max.5

Clinker will be grinned together with gypsum in a ratio 95 % clinker : 5 % gypsum.

The production of the expanded Chilanga Cement Plant will be as follows:

Daily output of clinker (tpd) 1,000

Annual production of clinker (300 working days) (tpy) 300,000

Annual production of cement (tpy) 315,000

All the annual production of cement will be packed in 50 kg paper bags and will be transported by road.

The nominal capacity of the rotary kiln line.

Clinker - daily output (tpd) 1,000

Clinker - annual output (tpy) 300,000

Cement - annual output (tpy) 315,000

The possible minimal production capacity of clinker of the rotary kiln line (without problems in operation) will be 60 % from the nominal capacity, e.g.

Daily minimal production (tpd) 600

Yearly minimal production (tpy) 180,000

The possible maximal production capacity of clinker of the rotary kiln line will be 10 % more than is the nominal capacity, e.g.

Daily maximal production (tpd) 1,100

Yearly maximal production (tpy) 330,000

One of the great advantages of the proposed expansion, in the case of the higher needs of the market, is the possibility of another expansion by the construction of a calcining chamber. Additional expansion will extend the production capacity in the volume of 50 %, in comparison with the capacity of the expanded Chilanga Cement Plant, according to version No 1.

The capacity after additional expansion will be as follows

Daily production of clinker (tpd)	1,500
Yearly production of clinker(tpy)	450,000
Yearly production of cement (tpy)	472,000

Note: There is a presumption to shut down the operation of the two existing wet process rotary kilns after putting into operation the proposed, expanded Chilanga Cement Plant. However, there is still the possibility to utilize one of the two existing rotary kiln for the future production of special sorts of cement. The two existing raw mills, slurry silos and slurry basins could be exploited for this production. The capacity of the crushing plant, clinker storage, cement grinding plant, cement silos and packing plant is sufficient and satisfactory.

6.3 FEASIBILITY NOMINAL PLANT CAPACITY OF ENTIRE PLANT, MAIN DEPARTMENTS, MAJOR EQUIPMENT UNITS

6.3.1 TECHNOLOGY

6.3.1.1 DATA OF RAW MATERIALS

Proposed composition of the raw mix (dry):

Limestone + phyllite (%)	98.6 %
Coal ash (%)	1.4 %
Output of the kiln (tpd)	1,000
Effective working days (d/y)	300
Annual production of clinker (tpy)	300,000
Annual production of cement (tpy)	315,000
Consumption of the raw material (dry conditions) (tpy)	480,000
Thereof raw material components (limestone + phyllite) (tpy)	473,280
ash from coal (tpy)	6,720
Consumption of the raw material components (dry conditions) (tpy)	473,280
Thereof 94 % limestone (tpy)	444,883
6 % phyllite (tpy)	28,397
Consumption of the raw material (1 % H_2O) (tpy)	478,060

Consumption of limestone (dry conditions)

tpy 444,883

tpd 1,483

Consumption of limestone (natural conditions 2 % H_2O)

tpy 453,962

tpd 1,513

Consumption of phyllite (dry conditions)

tpy 28,397

tpd 95

Consumption of phyllite (natural conditions; 5 % H_2O)

tpy 29,892

tpd 100

Consumption of gypsum (dry conditions) (tpy) 15,000

Consumption of gypsum in natural conditions (% H_2O) (tpy) 15,300

6.3.1.2 COAL CONSUMPTION

Black coal will be used for clinker burning.

Low calorific value

kcal/kg 6,456

kJ/kg 27,030

The presumed requirements per kg of clinker is 760 kcal (= 3,182 kJ)

Consumption of coal for clinker burning (dry)

(1,000,000x760) / 6,456 = 117,720 kg/d

Consumption of coal (dry conditions)

tpy 35,316

tpd 117.72

Consumption of raw coal (1.5 % H_2O)

tpy 35,854

tpd 119.5

tph 4.98

6.3.1.3 WATER CONSUMPTION

Process water demand

l/sec	8
m3/y	207,000
Circulating cooling water (l/sec)	20

Potable water demand

l/sec	0.2
m3/y	5,000

6.3.1.4 POWER CONSUMPTION

Specific power consumption per one ton of cement (kWh)	120
Annual power consumption (MWh)	37,800

6.3.2 CEMENT PLANT DEPARTMENTS

6.3.2.1 PRODUCTION DEPARTMENTS

01 - Limestone Extraction	(P + E)
02 - Phyllite Extraction	(P)
03 - Primary Crushing Plant	(P + R)
04 - Secondary Crushing Plant	(P + R)
05 - Preblending Storage of Limestone	(N)
06 - Storage of Phyllite	(P + R)
07 - Raw Materials Grinding Plant	(N)
08 - Blending Silo	(N)
09 - Rotary Kiln Line	(N)
10 - Clinker Storage	(P)
11 - Gypsum Storage	(P)
12 - Coal Storage	(P)
13 - Coal Grinding Plant	(N)
14 - Cement Grinding Plant	(P + R)
15 - Cement Silos and Dispatch of Bulk Cement	(P + E)
16 - Packing Plant and Bag Loading	(P + E)
17 - Electrical Equipment	(N)

18 - Central Control Room and Instrumentation	(N)

6.3.2.2 AUXILIARY DEPARTMENTS

2.0 - Main Switching Station	(P + E)
2.1 - Diesel Power Plant	(N)
2.2 - Compressed - Air Plant	(P)
2.3 - Water Supply and Distribution System	(P + E)
2.4 - Laboratory	(P + E)
2.5 - Workshops	(P + E)
2.6 - Stores	(P)
2.7 - Diesel Oil Tank	(P)
2.8 - Lubricants Store	(P)
2.9 - Garage	(P)

6.3.2.3 SERVICE DEPARTMENTS

3.0 - Drain and Sewerage Disposal	(P)
3.1 - Outdoor Lighting	(P + E)
3.2 - Roads	(P + E)
3.3 - Administration Building	(P)
3.4 - Gate - House	(P)
3.5 - Fencing	(P + E)

Note: P - Present (Existing)
E - Expansion (Extension)
R - Reconstruction
N - New

6.3.2.4 DESCRIPTION OF DEPARTMENTS

6.3.2.4.1 PRODUCTION DEPARTMENTS

01 - Limestone Extraction (P + E)

The limestone deposit (RP3 quarry) is situated 9 km south of the Chilanga Cement Plant The quality of limestone is fully suitable for cement production The volume of estimated reserves

(15.7 millions tons), is sufficient for the future cement production of more than 30 years, with a capacity of 1,000 tpd.

The extraction technology of the raw materials will be the same, there is only a need for the completion of the present quarry equipment

Working time: 16 (14) hpd, 2 shifts, 6 dpw, 260 dpy.

Annual extraction output (+ 5 % losses) (tpy)	476,660
Daily extraction output (tpd)	1,833
Weekly output (tpw)	11,000
Hourly output (tph)	131

02 - Phyllite Extraction (P)

Phyllite will be hauled from the deposit situated 1 km east of the Chilanga Cement Plant.

The hauling technology of phyllite will be the same as it is at present (it will be hauled by a loader from the face and loaded onto haulage trucks).

Working time: 1 shift / 14 days; 8 hpd; 18 dpy

Annual extraction output (+ 5 % losses) (tpy)	29,892
Daily extraction output (tpd)	1,660
Hourly output (tph)	208

03 - Primary Crushing Plant (P + R)

Both existing crushing plants (primary and secondary) will be utilized for limestone crushing. Transport equipment is the only reconstruction required

Quarry hauled limestone will be discharged into the hopper in the cement plant. Then it will be fed into the crusher by an apron feeder. The crushing itself will be carried out in the cone crusher. The crushed material will descend onto the rubber belt conveyer and transported to the existing free storage.

Working time: 16 hpd, 2 shifts / day, 6 dpw, 260 dpy.

Annual consumption of limestone (tpy)	453,962
Daily demand of limestone (tpd)	1,746
Weekly demand of limestone (tpw)	8,856
Necessary output of the cone crusher (14 hpd) (tph)	125
Required output of the cone crusher (tph)	250
Feed material lump size (mm)	0 760
Outlet material grain size (mm)	0 120
Free storage of limestone (t)	2,000

04 - Secondary Crushing Plant (P + R)

The secondary crushing of limestone will be performed in the existing secondary crushing plant (there is only a need to reconstruction the transport equipment).

Primary crushed limestone will be transported through the reconstructed belt conveyors from the existing, free storage to the existing, secondary crushing plant.

Crushed limestone will fall onto the impact-hammer crusher. From there it will be transported along the existing rubber belt conveyer, which will be extended to the preblending storage. The crushing plant will be dedusted by means of the existing cloth filter and ventilator.

Working time: 16 hpd; 2 shifts / day; 6 dpw, 260 dpy

Annual consumption of limestone (tpy)	453,962
Necessary output of the cone crusher (14 hpd) (tph)	125
Required output of the cone crusher (tph)	180
Outlet material grain size (mm)	0 ÷ 60

05 - Preblending Storage of Limestone (N)

The relatively great inhomogenity of the raw materials requires the building of a preblending storage of limestone. The storage charging will be ensured by means of a rubber belt conveyer and traveling stacker. It gradually creates a heaped pile with a triangular cross-section (Chevron system). The operation of the storage will be ruled in such way that the material will be charged by means of stacker always on one pile, while from the other one, the material will be extracted by a bridge type reclaimer. After the heaped pile will be complete and the extracted pile depleted the traveling stacker and bridge reclaimer change their position and the operation cycle of the storage will be repeated.

Preblended limestone will be extracted and transported by a bridge reclaimer along conveyers up on the operation bunker of the raw material grinding plant. The raw material quality will be checked in the sampling station situated one stage before the preblending storage. The equipment of the sampling station perform the following operations - taking in, dividing, crushing, drying and grinding of the individual samples. The samples will be taken into the laboratory. The results of the laboratory analyses will serve for the checking and controlling of the chemical composition of the raw material in the preblending storage.

Working time: 24 hpd, 3 shifts / day; 7 dpw, 300 dpy

Annual consumption of limestone (tpy)	453,962
Weekly consumption of limestone (tpw)	10,592
Storage capacity of limestone (t)	2 x 11,000
Reserve of limestone in days	2 x 7
Storage charging output (tph)	180
Storage reclaiming output (tph)	150
Working time of charging (hpd)	16

Working time of reclaiming (hpd) 24

06 - Storage of Phyllite (P + R)

Phyllite will be transported to the existing crane storage area by means of trucks. The storage area is comprised of the existing bin which will be filled by the existing grab crane. Phyllite will be transported from the bin to the operation bunker of the raw material grinding plant by a new rubber belt conveyer.

Annual consumption of phyllite (tpy) 29,892

Weekly consumption of phyllite (tpw) 700

Daily consumption of phyllite (tpd) 100

Storage capacity of phyllite (t) 2,000

Reserve of phyllite in days (d) 20

Transport output (tph) 50

07 - Raw Material Grinding Plant (N)

The individual components (limestone, phyllite) will be taken from the bunkers and fed by means of weighing feeders on the rubber belt conveyer . The raw material mixture falls then through double flap closure into the vertical mill. The roller mill is designed for drying and grinding of raw material to raw meal suitable for clinker burning. For drying of raw material is utilized the heat from the waste exhausted gas from the preheater of the rotary kiln line. The finished product will be transported from the cyclones and from the electrostatic precipitator by screw conveyers and bucket conveyer to the blending silo.

The overfalling material from the mill pan will fed through chain conveyor and bucket conveyer back into the mill. The dedusting equipment consists of cooling tower and electrofilter is common for dedusting of raw meal and rotary kiln line.

The dust separated in the dedusting equipment from the waste gas of raw material grinding plant as well as from the heat exchanger of kiln line is added to the finished raw meal transport, or it can be led directly to the feed in the preheater system. The transport of raw material and bunkers are dedusted by means of cloth filter and ventilator.

Raw meal sampler regularly will take in samples which will be carried to the laboratory. The results of analyses will serve for the control of chemical composition of prepared raw meal

For the erection and maintenance of grinding plant there is offered crane.

Working time: .... 3 shifts/day, 24 hpd, 7 dpw, 300 dpy

Annual consumption of raw meal (1 % H_2O) (tpy) 478,060

Weekly consumption of raw meal (tpw) 11,154

Daily consumption of raw meal (tpd) 1,594

Necessary output of raw mill (tph) 66.4

Required output of raw mill (tph) 75 (max 100)

Inlet material size (mm) .... 0 - 60

Fineness of ground raw meal .... 14 % R on the mesh 0.09 mm

Outlet moisture of raw meal (% H_2O) 1

08 - Blending Silo (N)

The required capacity of blending silo is 8,000 t. This quantity of raw meal presents the production of kiln line for approximately 5 days.

The ground raw meal will be transported above the grinding plant into the homogenization silo by means of air slides and bucket conveyer. The uniform filling of silo is ensured by the distribution air slide system. The exhausted air from the transport and filling equipment as well as from the silo will be dedusted by cloth filter and ventilator.

The bottom silo will be equipped with the special aeration and discharge system including regulation closure. The pressure air for the homogenization and aeration is ensured by blowers and pressure air distribution piping with the regulation device. The raw meal from the bottom of blending silo will be transported by the bucket elevator into the control storage bin (capacity 40 m^3) equipped with aeration and discharge equipment. The bin is laid on the tensometric weighing system. The raw meal from the control bin will led through the weighing equipment into the bucket elevator transporting it to the exchanger system.

The air from the whole weighing and dosing system will be exhausted and dedusted by cloth filter and ventilator.

Working time: .... 3 shifts/day, 24 hpd, 7 dpw, 300 dpy

Annual consumption of raw meal (1 % H_2O) (tpy) 478,060

Daily consumption of raw meal (tpd) 1,594

Dimension of proposed silo (m) .... 16 x 40

Effective volume of silo (t) 8,000

Raw meal reserve (d) 5

Final deviation in $CaCO_3$ content .... max. ± 0.3 % $CaCO_3$

Output of dosing equipment (tph) .... max 80

09 - Rotary Kiln Line (N)

Rotary kiln line consist of five - stage cyclone preheater of raw meal, own rotary kiln and grate cooler with the dedusting equipment.

The five - stage cyclone preheater will be installed in the steel structure tower.

The cyclones and connecting piping will be lined with refractory material.

In the individual cyclones there comes to the parallel heat transfer from the hot gas on the raw meal. After being preheated, the raw meal will be led into the rotary kiln for the finishing of burning process. The rotary kiln is lined with refractory material. The installation of air blasters minimalise the unpleasant effects of eventual adhesion and sticking of heated raw meal on the lining of preheater

Rotary kiln will be fired by ground coal, the calorific value of which was given at approximately 6,456 kcal/kg. The rotary kiln will be completed with ventilators for the cooling of kiln shell and outlet end.

Clinker produced by the kiln will pass through a grate cooler which have the double function of cooling clinker rapidly and taking off the secondary air necessary for the combustion of the kiln at maximum temperature.

The cooling of clinker is realized by means of ventilators installed at the individual chambers of grate cooler. The discharge of coarse grained part of clinker will be led into the clinker impact crusher. Clinker from the grate cooler will be transported by conveyor into the existing crane storage.

For the dedusting of waste gas from the heat exchanger of kiln line and simultaneously of vapour from the raw material grinding plant serves cooling tower and electrofilter. The dust separated in the cooling tower and in the electrofilter will be returned into the raw meal transport before the blending silo.

The waste air from the clinker cooler will be exhausted by ventilators through the bag filter and blown out to the atmosphere. The separated dust then will be led from the bag filter on the clinker transport.

The rotary kiln line will be capable of producing an additional 10 % of its rated capacity.

Note: In case of building up of the calcining chamber the output of rotary kiln line could be risen on additional 50 % of its rated capacity, e.g. 1,500 tpd of clinker.

Working time	3 shifts/day, 24 hpd, 7 dpw, 300 dpy
Output of dosing of raw meal (tph)	67 (max. 80)
Daily output of rotary kiln (tpd)	1,000
Hourly output of rotary kiln (tph)	42
Assumed heat consumption (kcal/kg of clinker)	760
Fuel	coal
Temperature of clinker after cooler	80 °C above the cooling air temperature

Kiln and Raw Grinding Dedusting

Approximate quantity of flue gas into the EP

- at the direct operation 75,00 Nm^3/h
- at the combined operation 100,000 Nm^3/h

Temperature of flue gas

- after preheater approx. 290 °C
- after cooling tower approx. 150 °C

Dust load of gas before the EP (g/Nm³) ... 65

Dust load filtered gas after the EP (mg/Nm^3) 50

10 - Clinker Storage (P)

Clinker from the grate cooler will be transported by horizontal chain conveyer into the existing clinker storage. Handling of clinker inside the clinker storage will be provided by two existing grab cranes.

Working time	3 shifts d, 24 hpd, 7 dpw, 300 dpy
Annual production of clinker (tpy)	300,000
Daily production of clinker (tpd)	1,000
Storage capacity of clinker (t)	approx. 25,000
Reserve of clinker in days (d)	25
Transport output into storage (tph)	42
Transport output out of storage (tph)	60

11 - Gypsum Storage (P)

Gypsum will be purchased from Nhana (copper works), where is produced as by-product and transported to Chilanga by trucks. Gypsum will be stored in the existing free storage and in the existing crane storage. Transport between free storage and crane storage will be ensured by means of trucks. Grab crane will be used for handling of gypsum inside of the storage.

Working time	3 shifts/day, 24 hpd, 6 dpw, 260 dpy
Annual consumption of gypsum (tpy)	15,300
Daily consumption of gypsum (tpd)	59
Storage capacity of gypsum (t)	
- free storage	3,000
- crane storage	1,900
Reserve of gypsum (d)	80

12 - Coal Storage (P)

Coal purchased from the Maamba mine will be transported to the cement plant by trucks. Coal will be stored in the existing free storage.

Annual consumption of coal (tpy)	35,854
Daily consumption of coal (tpd)	119.5
Capacity of the coal storage (t)	8,000
Reserve of coal (d)	65

13 - Coal Grinding Plant

Coal will be transported by belt conveyer from the free storage into the bin of the coal grinding plant Coal will be dosed from the bin into the „roller" mill The roller mill will be designed for the drying and grinding of raw coal into a coal powder (ground coal) The coal powder catching into the roller mill together with the exhausted gas will be dedusted in the cloth filter The coal powder separated in the dedusting system will be transported back into the coal powder silo The ground coal will be dosed from the silo by a weighting system and then it will be transported pneumatically to the rotary kiln burner by means of a blower

The coal grinding plant, because of the repeated use of inert gas and the short distance to the burner, will be situated near the rotary kiln

Working time 24 hpd, 3 shifts day, 7 dpw, 300 dpy

Annual consumption of raw coal (tpy)	35,854
Annual consumption of coal powder (tpy)	35,316
Daily consumption of coal powder (tpd)	117.72
Necessary output of the coal mill (tph)	5
Required output of the coal mill (tph)	8
Inlet coal size (mm)	0 ÷ 30 (max. 100)
Fineness of the ground coal (mm)	8 % rest on the mesh 0.09 mm
Effective volume of coal powder silo (t)	200
Coal powder reserve in hours (h)	40
Output of weighting system to the burner (tph)	5 (max 8)

14 - Cement Grinding Plant (P + R)

The purpose of this plant is to grind and mix clinker with gypsum into Portland cement. The existing number 1,2 and 3 cement mills and reconstructed raw mills number 1 or 2 will be utilized for the grinding of clinker

Existing cement and raw materials grinding plants are situated close to the existing clinker crane storage. The clinker storage includes existing feeding bins for clinker and gypsum. Two bins are situated one step in front of the existing cement and raw mills- one for clinker and another for gypsum These bins will be filled by the existing grab cranes. Clinker and gypsum will be taken from the bins by the regulable weight-feeders and fed directly into the inlet of the mill The open-circuit grinding system includes a tube mill with drive Cement will be transported from the outlet of the mill to the existing and new cement silos by an existing bucket elevator and screw conveyers after grinding

Emission of the dust from the cement mill and the conveying system will be separated by the existing electrofilter and cloth filters

The sampler situated at the end of the cement transport line will enable easy and regular checking of cement properties in the laboratory

Working time 24 hpd 3 shifts day 6 dpw 260 dpy

Net working time per day (hpd)	22
Annual production of cement (tpy)	315,000
Weekly production of cement (tpw)	7,269
Daily production of cement (tpd)	1,212
Necessary output of the cement plant (tph)	55
Required output of the cement plant (tph)	60
Ground components: clinker (%)	95
gypsum (%)	5
Fineness of grinding according to Blaine (cm^2/g)	3,000

Output of existing cement mills and reconstructed raw mill

	Output (tph)
Cement mill No.1	30
Cement mill No.2	10
Cement mill No.3	10
Raw mill No.4 (reconstructed)	10
Raw mill No.5 (reconstructed)	10
Total	**70**

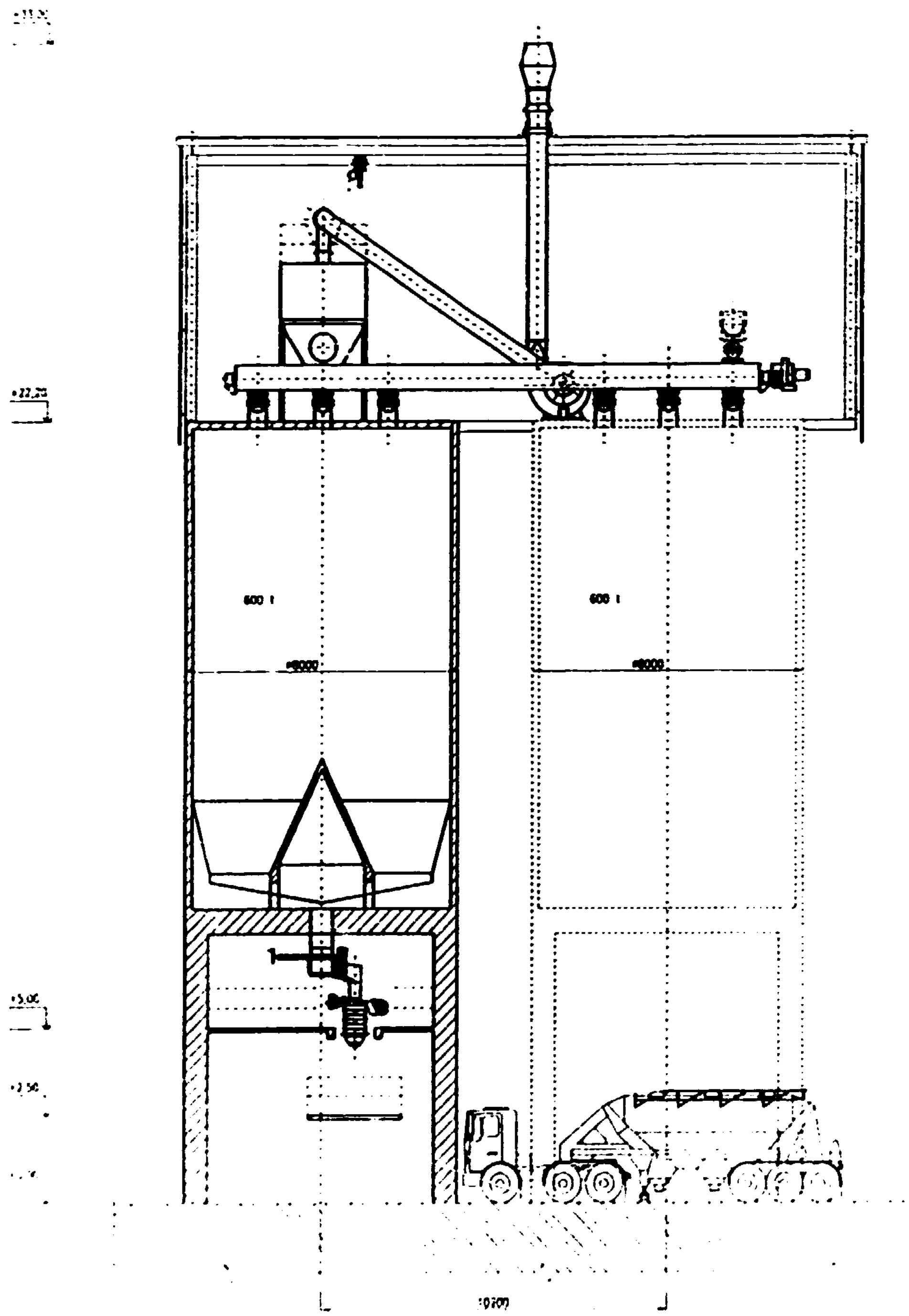
15 - Cement Silos and Dispatch of Bulk Cement

Cement will be stored in the following silos

	Capacity (t)
3 existing steel silos	3 x 1,400
3 existing reinforced concrete silos	3 x 1,500
1 existing reinforced concrete silo	600
1 new reinforced concrete silo	600
Total storing capacity	**9,900**

The ground cement will be transported from the cement grinding plant into the existing silos through existing screw conveyers, a bucket elevator and belt conveyer The new silo will be filled the same way, only the transport equipment will be prolonged The existing silo No 7, and the new silo No 8 will underpass cement into the tank trucks for direct loading of bulk (this will be the only way of using these silos) Finally, there will be two loading places for bulk cement (one in existing silo No 7, and the other in the new silo No 8) The new bulk loading system as well as the silos will be fitted out with dedusting equipment (cloth filters and fans)

Figure 6-2



Working time : 3 shifts per day, 24 hpd, 6 dpw, 260 dpy

Annual production of cement (tpy)	315,000
Daily production of cement (tpd)	1,212
Effective volume of the silos	(t)
Existing silo No.1	1,400
Existing silo No.2	1,400
Existing silo No.3	1,400
Existing silo No.4	1,500
Existing silo No.5	1,500
Existing silo No.6	1,500
Existing silo No.7	600
New silo No.8	600
Total capacity	**9,900**
Cement reserve in days (d)	8
Output of cement transport to silos (tph)	70
Output of bulk loading (tph)	200

Section from the silos No.7 and No.8 are represented on the Figure 6 - 2.

16 - Packing Plant and Bag Loading

Besides bulk cement 50 kg paper bags packed in two packing lines will be mainly dispatched. The first - existing packing plant has a rotary 12 - spout Fluxo packing machine with an hourly output of 1,600 bags (80 tph). The second, new proposed one will have a rotary 8 - spout packing machine with an hourly output of 1,400 bags (70 tph). The proposed future packing plant with loading into the lorries will serve for the Chilanga Cement Plant expansion. The new packing line will be built inside of the existing old packing building and it will be supplied by means of new transport equipment consisting of screw conveyers and a bucket elevator with cement only from the existing six cement silos. Cement will be transported into the operation bin above the packing machine and will be dosed from the bin into the rotary packing machine from which the full paper bags will fall onto the roller conveyer which will transport them through the bag cleaner onto the rubber belt conveyer. The bags will be alternately routed to two loading belts into the lorries by means of a tripper. The dedusting of the packing machine as well as of the transport equipment will be ensured by cloth filters.

The empty bags will be stored in the storage room with a capacity of 1,500,000 bags (two months capacity) on the first floor of the packing house.

Working time : 16 hpd, 2 shifts / day, 5 dpw, 240 dpy

Annual packing quantity of cement (tpy) 315,000

Daily packing quantity of cement (tpd) 1,313

Output of packing lines (tph) .... 2 x 70 (2 x 1,400 bags)

Required output of cement transported to packing plant (tph) .... 2 x 100

Annual consumption of empty bags (+ 5 % losses) (bags/year) 6,600,000

17 - Electrical Equipment (N)

The scope of requirements on the electrical appliance has to comply with demands on the production equipment at the respecting and using of adjacent and average modern apparatus and electric appliances.

The electrotechnical equipment serves only for the new production and auxiliary departments and there is divided in the following groups:

- Main switching station HT/3.3 kV
- Distribution substations HT/LT
- Outside electric cable distribution system (HT, LT)
- Control of technological process
- Lighting
- Lighting protection
- Intercom and safety systems

The mentioned groups presents the sets of electric equipment and elements, materials and conductors include of works necessary for the final installation and reliable operation.

General information

The equipment has to respect and fulfill the following requirements:

Temperature max/min (°C) 40/0

Relative humidity (%) .... 40 ÷ 80

Height above sea level (m) 1,280

Kinds of dusty materials .... cement, clinker, limestone

All dimensions are mentioned in metric system.

Distribution of electric power

For expansion of Chilanga Cement plant with capacity of 315,000 tpy cement is considered with installed two pieces of distribution substations HT 3.3 kV, which will be served for electric power supply

- Drives HT 3.3 kV with output to 800 1,000 kW

- Block transformers HT/LT (3.3/0.42 kV) with output 400 - 1,600 kVA for electric power supply of switchboard LT 0.4 kV (MCC)

- Transformers HT/LT (3.3/0.66 kV) with output over 150 kW for electric power supply of drives of regulation devices.

Data of electric power

Supplies - by tapping from the existing 33 kV overhead transmission line (ZESCO).

Voltage of distribution:

System - 33 kV/50Hz - HT distribution system for substations
- 3.3 kV/50Hz for HT drivers
- 400 V/50Hz for LT drivers
- 230 V/50 Hz for control distribution systems, lighting
- 660 V for drivers of regulation devices (frequency chamber)

Energy data

Installed input of the new departments : P_{ic} = 6,290 kW

Calculated load : P_{pc} = 3,507 kW

Recapitulation of inputs and consumption

Manufacture technology: HT drivers : 850 kW

LT drivers : 5,255 kW

Subtotal : 6,105 kW

Light and socket distribution system: 185 kW

Total new departments Pic = 6,290 kW

Specific consumption of electric power : 120 kWh/t of cement

Approximately yearly consumption : 37,800,000 kWh/y

from that: - Consumption of the new departments : 19,278,000 kWh/y

- Consumption of the existing departments : 18,522,000 kWh/y

Number and input of installed transformers:

- transformers : HT/LT : 3.3/0.4 kVA, N = 1,000 kVA 1 piece

N = 1,600 kVA ..... 1 piece

- transformers : HT/LT : 3.3/0.66 kV, N = 250 kVA............ 1 piece

N = 1,000 kVA......... 2 pieces

18 - Central Control Room and Instrumentation (N)

The supplier will ensure the two level control system as follows:

I - Control system

a./ Process level

It will be equipped with the process stations distributed in the following technological lines:

- Storing of limestone
- Raw material grinding plant and blending silo
- Rotary kiln line and clinker transport
- Coal grinding plant
- Packing plant and dispatch

The individual process stations ensure the collection and processing of signals from the process and processing and electric motor switchboards. Moreover this they perform the control of the drives, servomotors, valves as well as the necessary regulations of technological quantities. The process stations will be located close to the motor switchboards in the distribution substations of the technological lines.

b./ Superior level

It will be equipped with the necessary number of operator stations located in the central control room. The operator stations are connected on the process stations by means of serial bus. They ensure the operator functions as well as the printing of protocols.

c./ Apparatus outfit

Electrical drivers will be equipped with the apparatus for the checking of run. At each drive there will be installed the box for local control. The measuring of technological values (temperatures, pressures, levels etc.) will be realized by the apparatus installed on the technological equipment of individual lines. The outlet signal from the sensors will be connected on the process stations.

d./ Connection of the equipment on the electrical network

Each process station will be equipped with the source, the primary side of which will be connected to its relative switchboard. The secondary voltage for the connection of inlet and outlet signals is assumed to be 24 V (DC).

e./ Cables and their placing

It is required to use of cables enabling the trouble force transmission of signals till the process stations. The cables will be placed either on the cable grates or in the closed sheet through.

II - Distribution Equipment for the Production Process

In this part, the supplier will ensure the complete system of distribution equipment for the power connection and control of drivers corresponding with the control system namely regarding to the collection of data and their mutual transmitting. Each line representing the group of drives will be equipped with the necessary number of switchboards (MCC), from which the drives will be fed.

The drives HT/3.3 kV will be connected directly on the outlets from the boxes of distribution substations.

The switchboards (MCC) will contain the following parts:

- Inlet field : main circuit breaker + signaling and control elements

- Outlet fields : integrated blocks of drives, the composition of which will correspond to the individual types of drives.

- Fields with specific outfit: - regulators of drivers

- SOFT - starters etc.

The switchboards (MCC) will be equipped in the inlet fields the protection elements against overvoltage and higher harmonic.

6.3.2.4.2 AUXILIARY DEPARTMENTS

20 - Main Switching Station HT/3.3 kV (N)

The main switching station will be dimensioned for the needs of expanded cement plant, mainly for the new production and auxiliary departments.

The existing production, auxiliary and service departments which will be used for expanded Chilanga Cement Plant will be supplied by electric power the same way as at present.

The electric current for the switching station is connected from 33 kV overhead line.

The assumed composition is documented on the One line power distribution diagram (Annex 2, Drawing No. 4).

The main switching station will be situated in the free site next to the existing one.

21 - Diesel Power Plant (N)

The diesel power station is the standby power supply. The 200 kVA (184 kW) generator, in case of blackout, will automatically start and after run-out feed a section of low extension bus in turn feeding selected electric consumers, e.g. kiln auxiliary drive, cooling fans, emergency lighting with electric power until utility supply is restored.

22 - Compressed - Air Plant (P)

The existing compressed - air plant will be utilized for the present equipment consuming pressed air

The new proposed equipment needing pressed air will be connected with the compressor in the place of consumption

23 - Water Supply and Distribution System (P - E)

The existing operation water system covers the needs of service, cooling and potable water for the existing wet production, processed cement plant. The present capacity of the water system is 15 l/s. The consumption of the proposed expanded plant will be 8 l/s, so the presumption is that the present capacity of water supply system will be satisfactory.

The service and cooling water for the newly proposed departments (raw material grinding plant and rotary kiln line) will be connected with the existing water system. The new extended cooling circuit will contain the pumping station and distribution pipes.

24 - Laboratory (P + E)

The existing laboratory is equipped with suitable furniture as well as the apparatus required for quality control of raw materials, clinker and cement. Some apparatus will be completed for dry production process of clinker. There will be a need to supplement the X-ray spectrometer for quantitative analyses of eight elements (Si, Al, Fe, Ca, Mg, S, K, Cl).

25 - Workshops (P + E)

The equipment of the existing mechanical and electrical workshops will be sufficient for the proposed expansion of CHILANGA CEMENT PLANT. Only some special metal-working machines will be needed.

26 - Stores (P)

27 - Diesel Oil Tank (P)

28 - Lubricants Store (P)

29 - Garage (P)

The capacity and requirements of the expanded Chilanga Cement Plant will use these existing departments.

6.4 PLANT LAYOUT AND CHARTS

Plant layout of the expanded Chilanga Cement Plant is presented on the Drawings No 1 - and No 2 - General layout - see Annex 2

There are two possibilities of the siting of the new Preblending storage of limestone The first possibility - behind the new rotary kiln line from the longitudinal direction (see Annex 2, Drawing No 1).

The second possibility - Preblending silo is situated in front of the new rotary kiln line from the transversal direction (see Annex 2, Drawing No 2).

Complete flow sheet of all the necessary production departments is shown on the Drawing 3 - Flow sheet (Annex 2). Flow sheet includes complete production equipment, it means new machines and also necessary existing machines.

Annex 2 also includes Drawing No.4 - One Line Power Distribution Diagram.

Finally - Annex 2 contains several drawings - sections and floors - from the new production departments (drawings 5, 6, 7).

Geological map of Zambia and Limestone resources in Chilanga area are shown on the Drawing No.8.

6.5 SCOPE OF THE ENTERPRISE

6.5.1 SCOPE OF DELIVERY

The contract for the setting of an expansion of Chilanga Cement Plant will include the following deliveries and services:

- Machinery and equipment complete with erection
- Complete electrical equipment, instrumentation and controls completely with erection
- Construction materials complete with building and civil works
- Metal products, windows, doors, metal plates, etc.
- Soil test of the site
- Electric power supply
- Water supply
- Training and personnel
- Management of start-up, guarantee tests

All the above mentioned items also include mobile equipment for the transportation of raw materials.

Shipment of cement will be carried out by customers.

6.5.2 SCOPE OF THE PLANT

The expanded Chilanga Cement Plant will be using the following existing departments

01 - Limestone extraction

02 - Primary crushing plant

04 - Secondary crushing plant

10 - Clinker storage

11 - Gypsum storage

12 - Coal storage

14 - Cement grinding plant

15 - Cement silos

16 - Packing plant and loading

17 - Part of electrical equipment

All the existing auxiliary departments

All the existing service departments

The following new departments will be built:

05 - Preblending storage of limestone

07 - Raw material grinding plant

08 - Blending silo

09 - Rotary kiln line

13 - Coal grinding plant

15 - Cement silo - one new silo

16 - Packing plant - complete one new packing plant

17 - Part of electrical equipment

18 - Central control room and instrumentation

21 - Diesel power plant

Some auxiliary and service departments will be completed by the installation of the necessary equipment.

6.6 SELECTION OF TECHNOLOGY

Details on the technology selection describe the chapter 6 1 - PRODUCTION PROGRAM.

6.7 EQUIPMENT

6.7.1 PRODUCTION EQUIPMENT

05 - Preblending Storage of Limestone

Item	Q'ty	Name	Power (kW)	Weight (t)
05-001	1	Diverted gate	0.1	0.7
05-002	1	Belt conveyer	40.0	35.0
05-003	1	Sampling station consisted of		
		Sampler	4.0	0.4
		Rotating divider	0.4	0.1
		Hammer crusher	16.5	1.1
		Bucket elevator	3.0	3.5
		Roller mill	8.6	1.2
		Fabric filter	1.0	0.9
		Exhaust fan	4.0	0.4
		Piston sampler	0.1	0.1
		Carrousel storage	0.3	0.1
		Air compressor	5.5	0.3
05-004	1	Fabric filter	1.0	0.9
05-005	1	Exhaust fan	5.5	0.7
05-006	1	Belt conveyer	18.0	34.0
05-007	1	Stacker	48.5	65.0
05-008	1	Track of stacker	-	50.0
05-009	1	Face reclaimer	56.0	89.0
05-010	1	Track of reclaimer	-	37.0
05-011	1	Belt conveyer	18.0	32.0
05-012	1	Belt conveyer	18.0	18.5
05-013	2	Fabric filter	2.0	1.8
05-014	2	Exhaust fan	11.0	1.4
05-015	set	Slides, discharge outlets	-	4.8
05-016	set	Steel structures	-	10.5
05-017	set	Dedusting piping	-	1.8
		Power demand (kW)	**261,5**	
		Total weight (t)		**391,2**

06 - Storage of Phyllite

Item	Q'ty	Name	Power (kW)	Weight (t)
06-001	1	Hopper	-	3,5
06-002	1	Belt conveyer	7,5	7,5
06-003	1	Belt conveyer	18,0	17,5
06-004	2	Fabric filter	2,0	1,8
06-005	2	Exhaust fan	11,0	1,4
06-006	set	Slides, discharge outlets	-	1,8
06-007	set	Steel structures	-	2,3
06-008	set	Dedusting piping	-	1,6
		Power demand (kW)	**38,5**	
		Total weight (t)		**37,4**

07 - Raw Material Grinding Plant

Item	Q'ty	Name	Power (kW)	Weight (t)
07-001	1	Limestone bin, 300 t	-	29,0
07-002	1	Phyllite bin, 100 t	-	8,5
07-003	set	Load cell	0,1	0,4
07-004	1	Limestone belt weightfeeder	1,8	1,2
07-005	1	Phyllite belt weightfeeder	1,8	0,9
07-006	1	Belt conveyer	3,0	2,8
07-007	1	Magnetic separator	6,0	1,9
07-008	1	Triple flap	2,2	3,6
07-009	1	Roller mill	850,0	180,0
07-010	1	Bridge crane	28,0	11,8
07-011	1	Spray tower	110,0	70,0
07-012	1	Kiln fan	800,0	19,5

07-013	1	Electric precipitator	31,0	195,0
07-014	set	Rectifiers for electric precipitator	225,0	30,0
07-015	1	Chimney fan	800,0	18,5
07-016	1	Steel chimney	-	50,0
07-017	2	Screw conveyer	22,0	5,4
07-018	2	Double flap	2,2	0,8
07-019	1	Screw conveyer	11,0	3,6
07-020	1	Screw conveyer	22,0	5,4
07-021	1	Reversible screw conveyer	3,0	1,2
07-022	2	Double flap	2,2	0,8
07-023	1	Screw conveyer	3,0	1,1
07-024	1	Screw conveyer	4,0	1,9
07-025	1	Sampler	2,7	0,5
07-026	1	Diverted gate	0,1	0,7
07-027	1	Bucket elevator	30,0	44,0
07-028	1	Bucket elevator	7,5	8,7
07-029	1	Screw conveyer	3,0	1,1
07-030	1	Steel bin	-	7,5
07-031	set	Load cell	0,1	0,1
07-032	1	Blower	5,5	0,3
07-033	set	Silo discharged with set of gates	0,1	0,6
07-034	1	Belt weightfeeder	1,8	1,2
07-035	1	Screw conveyer	4,0	1,9
07-036	1	Loading head	0,7	0,4
07-037	1	Fabric filter	1,0	3,9
07-038	1	Exhaust fan	7,5	0,8
07-039	set	Piping with set of dampers	2,0	68,0
07-040	set	Slides, discharge outlets	-	8,0
07-041	set	Steel structures	-	6,0
07-042	set	Dedusting piping	-	1,8
		Power demand (kW)	**2994,3**	
		Total weight (t)		**798,8**

08 - Blending Silo

Item	Q'ty	Name	Power (kW)	Weight (t)
08-001	1	Air slide	-	0,7
08-002	1	Transport into blending silo	0,1	2,7
08-003	2	Fan	15,0	0,6
08-004	1	Fabric filter	1,0	3,9
08-005	1	Exhaust fan	11,0	0,9
08-006	1	Silo aeration	-	2,3
08-007	3	Blower	55,5	2,1
08-008	1	Silo discharged with set of gates	0,1	0,7
08-009	1	Air slide	-	0,9
08-010	1	Fan	3,0	0,3
08-011	set	Weighing and feeding equipment for raw meal to kiln preheater	2,8	9,4
08-012	1	Air slide	0,4	1,1
08-013	1	Fan	3,0	0,3
08-014	2	Sampler	0,4	0,1
08-015	2	Bucket elevator	80,0	55,0
08-016	1	Diverted gate	0,1	0,4
08-017	1	Screw conveyer	11,0	2,2
08-018	1	Fabric filter	1,0	3,9
08-019	1	Exhaust fan	11,0	0,9
08-020	1	Screw conveyer	2,2	0,7
08-021	set	Slides, discharge outlets	-	4,8
08-022	set	Steel structures	-	3,5
08-023	set	Dedusting piping	-	2,5
08-024	set	Aerationing piping	0,3	1,2
		Power demand (kW)	197,9	
		Total weight (t)		101,1

09 - Rotary Kiln Line

Item	Q'ty	Name	Power (kW)	Weight (t)
09-001	1	Preheater	-	152,0
09-002	set	Air blasters	0,6	6,4
09-003	1	Compressor station with compressed air receiver	15,0	0,7
09-004	1	Rotary kiln	175,0	425,0
09-005	1	Burner of rotary kiln	0,9	2,9
09-006	1	Primary air fan	37,0	1,4
09-007	1	Grate cooler with cooling fans	442,0	83,0
09-008	1	Clinker impact crusher	78,0	13,0
09-009	1	Chain conveyer	36,0	30,0
09-010	1	Sampler	2,0	0,5
09-011	2	Chain conveyer	72,0	60,0
09-012	1	Cooler of gas from grate cooler	26,0	100,0
09-013	1	Fabric filter	3,6	26,5
09-014	1	Exhaust fan	355,0	7,3
09-015	1	Steel chimney	-	15,0
09-016	1	Fabric filter	1,0	3,9
09-017	1	Exhaust fan	11,0	1,2
09-018	1	Bridge crane	28,0	11,8
09-019	set	Piping with set of dampers	2,0	24,5
09-020	set	Slides, discharge outlets	-	5,0
09-021	set	Steel structures	-	5,5
09-022	set	Dedusting piping	-	1,4
		Power demand (kW)	1285,1	
		Total weight (t)		977,0
		Refractories (t)		799,0

13 - Coal Grinding Plant

Item	Q'ty	Name	Power (kW)	Weight (t)
13-001	1	Hopper	-	3,5
13-002	1	Belt conveyer	37,0	34,8
13-003	1	Magnetic separator	6,0	1,9
13-004	1	Fabric filter	1,0	3,9
13-005	1	Exhaust fan	11,0	0,8
13-006	1	Coal bin with load cell	-	26,5
13-007	1	Apron feeder	9,0	5,5
13-008	1	Double screw conveyer feeder	4,0	3,2
13-009	1	Roller mill	145,0	40,0
13-010	1	Fabric filter	3,5	13,4
13-011	1	Exhaust fan	90,0	2,8
13-012	1	Rotary feeder	1,5	0,7
13-013	1	Screw conveyer	4,0	1,1
13-014	1	Sampler	-	0,1
13-015	1	Pulverized coal silo with load cell	-	29,5
13-016	1	Fabric filter with exhaust fan	1,5	1,3
13-017	set	Weighing and feeding equipment for coal powder	19,5	1,9
13-018	2	Air compressor	11,0	0,6
13-019	set	Firefighting system	30,0	6,5
13-020	1	Air compressor	37,0	0,8
13-021	1	Compressed air receiver	-	1,2
13-022	1	Electric hoist, 100 kN	7,0	0,8
13-023	1	Electric hoist, 50 kN	6,0	0,8
13-024	1	Belt conveyer	1,0	0,8
13-025	1	Draught fan	45,0	1,9
13-026	set	Mill ducts with set of dampers	2,0	12,8
13-027	set	Pulverized coal piping	-	0,4
13-028	set	Hot gas piping	-	8,9

13-029	set	Slides, discharge outlets	-	1,8
13-030	set	Steel structures	-	6,2
13-031	set	Dedusting piping	-	1,3
13-032	set	Compressed-air piping	-	1,6
		Power demand (kW)	**472,0**	
		Total weight (t)		**217,3**

15 - Cement Silos and Dispatch of Bulk Cement

Item	Q'ty	Name	Power (kW)	Weight (t)
15-001	1	Screw conveyer	40,0	8,1
15-002	set	Silo discharger with set of gates	0,1	0,4
15-003	1	Loading head	0,7	0,4
15-004	1	Silo aeration	-	1,1
15-005	1	Blower	18,5	0,7
15-006	1	Fabric filter	1,0	3,9
15-007	1	Exhaust fan	11,0	0,8
15-008	set	Slides, discharge outlets	-	0,3
15-009	set	Steel structures	-	0,3
15-010	set	Dedusting piping	-	1,1
15-011	set	Aerationing piping	-	0,2
		Power demand (kW)	**71,3**	
		Total weight (t)		**17,3**

16 - New Packing Plant and Bag Loading

Item	Q'ty	Name	Power (kW)	Weight (t)
16-001	1	Screw conveyer	90,0	21,5
16-002	1	Bucket elevator	22,0	14,3
16-003	1	Vibrating screen	3,0	1,6
16-004	1	Feed bin	-	4,2
16-005	1	Vertical double rotary feeder	2,0	1,2
16-006	1	Eight-spout packing machine	38,0	5,4
16-007	1	Belt conveyer	1,5	1,9
16-008	1	Belt conveyer	1,5	1,7
16-009	1	Machine for the slitting of bags	8,0	4,2
16-010	1	Screw conveyer	5,5	1,5
16-011	1	Belt conveyer	3,0	2,8
16-012	2	Bag tripper	2,0	0,7
16-013	2	Truck loading	10,5	19,4
16-014	1	Fabric filter	3,0	9,9
16-015	1	Exhaust fan	45,0	1,0
16-016	1	Air compressor	37,0	0,8
16-017	1	Compressed air receiver	-	1,2
16-018	1	Electric hoist, 32 kN	5,5	0,4
16-019	set	Slides, discharge outlets	-	2,8
16-020	set	Steel structures	-	3,2
16-021	set	Dedusting piping	-	2,4
16-022	set	Compressed-air piping	-	0,5
		Power demand (kW)	277,5	
		Total weight (t)		102,6

6.8 CIVIL ENGINEERING WORKS

6.8.1 DESCRIPTION OF GENERAL LAY-OUT

The building site is situated in the Chilanga cement plant approx. 1 km out of the main road Lusaka - Kafue. The site area for expansion 150 x 200 m; 30,000 m^2. Distance from the quarry 9 km. The building site is located about 18 km out of the capital Lusaka.

Architectural design

Planning conception has been predetermined by the manufacturing and flow sheet of clinker production process. Location of these buildings starting with crushing, storage and technology of raw material processing, follows the most suitable direction of production technology and dispatch of cement. Auxiliary and service buildings are existing. In the advance area there are situated the existing administration building, gate house and outside parking for passengers cars. All the new production buildings are possible to be approached by internal factory roads. Architectural design of the new buildings are characterized by simple shapes, technical detail of high quality, color surface finish of exterior and interior of the technologic equipment.

6.8.2 PRINCIPLES OF THE STRUCTURAL DESIGN

Principles of the technical design regarding the main structures are as follows:

- Bearing overhead structures are as a rule designed as steel bearing framed-type structures - main technological buildings.

- Bearing foundation structure is as a rule created by reinforced concrete framed-type footings and plain concrete footings.

- Silos are made of reinforced concrete, monolithic, made by sliding-shuttering technology.

- Filling masonry made of bricks, thickness 30 cm, as well as bearing structures of auxiliary plants, masonry of partition walls made of bricks, thickness of 15 cm.

- Plaster works internal as well as external made of smooth cement plaster.

- Cladding and roofing made of corrugated sheets of trapezoidal shape - in some buildings also with thermal insulation and waterproofing of the roofs.

- Other items are designed in a scope evident from the account of works and materials enclosed, for the consecutive buildings

- The building are technically equipped with electric wiring, lighting, weak-current distribution systems, lightning conductor, fire-alarm system, water system incl. water supply for technological and fire-fighting purposes and sewerage. In the control room there are designed air-conditioning units.

- Roads and paved areas in the factory are as a rule made of bituminous and partly of concrete.

6.8.3 DESCRIPTION OF NEW BUILDINGS

05 - Preblending storage of limestone

This department is designed as steel hall, under roofing, cladding with corrugated sheets of trapezoidal shape. Foundation structure is performed by concrete footings made of reinforced concrete. Further part made of reinforced concrete is the scrapers runway of technologic equipment. In the cladding there are embedded windows made of steel and gate serving as access. Lay-out dimension of the hall is 42x168 m. The floor made of concrete, thickness 15 cm, with gravel sand sub-base, 15 cm thick.

Item	Account of civil works and materials	Spec. unit	Quantity
1	Excavation works	m^3	2700
2	Fills from excavated material	m^3	430
3	Fills from gravel sand	m^3	1060
4	Concreting works-reinforced concrete	m^3	2200
5	Concreting works-plain concrete	m^3	1000
6	Reinforcing bars	kg	134.000
7	Masonry made of bricks, thickness 30 cm	m^3	-
8	Masonry for partition walls, thickness 15 cm	m^2	-
9	Internal plaster work	m^2	-
10	External plaster work	m^2	-
11	Waterproofing insulation	m^2	-
12	Thermal insulation for roofs	m^2	-
13	Locksmith's products-windows, doors	m^2	780
14	Small locksmith's products-anchor, ladders, stairs	kg	8900
15	Delivery of steel structures	t	900
16	Delivery of metal sheets for roofing and cladding	m^2	11.100

07 - Raw material grinding plant

The building includes conveyer bridge for raw material transport to the grinding plant, kiln line dedusting and bridge from the grinding plant to the blending silo

Conveyer bridges

Steel structure, roofing and cladding with corrugated sheets of trapezoidal shape Footings under steel supports made of concrete.

Raw material grinding plant

Overhead part includes bins-steel structure, roofing and cladding - corrugated sheets. Floor at terrain level and foundation footings made of plain concrete. Foundations under technological equipment made of reinforced concrete. Electrical switchboard room bricklayed with brick work masonry.

- Dedusting of kiln line and raw material grinding plant. Bearing structure under dedusting equipment - made of steel. There is situated electrical switchboard room. Floor at terrain level and foundations under the bearing structure are made of concrete. Foundation of the fan is made of reinforced concrete. Foundation under chimney-massive reinforced circular plate. Chimney is made of steel plate.

Item	Account of civil works and materials	Spec. unit	Quantity
1	Excavation works	m^3	2100
2	Fills from excavated material	m^3	600
3	Fills from gravel sand	m^3	80
4	Concreting works-reinforced concrete	m^3	500
5	Concreting works-plain concrete	m^3	700
6	Reinforcing bars	kg	39.000
7	Masonry made of bricks, thickness 30 cm	m^3	310
8	Masonry for partition walls, thickness 15 cm	m^2	100
9	Internal plaster work	m^2	710
10	External plaster work	m^2	480
11	Waterproofing insulation	m^2	17
12	Thermal insulation for roofs	m^2	210
13	Locksmith's products-windows, doors	m^2	290
14	Small locksmith's products-anchor, ladders, stairs	kg	4.700
15	Delivery of steel structures	t	480
16	Delivery of metal sheets for roofing and cladding	m^2	45.200

08 - Blending silo

It is resting on the reinforced concrete circular plate. The silo wall is made of reinforced concrete, thickness 25 cm, silo diameter 16,00 m. The wall will be performed by the method of sliding shuttering. Bottom of the silo is also made of reinforced concrete plate. Intermediate ceilings and roof are made of steel. Single stories are interconnected by means of steel staircase.

Item	Account of civil works and materials	Spec. unit	Quantity
1	Excavation works	m^3	660
2	Fills from excavated material	m^3	160

3	Fills from gravel sand	m^3	-
4	Concreting works-reinforced concrete	m^3	1350
5	Concreting works-plain concrete	m^3	160
6	Reinforcing bars	kg	20.000
7	Masonry made of bricks, thickness 30 cm	m^3	-
8	Masonry for partition walls, thickness 15 cm	m^2	-
9	Internal plaster work	m^2	-
10	External plaster work	m^2	-
11	Waterproofing insulation	m^2	-
12	Thermal insulation for roofs	m^2	-
13	Locksmith's products-windows, doors	m^2	200
14	Small locksmith's products-anchor, ladders, stairs	kg	-
15	Delivery of steel structures	t	120
16	Delivery of metal sheets for roofing and cladding	m^2	1.000

09 - Rotary kiln line

The line consists of exchanger tower, rotary kiln foundations and clinker cooler.

The exchanger tower

Overhead part made of steel structure. Road connection by means of stairs and freight elevator. Foundation made of reinforced concrete plate. At $\pm$ 0,000 floor made of pugging stuff and the electric switchboard room of brickwork masonry.

Rotary kiln foundations

Designed as framework reinforced concrete foundations. Under the kiln line there is designed concrete surface.

Clinker cooler

Overhead part consists of embedded steel structure, partly cladded with trapezoidal sheets. The ground floor made of concrete pugging stuff. Footings under the steel structure are made of concrete. Foundations under technological equipment are made of reinforced concrete To the clinker cooler pertains also the electric switchboard room made of brickwork masonry.

Item	Account of civil works and materials	Spec. unit	Quantity
1	Excavation works	m^3	3000
2	Fills from excavated material	m^3	1900
3	Fills from gravel sand	m	350
4	Concreting works-reinforced concrete	m^3	1800
5	Concreting works-plain concrete	m	[illegible]

6	Reinforcing bars	kg	87 000
7	Masonry made of bricks, thickness 30 cm	m	110
8	Masonry for partition walls, thickness 15 cm	m^2	50
9	Internal plaster work	m	450
10	External plaster work	m^2	510
11	Waterproofing insulation	m^2	270
12	Thermal insulation for roofs	m^2	200
13	Locksmith's products-windows, doors	m^2	80
14	Small locksmith's products-anchor, ladders, stairs	kg	29 000
15	Delivery of steel structures	t	750
16	Delivery of metal sheets for roofing and cladding	m^2	6 800

13 - Coal grinding plant

The building includes conveyer bridge for coal transport to the grinding plant and coal grinding plant.

Conveyer bridges

Steel structure, roofing and cladding with corrugated sheets of trapezoidal shape. Footings under steel supports made of concrete.

Raw material grinding plant

Overhead part including bins-steel structure, roofing and cladding - corrugated sheets. Floor at terrain level and foundation footings made of plain concrete. Foundations under technology equipment made of reinforced concrete. Electrical switchboard room bricklayed with brick work masonry.

Item	Account of civil works and materials	Spec. unit	Quantity
1	Excavation works	m^3	1350
2	Fills from excavated material	m^3	400
3	Fills from gravel sand	m^3	50
4	Concreting works-reinforced concrete	m^3	330
5	Concreting works-plain concrete	m^3	450
6	Reinforcing bars	kg	26.000
7	Masonry made of bricks, thickness 30 cm	m^3	200
8	Masonry for partition walls, thickness 15 cm	m^2	70
9	Internal plaster work	m^2	460
10	External plaster work	m^2	310

11	Waterproofing insulation	m^2	12
12	Thermal insulation for roofs	m^2	140
13	Locksmith's products-windows, doors	m^2	190
14	Small locksmith's products-anchor, ladders, stairs	kg	3100
15	Delivery of steel structures	t	320
16	Delivery of metal sheets for roofing and cladding	m^2	30 000

15 - Cement silos and dispatch of bulk cement

The building is designed as the reinforced concrete resting on reinforced concrete plate, thickness 100 cm, as the foundation plate. Upper plate of the silo is also made of reinforced concrete. Other ceilings in the silo as well as roofing are made of steel. Silo walls will be performed by the sliding shuttering. Thickness of silo wall is 25 cm, inside silo diameter is 8 m. Number of silos : 1 pcs. new. Cement transport to the silo is ensured by conveyer bridge, made of steel structure. Cladding with corrugated sheets of trapezoidal shape.

Item	Account of civil works and materials	Spec. unit	Quantity
1	Excavation works	m^3	300
2	Fills from excavated material	m^3	60
3	Fills from gravel sand	m^3	-
4	Concreting works-reinforced concrete	m^3	420
5	Concreting works-plain concrete	m^3	50
6	Reinforcing bars	kg	75 000
7	Masonry made of bricks, thickness 30 cm	m^3	-
8	Masonry for partition walls, thickness 15 cm	m^2	-
9	Internal plaster work	m^2	-
10	External plaster work	m^2	-
11	Waterproofing insulation	m^2	-
12	Thermal insulation for roofs	m^2	-
13	Locksmith's products-windows, doors	m^2	90
14	Small locksmith's products-anchor, ladders, stairs	kg	2700
15	Delivery of steel structures	t	40
16	Delivery of metal sheets for roofing and cladding	m^2	440

20 - Central control room

The building is designed as two-store building made of brickwork masonry, with reinforced concrete ceilings of monolithic type. The building is founded on footings. It is arranged in two aisles connected with connecting corridor, steel staircase in the space of the control room. With double floor - of steel structure, with windows and doors, roof made of two claddings, with thermal insulation and waterproofing. Brickwork masonry, thickness 30 cm, partition walls in the rooms, 15 cm thick. Continuos footings are monolithic, made of plain concrete. Ceilings made of reinforced concrete plates. Internal as well as external plaster works are made of cement lime - smooth. Floor made of concrete pugging stuff, 15 cm thickness, with gravel sand sub-base of 15 cm thickness. The building of control room is provided with air conditioning. Dimensions: length 15 m, width 12 m, height 7 m

Item	Account of civil works and materials	Spec. unit	Quantity
1	Excavation works	m^3	50
2	Fills from excavated material	m^3	15
3	Fills from gravel sand	m^3	25
4	Concreting works-reinforced concrete	m^3	90
5	Concreting works-plain concrete	m^3	25
6	Reinforcing bars	kg	5.400
7	Masonry made of bricks, thickness 30 cm	m^3	140
8	Masonry for partition walls, thickness 15 cm	m^2	260
9	Internal plaster work	m^2	570
10	External plaster work	m^2	310
11	Waterproofing insulation	m^2	240
12	Thermal insulation for roofs	m^2	180
13	Locksmith's products-windows, doors	m^2	90
14	Small locksmith's products-anchor, ladders, stairs	kg	2 100
15	Delivery of steel structures	t	-
16	Delivery of metal sheets for roofing and cladding	m^2	-

Note. The rest of buildings will be used from existing Chilanga cement plant.

6.9 COST ESTIMATE

6.9.1 INVESTMENT COSTS

6.9.1.1 MACHINERY AND EQUIPMENT

Machinery and equipment will be imported as a whole except of equipment which is available at the local market. Cost of imported machinery and equipment have been determined on the basis of the bid submitted by an European manufacturer F.O.B. European port

Survey of total costs is shown on the Schedule 6 - 1 - Estimate of Investment Costs: Equipment

Here are remarks to particular items:

- Item No 6: CIF Dar Es Salaam, includes freight charges and marine insurance from the European port to Dar Es Salaam.
- Item No 7: Transport Dar Es Salaam - Chilanga cement plant, includes transport costs of equipment, by trucks and by railway
- Item No 8: Erection. Based on experience, cost of erection is estimated at approx. 6 - 8 % of the cost machinery and equipment.
- Item No 9: Contingencies: include cost reserves estimated at 2% of total of items 1 to 8 in the case of equipment and 5 % of total items 1 to 8 in the case of civil works
- Item No 10: Customs, taxes and charges, respect tariffs and charges.

6.9.1.2 CIVIL ENGINEERING WORKS

Buildings and civil works will be carried out by the proved Construction Corporation from Zambia. Part of steel structures and metallic products shall be imported.

Costs of civil works and buildings have been estimated by taking in account the prices made available by Lusaka and Zambia.

Survey of total costs is shown on the Schedule 6 - 2 - Estimate of Investment Costs: Civil Engineering Works

The abstract of unit prices of particular civil works is stated below.

Account of civil works and material are introduced the Chapter VI, paragraph 6.8.3 Description of new buildings

UNIT PRICES OF PARTICULAR CIVIL WORKS

1. Excavation works (USD per m^3) 20
2. Fills from excavated material (USD per m^3) 8
3. Fills from gravel sand (USD per m^3) 11
4. Concreting works-reinforced concrete (USD per m^3) 190
5. Concreting works-plain concrete (USD per m^3) 14

6. Reinforcing bars (USD per ton) 1,315
7. Masonry made of bricks, thickness 30 cm (USD per m^2) 30
8. Masonry for partition walls, thickness 15 cm (USD per m^2) 20
9. Internal plaster work (USD per m^2) 17
10. External plaster work (USD per m^2) 3.5
11. Water proofing insulation (USD per m^2) 8
12. Thermal insulation for roofs (USD per m^2) 15
13. Locksmith s products-windows, doors (USD per m^2) 180
14. Small locksmith s products-anchor, ladders, stairs (USD per kg) 2.5
15. Delivery of steel structures (USD per ton) 800
16. Delivery of metal sheets for roofing and cladding (USD per m^2) 40

ESTIMATE OF INVESTMENT COSTS: EQUIPMENT

Schedule 6 - 1

No	Item description	Costs in USD		
		Foreign	Local	Total
1	**Production equipment**			
01	Limestone extraction	1,300,000	-	1,300,000
02	Phyllite extraction	-	-	-
03	Primary crushing plant	-	20,000	20,000
04	Secondary crushing plant	-	40,000	40,000
05	Preblending storage of limestone	2,500,000	-	2,500,000
06	Storage of phyllite	-	20,000	20,000
07	Raw material grinding plant	5,800,000	-	5,800,000
08	Blending silo	1,000,000	-	1,000,000
09	Rotary kiln line	6,300,000	-	6,300,000
10	Clinker storage	-	-	-
11	Gypsum storage	-	-	-
12	Coal storage	-	-	-
13	Coal grinding plant	1,700,000	-	1,700,000

14	Cement grinding plant	350,000	-	350,000
15	Cement silo and dispatch			
	of bulk cement	300,000	-	300,000
16	Packing plant and bag loading	800,000	-	800,000
17	Electrical equipment	700,000	-	700,000
18	Central control room	500,000	-	500,000
2	**Auxiliary equipment**			
20	Main switching station	200,000	-	200,000
21	Diesel power plant	120,000	-	120,000
22	Compressed air plant	-	-	-
23	Water supply and distribution	50,000	-	50,000
	system			
24	Laboratory	350,000	-	350,000
25	Workshops	150,000	-	150,000
26	Stores	-	-	-
27	Diesel oil tank	-	-	-
28	Lubricants store	-	-	-
29	Garage	-	-	-
3	**Service equipment**	-	-	-
4	**Spare parts**	**800,000**	-	**800,000**
	Subtotal	**22,920,000**	**80,000**	**23,000,000**
5	**Project planning**	**500,000**	-	**500,000**
6	**CIF - Dar es Salaam (IF)**	**1,146,000**	-	**1,146,000**
7	**Transport Dar es Salaam -**			
	Chilanga	**550,000**	-	**550,000**
8	**Erection**		**1,600,000**	**1,600,000**
9	**Contingencies**	**502,320**	**33,600**	**535,920**
	Subtotal	**25,618,320**	**1,713,600**	**27,331,920**
10	**Customs, faxes, charges**			

(on CIF value mimis project)			
Custom duty - free		-	-
V.A.T - free		-	-
Import license fee 5%		1,230,800	1,230,800
Custom clearance fee 4%		984,640	984,640
Total	25,618,320	3,929,040	29,547,360
of that - fixed assets	24,741,940	3,851,710	28,593,650
- current assets	876,380	77,330	953,710

Note to item 10: According to Investment Act. Zambia 1993. Part V, paragraph 30A and 31. the imports of machinery and equipment for selective industries are custom & tax free. Chilanga Cement PLC is considered to be awarded by these incentives.

ESTIMATE OF INVESTMENT COSTS:
CIVIL ENGINEERING WORKS

Schedule 6 - 2

No	Item description	Costs in US dollars		
		Foreign	Local	Total
1	Site preparation	-	500,000	500,000
2	Buildings and special civil works	2,000,000	6,000,000	8,000,000
	Subtotal	2,000,000	6,500,000	8,500,000
3	Project planning	-	250,000	250,000
4	CIF Dar es Salaam	100,000	-	100,000
5	Transport Dar es Salaam-Chilanga	60 000	-	60 000
6	Contingencies	108,000	337,500	445,500
	Subtotal	2,268,000	7,087,500	9,355,500
7	Custom, taxes, charges			
	(on CIF value)			
	20% Custom duty		432,000	432,000

20% V.A.T. (from CIF + cust duty)		518,400	518,400
5% Import fee (from CIF)		108,000	108,000
4% clearing agent fee (from CIF)		86,400	86,400
Total	**2,268,000**	**8,232,300**	**10,500,300**

ESTIMATE OF PRODUCTION COST: EQUIPMENT

Schedule 6 - 3

No.	Item	Costs in U.S. dollars Foreign	Local	Total

No other costs besides consumption of maintenance materials, grinding media, refractories and wages are not considered.

ESTIMATE OF PRODUCTION COSTS: CIVIL ENGINEERING WORKS

Schedule 6 - 4

No.	Item	Costs in U.S. dollars Foreign	Local	Total
1	Cost of maintenance carried out by Construction Corporation (considered 1% of the value of the initial fixed investment costs)	22,680	82,323	105,003

7 PLANT ORGANIZATION AND OVERHEAD COSTS

7.1 COST CENTERS

The cost centers are preserved as it is in the existing Chilanga Cement Plant. The comprehensive organization of the proposed expanded Chilanga Cement Plant and the lines of hierarchy are shown on the Organizational Chart, **Figure** 7 - 1. It reflects general organizational outline from Ndola Cement Plant.

Horizontally, the plant organization comprises the following departments:

- Head
- Production
- Engineering
- Materials
- Human Resource
- Sales
- Accounts
- Technical

7.1.1 HEAD DEPARTMENT

It covers all leading services and duties including security.

7.1.2 PRODUCTION DEPARTMENTS

It consists of six sections as follows:

- Overhead
- Quarry
- Continuous process
- Packing plant
- General gang
- Crushers

Their main job is operation of the production departments They are responsible both for the quantity and quality of manufactured clinker and cement.

7.1.3 ENGINEERING DEPARTMENT

It consists of five sections as follows:

- Overhead
- Mechanical

- Electrical
- Transport
- General

This department serves for:

- maintenance of mechanical and electrical equipment
- repairs and production of some spare parts
- repairs of buildings and general services

The transport section is responsible for :

- transport of coal and gypsum
- meeting requirements on personal and goods transport
- maintenance and repair of mobile equipment

7.1.4 MATERIAL DEPARTMENT

It consists of the two sections with the following responsibilities:

- stores
- purchasing

The stores will serve for purchasing, storing and issuing of spare parts, supplies and consumables necessary for operation of the plant.

7.1.5 HUMAN RESCUES DEPARTMENT

It consists of six sections which are responsible for personnel, security, canteen, clubs etc.

7.1.6 SALES DEPARTMENT

This department serves and plans for cement sale, purchasing of inputs according to the production schedule, etc.

7.1.7 ACCOUNT DEPARTMENTS

The department performs all duties connected with budgeting, cost accounting, wages, salaries and auditing.

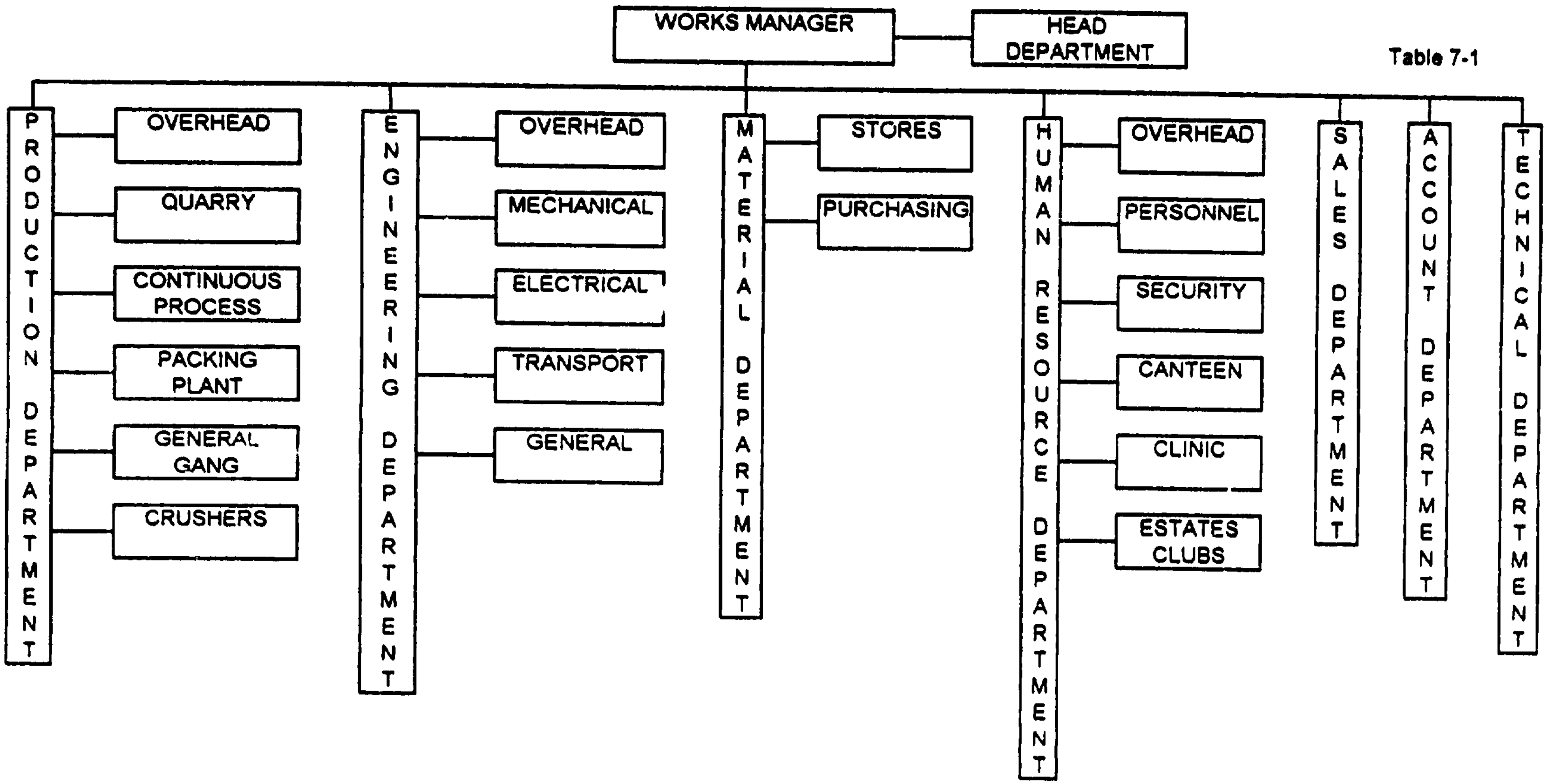
7.1.8 TECHNICAL DEPARTMENT

This department is responsible for chemical and physical analyses of raw materials, raw meal, coal, gypsum, clinker and cement carried out in conformity to the valid standards. Here are also archived designs and various documentation.

Summary view of the cost centers is depicted on the **Figure 7 - 1**.

ORGANIZATIONAL CHART

Table 7-1



7.2 OVERHEAD COSTS

Regarding cost calculation and analysis, the overhead costs are structured as follows.

- direct production and services (factory overhead costs)
- administration
- marketing
- finance and depreciation

The **Table 7 - 2 "OVERHEAD COSTS"** indicates the overhead costs generated within the operation of Chilanga Cement Plant excluding those stated in Chapters IV **"MATERIALS AND INPUTS"** and Chapter VIII **"HUMAN RESOURCE"**.

Table 7 - 2 : OVERHEAD COSTS (USD)

		Overhead costs				
No	**Item description**	**Factory**	**Administrative**	**Marketing**	**Finance**	**Depreciation**
1	Traveling	64,000				
2	Safety, protective clothing,welfare	49,000				
3	Training, publications	41,700				
4	Rent & Rates	10,400				
5	Social & Health expenses	95,300				
6	Mining licenses	10,000				
7	Chemicals & water reticulation	27,270				
8	Security charges	9,100				
9	Insurance premium	105,700				
10	Telephone, fax, postage		4,700			
11	Computer services		2,300			
12	Consultancy fees		20,500			
13	Recruitment		1,000			
14	Bank charges				3,200,000	
15	Depreciation					
	- civil engineering works 2%					210,000
	- equipment 4%					1,479,160

- mobile equipment	10%					59,800
- quarry depletion						305,100
16 Selling & distribution				340,000		
17 Demurrage				17,000		
18 Advertising				32,000		
Total :		**412,470**	**28,500**	**389,000**	**3,200,000**	**2,054,060**

The finance part of overhead costs includes the interests payable on loans (project and operation) and bank overdrafts.

Depreciation after installation of new technology: 2,054,060 USD

The total overhead costs arising from full operation capacity of Chilanga Works are: 6,084,030 USD.

The estimate of contribution paid to the Head Office of Chilanga Cement PLC in the year 1995 amounted to 4,300,000 USD. This amount should be as an additional part of administration overhead costs. Thereby the grand total of the overhead costs estimate per annum, excluding personnel costs, amount to 10,384,030 USD.

8 HUMAN RESOURCES

8.1 LABOUR AND STAFF

It is foreseen that skilled and unskilled labour will be recruited from the existing Chilanga Cement Plant and the town Chilanga.

Skilled graduates and technicians will be recruited at Chilanga Cement Plant and Ndola Cement Plant.

Key personnel and top executives will be transferred from existing cement plants in Zambia (Chilanga and Ndola).

The way of selection of all the personnel of the proposed expanded Chilanga Cement Plant will be prior to put the plant into operation.

Number of the personnel to undertake training either in Contractor's facilities or in Ndola Cement plant or during erection and start-up like is specified in the Chapter 9.

The required personnel for each departments are developed in the **Table 8 - 1** and **8 - 2**.

Description of employment	Working time	Shifts				Total	Women	Profession
		I	II	III	Ch			
1	2	3	4	5	6	7	8	9
HEAD DEPARTMENT		3				3	1	
Works manager	5/1	1	-	-	-	1		Ug
Assistant	5/1	1	-	-	-	1		T
Secretary	5/1	1	-	-	-	1	1	L
PRODUCTION DEPT.								
Overhead		4	1	1	1	7	1	
Production manager	5/1	1	-	-	-	1		Ug
Assistant	5/1	1	-	-	-	1		T
Secretary	5/1	1	-	-	-	1	1	L
Shift manager	7/3	1	1	1	1	4		T
Quarry		10	8	-	-	18		
Mining engineer	5/1	1	-	-	-	1		Ug
Foreman	6/2	1	1	-	-	2		T
Drilling machine operator	6/2	1	1	-	-	2		S
Compressor operator	6/2	1	1	-	-	2		S
Helper	6/1	1	1	-	-	2		U

Loader operator	6/2	1	1	-	-	2		S
Driver	6/2	4	4	-	-	8		S
Blasting technician	5/1	1	-	-	-	1		S
Crushers		3	3	-	-	6		
Crusher operator	6/2	2	2	-	-	4		S
Hopper attendance	6/2	1	1	-	-	2		U
Storage		3	3	1	1	8		
Stacher operator	6/2	1	1			2		S
Scraper operator	7/3	1	1	1	1	4		S
Helper	7/3	1	1	-	-	2		U
Raw grinding		1	1	1	1	4		
Raw mill attendance	7/3	1	1	1	1	4		S
Homogenizing		1	1	1	1	4		
Silo attendance	7/3	1	1	1	1	4		S
Clinker burning		1	1	1	1	4		
Rotary kiln attendance	7/3	1	1	1	1	4		S
Coal grinding		2	2	1	1	6		
Coal grinding attendance	7/3	1	1	1	1	4		S
Coal loader operator	7/3	1	1	-	-	2		S
Control room		2	2	2	2	8		
Control room operator	7/3	2	2	2	2	8		Ug
Crane storage		3	3	1	1	8		
Crane operator	7/3	2	2	1	1	6		S
Helper	7/3	1	1	-	-	2		U
Cement grinding		3	3	3		9		
Cement mill operator	6/3	2	2	2		6		T
Helper	6/3	1	1	1		3		U
Cement storage		1	1	1		3		
Cement transport helper	6/3	1	1	1		3		S
Packing plant		10	10	-	-	20		
Packing machine operator	5/2	2	2	-	-	4		S
Helper (paper bags)	5/2	2	2	-	-	4		U

Helper (loading)	5/2	6	6	-	-	12		U
Quality control (laboratory)		6	5	3	3	17	6	
Chief chemist	5/1	1	-	-	-	1		Ug
Assistant chemist	5/2	1	1	-	-	2	1	Ug
Laboratory analyst	5/2	1	1	-	-	2	1	Ug
Sample preparation	7/3	1	1	1	1	4	2	S
RTG - analyst	7/3	1	1	1	1	4		Ug
Sampling	7/3	1	1	1	1	4	2	U
ENGINEERING DEPARTMENT								
Overhead		5	-	-	-	5	2	
Engineering manager	5/1	1	-	-	-	1		Ug
Planning section	5/1	1	-	-	-	1	1	Ug
Maintenance planning	5/1	1	-	-	-	1		T
Mat.planning and purchasing	5/1	2	-	-	-	2	1	L
Mechanical engineering		12	6	3	3	24		
Maint.and workshop chief	5/1	1	-	-	-	1		T
Shift maintenance foreman	7/3	1	1	1	1	4		T
Shift maintenance mechanical	7/3	2	2	2	2	8		S
Workshop foreman	5/1	1	-	-	-	1		T
Machine-tool operator	5/1	2	-	-	-	2		S
Machine-tool operator	5/2	2	2	-	-	4		S
Filter	5/2	2	-	-	-	2		S
Helper	5/1	1	1	-	-	2		U
Electrical engineering		7	6	2	2	17		
Shift maintenance electrical	7/3	2	2	2	2	8		T
Workshop foreman	5/1	1	-	-	-	1		T
Electrician	5/2	2	2	-	-	4		S
Electrician-control system	5/2	2	2	-	-	4		T
Transport		12	4			16		
Transport manager	5/1	1	-	-	-	1		L
Driver	5/1	6	-	-	-	6		S

Mobile equipment maint.	5/2	4	4	-	-	8		S
Helper	5/2	1	-	-	-	1		U
General engineering		9	4	4	3	20		
General service foreman	5/1	1	-	-	-	1		T
Bricklayer	5/1	2	-	-	-	2		S
Helper	5/1	2	-	-	-	2		U
Substation a Hendance	7/3	2	2	2	2	8		T
Compressed air plant attend.	6/3	1	1	1	-	3		S
Water supply attendance	7/3	1	1	1	1	4		S
MATERIALS DEPARTMENT								
Stores		6	-	-	-	6	1	
Chief storeman	5/1	1	-	-	-	1		T
Storeman	5/1	2	-	-	-	2		S
Helper	5/1	2	-	-	-	2		U
Typist	5/1	1	-	-	-	1	1	L
Purchasing		2	-	-	-	2	1	
Material planning	5/1	1	-	-	-	1		T
Purchasing	5/1	1	-	-	-	1	1	L
HUMAN RES. DEP.								
Overhead		2	-	-	-	2	1	
Human manager	5/1	1	-	-	-	1		Ug
Typist	5/1	1	-	-	-	1	1	L
Personnel office		4	-	-	-	4	2	
Personnel chief	5/1	1	-	-	-	1		L
Personnel clerk	5/1	3	-	-	-	3	2	L
Security		6	5	6	6	23		
Security chief	5/1	1	-	-	-	1		T
Fire man	7/3	1	1	1	1	4		S
Gate-keeper	7/3	2	2	1	1	6		U
Watchman	7/3	2	2	4	4	12		U
Canteen		4	-	-	-	4	2	

Canteen chief	5/1	1	-	-	-	1		L
Cook	5/1	1	-	-	-	1		S
Servant	5/1	2	-	-	-	2	2	U
Clinic		**2**	-	-	-	**2**	**1**	
Doctor	5/1	1	-	-	-	1		Ug
Nurse	5/1	1	-	-	-	1	1	L
Estates clubs		**8**	-	-	-	**8**	**3**	
Estates chief	5/1	1	-	-	-	1		L
Clerks	5/1	7	-	-	-	7	3	L
SALE DEPARTMENT		**8**	-	-	-	**8**	**4**	
Sale manager	5/1	1	-	-	-	1		Ug
Salesman	5/1	2	-	-	-	2		T
Accountant	5/1	2	-	-	-	2	2	Ug
Payment	5/1	2	-	-	-	2	1	L
Typist	5/1	1	-	-	-	1	1	L
ACCOUNTS DEPT.		**9**	-	-	-	**9**	**6**	
Accounts manager	5/1	1	-	-	-	1		Ug
Budgeting	5/1	2	-	-	-	2	1	L
Vages and salaries	5/1	2	-	-	-	2	1	L
Cash and payments auditing	5/1	2	-	-	-	2	2	L
Clark	5/1	1	-	-	-	1	1	L
Typist	5/1	1	-	-	-	1	1	L
TECHNICAL DEPT.		**5**	-	-	-	**5**	**3**	
Chief designer	5/1	1	-	-	-	1		Ug
Designer	5/1	1	-	-	-	1		T
Documentation (archives)	5/1	2	-	-	-	2	2	T
Typist	5/1	1	-	-	-	1	1	L
TOTAL CEMENT PLANT		**155**	**70**	**31**	**26**	**282**	**34**	

Explanation:

Column 1 - Job tittle

Column 2 - Number of working days per week/number of shifts per day

Column 3 - 6 - Number of persons per shift

Column 7 - Number of persons per position

Column 8 - Number of women

Column 9 - Profession - Unskilled ... U

- Skilled ... S
- Technician .. T
- Leaving examination . L
- Undergraduate ... Ug

8.2 COST ESTIMATE

The required costs of personnel for each department are developed in the "Estimate of production costs - Table 8 - 2". The estimate of personnel costs in Table 8 - 2 is coming from macro-economic conditions of Zambia regarding specific socio-economic position of privatized company Chilanga Cement PLC.

Table 8 - 2 : Estimate of personal costs (USD)

Staff description	Cost per month	Annual costs per person		Total costs per year			Grand total
		Cost per person	No of persons	S+W	Pension	LP+G	
1	2	3	4	5	6	7	8
HEAD DEPT.							
Works manager	1,540	18,480	1	13,200	1,980	3,300	18,480
Assistant	560	6,720	1	4,800	720	1,200	6,720
Secretary	210	2,520	1	1,800	270	450	2,520
PRODUCTION DEPT.							
Production manager	1,008	12,096	1	8,640	1,296	2,160	12,096
Assistant	392	4,704	1	3,360	504	840	4,704
Secretary	182	2,184	1	1,560	234	390	2,184
Shift manager	1,960	5,880	4	16,800	2,520	4,200	23,520
QUARRY							
Mining engineer	952	11,424	1	8,160	1,224	2,040	11,424
Foreman	980	5,880	2	8,400	1,260	2,100	11,760
Drilling machine operator	560	3,360	2	4,800	720	1,200	6,720

Compressor operator	560	3,360	2	4,800	720	1,200	6,720
Helper	252	1,512	2	2,160	324	540	3,024
Loader operator	700	4,200	2	6,000	900	1,500	8,400
Driver	2,800	4,200	8	24,000	3,600	6,000	33,600
Blasting technician	210	2,520	1	1,800	270	450	2,520
CRUSHERS							
Crusher operator	1,400	4,200	4	12,000	1,800	3,000	16,800
Hopper attendance	252	1,512	2	2,160	324	540	3,024
STORAGE							
Stacker operator	560	3,360	2	4,800	720	1,200	6,720
Scrapers operator	1,120	3,360	4	9,600	1,440	2,400	13,440
Helper	252	1,512	2	2,160	324	540	3,024
RAW GRINDING							
Raw mill attendance	1,120	3,360	4	9,600	1,440	2,400	13,440
HOMOGENIZING							
Silo attendance	1,120	3,360	4	9,600	1,440	2,400	13,440
CLINKER BURNING							
Rotary kiln attendance	1,120	3,360	4	9,600	1,440	2,400	13,440
COAL GRIND.ATTEND.							
Coal grinding attendance	1,120	3,360	4	9,600	1,440	2,400	13,440
Coal loader operator	560	3,360	2	4,800	720	1,200	6,720
CONTROL ROOM							
Control room operator	5,600	8,400	8	48,000	7,200	12,000	67,200
CRANE STORAGE							
Crane operator	1,680	3,360	6	14,400	2,160	3,600	20,160
Helper	252	1,512	2	2,160	324	540	3,024
CEMENT GRINDING							
Cement mill operator	3,360	6,720	6	28,800	4,320	7,200	40,320
Helper	378	1,512	3	3,240	486	810	4,536
CEMENT STORAGE							
Cement transport helper	840	3,360	3	7,200	1,080	1,800	10,080
PACKING PLANT							

Packing machine operator	1,120	3,360	4	9,600	1,440	2,400	9,600
Helper (paper bags)	504	1,512	4	4,320	648	1,080	6,048
Helper (loading)	1,512	1,512	12	12,960	1,944	3,240	18,144
QUALITY CONTROL							
Chief chemist	798	9,576	1	6,840	1,026	1,710	9,576
Assistant chemist	1,260	7,560	2	10,800	1,620	2,700	15,120
Laboratory analyst	1,260	7,560	2	10,800	1,620	2,700	15,120
Sample preparation	840	2,520	4	7,200	1,080	1,800	10,080
RTG-analyst	2,520	7,560	4	21,600	3,240	5,400	30,240
Sampling	504	1,512	4	4,320	648	1,080	6,048
ENGINEERING DEPT.							
Engineering manager	952	11,424	1	8,160	1,224	2,040	11,424
Planning section	630	7,560	1	5,400	810	1,350	7,560
Maintenance planning	490	5,880	1	4,200	630	1,050	5,880
Material planning & purchasing	560	3,360	2	4,800	720	1,200	6,720
MECH.ENGINEERING							
Maintenance and workshop chief	658	7,896	1	5,640	846	1,410	7,896
Shift maintenance foreman	2,128	6,384	4	18,240	2,736	4,560	25,536
Shift maintenance mechanical	2,240	3,360	8	19,200	2,880	4,800	26,880
Workshop foreman	490	5,880	1	4,200	630	1,050	5,880
Machine-tool operator	560	3,360	2	4,800	720	1,200	6,720
Machine-tool operator	1,120	3,360	4	9,600	1,440	2,400	13,440
Filter	560	3,360	2	4,800	720	1,200	6,720
Helper	252	1,512	2	2,160	324	540	3,024
ELECTR.ENGINEERING							
Shift maintenance electrical	3,920	5,880	8	33,600	5,040	8,400	47,040
Workshop foreman	630	7,560	1	5,400	810	1,350	7,560
Electrician	1,120	3,360	4	9,600	1,440	2,400	13,440
Electrician-control system	2,240	6,720	4	19,200	2,880	4,800	26,880
TRANSPORT							
Transport manager	588	7,056	1	5,040	756	1,260	7,056
Driver	1,680	3,360	6	14,400	2,160	3,600	20,160

Mobile equipment maintenance	2,240	3,360	8	19,200	2,880	4,800	26,880
Helper	126	1,512	1	1,080	162	270	1,512
GEN.ENGINEERING							
General service foreman	630	7,560	1	5,400	810	1,350	7,560
Bricklayer	560	3,360	2	4,800	720	1,200	6,720
Helper	252	1,512	2	2,160	324	540	2,160
Substation attendance	4,480	6,720	8	38,400	5,760	9,600	53,760
Compressed air plant attendance	840	3,360	3	7,200	1,080	1,800	10,080
Water supply attendance	1,120	3,360	4	9,600	1,440	2,400	13,440
MATERIAL DEPT.							
Chief storeman	560	6,720	1	4,800	720	1,200	6,720
Storeman	560	3,360	2	4,800	720	1,200	6,720
Helper	252	1,512	2	2,160	324	540	3,024
Typist	182	2,184	1	1,560	234	390	2,184
Material planning	490	5,880	1	4,200	630	1,050	5,880
Purchasing	490	5,880	1	4,200	630	1,050	5,880
HUMAN RES.DEPT.							
H/R manager	840	10,800	1	7,200	1,080	1,800	10,080
Typist	182	2,184	1	1,560	234	390	2,184
Personal chief	560	6,720	1	4,800	720	1,200	6,720
Personal clerk	546	2,184	3	4,680	702	1,170	6,552
Security chief	630	7,560	1	5,400	810	1,350	7,560
Fireman	1,120	3,360	4	9,600	1,440	2,400	13,440
Gate-helper	756	1,512	6	6,480	972	1,620	9,072
Watchman	1,512	1,512	12	12,960	1,944	3,240	18,144
Canteen chief	490	5,880	1	4,200	630	1,050	5,880
Cook	210	2,520	1	1,800	270	450	2,520
Servant	252	1,512	2	2,160	324	540	3,024
Clinic - doctor	840	10,080	1	7,200	1,080	1,800	10,080
Clinic - nurse	490	5,880	1	4,200	630	1,050	5,880
Estate (club) - chief	560	6,720	1	4,800	720	1,200	6,720
- clerk	1,960	3,360	7	16,800	2,520	4,200	23,520

SALES DEPT.							
Sales manager	840	10.080	1	7.200	1.080	1.800	10.080
Salesman	1.120	6.720	2	9.600	1.440	2.400	13.440
Accountant	1.120	6.720	2	9.600	1.440	2.400	13.440
Payment	560	3.360	2	4.800	720	1.200	6.720
Typist	182	2.184	1	1.560	234	390	2.184
ACCOUNTS DEPT.							
Accounts manager	840	10.080	1	7,200	1.080	1,800	10,080
Budgeting	560	3.360	2	4.800	720	1.200	6.720
Wages and salaries	560	3.360	2	4.800	720	1.200	6.720
Cash & payments audit	560	3.360	2	4.800	720	1.200	6.720
Clerk	280	3.360	1	2.400	360	600	3.360
Typist	182	2.184	1	1.560	234	390	2,184
TECHNICAL DEPT.							
Chief designer	840	10,080	1	7.200	1.080	1.800	10,080
Designer	672	8.064	1	5.760	864	1.440	8.064
Documentation (archives)	980	5,880	2	8,400	1.260	2.100	11.760
Typist	182	2,184	1	1,560	234	391	2.184
TOTAL			**282**	**839,520**	**125,928**	**209,880**	**1,175,328**

University graduates : 262,080 USD

Technicians & Leaving examination : 449,232 USD

Skilled workers : 376,320 USD

Unskilled workers : 87,696 USD

Explanation of "Table 8 - 2" :

Column 1 - names of departments and the positions within them

Column 2 - monthly cost of personnel in particular position

Column 3 - annual cost per person in particular position

Column 4 - number of persons working at the same position

Column 5 - total costs - salaries, wages, allowances and overtime per year covering the work of specific position

Column 6 - total costs - Pension/ZNPF per year covering the specific position

Column 7 - total costs - Leave pay & Gratuity per year covering the specific position

Column 8 - grand total costs per year covering the specific position

9. PLANT IMPLEMENTATION

9.1 PROPOSED TIME IMPLEMENTATION SCHEDULE

The project implementation phase will embrace the period of 24 months from the awarding of the contract to the start of production.

The implementation phase includes the following stages:

- Setting up project implementation management
- Detailed engineering, tendering and evaluation of bids
- Awarding of contract
- Site preparation and development
- Soil study
- Civil works
- Detailed engineering of equipment and civil works
- Trial runs, testing
- Start-up and commissioning
- Training of the staff and labour

The duration of the above mentioned stages and their mutual time overlapping is shown in Table 9-1.

9.1.1 TENDERING AND PROJECT MANAGEMENT TEAM

The Project Management Team is set up in order to prepare the tendering and evaluation of bids and to decide on the awarding of the contract.

It is intended that later the team should form the base of the managerial, technical and operational staff to be put in charge of running the plant.

9.1.2 CONTRACTING

Based on the evaluation of bids, contract negotiations will start. The result will be the awarding of the contract to a selected contractor.

9.1.3 SITE PREPARATION AND DEVELOPMENT

Since the land is owned by the State, preparation and development of the site can be triggered as soon as the contract has been signed.

9.1.4 SOIL STUDIES

Prior to the planning of buildings and civil works, the contractor will prepare the soil studies including test trenches, pertinent in site examinations to enable an obtaining of an exact interpretation concerning the foundation of buildings and civil works

Table 9-1: Project Implementation Programme

Year	1996			1997				1998				1999				2000				2001	
Trimestre	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II
Particular																					
Feasibility Study	O																				
Decision	—	—																			
Project Implementation Management			—	—	—	—	—	—	—	—	—	—	—	—							
Tendering / Evalution of Bids			- -	- -																	
Contracting					O																
Site Preparation and Development							—														
Soil Tests							—														
Study of Preliminary Civil Works								—													
Project Planning							—	—													
Preliminary Civil Works								—	—	—	—										
Delivery of Construction Material									—	—											
Delivery of Machinery and Equipment										—	—										
Erection											—	—	—	—							
Finalizing of Civil Works												- -	- -	- -							
Testing															—						
Putting into Operation																—	—				
Trial runs																—					
Start-up																—	—				
Training of Personnel														—	—						

9.1.5 CIVIL WORKS STUDY

Results of the soil studies shall be used for the planning of the following civil works

- Land and roads preparation
- Auxiliary buildings
- Foundations of the production buildings

9.1.6 DETAILED ENGINEERING OF EQUIPMENT AND CIVIL WORKS

The designs of the technology and machinery should precede the designs of buildings and both will provide basic data for the preparation of the designs of the electrical equipment and instrumentation.

9.1.7 EXECUTION OF CIVIL WORKS

There will be only one construction area inside the CCL. The scope of the initial building and civil works will mainly include those giving way to the erection of heavy machinery and equipment.

9.1.8 ERECTION OF MACHINERY AND EQUIPMENT

The sequence of the erection works will be as follows:

- Production machinery and equipment
- Electrical equipment
- Instrumentation and controls
- Connection to utilities

The erection works will be performed by private industry corporation manpower, supervised by the contractor's delegated staff.

9.1.9 FINAL BUILDING AND CIVIL WORKS

These will be continuously performed together with the erection of machinery in order to provide uninterrupted follow-up of the latter.

9.1.10 TRIAL RUNS, TESTING

Individual plant departments will be put into run by tests, without and subsequently with, material according to the time-schedule as per the contract.

9.1.11 START-UP AND COMMISSIONING

After the tests described in the Chapter 9.1.10 are successfully accomplished, plant production will start running in. It is expected that the full production rate of the plant will be achieved within 6 months after start-up. Within this period production tests and commissioning will be performed as per pertinent stipulations of the contract.

9.1.12 TRAINING

It is considered the basic training will take place during erection and start-up. The specialized personnel will receive additional training in some contractor's amenities and in the Ndola Cement Factory.

9.1.13 SELECTION OF THE PROJECT IMPLEMENTATION PROGRAMME AND TIME SCHEDULE

The Table 9 -1, that can be found at the end of this chapter, lists individual activities and their duration during project implementation.

a) Decisive Activities

Preconstruction phase:

- Setting up of management, tendering, evaluation of bids, awarding of contract........7 months
- Contracting and subcontracting........5 months
- Coming of contract into force........2 months

Construction phase:

- Project planning........6 months
- Civil works........12 months
- Delivery of the machinery and equipment........6 months
- Erection........12 months
- Final building and civil works........9 months
- Testing, trial runs........3 months

b) Further Activities

Hereinafter, interacting activities, bringing about different implications or implementation, are listed:

- Delivery of machinery and equipment shall be materialized from the 9th to 15th month
- Delivery of the electrical equipment, instrumentation and controls shall be materialized from the 12th to 15th month
- Training of the specialized personnel in the contractor's amenities will be finalized by the end of the 18th month
- Recruitment of the staff will be finalized by the end of 12th month
- Recruitment of labour will be finalized by the end of erection
- Raw materials, ›al, fuel and inputs for the production of cement as well as the power and water supply will be available- one month before the end of erection at the latest

c) Manpower and Skills

Civil works: Civil works will be carried out by the Construction Corporation from Zambia under the contractor's supervision. The supervision personnel will consist of one specialist. The total number of civil works manpower will total 250, in the highest construction stage up to 500.

d) Erection

The erection of the plant will be managed, co-ordinated and supervised by the following contractor's personnel:

- A mechanical erection supervisor (1 person)
- An electrical supervisor (1 person)
- Mechanical erection specialists (2 persons)
- Electrical erection specialists (2 persons)
- A refractory bricks-lying specialist (1 person)

The Contractor's personnel will be assisted by skilled local manpower recruited by the Industrial Corporation. The number of local personnel will number about 150 persons.

The total number of the erection personnel will thus be 80 persons, in the higher erection stage about 150 persons.

e) Start - up

The plant will be started up under management and supervision of the following Contractor's staff:

- one senior engineer
- three engineers - specialists
- two chemists
- two kiln operators
- two mill operators

Total: ten (10) persons

The Contractor's staff shall be assisted by skilled production personnel as per Chapter 8.

f) Training

The Contractor shall organize training of the local specialized staff is his amenities and in the Ndola Cement plant.

This staff will consists of:

- one production manager (Contractor)
- one quality control manager (Contractor)

- one mechanical engineer (Ndola)
- one electrical engineer (Ndola)
- two kiln operators (Contractor)
- two mill operators (Contractor)

Total: eight (8) persons

Training of other personnel shall be ensured during erection and commissioning.

g) Start -up

It is considered the stage of start - up and running-in of the plant will take one year at the end of which the normal rated production capacity will be reached.

Production will continuously rise during start - up period as follows:

- 1-st quarter : 50 %
- 2-nd quarter : 70 %
- 3-rd quarter : 90 %
- 4-th quarter : 100 %

The average production capacity utilization is 77.5 % of the full capacity. It means 244,125 tpy of cement.

h) Site Development

In the frame of civil works it will be necessary to make road connection, water and power supply.

The Contractor will set up stores to shelter various supplies and deliveries and housing for erection and supervising personnel.

9.2 ESTIMATE OF IMPLEMENTATION COSTS

9.2.1 MANAGEMENT OF PROJECT IMPLEMENTATION

Number of staff, persons 3

Duration, months 30

Average salary per month, US dollars 660

Total cost of salaries, US dollars 59,400

9.2.2 CO-ORDINATION AT PROJECT IMPLEMENTATION

Number of foreign experts 1

Duration, months 28

Average salary per month, US dollars 10,000

Total salary, US dollars	280,000
Other expenses (air-ticket)	1 200
Board and accommodation, US dollars	56,000
Total costs	337,200

9.2.3 ERECTION

Number of foreign supervisors and specialists, persons	7
Duration, man/months	48
Average salary per month, US dollars	9,000
Total salaries, US dollars	432,000
Other expenses, US dollars	9,400
Board and accommodation, US dollars	192,000
Total costs, US dollars	633,400

9.2.4 START-UP

Number of foreign specialists	10
Duration of stay, man/months	30
Average salary per month, US dollars	9,000
Total salaries, US dollars	270,000
Other expenses (air-tickets), US dollars	12,000
Board and accommodation, US dollars	135,000
Total costs, US dollars	417,000

9.2.5 TRAINING

Number of locally trained specialists	5
Duration of training, man/months	30
Average salaries/wages, US dollars	450
Total salaries/wages, US dollars	13,500
Other expenses	9,000
Total costs	22,000

9.2.6 OTHER GENERAL COSTS

Rent and operation of offices, motor cars, travel and telecommunication expenses, etc., US dollars	330,000
Materials and inputs for trial run and start-up, US dollars	200,000
Salaries and wages of recruited personnel during project implementation period, US dollars	380,000
Contingencies, US dollars	119,000
Total general costs, US dollars	1,029,000

9.2.7 INTERESTS DURING CONSTRUCTION

Two and a half year interests from the loan 5,800,000 USD as a first part of the foreign loan 28,890,920 USD at the interest rate 9 % is not paid during construction (grace period) The amount of this interest is 1,394,378 USD, which is supposed to be paid out during production period

Table 9 - 2: ESTIMATE OF INVESTMENT COSTS: PROJECT IMPLEMENTATION

in thousand US dollars

No	Item description	Costs		
		Foreign	Local	Total
1	Project implementation management	-	59 4	59.4
2	Co-ordination	281.2	56 0	337 2
3	Erection	441.4	192 0	633 4
4	Start-up	282 0	135 0	417 0
5	Training	-	22 5	22 5
6	General costs	-	1,029 0	1,029 0
7	Interests during construction	0	-	0
	Total	**1,004.6**	**1,493.9**	**2,498.5**

10 FINANCIAL ANALYSIS AND STANDING OF THE ENTERPRISE

10. 1 REPUTATION

The Chilanga Cement PLC is well-known cement producing company because of its monopoly position at Zambian cement market and production of high quality.

More information about the company are as follows:

Corporate information

Board of directors consists of four representatives of major shareholder CDC , two representatives of ZPTF (Zambia Privatization Trust Fund) and one representative of ZAMIC (Zamanglo Industrial Corporation Ltd.) Two additional persons - the Alternate directors - represent CDC.

Management of the company consists of the General Manager, Finance & Administration Manager, Company Technical Manager, Chief Marketing Manager, Works Manager - Chilanga Works and Works Manager - Ndola Works.

Institutions and companies co-operating with Chilanga Cement PLC are as follows:

Lead merchant bank - Stanbic Bank Zambia Limited, Lusaka, Zambia

Advisers and sponsoring brokers - Standard Corporate and Merchant Bank Limited, Johannesburg, South Africa.
- Cavmont Securities Limited, Lusaka, Zambia
- Meridien Financial Services Limited, Lusaka, Zambia
- Meridien Securities Limited, Lusaka, Zambia

Adviser to Chilanga Cement - Standard Chartered Merchant Bank Zimbabwe Limited, Harare, Zimbabwe

Auditors of Chilanga Cement - KPMG Peat Marwick Certified Accountants , Lusaka, Zambia

Reporting accountants - Price Waterhouse Certified Accountants, Lusaka, Zambia

Commercial bankers - Barclays Bank of Zambia Limited, Lusaka, Zambia
- Meridien Biao Bank Zambia Limited, Lusaka, Zambia
- Standard Chartered Bank Zambia Limited, Lusaka, Zambia
- Zambia National Commercial Bank Limited, Lusaka, Zambia

The Chilanga Cement PLC is well-known company because of it s financial stability. At present it is only company quoted at LuSE (Lusaka Stock Exchange). Profit history below underlines this fact.

Table 10 - 1 : Audited Profit History of Chilanga Cement

Kwacha '000	9 month ended 31 Dec 1994	Years ended 31 March 1994	1993	1992	1991	1990	1989
Turnover	11 972 269	12 363 387	5 350 944	2 143 103	920 109	377 522	176 636
Profit before taxation	1 703 904	2 656 739	1 241 136	212 309	138 497	70 102	21 231
Taxation	787 878	851 819	409 644	100 492	63 783	28 210	5 851
Profit after taxation	916 026	1 804 920	831 492	111 817	74 714	41 892	15 380
Proposed preference dividends	138	184	184	184	184	184	184
Profit attributable to ordinary shareholders	915 888	1 804 736	831 308	111 633	74 530	41 708	15 196
Proposed ordinary dividends	450 138	902 276	415 562	55 724	37 173	10 000	5 000
Retained profit for the year	465 750	902 460	415 746	55 909	37 357	31 708	10 196
Earnings per ordinary share /Kwacha/	4.58	9.02	4.16	0.56	0.37	0.21	0.08
Dividends per ordinary share /Kwacha/	2.25	4.51	2.08	0.28	0.19	0.05	0.02
Dividend cover	2.0	2.0	2.0	2.0	2.0	4.2	3.0
Year-on-year inflation rate as at 31 December	35%	35%	138%	191%	111%	105%	158%
USD/Kwacha exchange rate as at 31 December	712	712	685	379	100	48	22

Note: Please, see bottom line for the conversion of Zambian Kwacha to USD.

10.2 CAPITAL STRUCTURE

The summarized Balance sheets of Chilanga Cement Plant at 31March 1994 (the end of an old fiscal year) and at 31 December,1994 (the end of a new fiscal year), based on the audited accounts, show the capital structure of the company.

Table 10 - 2 : The Summarized Balance Sheets of Chilanga Cement Plant

	31 December 1994	31 March 1994
	K millions	K millions
1. Fixed assets	17 419	1 180
2. Current assets	7 431	5 577
2.1 Stocks	6 072	4 145
2.2 Debtors	972	911
2.3 Cash and bank balances	387	521
3. Current liabilities	3 843	3 521
3.1 Bank overdrafts	165	129
3.2 Creditors	2 154	1882
3.3 Short term loans	86	57
3.4 Dividends payable	1 100	955
3.5 Taxation	338	498
4. Net current assets (2. - 3.)	3 588	2 056
5. Total assets - Current liabilities (1. + 2. - 3)	21 007	3 236
Financed by:		
6. Share capital	103	103
7. Reserves	19 358	2 099
8. Total shareholders' funds	19 461	2 202
9. Long term indebtedness	342	370
10. Deferred liabilities	1 204	664
11. Equity + Long term liabilities (8. + 9. + 10.)	21 007	3 236

Liquidity ratios:	Current ratio	7,431/3,843 = 1.93	5,577/3,521 = 1.58
	Quick ratio	1,359/3,843 = 0.35	1,432/3,521 = 0.41
	Cash ratio	387/3,843 = 0.10	521/3,521 = 0.15

The revaluation of fixed assets in the new fiscal year system is commented further on

Asset revaluation

The financial effect on the audited balance sheet as at 31 December 1994 of the asset revaluation carried out during the year 1994 was that fixed assets and reserves were increased by K 16 082 million.

Investments

The company has an investment consisting of 500 000 ordinary shares (0.818 % of the issued ordinary share capital) in Ipcom Limited, a Zimbabwean company. Because of Zimbabwe's historic exchange control restrictions, the investment has been written down in Chilanga Cement's books to a nominal K1.

Ipcom (an accounting company) made an audited profit for the fiscal year ended 31 December 1994 of 677 000 Zimbabwean dollars (some K562 million) and the shares were traded at 0.47 ZD (approx. K46) per share, which would value Chilanga Cement's investment at 235 000 ZD (some K23 million).

Stocks

Stocks comprises of raw materials and consumables, finished and unfinished production, stores and spares, fuel, lubricants and others. It comprises as well the medical, canteen and stationery stocks and products in transit.

Debtors

This Feasibility Study does not analyze this area for trade debtors at corporate level. Generally, Chilanga plant has not big problems with outstanding trade debtors for more than 30 days period.

Share capital

The share capital issued and fully paid is 2,633,000 of 7% redeemable non-cumulative preference shares of K1 each in the value of K2,633,000 and 200,039,904 ordinary shares of 50n each in value of K100,020,000.

Table 10 - 3 : Reserves (in Kwacha)

		Foreign		
	Revaluation	Exchange rate	Revenue	
	Reserve	Reserve	Reserve	Total
At 1 April 1994	467,984	397	1,630,118	2,098,499
Profit for the period	-	-	465,888	465,888
Revaluation surplus - cost	16,487,633	-	-	16,487,633
- depreciation	306,381	-	-	306,381
At 31 December 1994	17,261,998	397	2,096,006	19,358,401

The balance on the foreign exchange reserve at 31 December 1994 represents the unrealized gain on one foreign currency loan, funds for the repayment of which were deposited in the pipeline prior to 7 January 1983. The Bank of Zambia has indicated its intention to meet obligations denominated in foreign currencies at the rate of exchange ruling on that date provided funds were deposited with them prior to that date. This reserve will be transferred to the profit and loss account when the funds are externalized.

Bank overdrafts

At 31 December 1994, the company had bank overdrafts outstanding as follows:

Standard Chartered Bank Zambia Limited	K112 237 000 /approved Kll3 million/
Barclays Bank of Zambia Limited	K49 491 000 /approved K70 million/
Meridien Biao Bank Zambia Limited	K3 180 000 /approved K50 million/
Zambia National Commercial Bank Limited	nil /approved K30 million/

At that date, the above facilities totaled K263 million. Standard Chartered Bank Zambia Limited has recently renewed its facility of K113 million. Barclays Bank of Zambia Limited has already approved an increase in its facility to K200 million, with a further facility of another K100 million should it be needed. Other overdraft facilities will no longer be utilized.

Creditors

The trade creditors debt amount is comparable to trade debtors credit on the corporate level. Detail structure of them is not available.

At Chilanga plant level the biggest creditor is ZESCO Limited, the electricity supply corporation. ZESCO billing is two months in arrears. More than 60 days creditors at amount more than K500,000 was not found.

Loans

The only loan in the books at 31 December 1994 was in Kwacha denominated loan from the Ministry of Finance of the Government. This loan is repayable in 15 equal annual installments from July 1993 and bears fixed interest at 50% per annum. The balance of the loan at 1 January 1995 was K427.5 million.

In addition, the company has, for several years, been meeting the foreign exchange losses on a European Investment Bank /"EIB"/ loan taken out in 1980 by INDECO /then majority shareholder, subsequently ZIMCO/, on behalf of the company to finance a rehabilitation programme. The proceeds of the loan /which is denominated in ECU/ were passed to the company in exchange for preference shares to a value of K2,633,000, that being the Kwacha equivalent at the time of the amount of the loan /ECU 2,627,625/. When the Kwacha began to depreciate rapidly against the USD, INDECO proposed that it should continue to service the loan at the historic exchange rate, while Chilanga Cement should bear the exchange losses. In the nine months to 31 December 1994, the cost of meeting these exchange losses was K189 million. As part of the privatization process, the company has agreed to assume ZIMCO s rights and obligations under the original loan agreement. A loan assumption agreement is expected to be signed soon and the preference shares have been redeemed /see paragraph 7.5/. As at 1 January 1995 the balance of the loan was ECU 1,112,571 /some K1,204 million/ A further amount of ECU 103,266 /some K112 million/ was repaid by

Chilanga Cement in January 1995 The loan bears interests at 2 % per annum and is repayable in half yearly installments. The last installment is due on 15th January 2000

Subsequent to 31 December 1994, the company has negotiated a short term working capital loan facility from CDC of USD 1.5 million /some K1 238 million/, with a bullet repayment by 30 June 1996. The loan bears interest at a rate of 10.375% p.a. The first drawing under this facility was made on 28 February 1995, when CDC advanced USD 800 000/K660 million/.

The company has also borrowed money to cover the costs of the environment Project with DANIDA. A loan agreement is expected to be signed imminently, whereby the Ministry of Finance of Zambia will agree to lend to the company the Kwacha equivalent of DKR13.3 million /some K 955 million/, which is the amount that DANIDA is making available to cover the offshore costs of the environment issues. The loan will be Kwacha-denominated, bear interest at 10% p.a., and be repayable in 30 equal half-yearly installments, commencing on the date of commissioning /expected to be ind-first quarter 1996/.

The company is also negotiating with one of its local bankers for a Kwacha loan of K600 million to cover the local costs of the environmental issues.

Additionally, the company expects to incur limited short term borrowings throughout the year to finance specific imports of spares and/or consumables

If all of the company's loan facilities were fully utilized the company's debt could be summarized as follows:

Table 10 - 4 : Summarize of the Company's Debt

	K million	Thousand USD*
Debt as at 31 December 1994:		
Long and short term loans	428	601
Overdraft	165	232
Debt originating subsequent to 31 December 1994:		
EIB loan	1,092	1,534
CDC loan	1,238	1,739
DANIDA loan	1,955	2,746
Kwacha denominated loan	600	842
Increased overdraft facility	248	348
Total debt	5,726	8,042
Shareholders funds as at 31 December 1994	19,461	27,332
Debt: Shareholders funds ratio	29%	29%

* Exchange rate as at 31 December 1994 712 K/USD

Deferred liabilities

The full potential liability for retirement benefits payable to employees and provided for in the accounts in full was at December 1994 K1,203,942,000 (March 1994 - K664,197,000).

Table 10 - 5 : Reconciliation of Operating Profit to the Net Cash Inflow From Operating Activities

	New fiscal year	Old fiscal year
in Zambian K'000	December	March
	1994	1994
Profit before taxation	1,703,904	2,656,739
Interest payable	253,494	600,311
Exchange loss on EIB loan	188,977	139,880
Operating profit	2,146,375	3,396,930
Depreciation	948,562	168,536
Provision for deferred liability	539,745	349,718
Deferred expenditures amortized	3	3
Loss/(profit) on sale of tangible assets	258	(1,485)
Increase in debtors	(60,401)	(489,248)
Increase in creditors	272,018	568,528
Increase in stocks	(1,927,596)	(1,293,076)
Net cash inflow from operating activities	**1,918,964**	**2,699,906**

11. INVESTMENT PLAN

11. 1 MARKETING COSTS

The marketing costs assessed in Chapter 7 as overhead costs are arising from:

a/ Chilanga Cement Plant Sales department operation - traveling, petrol consumption, office supplies, postage, etc.

b/ Sales promotion, costs of transport, rents of Zambia Railway facilities in Lusaka and Kabwe, etc Applied more then less at export sales.

c/ Department for purchasing at Chilanga plant and Marketing department at Head Office of Chilanga Cement PLC as a part of contribution amount paid monthly by the plant (included in the administration overheads).

11.2 PRODUCTION COSTS

Computing of annual production costs takes into account the full production capacity of the plant 315,000 tons of cement an all items of cost structure included in Chapters 4,7 and 8.

The unit costs per ton of cement on annual basis are listed below:

Item No	Item description	Costs in USD	%
1	Materials and inputs	23.37	38.91
2	Personnel overhead costs	3.73	6.21
3	Factory overheads	1.31	2.18
4	Factory costs (1+ 2+ 3)	28.41	47.30
5	Administrative overheads	13.74	22.88
6	Sales & distribution costs	1.23	2.05
7	Operating costs (4+ 5+ 6)	43.38	72.23
8	Depreciation	6.52	10.85
9	Financial costs	10.16	16.92
10	Production costs (7+ 8+ 9)	60.06	100.00

The item 5 "Administrative overheads" includes ones from Table „OVERHEAD COSTS" in Chapter 0.7 as well as the contribution to Head office.

There is an effective functioning of material management considered in the stock with as low as possible level of inventories, semi-products and finished products (see Chapter 11, part "Working capital"). For the weighted prices (80% local bagged and 20% exported cement) of the variants A, B and C the percentage of the production costs is as follows:

A	60.06/80.40	74.70 %
B	60.06/88.80	67.64 %
C	60.06/84.60	70.99 %

11.3 ACCOUNTS AND STATEMENTS

For next analyses are used the "INCOME STATEMENT ANALYSIS" and "CASH FLOW ANALYSIS" Data for these analyses are taken from Chapter 3 2, Chapter 11 2 and Schedule 4 1

11.4 ANALYSIS OF FINANCIAL STATEMENTS

The income statements for three price variants of bagged cement coming from expected sales in future (Chapter 3 2) and production costs (Chapter 11 2) are as follows

Table 11 - 2: Income Statement Analysis (in USD)

Variant	A	B	C
Local bagged price	86.00	96.00	91.00
Export price	58.00	60.00	59.00
Weighted price (20% export)	80.40	88.80	84.60
Production costs	60.06	60.06	60.06
Gross profit per ton	20.34	28.74	24.54
Full capacity gross profit estimate	6,407,100	9,053,100	7,730,100

Table 11 - 3: Cash Flow Analysis (in USD)

	Year 2000			Year 2001-2011		
	A	B	C	A	B	C
Cash sales	20,100	22,200	21,150	25,326	27,972	26,649
Production costs	17,947	17,947	17,947	18,919	18,919	18,919
Profit taxable	2,153	4,253	3,203	6,407	9,053	7,730
Tax (weighted)	667	1,318	993	1,986	2,806	2,396
Profit after taxation	1,486	2,935	2,210	4,421	6,247	5,334
Depreciation	2,054	2,054	2,054	2,054	2,054	2,054
Net cash flow	3,540	4,989	4,264	6,475	8,301	7,388

The weighted tax is computed from 80% of 35% and 20% from 15%. (See Chapter 11 6 TAX POSITION)

In the year 2000 the capacity utilization is estimated at 250,000 tons of cement It means 79.37 % utilization of full production capacity 315,000 tons

In this case the production costs are changed due to variable costs (most of material and inputs) and in total they are relatively higher due to fixed costs.

The Net cash flow is computed without considering of interests arising from bank deposits. This simplified computing of net cash flow shows that there is needed another source of project financing in the year 2000 unless the price reaches level B.

The foreign part of Total Investment Costs is assumed as being a loan which will be requested from foreign investor.

This item presents an amount of 28,890,920 USD (see Chapter 11.8.1).

11.5 DETAILED ANALYSIS OF BALANCE SHEETS

Detailed analysis of Balance sheets requires a special focus on financial issues of the company as a whole, i.e. the Head Office, Ndola plant and Chilanga plant operations.

11.6 TAX POSITION

The tax position of Chilanga Cement PLC can be examined from the historical data how the profit of company was taxed. They are as follows:

Table 11 - 4 : The Tax Position of Chilanga Cement PLC

Year	1989	1990	1991	1992	1993	1994	1995*
Profit before tax (in million K)	21.2	70.1	138.5	212.3	1,241.0	2,657.0	2,294.0
Tax (in million K)	5.1	7.6	28.1	15.0	410.0	852.0	1,066.0
Percentage (%)	24.05	10.84	20.29	7.07	33.04	32.07	46.47

* not yet audited when data issued

The percentage mentioned above shows an unstability in the tax payments. Information related to reason for this state were not available. In the year 1993 the rate of 15% was applicable to taxable profits attributable to export sales. The standard rate of 35 % was applicable to taxable profits arising from local sales (Source: PROSPECTUS 1995, Chilanga Cement PLC).

The INCOME TAX CHAPTER 668 OF THE LAWS OF ZAMBIA, SECOND SCHEDULE PART III Exempt organizations says

„ (2) The income of the following shall be exempt from tax:

(a) the Commonwealth Development Corporation „

At the other place of the CHAPTER 668 are mentioned Rates of Initial and Wear and Tear Allowances for machinery and plant implements.

Because closer information on allowances within implementing new equipment are not available this Feasibility Study does not apply them.

It should be highlighted that CDC has provided this privilege as a public organization. Will the Government of Zambia keep this exemption of tax and for how long now that CDC is directly involved in privatized company such as Chilanga Cement PLC. Clarification need to be made

11.7 INSURANCE (COVERAGE OF FIXED ASSETS, INVENTORIES, ETC.)

The insurance premiums are paid for the Chilanga Cement company as a whole and they are reimbursed from contribution taken from Cement plants

The values of insurance premiums paid during the period from 1993 to 1995 are as follows:

Table 11 - 5 : The Values of Insurance Premiums

	PLANT ALL RISKS	MARINE	MOTOR VEHICLE COMPREHENSIVE	MACHINERY BREAKDOWN	TOTAL
1993	26,385	3,572	3,777	-	33,734
1994	60,898	37,515	27,508	7,715	133,636
1995	50,895	71,054	39,981	9,943	171,873

The figures are in K'000. Source: Financial Department, Chilanga Cement PLC

In 1993 the machinery breakdown policy was still under review.

11.8 TOTAL INVESTMENT COSTS

11.8.1 PRE-PRODUCTION INVESTMENT COSTS

11.8.1.1 FIXED ASSETS

Taking into account the fact that the land for erection of new kiln-line is free of charge the fixed investment costs include merely those of machinery, equipment, buildings, civil works, housing colony and auxiliary facilities.

Data on fixed investment costs are taken from Chapter VI, Table 6.1 - Equipment, 6.2 - Civil Engineering Works and 6.4 - Estimate of production Costs: Civil Engineering Works and are in US dollars.

Table 11 - 6 : FIXED INVESTMENT COSTS

Item	Costs			
	Foreign	Local	Total	%
Equipment	24,741,940	3,851,710	28,593,650	73.14
Civil Engineering	2,268,000	8,232,300	10,500,300	26.86
Fixed investment costs	27,009,940	12,084,010	39,093,950	100
Percentage	69.09	30.91	100	

11.8.1.2 PRE-PRODUCTION CAPITAL EXPENDITURES (FIXED ASSETS)

The individual items of the pre-production capital expenditures are evaluated in Chapter IX

The preparatory investment studies are not included due to the grants provided by the Japanese donors through UNIDO. The values are in U.S. Dollars as follows:

Table 11 - 7 : Pre-production Capital Expenditures

Item	Foreign	Local	Total
Pre-production Capital Expenditure	1,004.6	1,493.9	2,498.5
Percentage	40.21	59.79	100

11.8.1.3 WORKING CAPITAL (CURRENT ASSETS)

Spare parts necessary for 2 year operation of the proposed plant being an integral part of machinery and equipment supply is the only item of these costs and its value is taken from Chapter VI, Table 6.1 - ESTIMATE OF INVESTMENT COSTS: EQUIPMENT

Table 11 - 8 : Working Capital

Item	Costs		
	Foreign	Local	Total
Working Capital	876,380	77,330	953,710
Percentage	91.89	8.11	100

The working capital is 2.24 % from the total pre-production investment costs.

11.8.1.4 SUMMARY OF THE PRE-PRODUCTION INVESTMENT COSTS

Table 11 - 9 : Summary of the Pre-production Investment Costs

	Costs			
Item	Foreign	Local	Total	%
Fixed Assets				
* Fixed Investment Costs	27,009,940	12,084,010	39,093,950	91.89
* Pre-production Capital Expenditure	1,004,600	1,493,900	2,498,500	5.87
Current Assets				
Working Capital	876,380	77,330	957,710	2.24
Total Initial Investment Costs	28,890,920	13,655,240	42,546,160	100
Percentage	67.90	32.10	100	

11.8.2 INVESTMENT COSTS DURING PRODUCTION

11.8.2.1 FIXED INVESTMENT COSTS

Expected life of the mobile equipment is 10 years as it is depreciated by 10 per cent a year Therefore one replacement of the truck pool during 12 years of plant operation during the economic life of project is considered in total amount of 600,000 USD

11.8.2.2 WORKING CAPITAL

Value of working capital just at the beginning of production phase should be amounted as a permanent storage capacity of materials, inputs, semi-products and products.

The value is supposed as follows:

Gypsum	... 10 days	... 13,260 USD
Coal	... 10 days	... 50,914 USD
Clinker	... 5 days	... 390,053 USD
Cement bagged	... 5 days	... 451,027 USD
Diesel oil	... 10 days	... 4,100 USD
Paper bags	... 30 days	... 206,670 USD
Spare parts, grinding media,refractories	... 1 year	... 680,000 USD
Medical, canteen and stationary stocks	... 1 year	... 50,000 USD
Total		**... 1,846,024 USD**

11.9 FINANCIAL APPRAISAL

The financial analysis is supposed to assess the production capacity expansion project with production capacity of 1,000 tons of clinker per day (corresponding to 315,000 tons of cement per year).

The foreign part of Total Investment Costs is supposed to be a loan from foreign investor.

This item presents an amount of 28,890,920 USD (see Chapter 11.8.1).

Basic loan amount:	... 28,890,920 USD
Payback period:	... 12 years
Internal rate of return	... 9.0 %
Grace period	... 2.5 years for the 1st part of the loan

According to the schedule of implementation of project (Chapter 9) is the schedule for payments as follows:

The first part of loan 5,800,000 USD will be deposited 2.5 years before the end of pre-production period. Interests arisen within the grace period are of 1,394,378 USD being paid out during production period.

Second part of loan 23,090,920 USD will be deposited at the beginning of production period. The cash annual installments as payback amounts are 4,035 thousand USD. **The inflation (discounting) rate for the purpose of this Feasibility Study is not considered.**

Net Present Value:

$$NPV = -28,890,920 + \sum_{j=1}^{12} \frac{4,035,000}{(1+0.09)^j} = +2,606.49\ \text{USD}$$

***Note:** Break-even point, Sensitivity analysis and various ratios will be computed by the COMFAR facilities.

12. ECONOMIC ANALYSIS NATIONAL AND REGIONAL LEVEL

12. 1 EMPLOYMENT EFFECTS

One of the advantages of Chilanga Cement PLC, company as a whole is the trained and skilled staff keeping operation of the company running.

The company takes use of every opportunity to employ women and place them to position convenient for women though character of cement production industry does not allow many opportunities for women because of safety reasons.

The increased production of cement as a consequence of new machinery and equipment implementation press more to decrease the number of employees, especially the unskilled ones. Therefore, the results of project will not be the increase of employee number in Chilanga Cement Plant. Nevertheless, the development of construction industry will offer employment opportunities through the increased activities of construction companies processing Chilanga cement in the region.

The cement plant alone has limited opportunities for employing large number of people from outside.

There are several limitations, as follows:

- additional costs for training (effective operation, safety)
- economical operation to reach a maximal profit

12. 2 FOREIGN EXCHANGE EFFECTS

The stability of Chilanga Cement Plant export sales contributes to the collection of hard currency for Zambian economy, which can be used for alternative investment. Thus, Chilanga Cement PLC ensures the multiply effect for Zambian economy.

12. 3 ECONOMIC INDUSTRIAL DIVERSIFICATION

The economic industrial diversification will be developed if Chilanga Cement Plant expands and makes use of national subcontracting industries performing in the same sector.

12.4 INSTITUTIONAL SUPPORT INCENTIVES

Provided that the tax advantage given to CDC by the government of Zambia are transferred to Chilanga Cement PLC for at least 30 additional years the financial figures provided in this report confirm the profitability of an investment in the optimization and expansion of CCL.

13. CONCLUSIONS

* The expansion of the Chilanga Cement plant in Zambia appears to be a profitable project for both the country and the company provided that investment means new technology, an enlarge markets base on proven geological raw material reserves.

* The forecast of consumption of cement in Zambia (including export) is supposed as follow:

- after year 2000 approximately 530,000 to 600,000 tpy cement

- after year 2015 approximately 750,000 to 800.000 tpy cement

* Maximal quantity of the production of the expanded Chilanga Cement Plant after the year 2000 will be approximately 315,000 tpy of cement.

* **The total volume of proved reserves of raw material for the expansion of the plant is adequate for more than 30 years cement production, it means 15.7 million tons.**

* Because of the vicinity of the capital Lusaka (18 km) and southern part of the country, where presumably the main future consumption of cement will be, the actual location of Chilanga Cement Plant is very convenient.

* **From the two alternatives of the expansion of Chilanga Cement Plant, Alternative No.2 (dry process of clinker production with capacity of 1,000 tpd clinker - annual output 315,000 tpy cement), has been selected**

* One of the advantages of the alternative chosen is to make use of some existing departments.

* **Chilanga Cement Plant after expansion will still produce the two types of final products: normal Portland cement and high early strength cement according to Zambia Standard ZS 001 : 1972.**

* Regarding predicted consumption of cement in Lusaka Province, Southern Province as well as in Malawi and Tanzania the share of local and export is as follows:

Local sales (bagged and bulk) .... 80 %

Export .... 20 %

* **The export sales require a specific approach in terms of sales promotion and a strong improvement of the company marketing activity.**

* The local sales are to be increased particularly in Lusaka region due to expected boom in construction sector.

* The support from the Government underlines this idea.

* The expansion of cement production in Chilanga requires foreign capital as well as Chilanga Cement PLC owns financial sources.

* Repaying the foreign loan (annual installments of 4 million USD) along with to be operation running effectively requires that profit generated in Ndola Cement Plant be used to support the overall debts.

* The final decision to carry out the project of Chilanga Cement Plant by expanding production capacity is supposed to be made by the Board of Directors, or in fact by CDC, the major shareholder.

* The decision obviously will influence the dividend policy of the company because major part of retained profit should be used for payments of the loan installments. The internal sources of financing as equity, profit after taxation and rationalization have to be seriously considered. A good base for the rationalisation's exercise will be to switch to the dry process and to make better use of the well trained staff operating the plant.

* The rationalization supposed a better marketing oriented approach with the use of modern information system.

14. RECOMMENDATIONS

14.1

Action: To implement the optimization and expansion project according to UNIDO neutral advises provided in the feasibility study. An investment decision should be taken by the shareholders

Responsible actor: The CCL management

Deadline : Before the end of fiscal year 1996

14.2

Action: To clarify with the Government the duration and the level of the income tax holiday provided to CDC

Responsible actor: The CCL management

Deadline : As soon as possible

14.3

In order to reduce the production costs and to optimize the company, two main actions should be done:

14.3.1

Action: To decide on the implementation of the dry process technology

Responsible actor: The CCL management and shareholders

Deadline : Before the end of the fiscal year 1996

14.3.2

Action: To carry out detailed geological, chemical and technological study of RP3 deposit limestones and Phyllite Quarry phyllites properties with regard to requirements of the dry cement production process.

Responsible actor: The CCL management using a geological consulting company

Deadline : After the decision implementing the dry process technology and before the start-up of the operation of the new investment

14.4

In order to stabilize and optimize the volumes of cement sale, two main actions should be done in the field of marketing:

14.4.1

To strengthen the marketing department in setting up reliable market information system in Chilanga Cement PLC which should integrate national, regional and international data on a computerized system.

Responsible actor: The CCL management

Deadline : As soon as possible

14.4.2

Action: To elaborate market concept and a marketing strategy with the objective to facilitate the shareholders and the management decisions and facilitate the identification of new markets for sale opportunities.

Responsible actor: The CCL management with the support of consultant firm / UNIDO.

Deadline : As soon as possible

14.5

In order to facilite the expansion of the company, two main actions should be performed:

14.5.1

Action: To undertake support technical study which should prove the availability the additional limestone reserves, especially in the lower part of RP3 deposit (under the 60m RL) and then on its north eastern continuation parts. In addition accurate determination of geomechanical properties of the rocks in deposit should be ascertain with the aim to change the final pit slope inclination more than 45° with very small additional costs.

Responsible actor: The CCL management using a geological consulting company / UNIDO.

Deadline : Recommended period should be before the end of fiscal year because of no possibility to implement new pit slope due to future no accessibility.

14.5.2

Action: To prove the availability of additional reserves of limestones after approximately twenty years by carrying out detailed geological investigation of Outpost Hill deposit.

Responsible actor: The CCL management and the geological consulting firm / UNIDO

Deadline : 5 years before the depletion of RP3 deposit (approximately in the year 2010).

ANNEX 1

MISSION ACTIVITIES AND THE EXPERTS' WORK PLAN

DATE	ACTIVITIES
October 7, 95	Travel Vienna - Lusaka via London
October 9, 95	Meetings in Chilanga Cement Limited (CCL) with Mr. P. Gorman, General Manager of CCL , Chilanga Works with Mr. E.Simakoloyi, Works Manager and Mr. J. Mills, Mining Engineer
October 10, 95	Meetings in the COMESA Secretariat with Mr. J. E. O. Mwencha, Director of Industry, Energy and Environment; Mr. M.A. Salah, Senior Officer COMESA and Mr. M. Sichilima, COMESA Officer
October 11, 95	Meetings in COMESA Secretariat with Mr. E. Mashama, Computer Operator from Industry Division and Mr. E. Twagirumukiza, Head of Statistician Unit
October 12, 95	COMESA Library, Study of documents
	Meeting with Mr. Y. E. Amaizo, backstopping officer from UNIDO Vienna and Mr. J. E. O. Mwencha. Discussion on the objectives of the mission
October 13, 95	Chilanga Works, meeting with Mr. E. Simakoloyi and Mr. J. Mills, discussion on the main points of the operation of Chilanga Works and on Chilanga area cement raw materials deposits
October 16-17, 95	Visits of Ndola Works and Ndola Deposit (accompany by Mr. K. Karima, CCL Technical Manager) and meeting with Mr. M.Kapepula, Ndola Works Manager
October 18, 95	Study of the documents gained
October 19, 95	Chilanga Works, meetings with Mr. Henry, Production Manager; Mr. G.M. Malimba, Works Technical Manager and Mr. J. Mills
October 20, 95	Study of the documents gained
October 23, 95	Chilanga Works, meetings with Mrs. T. Mordue, Financial Manager; Mr. J. Luhana and Mr. P. Maanga, Marketing Managers; Mr. E. Munthali, Manager of Human Resources and Mrs. L. Mwakabanga, Works Accountatnt. Geologists of the team visited RP3 quarry with Mr. J.Mills
October 24, 95	Field survey in RP3 quarry (geologists)
October 25, 95	Field survey in RP3 quarry (geologists), meetings with Mrs. L. Mwakabanga and Mr. C. Sengebwila, Financial Controller (economist) and meeting with Mr.Henry (team leader)
October 26, 95	Zambia Revenue Authority, meeting with Mr. J. B. Chirwa, VAT Consultant ZRA and Mr. B. Mwiinga, Assistant Commissioner ZRA. Geological Survey, meeting with Mr. J. C. Michelo, Technical Records Officer and study of the geological reports.

	National Commission for Development and Planning, meeting with Mr. E. Musenge, Officer of Macroeconomic Policy Dept
October 27, 95	CCL, meetings with Mrs. L. Mwakabanga, Mr. C. Sengebwila, Mr. Henry, Mr. I. M. Shansonga, Assistant Quarry Manager, Mr. G. M. Malimba and Mr. K. Karima
October 30, 95	CCL, Meetings with Mr.Henry, Mr. P. Maanga, Mr. C. Sengebwila, Mrs. L. Mwakabanga, S.Lisulo, Material Manager, J.Zulu, Works Engineer, Mr. I. Siansonga and Mr. M. Malimba
October 31, 95	Geological Survey, meeting with Mr. J. C. Michelo,
	Government Printers, gaining of laws needed
	Barclay Bank
November 1, 95	Field survey, visit of deposits RP1, Outpost Hill, Shimabala
November 2, 95	Final meetings, Zambian Railways
November 3, 95	Completion of the documents gained
November 5, 95	Travel Lusaka - Vienna via London

ANNEX 2

Y.E. Amalzo/sd
24 April 1995
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TR/RAF/90/902

Action programme to support the dynamic development of the building materials industry in the COMESA region

TERMS OF REFERENCE

ZAMBIA

FEASIBILITY STUDY FOR THE OPTIMIZATION AND EXPANSION OF THE CHILANGA CEMENT PLANT

Prepared by the
Feasibility Studies Branch

A. BACKGROUND INFORMATION

After nine years of continuous growth in the demand for cement, capacity utilization by the Zambian cement industry reached 85% in 1991. The Structural Adjustment Programme (SAP) by the Government of the Republic of Zambia in that year caused a significant decline of the Zambian economy. As a result, the construction industry entered a period of major recession.

In 1994, some results from the SAP were being experienced by the Zambian economy. Interest rates were declining, inflation was significantly reduced, and there was reasonably firm control of the money supply. Zambia, therefore, can look forward to the start of a period of sustained growth in domestic economic activity.

Demand for cement will begin to increase as the national economy develops. As current cement usage is only 32 Kg per capita per annum, it is likely that early small developments in the economy will be reflected in very significant demand increases for cement.

Additionally, changes in the mining technology employed by Zambia's copper mining industry will dramatically increase the demand for cement as a stabilization of backfill by the year 2000.

The objective of the study is the identification of the optimum programme of capacity development in the Zambian cement industry and an evaluation of the sub-regional market.

Chilanga Cement Ltd. (CCL) is the sole producer of cement in Zambia. Having been in operation since 1950, CCL runs two cement works having two kilns in service each. The original factory, situated 15 km south of Lusaka, remains a wet process factory with a capacity of 200,000 tons of cement per annum. In 1986, a second factory was commissioned at Ndola in Zambia's Copperbelt Province which uses dry technology and has a capacity of 350,000 tons.

CCL was a parastatal organization operating under the Zambia Industrial Mining Company. A significant shareholding of CCL was in private ownership. In accordance with the policies of the Government of Zambia to adjust the structure of the national economy to a free market, CCL was recently privatized. The Zambia Privatization Authority (ZPA) announced in May that the Commonwealth Development Corporation (CDC), the longstanding shareholder in Chilanga Cement Plant, had exercised its preemptive rights and become the majority shareholder in the company. Chilanga Cement Plant was among the second tranche of companies offered for sale by the ZPA. The CDC signed a US$ 5.4m agreement with the Zambia Industrial and Mining Company (ZIMCO), the state holding company which had previously controlled Chilanga Cement Plant, to increase CDC's holding from 24% to 50.1%. Zamanglo Industrial Corporation (ZAMICO), a subsidiary of South Africa's Anglo American Corporation, is the second-largest shareholder with 12.6%. Chilanga Cement has operations in Ndola and in Chilanga, south of Lusaka, at the time of the deal its net assets were valued at US$ 24m and its total shareholding at US$ 21m.

According to its annual report for 1993, the CDC has shares in seven Zambian companies.

Of these, Kafue Textiles of Zambia, Zambia Cashew Company and Nanga Farms were, along with Chilanga Cement Plant, in the second tranche of companies to be privatized and the CDC has the option to buy the controlling interests in all of them.

The market history of CCL is one of gradual increase from inception to Independence, with a peak corresponding to the construction of Kariba Dam in the mid-1950s. A post Independence construction boom brought the market from 150,000 tons in 1964 to 450,000 in 1974 The fall in the copper price in 1974 ended the buoyant fortunes of the construction industry. Between 1976 and 1983, the industry languished with domestic annual cement sales of approximately 250,000 tons. During this period, export markets were penetrated to utilize the excess capacity of the company and earn the foreign exchange required for the survival. A major rehabilitation of production equipment was executed in the early 1980s. Thereafter, a gradual growth in sales was achieved with the domestic market reaching 370,000 tons in 1991. The SAP has restrained the market to approximately 260,000 tons per annum since. The regional export markets have been developed to a level of 20% of total sales.

Could CCL become a profitable cement plant with an increase of its sales at the regional level, i.e. Common Market for Eastern and Southern Africa COMESA, Botswana and South Africa?

Is there an urgent need of localization of suitable limestones reserves in the Lusaka region?

In terms of efficiency and production cost, should the dry process technology be adopted? Should'n it be more cost-effective to review also the replacement of the outmoded wet process with a new mini-cement plant?

Will the new owners be interested in investing in the CCL provided that the feasibility study demonstrates the profitability of the final recommendation? Which are the financial institutions which could provide loans at a reasonable interest rate?

All this major questions will be answered in the feasibility study.

B. PURPOSE OF THE PROJECT

The purpose of the project is to carry out a feasibility study (with a special focus on regional market) on the optimization and expansion of the Chilanga Cement Plant in Lusaka- Zambia. The immediate objective is to enable the Head's executives, the new shareholders in close consultation with the COMESA Secretariat and the Government of Zambia to make an investment decision regarding the upgrading/modernization of the CCL after the privatization of the plant.

C. RESPONSIBILITIES OF THE CONTRACTOR

The contractor is required to prepare a feasibility study with a strong regional market emphasis for the optimization and expansion of the Chilanga Cement Plant in Lusaka following the methodology proposed in the UNIDO Manual for the Preparation of Industrial Feasibility Studies. Accordingly, the study will cover the following items, each providing detailed information and analyses of the enquiries performed, and analysis of the most attractive proposal and recommendations for follow-up action. The study will also include annexes, financial tables, economic statistical tables, charts, diagrams, engineering designs and drawings, etc. The Contractor is required to undertake the work specified below, bearing in mind that these activities are not exhaustive.

D. OUTLINES OF THE STUDY

I. <u>Executive summary</u>

- The enterprise after the privatization:

  1. Its principal position in and interrelations with the business environment
  2. A regional cement plant

- General indicators: business objectives and corporation strategies, general strengths and weaknesses

- Marketing concept and plant capacity

- Raw material inputs and factory supplies

- Location, site and environment including location of suitable limestone reserves in the Lusaka region

- Engineering situation and technology

- Plant organization and overhead costs

- Human resources

- Plant implementation schedule

- Financial analysis, standing and investment plan

- Economic analysis

- Conclusions

- Recommendations/Actions

2. Background and history

2.1 Background
2.2 The enterprise
2.3 History

3. Market analysis and marketing concept

3.1 Market structure and characteristics
3.2 Sales of products and by-products
3.3 Sales organization
3.4 Value of stock of semi-finished and finished products
3.5 Analysis of marketing costs (direct and overhead costs)
3.4 Analysis of the main competitors
3.5 Analysis of strengths and weaknesses of the firm
3.6 Evaluation of the marketing concept; conclusions and recommendations

4. Raw materials and factory supplies

4.1 Characteristics of raw materials and factory supplies
4.2 Supply programme

5. Location, site and environment

5.1 Location and site of the plant
5.2 Location of suitable limestone reserves in Lusaka and in the sub-region
5.3 Local conditions
5.4 Assessment of environment impacts, public and corporate policies, conflicts, costs and environmental forecast

6. Engineering and technology

6.1 Production programme
6.2 Plant capacity
6.3 Feasibility nominal plant capacity of entire plant, main departments, major equipment units
6.4 Plant layouts and charts (show existing structure of plant on physical layouts and on functional charts and layouts)
6.5 Scope of enterprise (show scope of enterprise on layout drawings, and divide it into project components and cost centres)
6.6 Selection of technology and justification of optimization through replacement if needed
6.7 Equipment and maintenance constraints
6.8 Civil engineering works

7. Plant organization and overhead costs

7.1 Cost centres
7.2 Overhead costs (list overhead costs and classify into factory overheads, administrative and marketing overheads, depreciation charges and financial overheads)

8. Human resources

8.1 Labour
8.2 Staff

9. Plant implementation

9.1 Proposed time implementation schedule
9.2 Estimated implementation costs

10. Financial analysis and standing of the enterprise

10.1 Reputation with reference to
a) Bankers: credit standing, balances carried, type and length of loans, guarantees, general performance.
b) Major creditors: buying policies, special terms, payment record, general performances
c) Customers: standing of the enterprise and its products in the trade, and its advantages or disadvantages over other companies in the same trade
10.2 Capital structure

11. Investment plan

11.1 Marketing costs
11.2 Production costs
11.3 Accounts and statements
11.4 Analysis of financial statements
11.5 Detailed analysis of balance sheets
11.6 Tax position
11.7 Insurance (coverage of fixed assets, inventories etc.)
11.8 Total investment costs (including working capital requirement)
11.9 Financial evaluation
a) Payback period
b) Internal rate of return
c) Break-even point
d) Sensitivity analysis (discounting rate, inflation, sale programme modification)

12. Economic analysis national and regional level

12.1 Employment effects
12.2 Foreign exchange effects
12.3 Determination of significant distortions of markets prices
12.4 Economic industrial diversification

13. Conclusions

14. Recommendation/Actions

15. Annexes

a) Comfar inputs data sheets
b) Comfar diskettes
c) Comfar graphic's tables

E. SCOPE OF CONTRACTOR'S SERVICES

Under the general and direct supervision and guidance of UNIDO (Feasibility Studies Branch), the feasibility study report will be prepared by an international contractor under UNIDO sub-contracting conditions. The report will be prepared in English.

F. PROVISION OF SERVICES AND EQUIPMENT

1. The contractor will work in close contact with the backstopping officer at UNIDO Headquarters.

2. During their travel in the field, UNDP/UNIDO and COMESA Secretariat offices will help the consultants in contacting appropriate public or private sector officials, directly interested or involved in the project.

3. The Chilanga Cement Plant and the COMESA Secretariat will accommodate most appropriate personnel as a liaison office, who will assist the team as required.

4. Office facilities and local transportation will be provided by COMESA Secretariat to the consultants only in Lusaka.

G. GENERAL TIME REQUIREMENT

Implementation schedule of the opportunity study compilation and its follow-up is as follows

-	Award of contract and briefing in Vienna	A
-	Fielding of expert and briefing with the COMESA Secretariat experts	A+ 0.5
-	Completion of field survey and debriefing	A+ 1.5
-	Submission of the interim report (plan)	A+ 3.0
-	Submission of the draft final report	A+ 4.5
-	Debriefing session with UNIDO	A+ 5.0
-	Submission of the final report	A+ 6

UNIDO will finalize the comments within 15 days after submission of the draft feasibility study report by the contractor. The final report will be submitted within 1 month after receipt of UNIDO comments.

H. THE REPORTS

Three copies of the interim and 50 copies of the final report compiled in English will be submitted to UNIDO with the blue standard cover pages (examples attached).

ANNEX 3

BACK-TO-OFFICE MISSION REPORT

1. *NAMES: Yves Ekoué Amaïzo 2. DEPARTMENT: ITPD/IS 3. BRANCH: FEAS*
   A.R. Marei MFRD/PF IS

4. *PLACE VISITED: Lusaka, Zambia (Marei/Amaizo), Windhoek & Otjiwarongo (Marei)*

5. *DATES: 11/07/94 - 20/07/1994 (including travel) (Amaizo)*
   12/07/94 - 21/07/1994 (including travel) (Marei)

6. *PURPOSE OF THE MISSION:*

Reorientation of the project and Tripartite Review Meeting PTA, UNIDO, Japan. TF/RAF/90/902: Action Programme to support the Dynamic Development of the Building Materials Industry (with particular reference to the cement industry) in the PTA sub-region. On the basis of the evaluation report jointly prepared by UNIDO and the donor (Japan) representatives, the Feasibility Studies Branch decided to focus the project on support to the private sector and to develop more investment oriented activities. After Mr. P. Wiedemann, Mr. Amaïzo has been designated as the new backstopping officer. In the line with the team approach of UNIDO, technical support was requested from MFRD/PF/IS (Mr. Marei) and ISED/CHEM (Mr. Hagan).

7. *ACHIEVEMENTS:*

7.1. TF/RAF/90/902

The UNIDO mission held several discussions with the PTA Industry and Energy Division, the Zambian Development Bank, the Japanese Permanent Mission in Lusaka, the Management of Chilanga Cement Factory in Zambia and the UNIDO office. Out of US$ 700,000.-, US$ 300,000.- is the remaining amount left to implement the four new outputs agreed upon by the PTA Secretariat and UNIDO. Please refer to the minutes of the main meeting held at the PTA on the reorientation of the project. The minutes was presented to the japanese First Secretary who very much appreciated the visit. He mentioned that he had not received any reports which were produced. We agreed that Mr. Salah (PTA) will provide him all available reports in order to keep everybody at the same level of information.

Following UNIDO preparatory investigations on potential co-operative institutions or firms, Mr. Amaïzo presented the three following firms/institutions to the PTA:

- *UK private sector: Intermediate Technology*
- *Slovakia private sector: KERAMO Project - A.S. TRENCIN*
- *India public sector: Entrepreneurship Development Institute*

Priority will be given to the firm/institution which could provide the best proposal for the implementation of the new output 3: General survey on alternative building materials in the PTA region including the regional workshop (lime and ceramics). PTA and UNIDO are discussing the cost sharing issue and final decision will be taken before the end of August.

In order to provide PTA Secretariat with a comprehensive programme on building material, it was agreed that a special output should be: a preparatory assistance on fund mobilization programme on that particular sector. The four following aspects should be covered:

- *the modality of the establishment of a cost sharing/reimbursable investment facility;*
- *training and capacity building;*
- *advisory services in building material sector;*
- *introduction of new technology/pilot plant in building materials with selected developing countries.*

The report will be discussed later on during a donors' meeting which will be organized by the PTA Secretariat where financial commitment of present donors would be requested. UNIDO will be playing its usual role as associated neutral support agency to the PTA Secretariat. Among the donors, we foresee financial institutions such as PTA Bank, African Development Bank, various Development Bank, private sector and the Japanese Government.

7.2. *Meeting with the Zambian Development Bank: The mission was headed by Mr. Taylor, UNIDO UCD. Presentation was made on UNIDO cooperation with financial institutions. The management of ZDB shows great interest in UNIDO expertise possibilities. It was agreed that:*

1. *A general cooperation agreement will be signed between UNIDO and ZDB.*

2. *UNIDO (Mr. Marei and Mr. Amalzo) will provide a trust fund agreement with US$ 50,000.- and various information on UNIDO investment activities to the UCD who will forward it to ZDB.*

7.3 *It was agreed during the meeting with the PTA representatives that Mr. Marei should proceed from Lusaka to Windhoek, Namibia as urgently as possible instead of Tanzania in order to follow up the Government's request as supported by the PTA as well as the existing cement company in Otjwarongo on setting up two cement plants in Namibia. A message was sent by fax to UNIDO as attached for information.*

A. *Namibia*
Otjiwarongo
Meetings were held during the period 18 - 20/7/94 (MacPhail Pty Ltd.) in Windhoek attended by:

Mr. Howard J. Hebbard, Managing Director Macphail Co.
Mr. Marius Liefferink, Marketing Manager, Macphail Co.

The main purpose of these meetings was to discuss the possibility of rehabilitating and upgrading of the existing factory located in Otjiwarongo, *Namibia. The company already carried out some studies on the rehabilitation of the existing cement plant through BKS Incorporated (South Africa), August 1993 and other one business proposal February 1993 by BSA-BSS.*

All discussions through these meetings concentrated on upgrading the production line of 14 t/h i.e. 60,000 t/a which actually is producing 40,000 t/a. As the management of this company MacPhail is the main shareholder and just took over the cement factory from another inefficient management, accordingly the discussions concentrated also on how UNIDO could assist the new management to upgrade and rehabilitate the cement plant. As the picture of the plant's situation and the proposals explained for rehabilitating and upgrading it were vague for me, it was decided to visit the plant's site at Otjiwarongo.

A visit by air applying a special air plane was prepared on 19/7/94 early in the morning accompanied by the a/m marketing manager. The machinery and equipment applied for the cement production were visited and evoluated. The available documents were checked. My observations could be summarized as follows:

1. *Raw material investigations and a bankable Feasibility Study should be carried out before any decision to be taken either to rehabilitate or to establish a new cement plant based on the following remarks:*
   - i. *escaping from one area to the other as the silica content was changing and creating problems to the quality of cement produced.*
   - ii. *the clays are not true clays as it is in the process of complete weathering.*
   - iii. *there are some foreign pockets in the marble (limestone) consisting of metamperphrised inclusions amphipoles, cericites, chlorites etc.*

2. *For the raw mill, it was observed that*
   - i. *the liners are in bad shape*
   - ii. *grinding media is not sufficient*
   - iii. *the raw materials (hard marble) are in need to be pre-crushed to increase the production of the mill (output)*
3. *No available instrumentation for operating the plant efficiently (O_2 & CO monitoring)*
4. *The kiln rings are welded causing deformation against the shell*
5. *The sealings of the kiln are in a very bad shape causing excess air to enter the system*
6. *The clinker is very hard due to overburning*
7. *The temperatures of the entire kiln system is not well controlled. i.e. the kiln exit gases temp. is reaching 440°C.*
8. *The raw mill is of two diameters and the output could not satisfy the production.*
9. *The cement mill is sprayed by water to cool the cement*
10. *There is no identification of any statistical consumptions e.g. the grinding media, electricity, coal, etc.*

11. *The production capacity of the cement mill is low, in any case the mill is suffering from the very hard clinker introduced (overburnt) plus exceeding the fineness of the cement produced than required 3600/cm^2/gm*

After returning back to Windhoek a meeting was held with the MD and the Marketing Manager. In this meeting it was explained that any investment in the upgrading and rehabilitating the existing plant will be of no use as the plant was initially installed on collecting some machinery from here and there and already this plant exhausted much investment during the last few years. A new production line will be the solution. The investment in the new plant should include some investment for the old plant just to keep it running.

After, long discussions the Managing Director agreed with this proposal and that action will be taken by him to contact UNIDO to cover all the assistance required under an SF/TF Agreement to instal the new plant starting from the raw material investigations till commissioning and operating the plant by UNIDO experts and specialists for 2 or 3 years.

The company will contact officially UNIDO in the nearest future by max. August 1994 requesting to sign of the SF/TF Agreement based on the conditions agreed upon in the aforementioned meetings.

B. Okashana Co.

a. A meeting was held with Mr. J.R. Gebhardt, Managing Director to discuss the steps to be followed by himself and UNIDO to implement the items indicated in the signed memorandum (attached) in China between TCDRI, Tianjin, himself on behalf of the company and myself. This company-Okashana, is a company supported by the government of Namibia to start to instal a new cement plant in Karibib area under UNIDO supervision.

b. This meeting was followed by another meeting attended by the Managing Director and
Mr. Tsudao Gurirab, Permanent Sec. Ministry of Trade and Industry
Mr. Petrus T. Damaseb, Sec. to the President of Namibia (Director, Bank of Namibia)
In this meeting, the a/m officials showed their interest for UNIDO to supervise the establishment of a new cement plant in Karibib area and to assist Mr. Gebhardt, Managing Director already appointed by the Government to take care and be responsible for this project. This company could be considered as a governmental (public sector). Mr. Gurirab confirmed that the Ministry of Trade and Industry will contact UNDP officially requesting UNIDO's involvement to support Okashana Company in implementing all the phases required to instal a new cement plant in Karibin area.

c. The company carried out a pre-feasibility study by J.C. Rogers - F.N.D.C., I.A. Galloway-HKW Consulting Engineers - July 1993 on proposed 300 tpd cement factory.

d. *The a/m pre-feasibility study was reviewed and it was found that the following should be carried out before deciding about the capacity of the plant.*

   i. *Raw materials investigation should be carried out based on the Norms and Pre-requisites For Setting Up a New Cement Plant Project or Extending Existing Production Line prepared by Mr. Marei.*
   ii. *Feasibility study based on the Guidelines for the preparation of Industrial Investment Studies - prepared by the Feasibility Studies Branch, July 1992. The a/m Norms & Guidelines were requested officially (copy attached) to be sent to the managing director.*

e. *A SF/TF Agreement (revolving) to cover the preliminary phase as indicated in the attached letter should be prepared and forwarded to the company for signature.*

8. *ACTIONS:*

8.1. *TF/RAF/90/902:*

- *Chilanga Cement Plant will provide PTA with the official request for the feasibility study.*
- *UNIDO/PTA will pursue discussions regarding the cooperative firm/institution to undertake the general survey on lime and ceramics including the workshop.*
- *UNIDO will finalize the budget revision and will submit to the Japanese Permanent Mission in Vienna.*
- *PTA will provide the Japanese Permanent Mission in Lusaka with available reports.*

8.2. *Zambian Development Bank:*

UNIDO will provide the UCD with the trust fund agreement with US$ 50,000.- revolving fund, the general cooperation agreement between UNIDO and ZDB for follow-up actions.

8.3
- *ISED/CHEM in cooperation with the concerned BSO CPD/AFR to draft the SF/TF Agreement (revolving) covering the preliminary stage (raw material investigation and feasibility study) for Okashana Co.*
- *FMD/PF/IS to react with the official request expected to be received from MacPhail Co. and ask ISED/CHEM and CPD/AFR to cooperate to draft the SF/TF Agreement.*
- *FMD/PF/IS to provide the two companies with the norms and pre-requisites for setting up a new cement plant and the guidelines for the preparation of a feasibility study.*
- *ISED/CHEM to advise and follow technically the preliminary phase regarding the raw material investigations and the feasibility study for both Namibian Cement Companies.*
- *ISED/CHEM to follow the implementation of the following phases i.e. the tendering, evaluation of the tenders, contracting, erection, commissioning and*

operating the plant by UNIDO experts and specialists for 2 - 3 years as every phase will be covered by a special SF/TF Agreement.

9. ***DETAILED REPORT:** None*

10. ***SIGNATURE:*** 11. ***DATE:** 22 July 1994*

12. ***DISTRIBUTION:***

Mr. M. de Maria y Campos
Mr. K. Venkataraman
Mr. J-M. Deroy
Ms. A. Tcheknavorian
Mr. B. Jamilla
Mr. S. Zampetti
Mr. D-J. Ghozali
Mr. S. Ndam
Mr. M. Youssef/Mr. N. Biering/Mr. K. Hagan
Mr. U. Loeser
Mr. B. Andrasevic
Mr. S. Sachdeva/Ms. Q. Li
Mr. P. Wiedemann
Ms. D. Magliani-Streitenberger/Mr. T. Otsuka
Mr. V. Klykov
Ms. R. Touré
Mr. K. Hagiwara
Ms. M. Pokane
Mr. Y. Okello

Zambia:
Mr. O. Yucer, Resident Representative, UNDP, Lusaka, Zambia
Mr. E. Taylor, UCD, UNIDO, Lusaka, Zambia

For UCD: Please inform:
- *Messrs. Mwencha/Salah, PTA Secretariat*
- *Zambia Development Bank - Mr. Mwinga*
- *Ms. Elisabeth Merz, JPO, Namibia*

Attachments: - *Minutes of the meeting held at the PTA Secretariat to review project: TF/RAF/90/902*

- *Letter received from Mr. J.R. Gebhardt, MD of Okashana Co., Namibia*

PREFERENTIAL TRADE AREA
FOR EASTERN AND SOUTHERN AFRICAN STATES

ZONE D'ECHANGES PREFERENTIELS DES ETATS DE L'AFRIQUE DE L'EST ET DE L'AFRIQUE AUSTRALE

ZONA DE COMERCIO PREFERENCIAL PARA OS ESTADOS DA AFRICA ORIENTAL E AUSTRAL

Tel:260-1-229726/29
Telex ZA 40127
Fax:260-1-225107

Lotti House
Cairo Road
P.O. Box 30051
10101 Lusaka, Zambia

FACSIMILE TRANSMISSION INSTRUCTIONS

To: *UNIDO*

ATTN: MR. ZAMPETTI/ GHOZALI /INFO DEROy

City: *Vienna*	Country: *Austria*
Fax No.: *232153*	No. of pages:
From: *M.A. Sallah*	Division: *Industry*
Date: *15/7/94*	Reference:
Sender's Tel. No.:00-260-1-229726/32	Fax No.: 00-260-1-225107

MESSAGE

Re: Project No. TF/RAF/90/902 - Action Programme to Support the Dynamic Development of the Building Materials Industry with Particular Reference to Cement

Following our discussions with UNIDO staff (AMAIZO/MAREI) who are here to review the above project, we wish to let you know that it was felt important that Dr. Marei should proceed from Lusaka to Windhoek - Namibia as urgently as possible instead of Tanzania in order to follow up the government's request supported by PTA on setting up two cement plants in Namibia.

He will be travelling to Windhoek on Sunday, 17th July, 1994.

Regards.

M.A. Salah
Officer-in-Charge
INDUSTRY & ENERGY DIVISION

MINUTES OF THE MEETING HELD AT THE PTA SECRETARIAT TO REVIEW PROJECT NO. TF/RAF/90/902 - ACTION PROGRAMME TO SUPPORT THE DYNAMIC DEVELOPMENT OF THE BUILDING MATERIALS INDUSTRY WITH PARTICULAR REFERENCE ON CEMENT

Present	Dr Y. E Amaizo	UNIDO
	Dr A. R. Marei	UNIDO
	Mr A. N. Salah	PTA Secretariat
	Mr M. Sichilima	PTA Secretariat

Prior to the main meeting Dr Amaizo, Salah and Sichilima held a brief discussion with the Director of Industry of the PTA at which the general strategy was discussed. The discussion included new activities on cost sharing basis, co-operation with financial institutions and south - south partnership.

The agenda of the meeting was adopted as follows:

1 General review and re-orientation of the project

2 Identification of new outputs

3 Work plan for the next six months and budget revision

4 Tripartite review meeting

1 GENERAL REVIEW AND RE-ORIENTATION OF THE PROJECT

The meeting noted that the following outputs under the project were achieved:-

The following additional outputs which were not in the project document were also achieved namely:-

Output 1 A survey (report) of the state of the building materials industry internationally with particular reference to the PTA

Output 2 Eight cement surveys reviewing the state of the cement industry

Output 3 Eight cement enterprises surveys for each of the enterprises to be examined in the diagnostic studies.

Output 4 Two seminars on the Economic technological and technical dimensions of industrial expansion, diversification and modernization on cement.

Outputs 5 and 6, as below, were not implemented and would not be implemented in the re-oriented project, on the basis of the evaluation report.

Output 5 selected — Direct medium term Human technical assistance to three enterprises

Output 6 — An evaluation of the extent to which the eight enterprises diagonized under output 2 above were able to successfully implement the short term remedial measures proposed.

In addition to outputs 1-4 above the following reports were prepared:-

1 Study of the present situation and proposal for a development strategy of the cement industry in Kenya.

2 Promotion of PTA cement standards coordination .

3 Guidelines for improvements of plant maintenance in the PTA cement industry

4 Promotion of preventive maintenance routines in selected PTA cement plants

The meeting noted that the outputs already achieved were not directly investment oriented. Most of the reports give a good picture and provide some information of the region, but did not lead directly to any investment decisions or actions.

In light of the above it was agreed to link more closely with financial institutions particularly the PTA bank and African development bank and work out new activities which would be investment oriented, on cost sharing basis, where ever possible.

It was also noted that there was no output foreseen for the preparation of follow up action on the project. The meeting agreed to include that as an output in the re-oriented programme

The PTA and UNIDO agreed that four new outputs as below were to be implemented in a flexible way.

2 IDENTIFICATION OF NEW OUTPUTS

The following outputs were identified:

Output 1 — Fund mobilization programme on building materials in the PTA with the following components (preparatory assistance)

a) Establishment of cost sharing/ reimbursable investment facility

b) Training and capacity building

c) Advisory services

d) Introduction of up to date technology in building materials with selected developing countries

Output 2 Feasibility study for expansion of Chilanga cement factory in Zambia with special emphasis on raw material investigations, regional market and privatization issues.

Output 3 General survey of alternative building materials in the PTA region with the following components;

a) Availability of lime and pozzclanic materials

b) How to apply limestone for lime production as a binding material

c) Use of lime as a binding material

d) Regional workshop on lime and alternative binding materials

Output 4 Donors meeting for cost sharing arrangement on the new programme on building materials in the PTA region (22 countries).

3 WORK PLAN FOR THE NEXT SIX MONTHS AND BUDGET REVISION

The meeting noted that the balance on the project was US $ 310,000.00. PTA and UNIDO agreed to revise the budget as follows:

	Activity	Estimated cost (US $)
1	Feasibility study for expansion of Chilanga cement factory in Zambia	90,000.00
2	Fund mobilization programme on building materials in the PTA (preparatory assistance)	40,000.00
3	General survey on alternative building materials in the PTA region, including the cost of a regional workshop (travel and DSA for participants) on the basis of cost sharing (US $100,000 each from UNIDO and Intermediate Technology of UK)	200,000.00

4	Donors meeting on cost sharing arrangement new programme.	20,000.00
5	Follow up meetings and ad-hoc activities	60,000.00

- Tripartite review meeting PTA, Government of Japan and UNIDO in Vienna or Lusaka.
- Unido staff supervision missions
- Miscellaneous and unforseen expenses
- Small equipment
- Ad-hoc consultants for advisory services

The work plan for 1994 and 1995 is attached.

WORK PLAN 1994-1995

1994

1	End of July	- Mission report by UNIDO staff, including minutes of the review meeting - Submission of budget review by UNIDO to Permanent mission of Japan in Vienna
2	Mid August	- Receipt of terms of reference by UNIDO for output 2 " Feasibility study for expansion of Chilanga cement factory in Zambia with special emphasis on raw material investigations, regional market and privatization issues" from Chilanga Cement and the PTA Secretariat - Confirmation of commitment by the U.K private sector Company to co-finance output 3 " General survey of alternative building materials in the PTA region with the following components". UNIDO and the U.K private sector company to provide US $100,000.00 each (including workshop and participation of participants)
3	Start September	- Receipt Japanese non-objection on budget revision.
4	Mid September	- UNIDO's official authorization of use of remaining funds - Recruitment of consulting firms for outputs 1,2 and 3 above
5	November/December	- Regional workshop
6	December	- Discussion of draft reports

1995

7	February	- Finalization of reports and approval
8	March	- Donors meeting - Tripartite Rewiew meeting (Vienna or Lusaka) - Submission of final report

R. Oestreicher/Y.E. Amaizo
6 September 1994

Note to the file

Subject: TF/RAF/90/902 - Action programme to support the building materials sub-sector in the PTA countries

A meeting was held today with Messrs. P. Strapec and A. Mikula from Keramoprojekt Trencin a.s (Slovakia) and Mr. Amaizo and Ms. Oestreicher from ITPD/IS/FEAS to discuss action to be taken regarding future activities, in particular concerning the tasks listed as Output No. 1 (Fund mobilization programme on building materials in the PTA), No. 2 (Feasibility Study for expansion of the Chilanga Cement factory) and No. 3 (General survey of alternative building materials in the PTA region), as listed in the Annex to Mr. Amaizo's back-to-office report.

It had been agreed to develop each project output on a cost-sharing basis. After several discussions with Intermediate Technology of UK, UNIDO finally came to the conclusion that this group was not prepared to co-finance the general survey. One of the main issues of the meeting with Keramoprojekt (altenative choice) was to clarify the modality of their financial involvement.

Initially, Mr. Amaizo gave a presentation outlining the background and objectives of the project as well as the outputs expected.

The representatives of Keramoprojekt explained that they had been unsuccessful in securing co-financing from the Slovakian Government. However, they were prepared to lower their fee of $ 13,000.-per man/month to $ 10,000.- as their participation in the cost-sharing arrangement.

It was also explained that Keramoprojekt staff had undertaken several feasibility studies for cement and other building materials for UNIDO and also disposed of vast experience in Africa.

Output 1: Fund mobilization programme on building materials in the PTA region. Keramoprojekt would also make available the services of a financial analyst who would concentrate on the establishment of a cost-sharing/reimbursable investment facility; an investment specialist/industrial economist from UNIDO would assist in the preparation of the reports under the supervision of the backstopping officer.

Output 2: Feasibility study for the expansion of the Chilanga Cement factory in Zambia. The PTA Secretariat (over the phone) agreed to send to UNIDO the draft terms of reference and the official request received from Chilanga Cement plants and to consider Keramoprojekt as one of the potential consulting firms.

Output 3: General survey of alternative building materials in the PTA region.
It was agreed that Keramoprojekt would submit a proposal to UNIDO encompassing the procurement of two teams of experts to undertake field work and prepare the reports. The teams would each comprise of a technologist, a geologist specialized in lime, and another geologist specialized in ceramics. Messrs. Salah, Sihilima and Byll would reinforce the teams as UNIDO and PTA experts. One team would cover the French-speaking, the other one the English-speaking countries.

It was agreed that the money available in the remaining budget would not suffice to cover the organization of the regional workshop on lime and alternative building materials. We suggested to Keramoprojekt to inform UNIDO and PTA officially so efforts could be undertaken to secure financing of the workshop.

Re. the countries to be covered, it was agreed with the PTA (over the telephone) that every team should cover 3 - 4 countries each. For those countries which could not be covered due to budgetary constraints, the PTA would procure all information on the subject available at the present time and hand it to the experts in the course of the briefing sessions in Lusaka. For security reasons, Rwanda, Somalia, Burundi and Angola should not be visited at this point in time. Also, the PTA will provide by FAX all missing information re. the countries to be covered and the duration of the missions, the names of experts, terms of reference, etc. Furthermore, PTA suggested to field the experts to Lusaka end of October/beginning of November.

Cleared and cc: *Mr. Strapec* *Mr. Amaize*
Mr. Mikula *~~Ms. Oestreicher~~*

cc: *Mr. Zampetti*
Mr. Ghozali
Mr. Gonzalez-Hernandez
Mr. Ndam
Mr. Hagan
Mr. Hagiwara
Mr. Klykov
Mr. Otsuka
PTA Secretariat: Mr. Salah
Mr. Sichilima
Mr. Mwencha
UNIDO CD Zambia: Mr. Taylor

ANNEX 4

Cleared by Mr. D.-E. Ghozali, Head ITPD/IS/FEAS
7 November 1995

BACK -TO- OFFICE MISSION REPORT

1.Name: Yves Ekoué Amaizo **2. Division:** ITPD **3. Branch** IS/FEAS

4. Places visited:	4.1	Antananarivo - Madagascar	5-12 October
	4.2	Pretoria/Johannesburg - South-Africa	12-13 October
	4.3	Lusaka - Zambia	13-19 October

5. Dates: 5/10/95 to 19/10/95 (including travel time)

6. Purpose of mission:

TF/RAF/90/902 - Action programme to support the building materials subsector in the COMESA Region (Common Market for East and Southern Africa):

* To develop a new fund raising approach in the building materials sector with special emphasis on cooperation between regional and national authorities and direct support to the private sector;
* To coordinate and participate in the on-going pre-investments studies and provide advice on the follow-up actions;
* To hold consultations with COMESA representatives, the private sector and South Africa representatives on the housing programme.

7. Achievements:

Antananarivo:

The mission held several discussions with both the public and the private sectors directly involved in the fund raising for the building materials sector in Madagascar. It should be recalled that Madagascar was one of the nine COMESA countries selected for the opportunity study/general survey on alternative building materials in the sub-region. The results of the study were confirmed by the local counterparts and UNIDO was urged to take appropriate actions in close consultation with the COMESA Secretariat in order to facilitate the implementation of the practical recommendations. Suggested investment projects are attached for easy reference. For more details, please contact the UNIDO Feasibility Studies Branch or the COMESA Secretariat - Industry, Energy and Environment Division.

The representatives of the private sector were insisting on the fact that if mobilized, a pre-investment facility should be decentralized at the country level. At the regional level, special attention should be given to the partnership between the Indian Ocean Commission and COMESA. The sub-regional concept should be flexible enough to facilitate the participation of other neighbouring countries, not members of COMESA. Finally, although priority was given to alternative building materials, the private sector insisted that in the fund raising process, cement and alternative building materials should be given the same priority. In fact, the joint venture possibilities seem to be much higher in the cement sector because of the large scale possibility of investment. Representatives of the wood sector suggested that at least 25 % of the total amount of the project be reserved to support wood production for the housing sector.

Specific consultations were held on specific projects and advice on pre- investment and finance was provided.

1995 TSSI Proposals: Investment forum for the countries members of the Indian Ocean Commission. Out of US$ 700, 000 requested, only US$ 300, 000 were earmarked by the UNDP-Regional Bureau. Due to difficulties faced in mobilizing the remaining amount, it was suggested by the UCD, the UNDP Resident Representative (Madagascar) and the representative of the private sector, that it would be more profitable to the region if the forum be limited to the sub-contracting partnership aspects. The already earmarked funds will be enough to cover this event planned for end 1996. Appropriate UNIDO responsible officers may consider this option in the preparation of their programme for 1996.

XP MAG 93 013: Funds for market study were provided by the national promoter. The latter is still waiting for UNIDO co-financing part of the feasibility study (verrerie industrielle, multi-produits). Relevant responsible officers should inform the UCD on the status of the project and the chance to get UNIDO's contribution as planned.

Pretoria/Johannesburg

A working session was organized by the Ambassador of South Africa during the mission's stay in Madagascar. Fund raising for the building materials sector and support to the housing/shelter programme in South Africa is welcome. It is a direct link with South Africa's Reconstruction and Development Programme (RDP). It was agreed that a joint mission COMESA Secretariat and UNIDO should go to South Africa and present the approach to the decision makers early 1996. It was suggested to the COMESA Secretariat that a SADC representative should also be invited to join this mission.

The Reconstruction and Development Programme has been adopted as the socio-economic policy framework of the Government or National Unity. In the speech of Minister Jay Naidoo in Johannesburg (14/02/94), in which special emphasis was put on " **demand for investment funds,**" the following five key RDP programmes were presented:

1- Meeting the basic needs of South Africans (job creation, land reform, provision of socio-economic infrastructure in the form of **housing**, water sanitation, transport, health care, social welfare and security);

2- Developing human resources through an integrated education and training programme (including involvement in decision-making that affects South Africans lives, modernization of industries, skills to generate new businesses,

3- Building the economy by removing weaknesses and barriers to growth and investment and commitment to aim public investment at meeting basic needs and alleviating poverty (investment in productive enterprises, **promotion of investment** that will stimulate the long term competitiveness of South African economy);

4- Democratizing the State and society **to invite people to participate in decision-making that affect their lives;**

5- Implementing the RDP by mobilizing the widest range of stakeholders, utilizing **the very wide consensus of the RDP.**

The key elements of the public investment programme are:

1. **Housing**
2. Municipal infrastructure and transport
3. Energy
4. Telecommunications
5. Water and Sanitation
6. Human Resource Development
7. Small and medium scale enterprises

In the housing area, the immediate objective is to build 1 million houses by 1999 in order to alleviate the existing shortage of 1.5 million houses.

Any project related to the building material sector which will put emphasis on partnership with local business, will be of great interest for South Africa. The participation of regional institutions such as COMESA, SADC, IOC and the African Development Bank will be required. UNIDO as a neutral agency within the framework of the United Nations could provide the necessary link between private and public sectors, national and regional institutions, financial institutions and beneficiaries.

It was agreed that the programme concept will be submitted to the National Economic Development and Labour Council (NEDLAC) for preliminary screening. NEDLAC is formed as a forum by the Government of South Africa for negotiating and obtaining consensus on major policy issues. One of its mandates is to contribute towards peace and security as well as creating an environment for international cooperation and collaboration during the process of the opening of the South African economy.

UNIDO Investment Programme on Building Materials and Housing will pull the public and private sectors into partnership, particularly at the local level. In rural areas, the project should also be a good example for experiencing popular involvement in governance.

Finally, the UNIDO programme should link up directly with the MASAKHANE CAMPAIGN which means " let us build each other " In practice, Masakhane is a government-driven programme launched in partnership with civil society. Its aim is to knit the tattered fabric of South African society; **to persuade people to pay for services** and, in short, to bring normality to local governments and the lives of the people they serve. Most of the Government officials believe that **the campaign will** not only **create conditions** conducive to effective local government but also to **large-scale investment in housing** and service infrastructure.

The UNIDO Investment Programme Concept will be finalized by end January 1996 and endorsed by the COMESA Secretariat end February. The joint mission to South Africa could be planned for March 1996.

Lusaka

TF/RAF/90/902: Five issues were discussed with the representatives of the Industry, Energy and Environment Division of COMESA Secretariat.

1- Final report: General survey on alternative building materials in selected COMESA countries

The dispatching to all COMESA countries, South Africa, Botwana and to regional institutions such as SADC, PTA Bank and IOC will be done by COMESA Secretariat. The cost of reproduction will be shared by UNIDO and COMESA. The selected projects will be given priority for funding and support in the Fund Raising Programme. The mission briefed COMESA staff on the position of some COMESA member states wishing to develop part of the follow-up programme at the national level.

2- Fund-raising programme on building materials (FRP-BM)

A working session has been organized with all UNIDO experts and staff (7) and COMESA Secretariat staff concerned (3) in order to harmonize and clarify the priority outputs of the FRP-BM. It was agreed that the programme will not only focus on COMESA but will integrate SADC, IOC and other regional institutions willing to commit themselves technically and financially.

It was decided that UNIDO will provide COMESA with two proposals:

2.1- A fund raising concept on building materials covering East and Southern Africa including Indian Ocean (to be coordinated at the national level as a pre-investment activities credit facility with a direct participation of the private sector). The following outputs are already agreed upon

a. Pre-investment Facility for direct support to building materials projects
b. Training and capacity building for national support institutions

c. Provision of Advisory services
d. Support to pilot projects cofinanced with private sector
e. Pre-investment studies on sustainable financial mechanismen (garanty, debt conversion for industry, capital market and rural financing etc).

2.2- A regional investment promotion programme (to be coordinated at the regional level as a technical assistance programme).

Both proposals will complement each other and the problem of leadership will be neutralized due to the decentralisation/modular approach proposed.

COMESA Secretariat will keep UNIDO informed about the outcome of the meeting between SADC and COMESA on the future of both institutions.

UNIDO will provide COMESA with the final draft version of the fund raising concept and the regional investment promotion programme on building materials by end January 1996.

3- Feasibility study for the expansion/privatization of the Chilanga Cement Plant (CCP) in Zambia

The team of experts of Keramoprojekt and the backstopping officer visited the plant in Lusaka and the one in Ndola. They reviewed the various alternatives and made relevant proposals which are going to be confirmed by the findings of the geological experts. Due to political unrest and time constraints, it was not possible for the backstopping officer to provide the Managing Director of the newly privatized company with the first conclusion. The interim report on the feasibility study will be ready for end November 1996. The UNIDO approval is expected by early December. The draft final report should be out by early February 1996. The company requested UNIDO to keep all information confidential. For additional information, authorization of the Managing Director of Chilanga Cement Plant will be required.

As a general remark, final decision on the expansion of the CCP can only be based on an alternative raw materials investigation in the Lusaka region.

4- Tripartite review meeting:

COMESA will prepare the relevant form and will inform UNIDO at least 3 months in advance about the proposed period. It was suggested to postpone the meeting in order to provide enough time for the completion of the on-going outputs and to close the project at the same time; the second trimester of 1996 will be the appropriate period.

5- Donors meeting

COMESA and UNIDO in close cooperation with SADC and IOC will suggest to hold such a meeting. The joint mission to South Africa, SADC Headquarters and IOC Headquarters would have taken place and the Fund Raising Concept/Programme on Building Materials will have been circulated and should obtain a large informal support from members states.

8. Follow-up action (please also refer to attached table)

8.1 COMESA will provide UNIDO with the Project Performance Evaluation Report as well as the estimated period scheduled for the tripartive review mission (mid-January)
8.2 UNIDO will provide COMESA with both fund raising concept and the regional pre-investment activities programme (end January).
8.3 COMESA will dispatch the draft final concept and programme to all members countries and South Africa and Botwana, regional institutions (including Economic Commisision for Africa) and request informal commitment and support (February 1996).
8.4 Joint UNIDO/COMESA mission to South Africa, SADC and IOC Headquarters (March 96).
8.5 Decision on the holding of a donors meeting which could be linked with the tripartite review meeting (June 1996).
8.6 Operational completion of the project planned for October 1996.

9. **Detailled substantive report:**
Not required. Background material and more details could be obtained from ITPD/IS/FEAS or from the COMESA Secretariat, Industry, Energy and Environment Division.

10. Date of report: 6 November 1995 **11. Signature:**

12. Distribution:

Mr. de Maria y Campos, Director-General/MCM Unit
Ms. King-Akérélé
Mr. Maruno
Mr. Piskounov
Mr. Deroy
Mr. Ndam
Mr. Ghozali
Mr. Gonzalez-Hernandez
Mr. Karlsson
Mr. Ben Brahim

Mr. Wiedemann
Mr. Andrasevic
Mr. Kurowski
Ms. Touré
Mr. Abela
Mr. Antonio
Mr. Biering
Ms. Zakiyatou
Mr. Klykov
Mr. Hagan
Mr. Hagiwara
Ms. Pokane
Mr. Otsuka

Madagascar:
Mr. Metcalf, ResRep - UNDP
Mr. D'Adesky, UCD

Zambia
Mr. Yucer, Res. Rep. - UNDP
Mr. Brevig, JPO - UNIDO

South Africa
Mr. Whaley, Res. Rep. - UNDP
Dr. Mwencha, Director - COMESA

1) MADAGASCAR

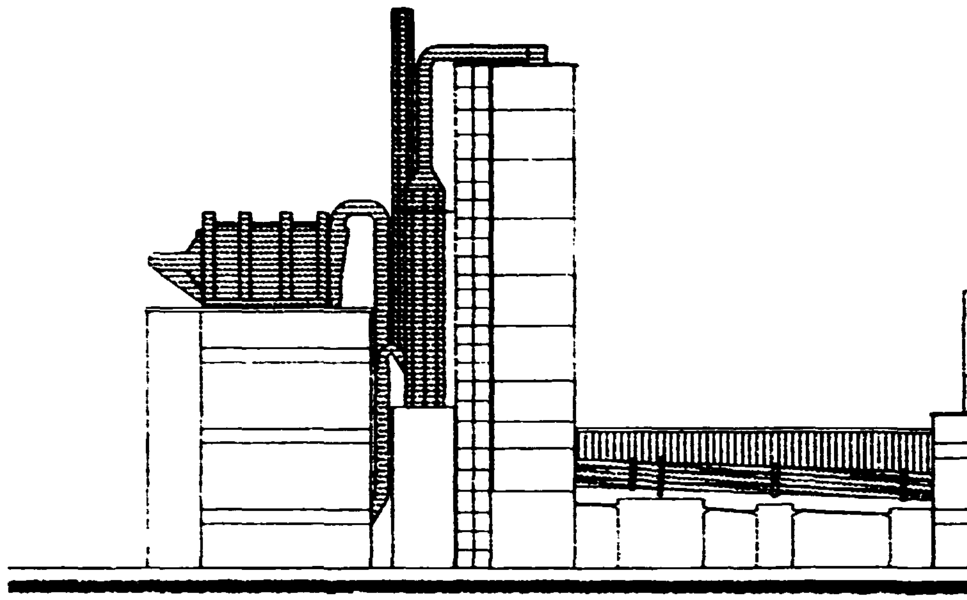
Responsibility	Short Description	Responsible Person	Deadline
Follow-up of TF/RAF/90/902: Regional programme concept	Transmission of fund-raising concept (FRC) and regional pre-investment activities programme (RPAP) to COMESA for dispatch to countries concerned	Y.E.Amaïzo	end January 1996
Follow-up of TF/RAF/90/902: Donors meeting	Decision of holding of donors meeting to be taken by UNIDO/COMESA/SADC	Y.E.Amaïzo	June 1996
Follow-up of TF/RAF/90/902: Project completion	Tripartite review meeting and operational completion	Y.E.Amaïzo	October 1996
Indian Ocean Forum	Investment Forum or Subcontracting Partnership Meeting	T. Abela O. Zakiyatou F. d'Adesky	end Dec. 1996
Feasibility study	"Verrerie Industrielle"	L. Kurowski	December 1996

2) SOUTH AFRICA

Responsibility	Short Description	Responsible Person	Deadline
Follow-up of TF RAF 90 902 Regional programme concept	Transmission of fund-raising concept (FRC) and regional pre-investment activities programme (RPAP) to COMESA for dispatch to countries concerned	Y E Amaïzo	end January 1996
Follow-up of TF/RAF 90/902 Donors meeting	Decision of holding of donors meeting to be taken by UNIDO/COMESA/SADC	Y E Amaïzo	June 1996
Follow-up of TF/RAF/90/902: Project completion	Tripartite review meeting and operational completion	Y E Amaïzo	October 1996
Joint mission	COMESA/SADC/ UNIDO to SADC/IOC Hqs., South Africa	Y E Amaïzo	March 1995

3) ZAMBIA

Responsibility	Short Description	Responsible Person	Deadline
Follow-up of TF/RAF/90/902: Regional programme concept	Transmission of fund-raising concept (FRC) and regional pre-investment activities programme (RPAP) to COMESA for dispatch to countries concerned	Y E Amaïzo	end January 1996
Follow-up of TF/RAF/90/902: Donors meeting	Decision of holding of donors meeting to be taken by UNIDO/COMESA/SADC	Y E Amaïzo	June 1996
Follow-up of TF/RAF/90/902: Project completion	Tripartite review meeting and operational completion	Y E Amaïzo	October 1996
Follow-up of TF/RAF/90/902: Distribution of documents	Dispatch of FRC and RPAP to COMESA, SADC and IOC member countries	Y E Amaïzo	end January 1996
Evaluation	TF/RAF/90/902 - PPER and Tripartite Review Meeting	Y E Amaïzo	end February 1996



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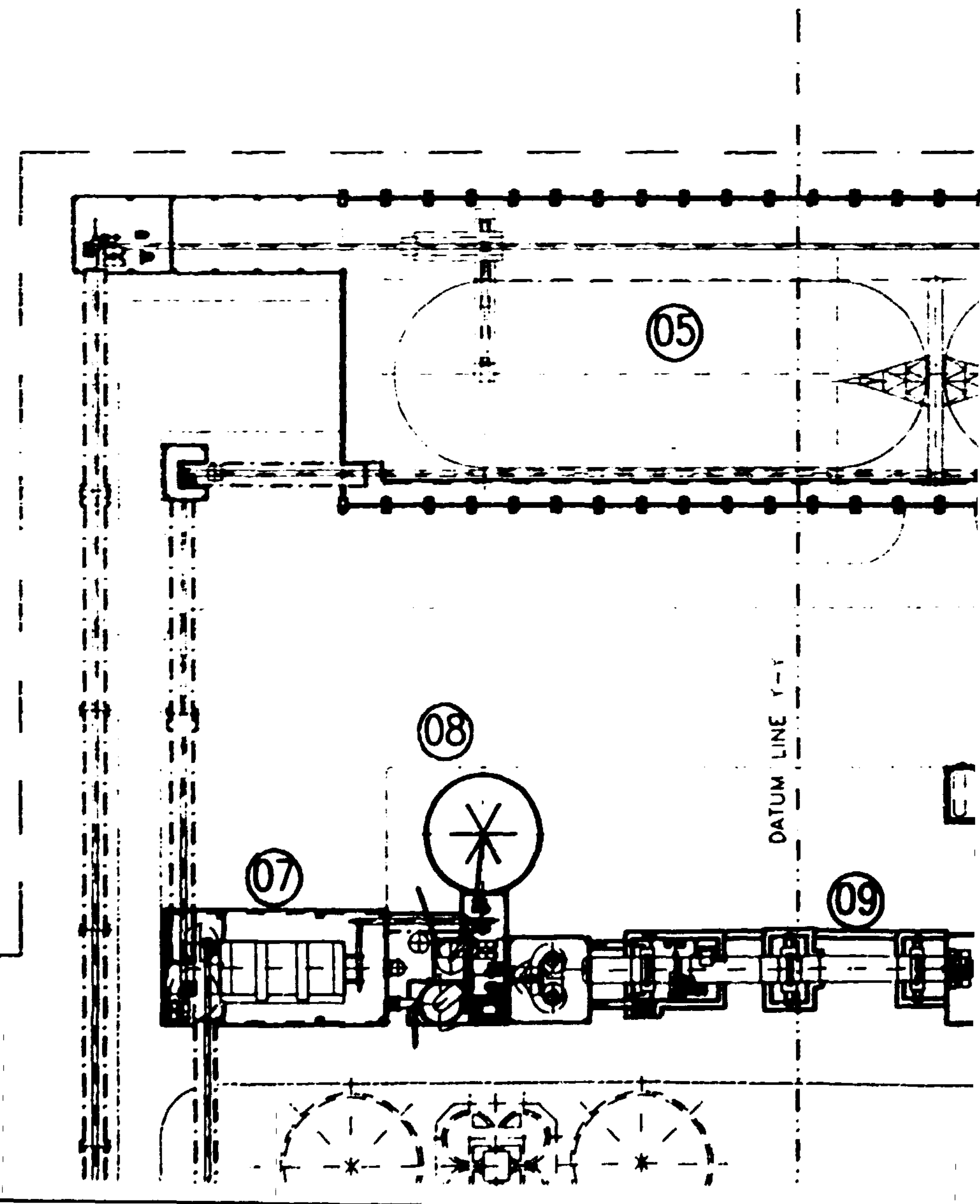

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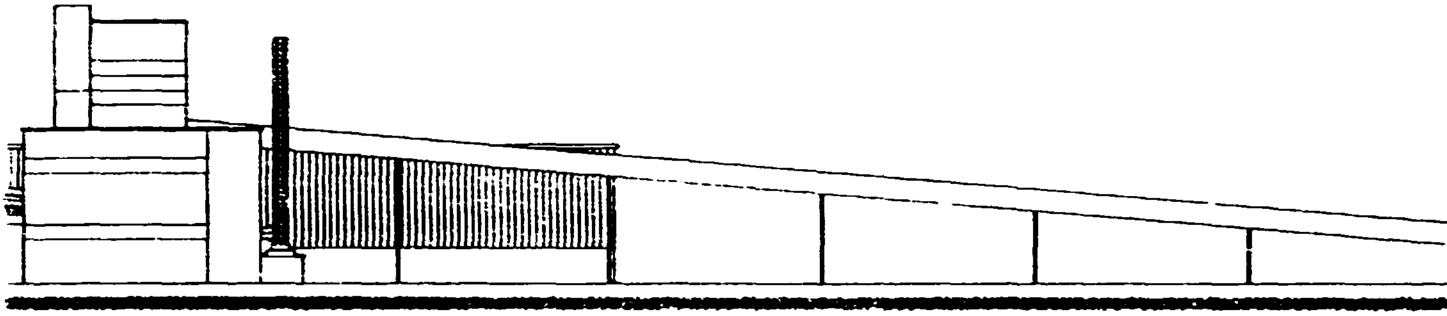

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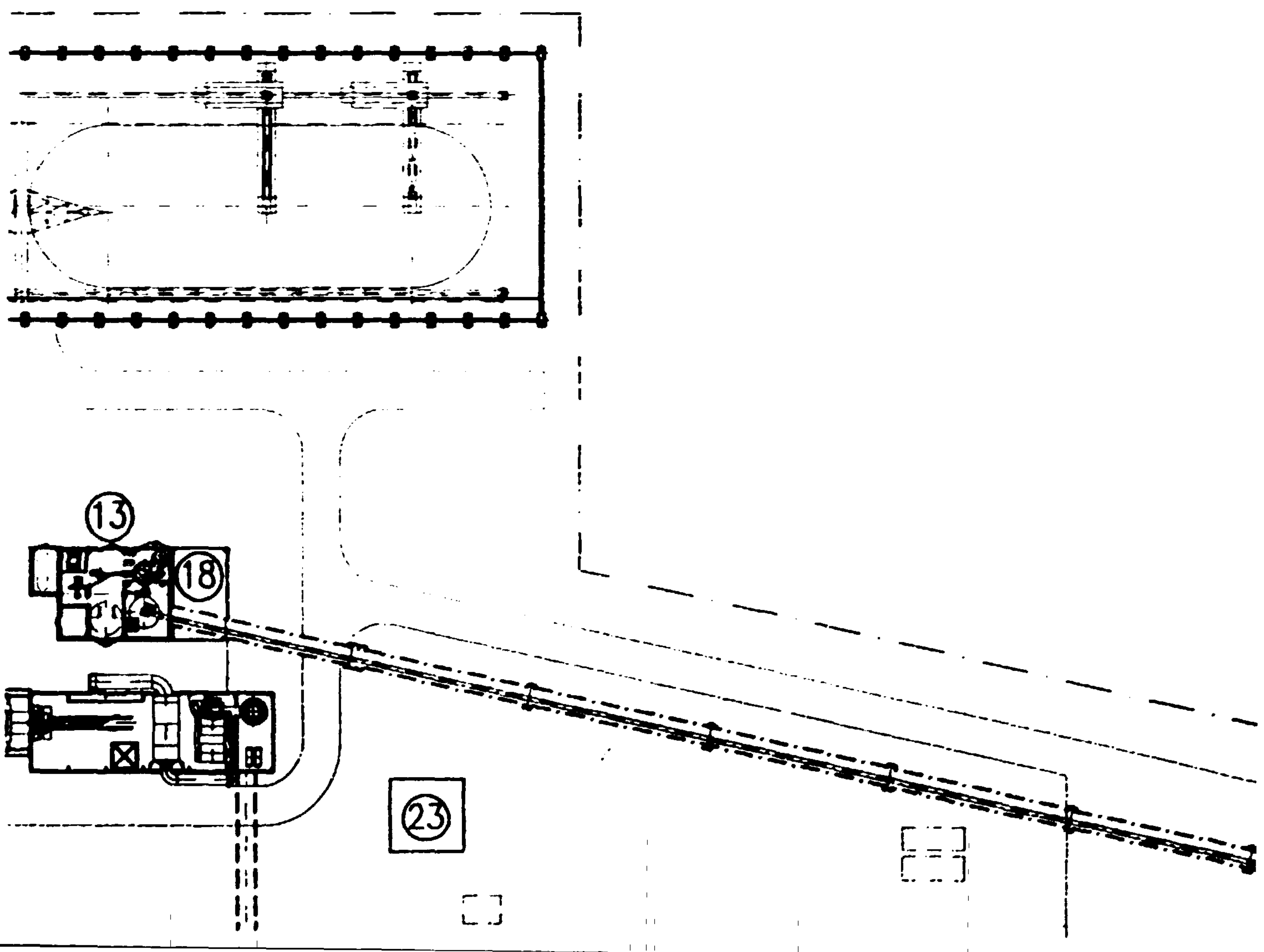

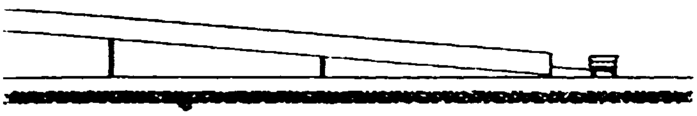

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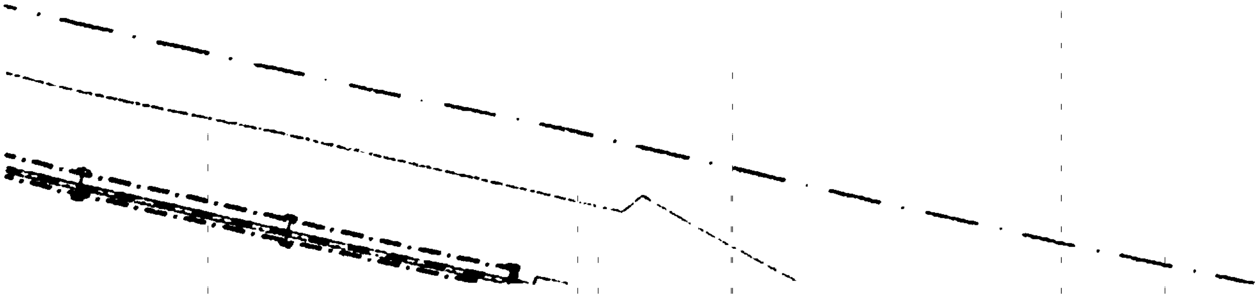

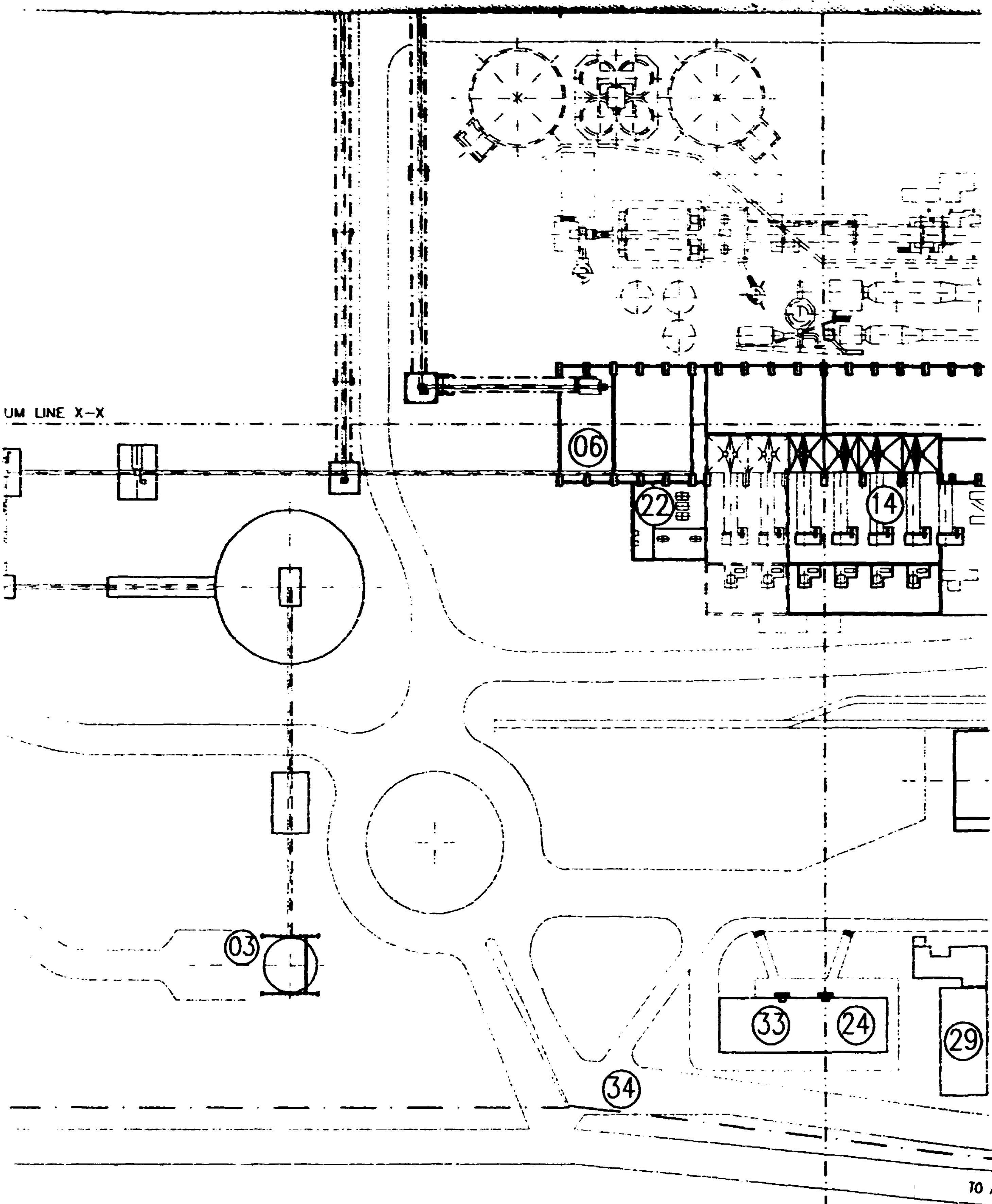

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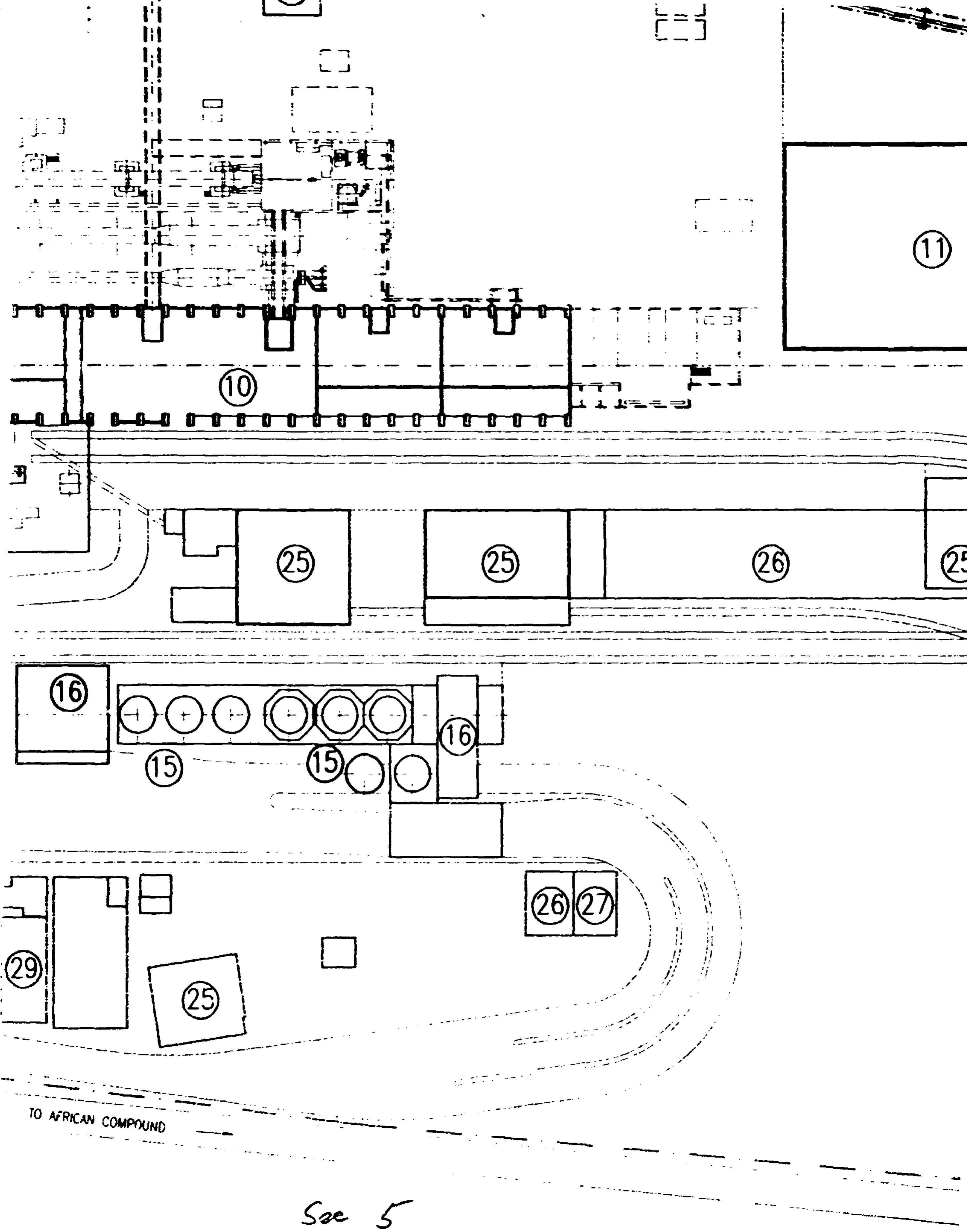

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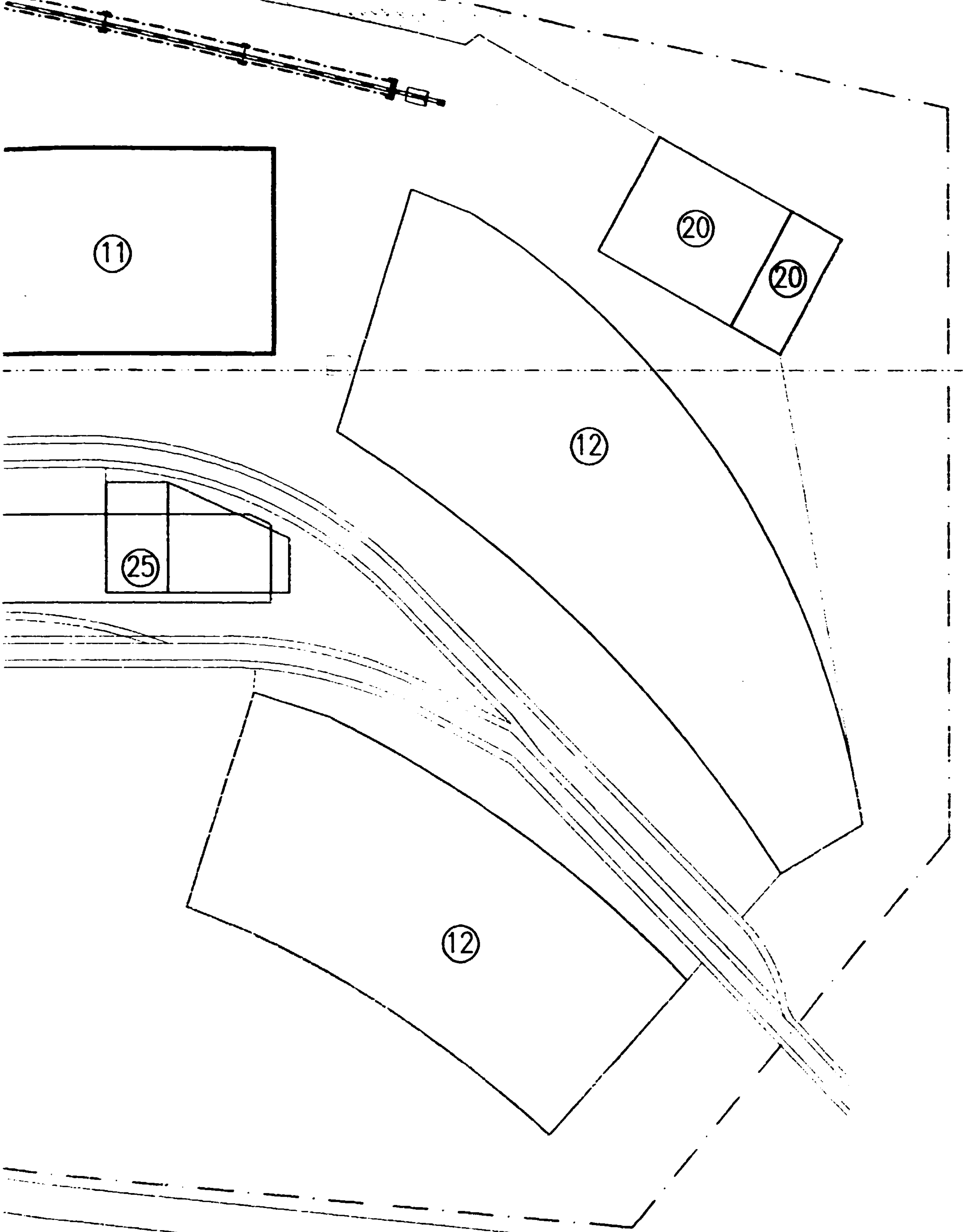


Ses 6

Sec 7

PRODUCTION DEPARTMENTS

01 – Limestone extractoin
02 – Phyllyte extraction
03 – Primary crushing plant
04 – Secondary crushing plant
05 – Preblending storage of limestone
06 – Storage of phyllyte
07 – Raw material grinding plant
08 – Blending silo
09 – Rotary kiln line
10 – Clinker storage
11 – Gypsum storage
12 – Coal storage
13 – Coal grinding plant
14 – Cement grinding plant
15 – Cement silos and dispatch of bulk cement
15 – Cement silos and dispatch of bulk cement
16 – Packing plant and bag loading
16 – Packing plant and bag loading
17 – Electrical equipment
18 – Central control room and instrumentation

AUXILIARY DEPARTMENTS

20 – Main switching station
20 – Main switching station
21 – Diesel power plant
22 – Compressed–air plant
23 – Water supply and distribution system
24 – Laboratory
25 – Workshops
26 – Stores
27 – Diesel oil tank
28 – Lubricants store
29 – Garage

SERVICE DEPARTMENTS

30 – Drain and sewerage disposal
31 – Outdoor lighting
32 – Roads
33 – Administration building
34 – Gate–house
35 – Fencing

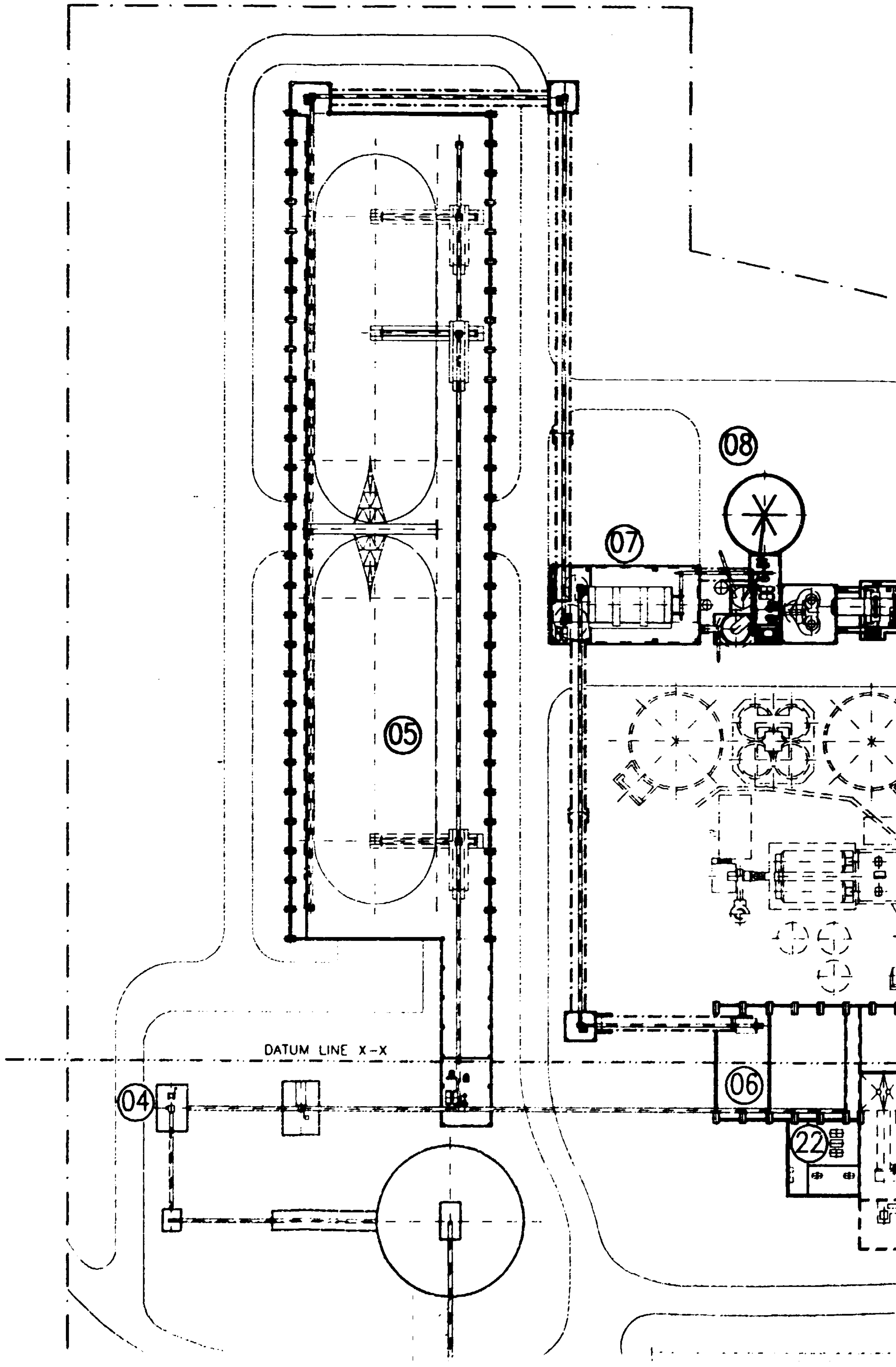
NOTE:

——— NEW DEPARTMENTS

——— EXISTING UTILISED DEPARTMENTS

– – – – EXISTING NOT UTILISED DEPARTMENTS

UNIDO VIENNA	KERAMOPROJEKT a.s. TRENČÍN	DATE: JANUARY 1996
EXPANSION OF THE CHILANGA CEMENT PLANT		FILES NO:
GENERAL LAYOUT		SCALE: 1:1000
		DRAWING NO: 1



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07
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DATUM LINE X-X
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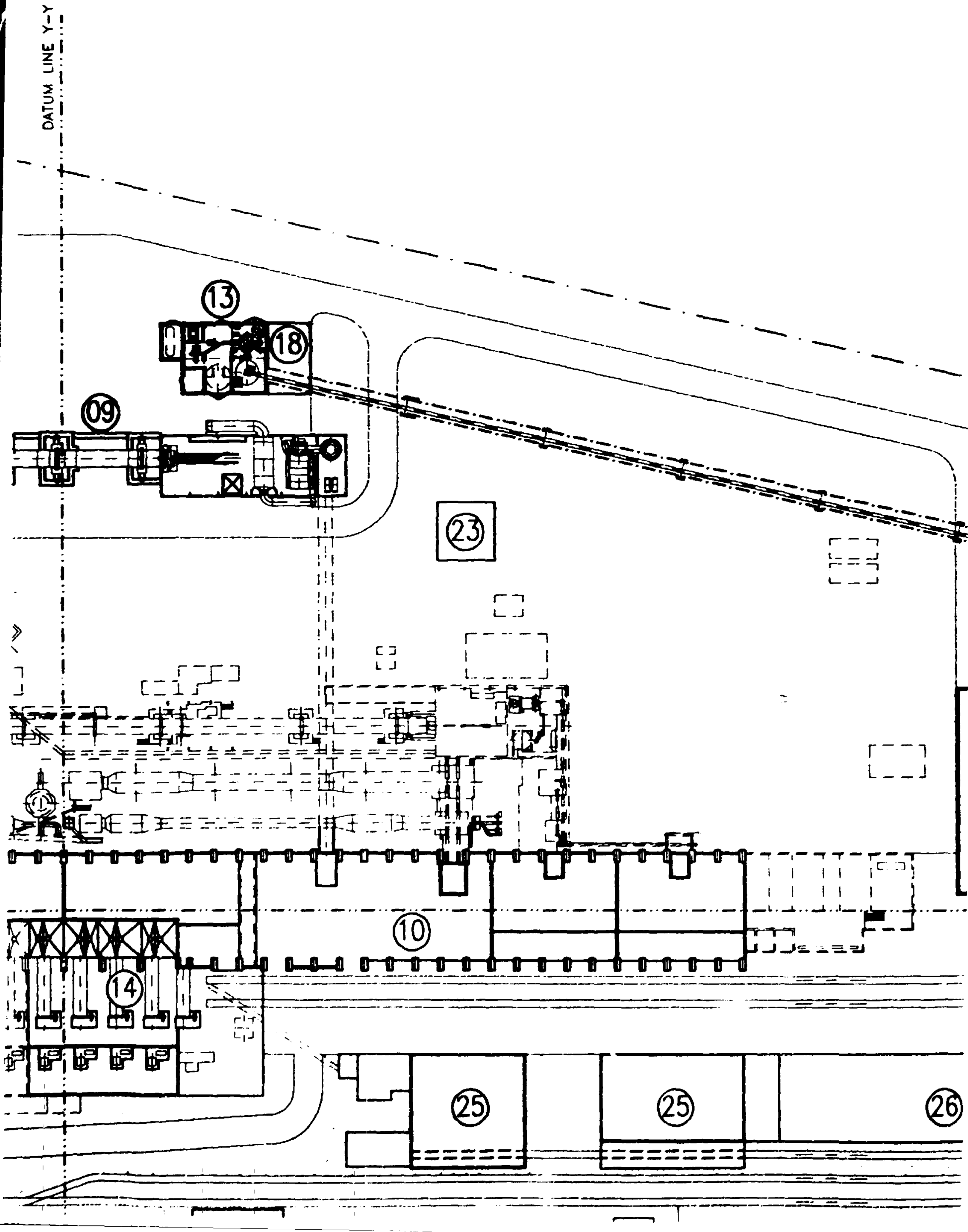
Sec 2



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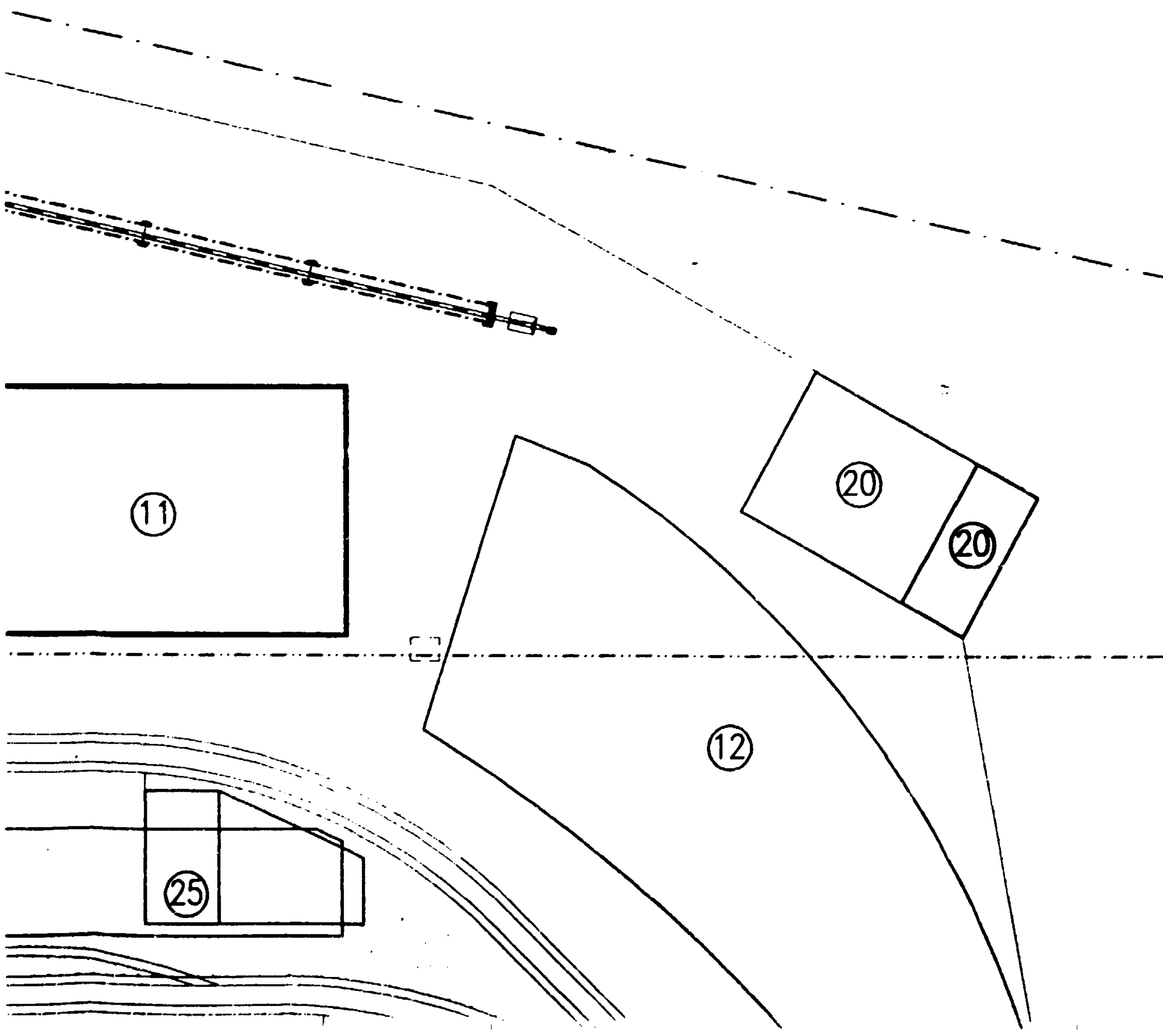

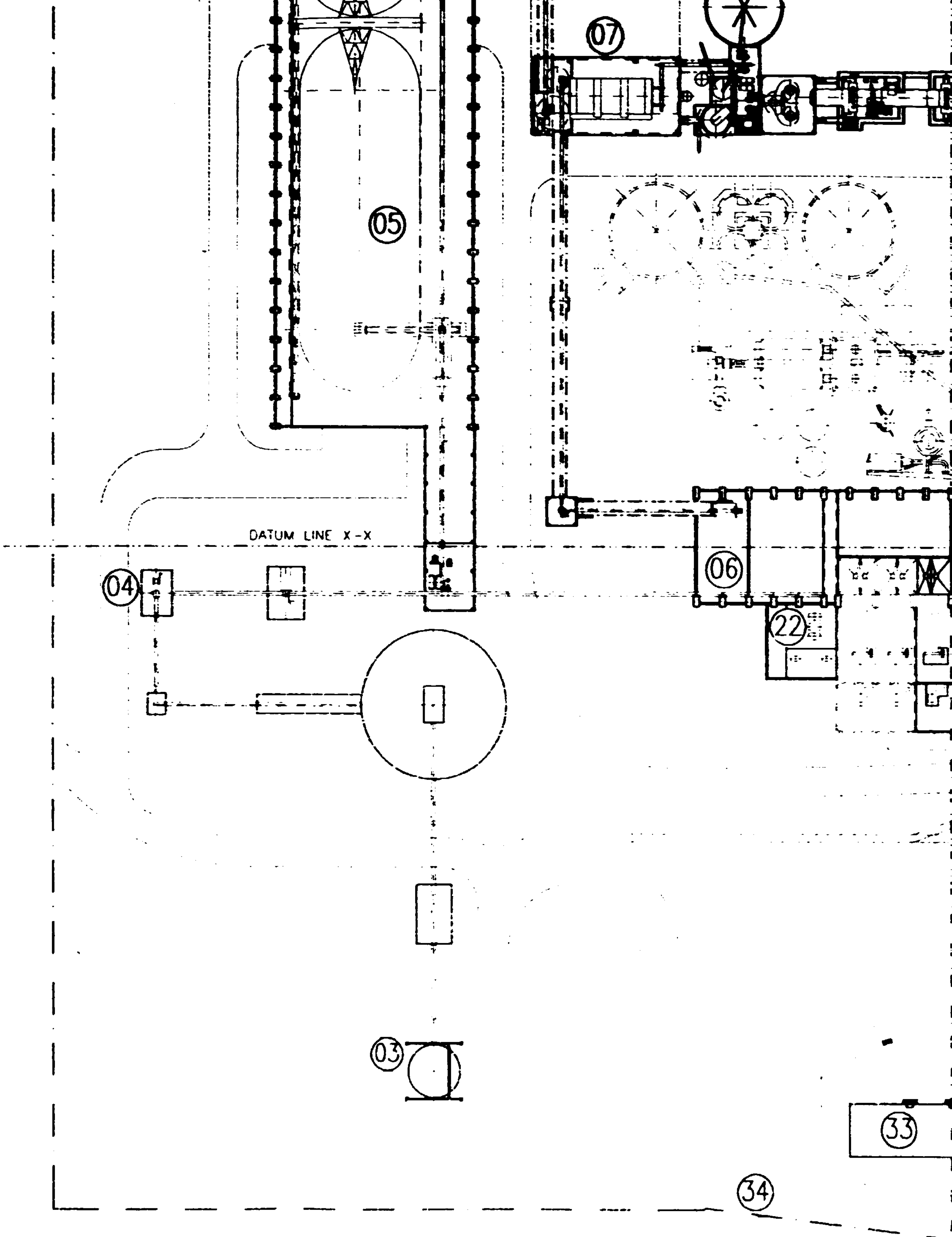

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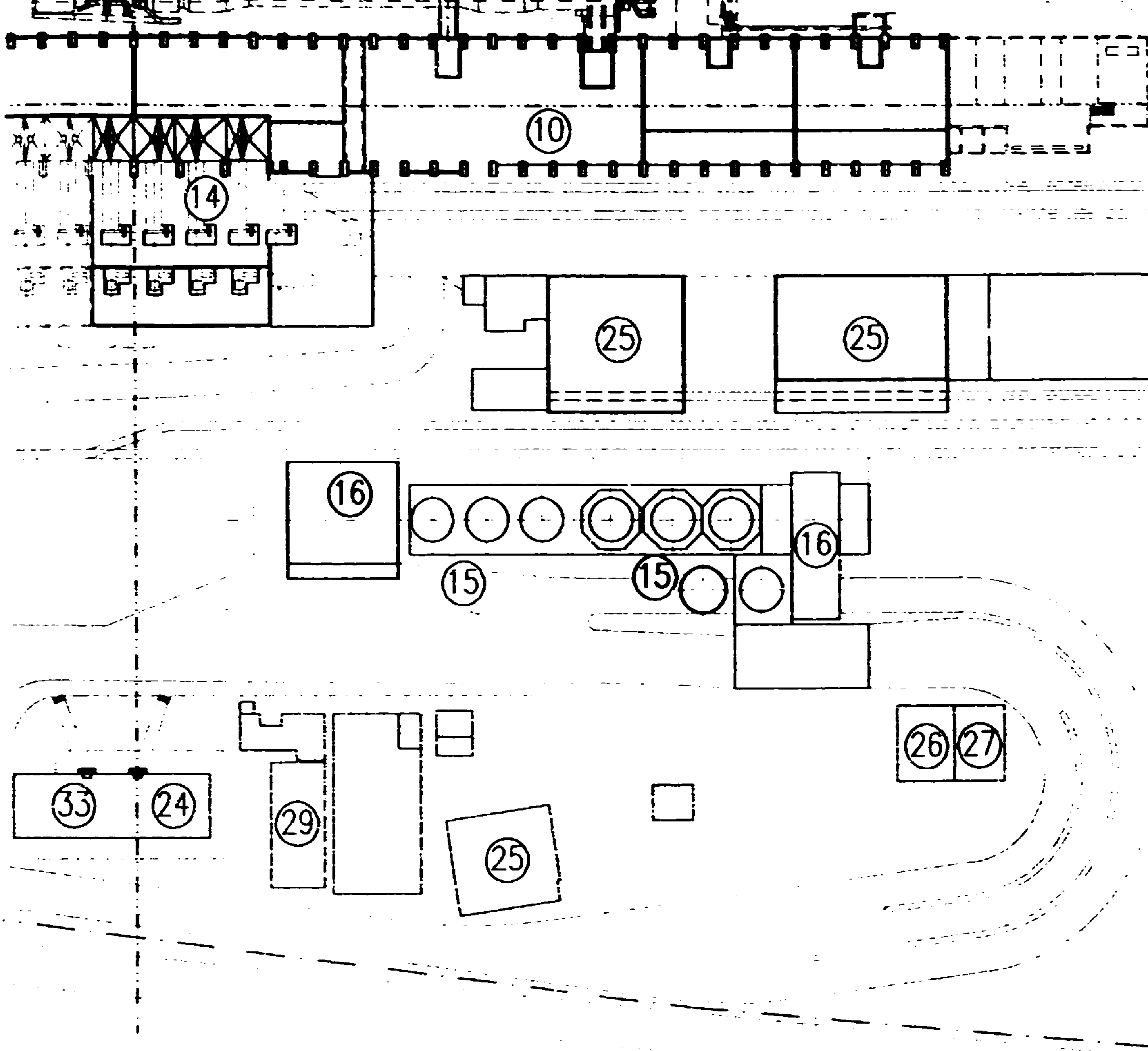

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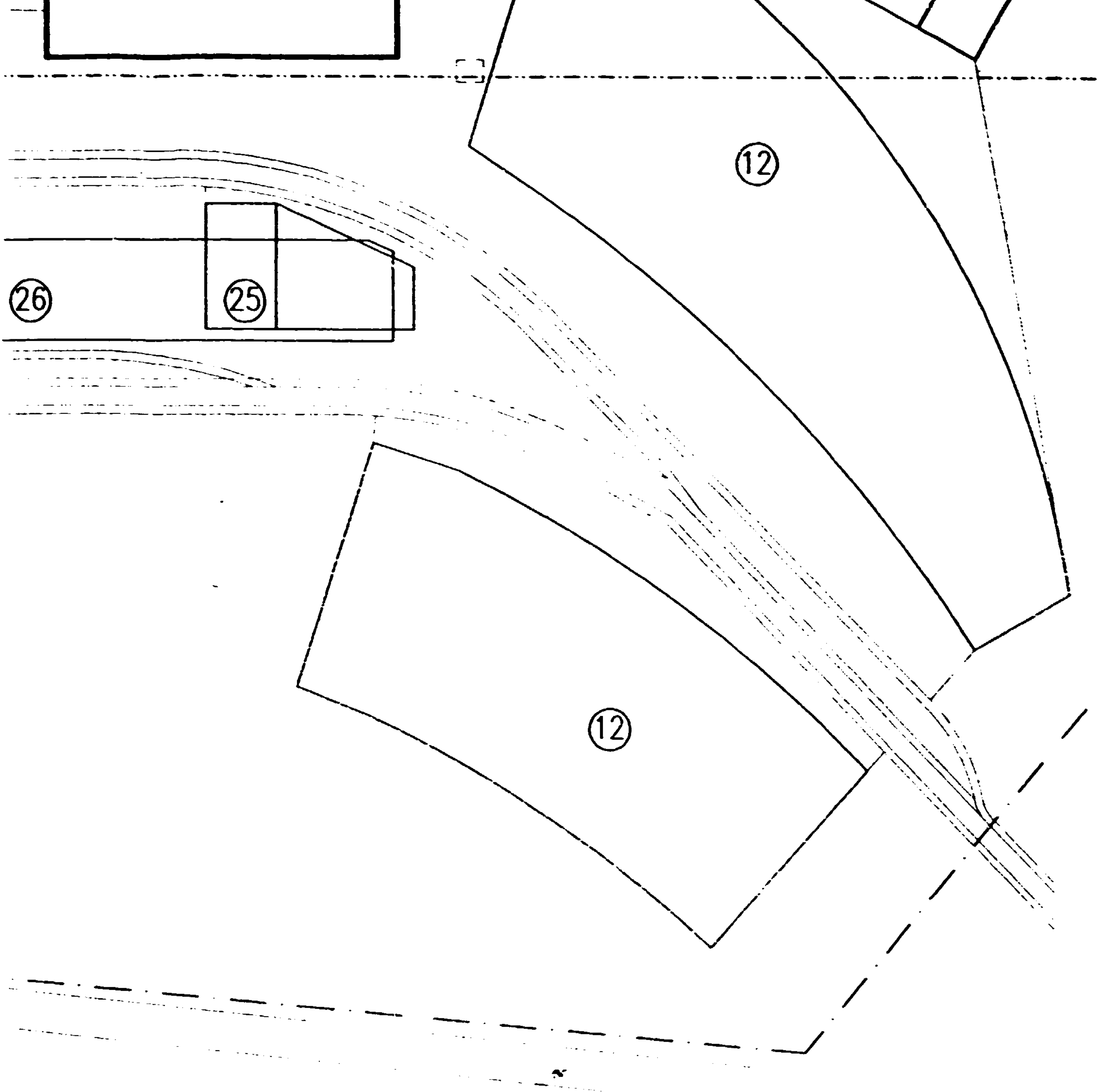

See 6

PRODUCTION DEPARTMENTS

01 – Limestone extractoin
02 – Phyllyte extraction
03 – Primary crushing plant
04 – Secondary crushing plant
05 – Preblending storage of limestone
06 – Storage of phyllyte
07 – Raw matericl grinding plant
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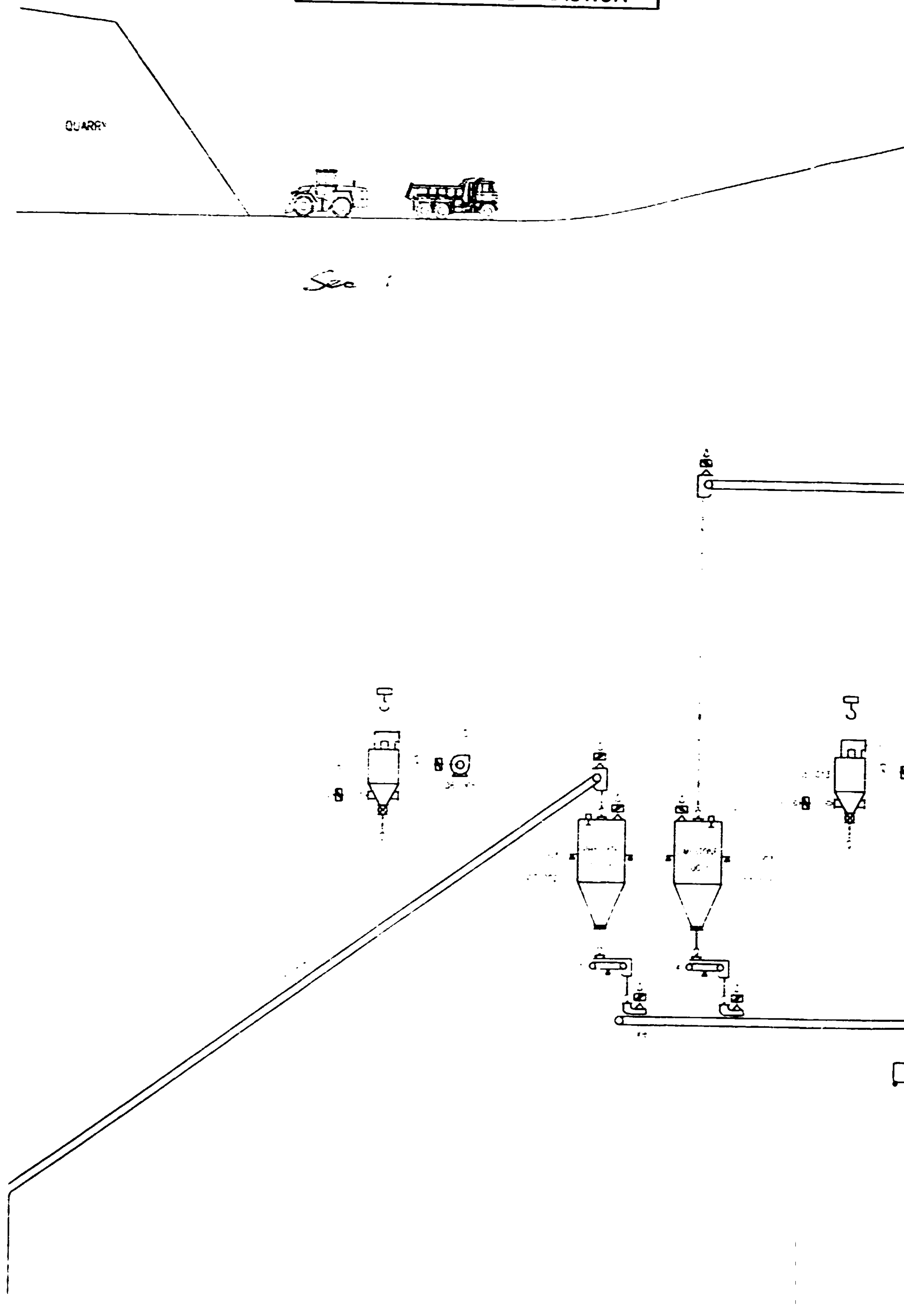
SERVICE DEPARTMENTS

30 – Drain and sewerage disposal
31 – Outdoor lighting
32 – Roads
33 – Administration building
34 – Gate-house
35 – Fencing

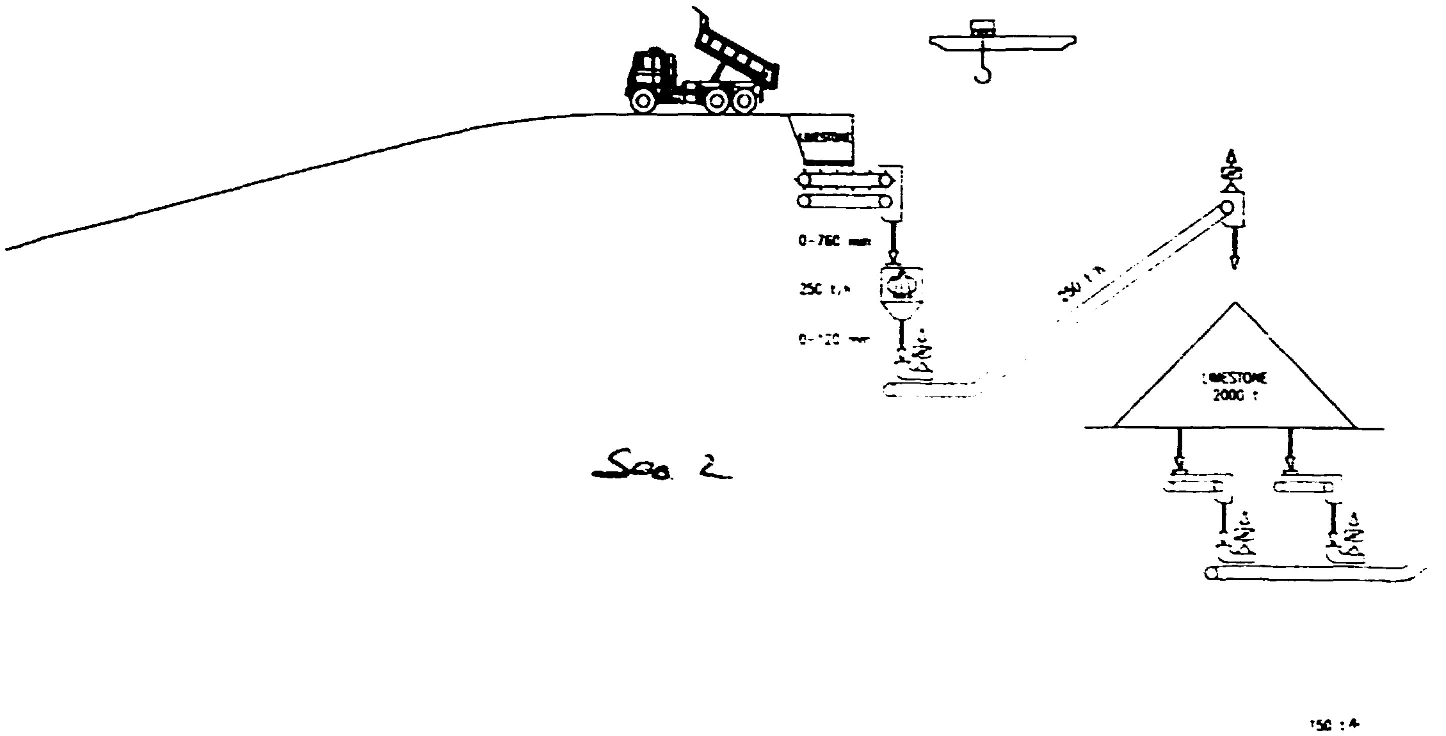
SEC 7

UNIDO VIENNA	KERAMOPROJEKT a.s. TRENČÍN	DATE: JANUARY
EXPANSION OF THE CHILANGA CEMENT PLANT		FILES NO:
GENERAL LAYOUT		SCALE: 1:1000
		DRAWING NO: 2

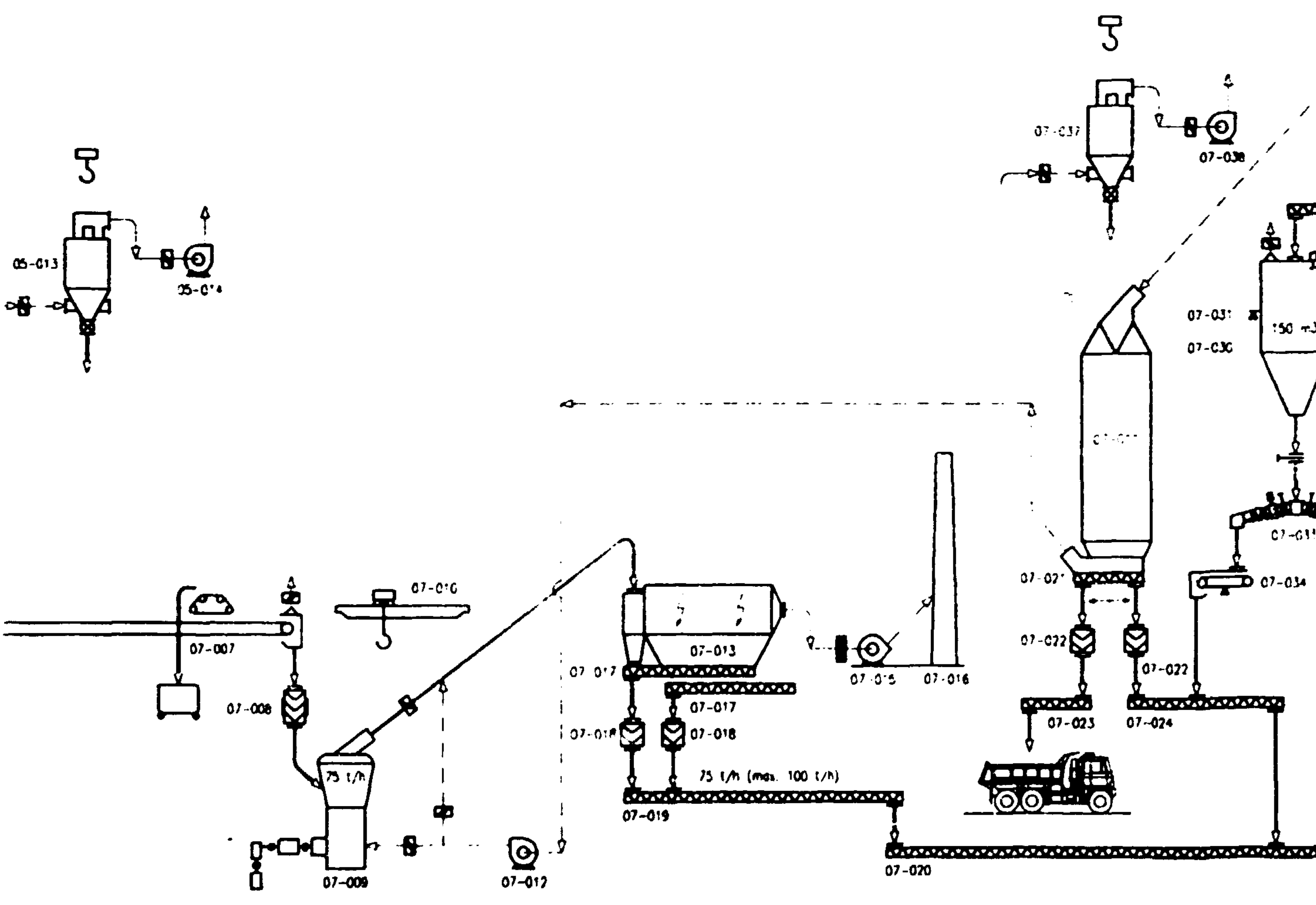
01-LIMESTONE EXTRACTION



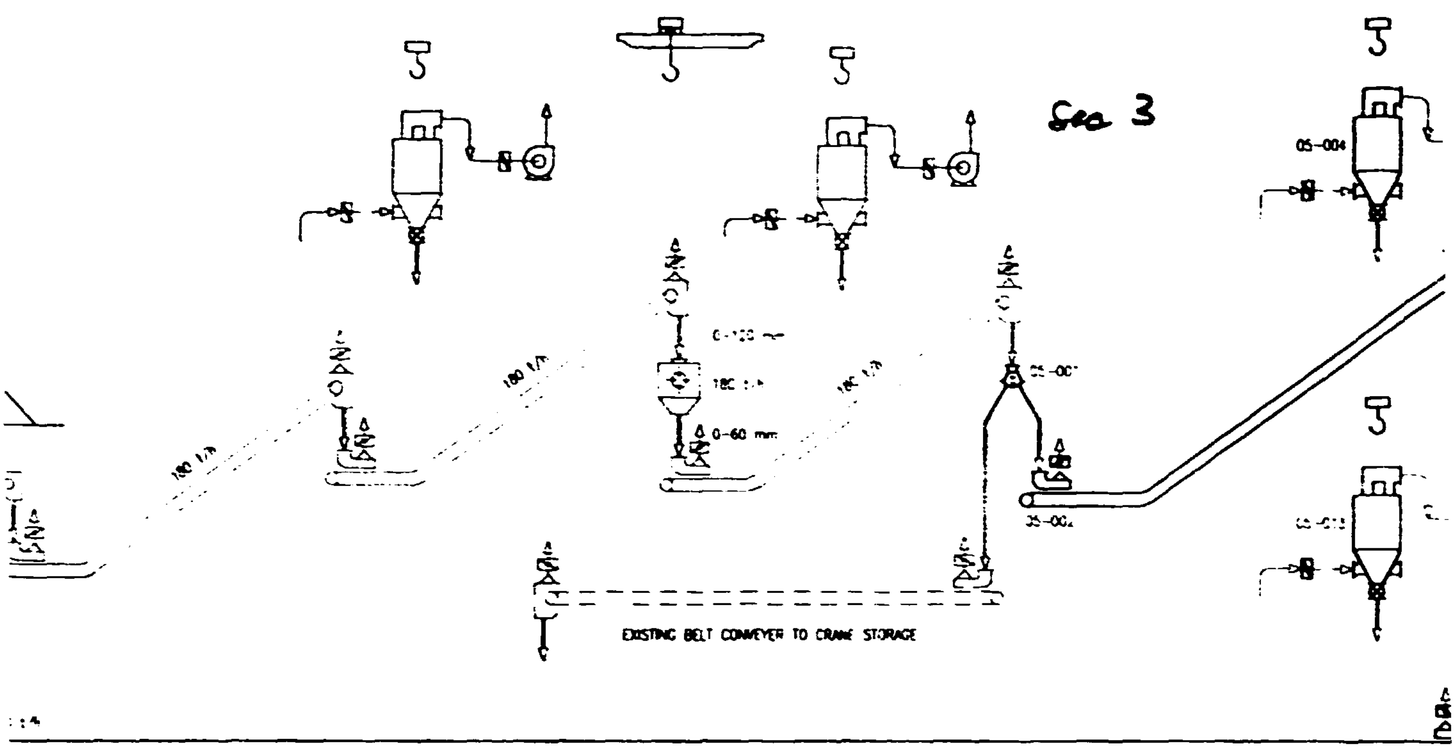
03-PRIMARY CRUSHING PLANT



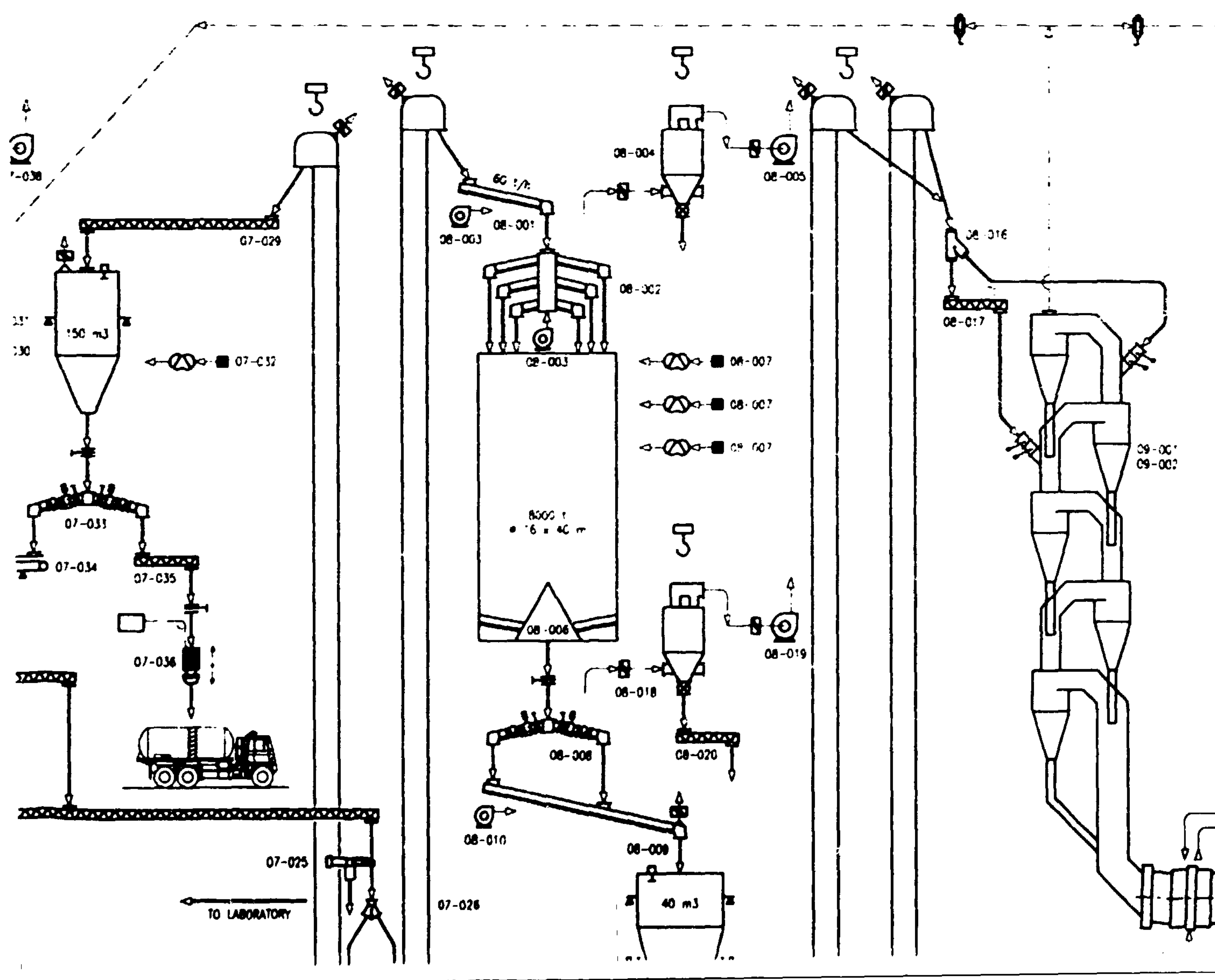
07-RAW MATERIAL GRINDING PLANT



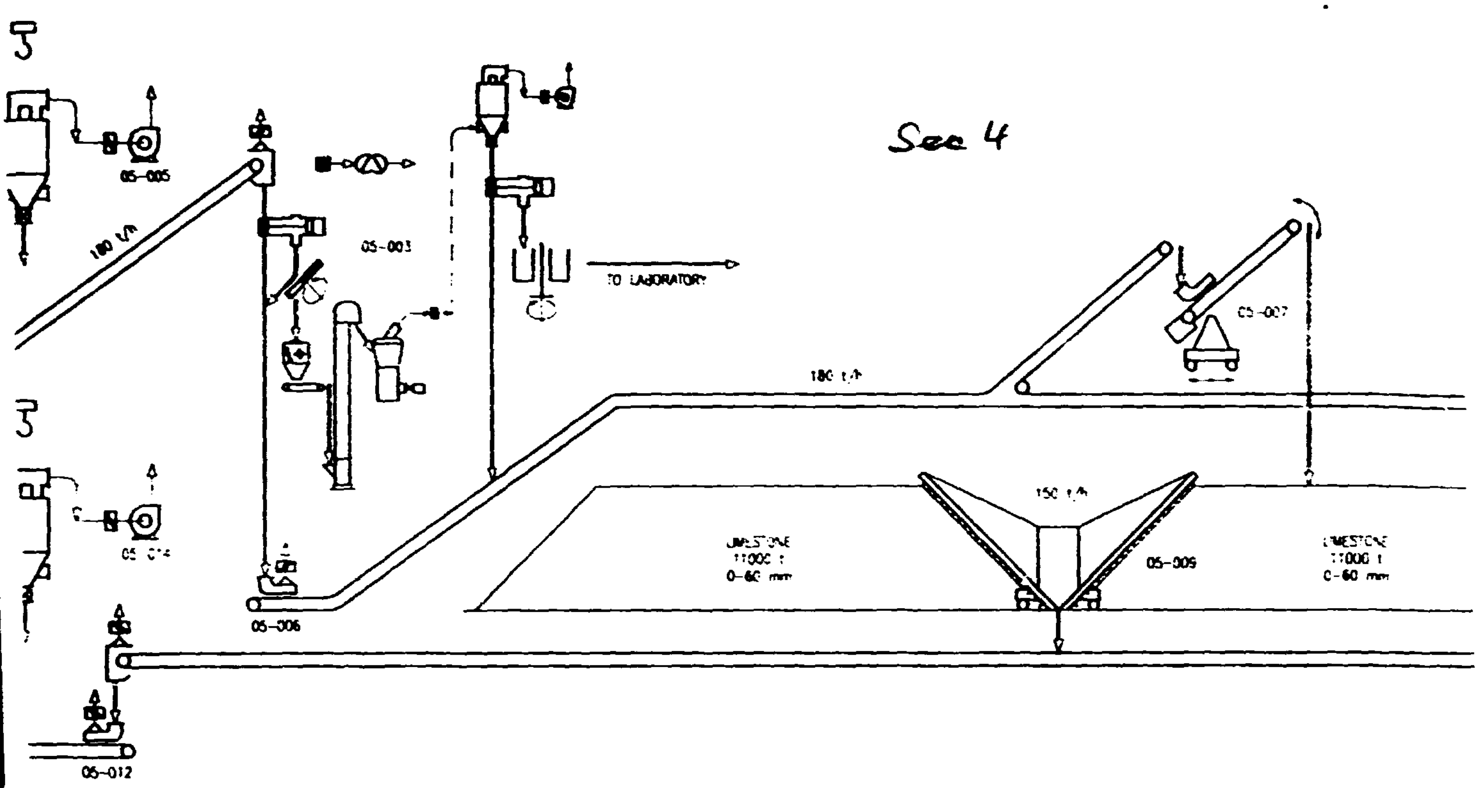
04–SECONDARY CRUSHING PLANT



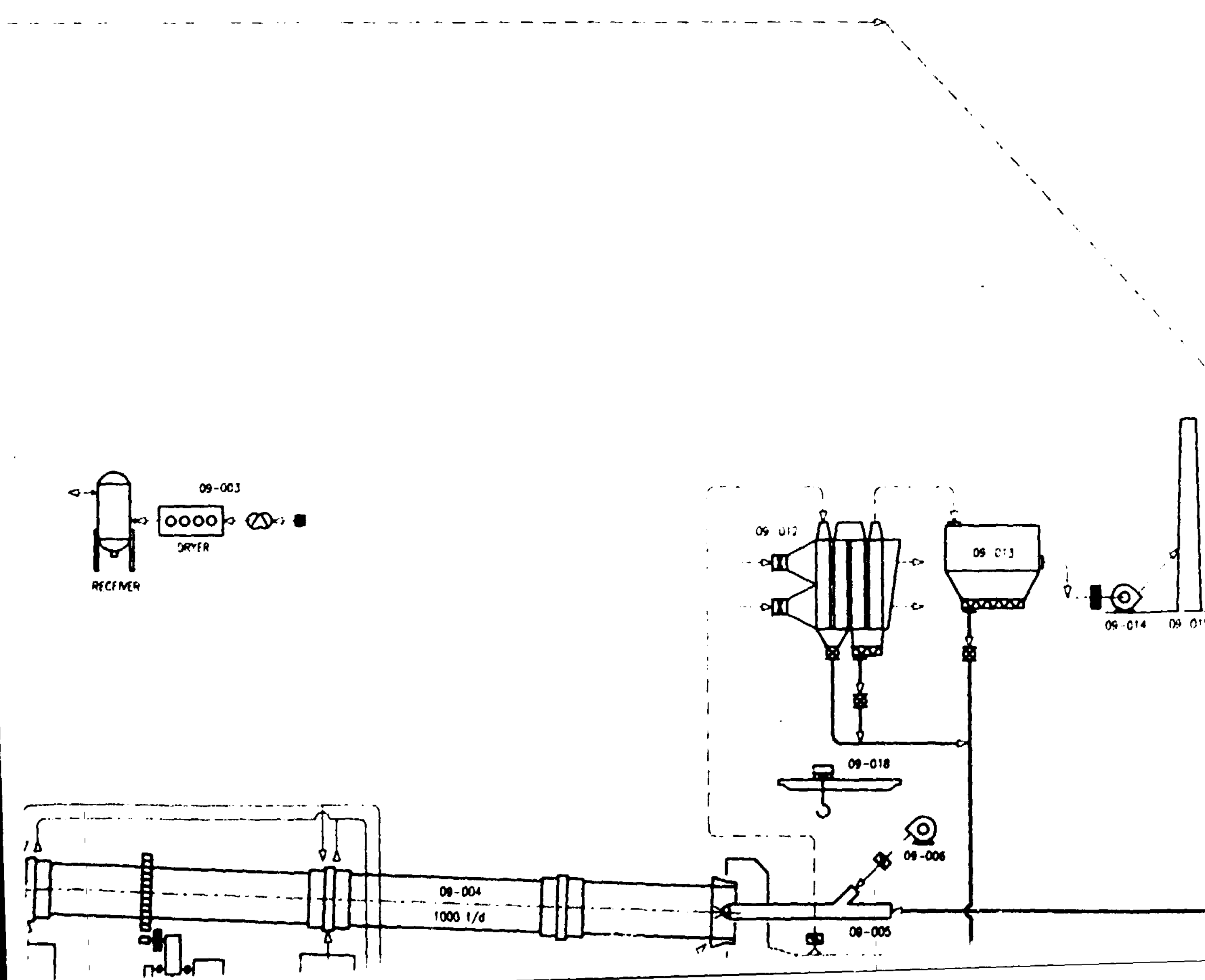
08–BLENDING SILO



05-PREBLENDING STORAGE OF LIMESTONE

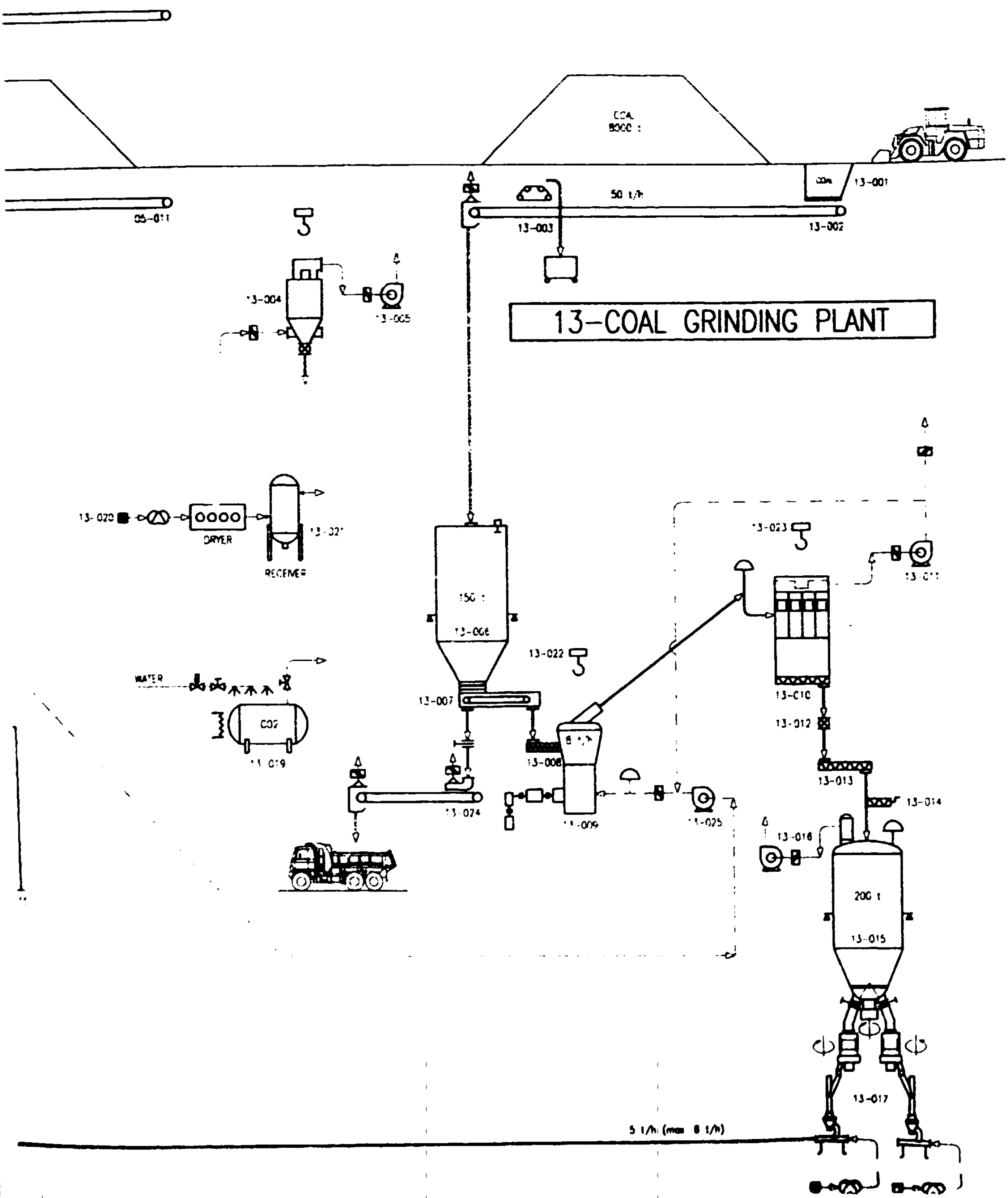


09-ROTARY KILN LINE



12-COAL STORAGE

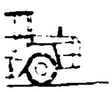
See 5



05 – Preblending Storage of Limestone

Item	Q'ty	Name
05-001	1	Diverter gate
05-002	1	Belt conveyer
05-003	1	Sampling station consisted of :
		Sampler
		Rotating divider
		Hammer crusher
		Bucket elevator
		Roller mill
		Fabric filter
		Exhaust fan
		Piston sampler
		Carrousel storage
		Air compressor
05-004	1	Fabric filter
05-005	1	Exhaust fan
05-006	1	Belt conveyer
05-007	1	Stacker
05-008	1	Track of stacker
05-009	1	Face reclaimer
05-010	1	Track of reclaimer
05-011	1	Belt conveyer
05-012	1	Belt conveyer
05-013	2	Fabric filter
05-014	2	Exhaust fan

See C



06 – Storage of Phyllyte

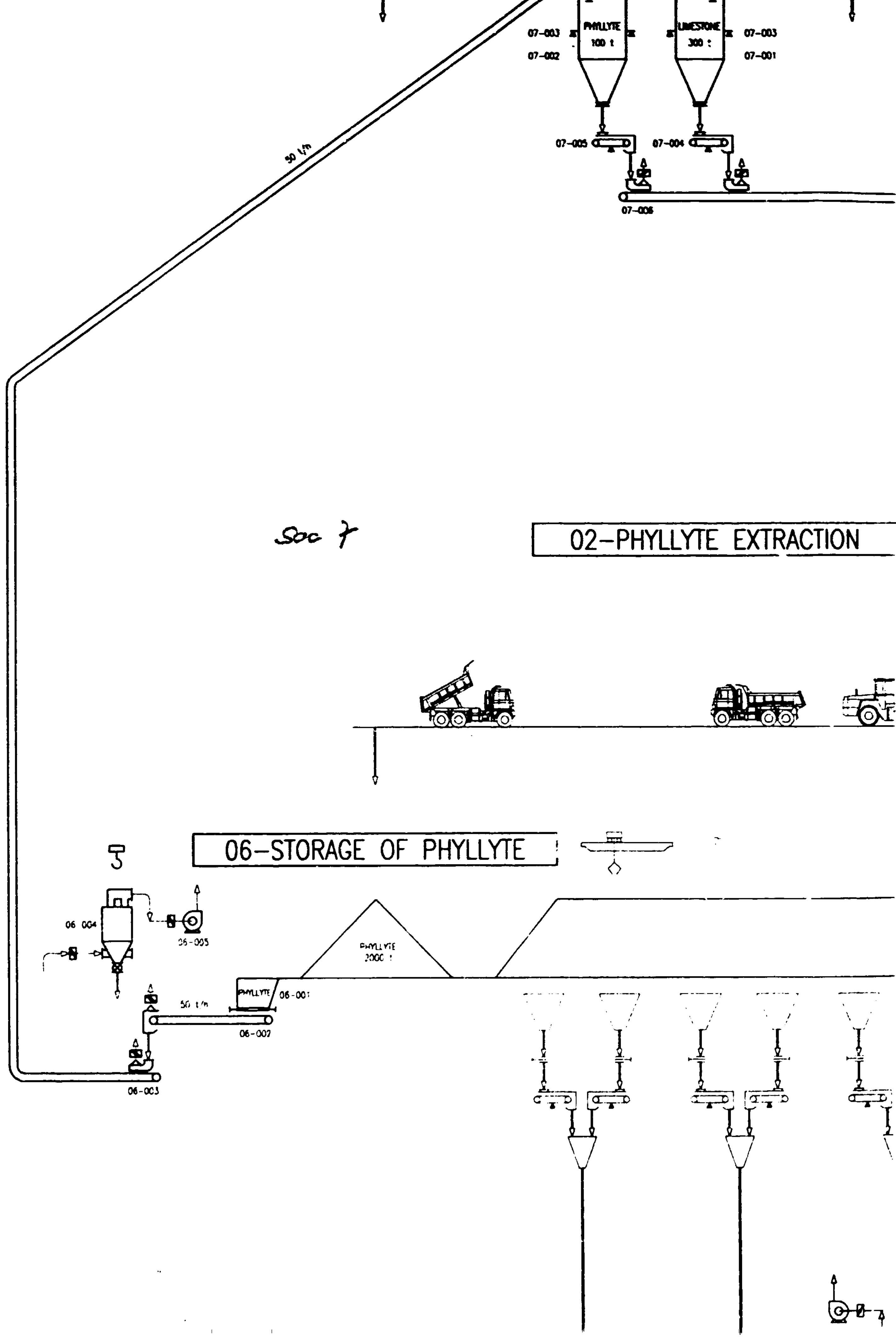
Item	Q'ty	Name
06-001	1	Hopper
06-002	1	Belt conveyer
06-003	1	Belt conveyer
06-004	2	Fabric filter
06-005	2	Exhaust fan

07 – Row Material Grinding Plant

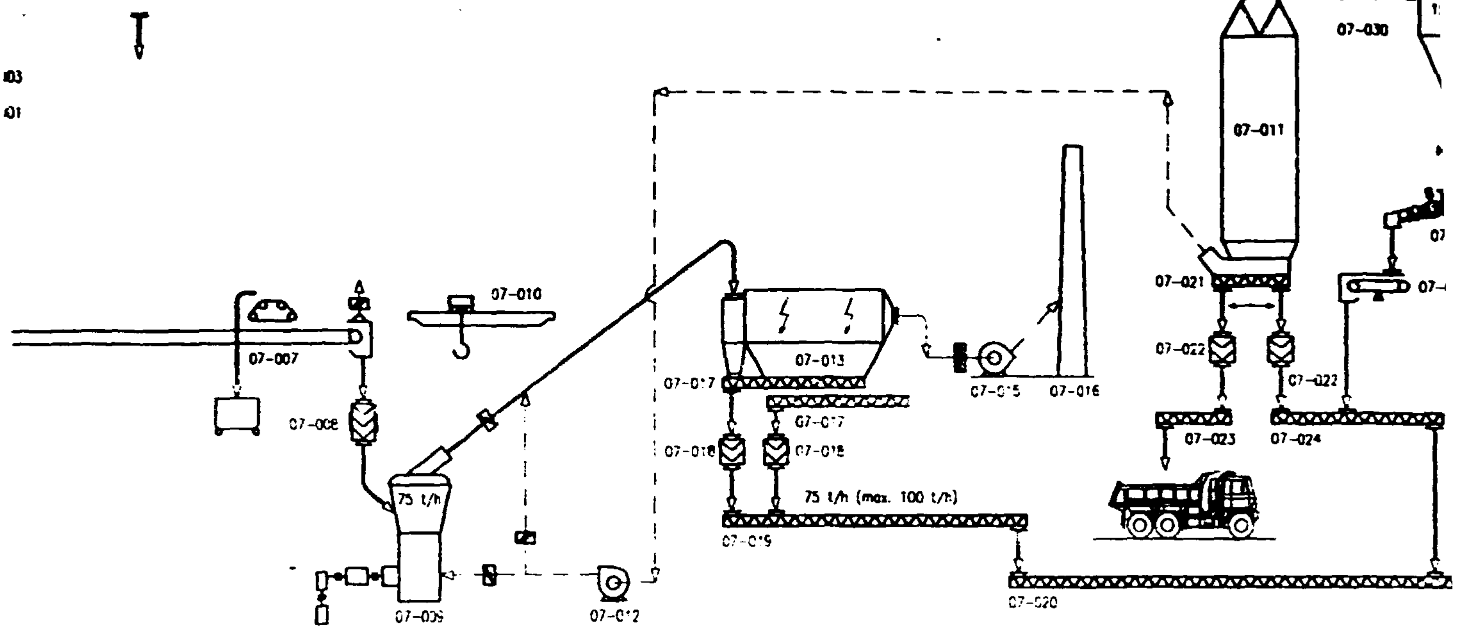
Item	Q'ty	Name
07-001	1	Limestone bin, 300 t
07-002	1	Phyllyte bin, 100 t
07-003	set	Load cell
07-004	1	Limestone belt weighfeeder
07-005	1	Phyllyte belt weighfeeder
07-006	1	Belt conveyer
07-007	1	Magnetic separator
07-008	1	Triple flap
07-009	1	Roller mill
07-010	1	Bridge crane
07-011	1	Spray tower
07-012	1	Kiln fan
07-013	1	Electric precipitator
07-014	set	Rectifiers for electric precipitator
07-015	1	Chimney fan
07-016	1	Steel chimney
07-017	2	Screw conveyer
07-018	2	Double flap
07-019	1	Screw conveyer
07-020	1	Screw conveyer
07-021	1	Reversible screw conveyer
07-022	2	Double flap
07-023	1	Screw conveyer
07-024	1	Screw conveyer
07-025	1	Sampler
07-026	1	Diverter gate
07-027	1	Bucket elevator
07-028	1	Bucket elevator
07-029	1	Screw conveyer
07-030	1	Steel bin
07-031	set	Load cell
07-032	1	Blower
07-033	set	Silo discharger with set of gates
07-034	1	Belt weighfeeder
07-035	1	Screw conveyer
07-036	1	Loading head
07-037	1	Fabric filter
07-038	1	Exhaust fan

08 – Blending silo

Item	Q'ty	Name
08-001	1	Air slide
08-002	1	Transport into blending silo
08-003	2	Fan
08-004	1	Fabric filter
08-005	1	Exhaust fan
08-006	1	Silo aeration
08-007	3	Blower
08-008	1	Silo discharger with set of gates
08-009	1	Air slide
08-010	1	Fan
08-011	set	Weighing and feeding equipment for raw meal to kiln preheater
08-012	1	Air slide
08-013	1	Fan
08-014	2	Sampler
08-015	2	Bucket elevator
08-016	1	Diverter gate
08-017	1	Screw conveyer

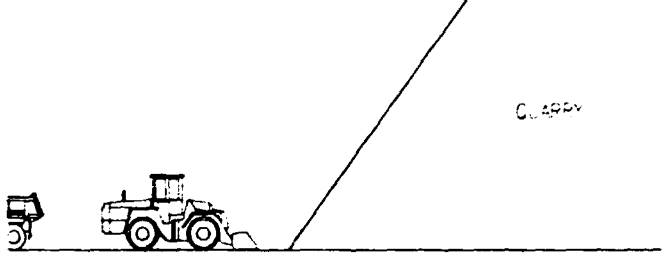


PHYLLYTE
100 t
LIMESTONE
300 t
07-003
07-002
07-003
07-001
07-005
07-004
07-006
50 t/h
Soc 7
02-PHYLLYTE EXTRACTION
06-STORAGE OF PHYLLYTE
06 004
06-005
PHYLLYTE
2000 t
PHYLLYTE
06-001
50 t/h
06-002
06-003

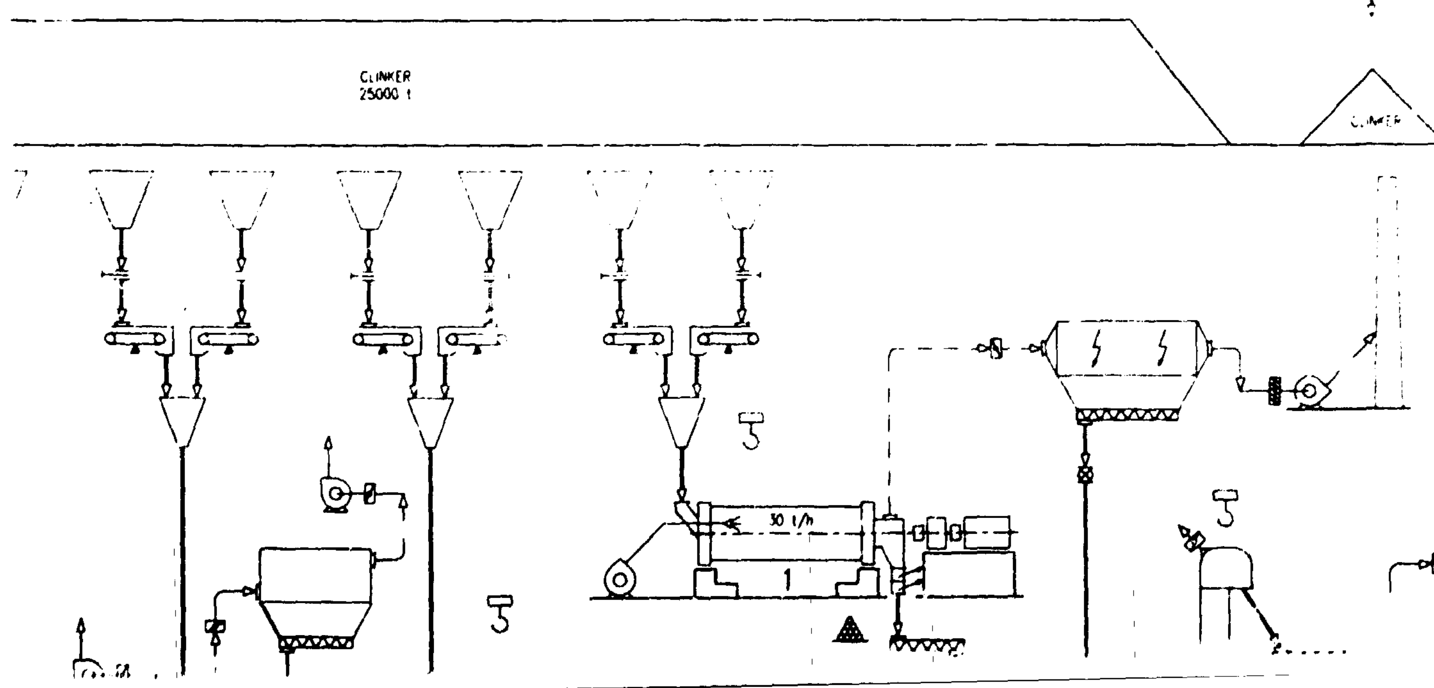


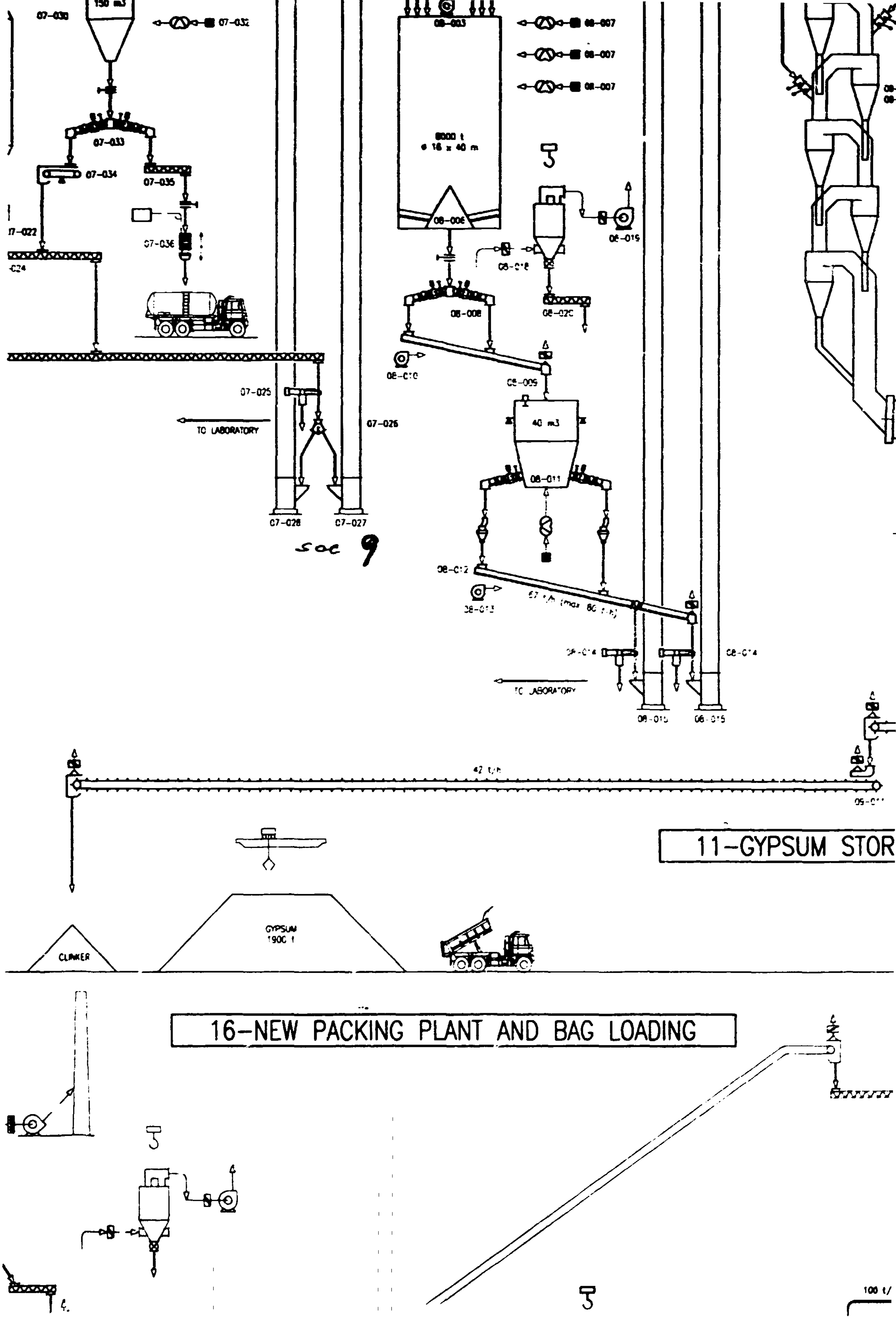
Sec 8

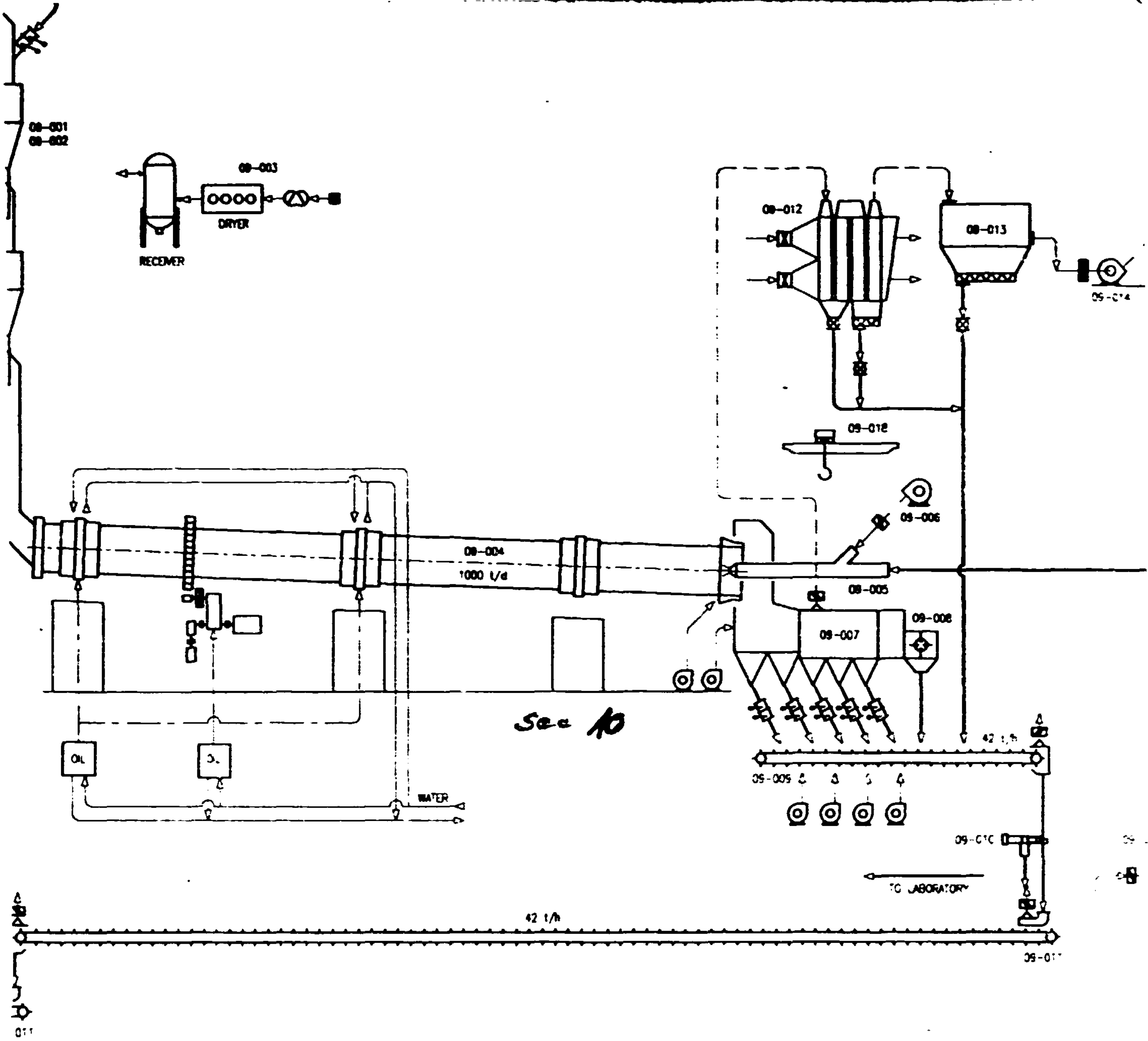
RACTION



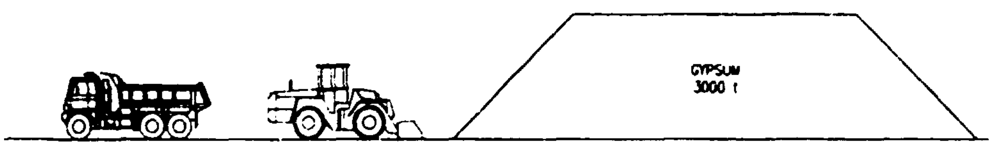
10-CLINKER STORAGE



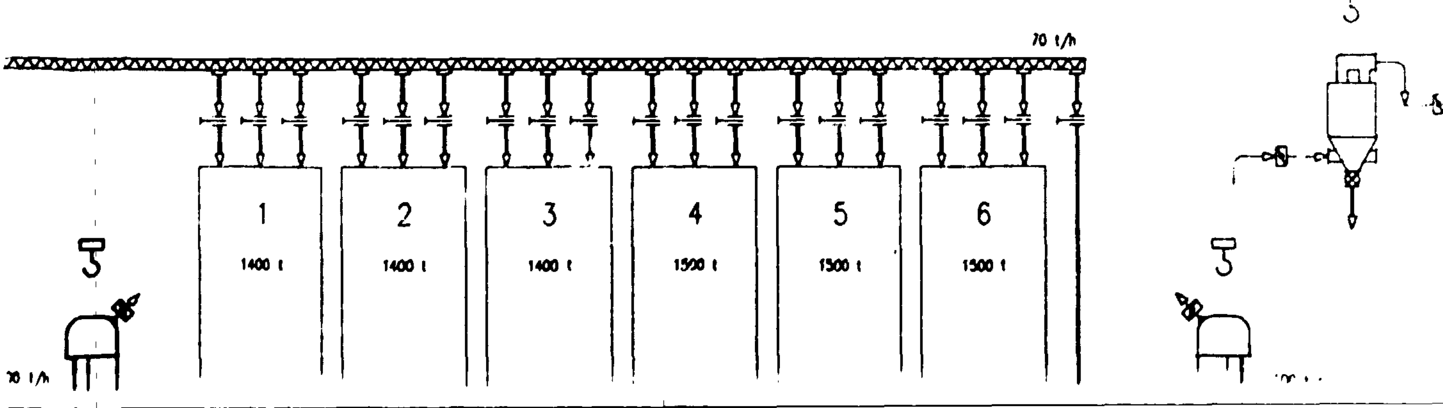

150 m3
07-030
07-032
07-033
07-034
07-035
07-036
07-022
07-025
TO LABORATORY
07-026
07-028
07-027
soc 9
08-003
08-007
08-007
08-007
8000 t
ø 16 x 40 m
08-006
08-019
08-018
08-020
08-008
08-010
08-009
40 m3
08-011
08-012
08-013
08-014
08-014
TO LABORATORY
08-015
08-015
42 t/h
11-GYPSUM STOR
CLINKER
GYPSUM
1900 t
16-NEW PACKING PLANT AND BAG LOADING
100 t/

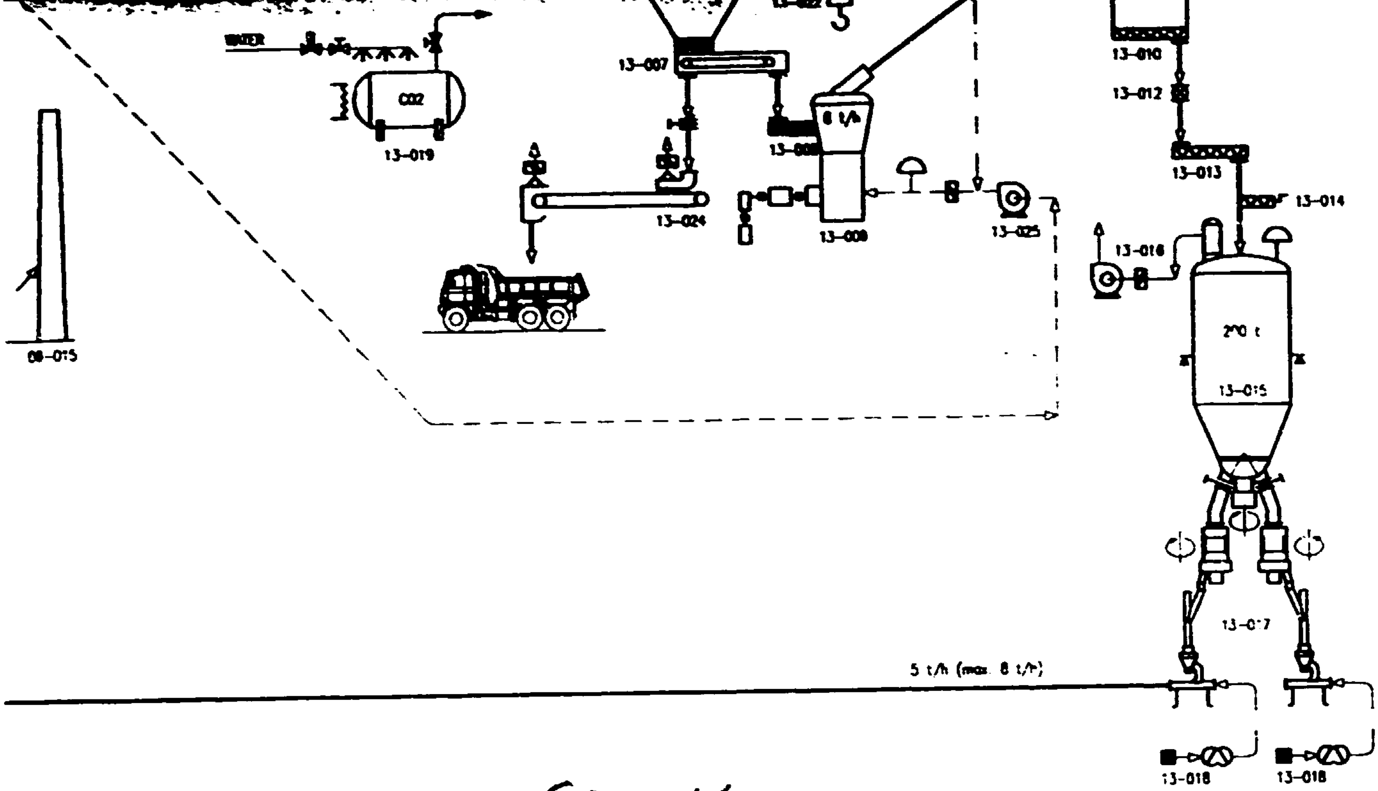


ORAGE

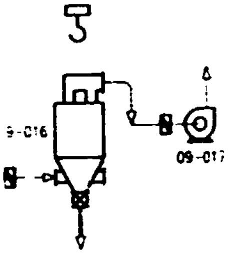


15–CEMENT SILOS AND DISPATCH OF BULK CEMENT

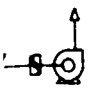




Sec 11



16-EXIST PACKING PLANT AND BAG LOADING



14

07-025	1	Sampler
07-026	1	Diverter gate
07-027	1	Bucket elevator
07-028	1	Bucket elevator
07-029	1	Screw conveyer
07-030	1	Steel bin
07-031	set	Load cell
07-032	1	Blower
07-033	set	Silo discharger with set of gates
07-034	1	Belt weighfeeder
07-035	1	Screw conveyer
07-036	1	Loading head
07-037	1	Fabric filter
07-038	1	Exhaust fan

08 – Blending silo

Item	Q'ty	Name
08-001	1	Air slide
08-002	1	Transport into blending silo
08-003	2	Fan
08-004	1	Fabric filter
08-005	1	Exhaust fan
08-006	1	Silo aeration
08-007	3	Blower
08-008	1	Silo discharger with set of gates
08-009	1	Air slide
08-010	1	Fan
08-011	set	Weighing and feeding equipment for raw meal to kiln preheater
08-012	1	Air slide
08-013	1	Fan
08-014	2	Sampler
08-015	2	Bucket elevator
08-016	1	Diverter gate
08-017	1	Screw conveyer
08-018	1	Fabric filter
08-019	1	Exhaust fan
08-020	1	Screw conveyer

Sec 12

09 – Rotary Kiln Line

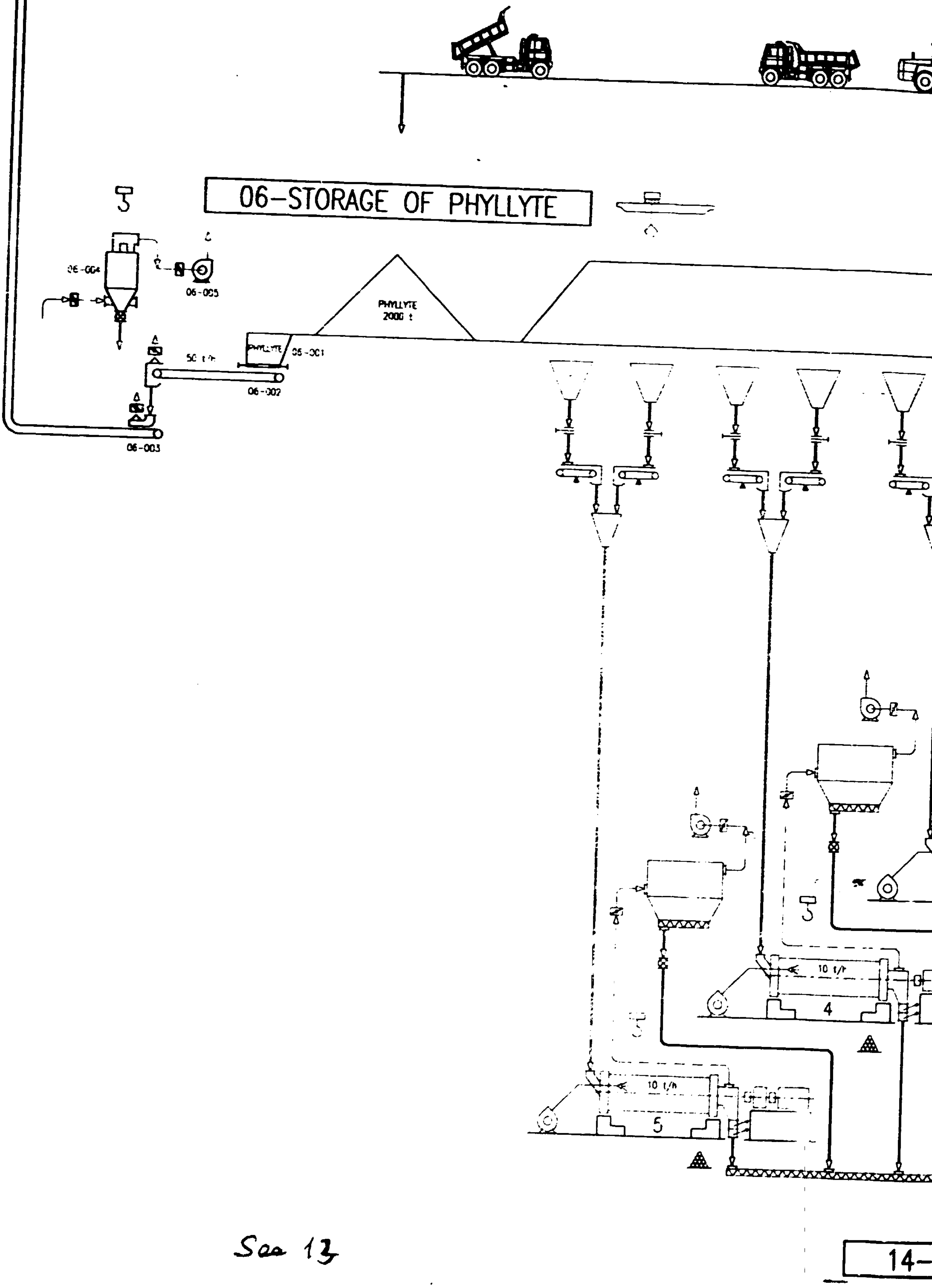
Item	Q'ty	Name
09-001	1	Preheater
09-002	set	Air blasters
09-003	1	Compressor station with compressed air receiver
09-004	1	Rotary kiln
09-005	1	Burner of rotary kiln
09-006	1	Primary air fan
09-007	1	Grate cooler with cooling fans
09-008	1	Clinker impact crusher
09-009	1	Chain conveyer
09-010	1	Sampler
09-011	2	Chain conveyer
09-012	1	Cooler of gas from grate cooler
09-013	1	Fabric filter
09-014	1	Exhaust fan
09-015	1	Steel chimney
09-016	1	Fabric filter
09-017	1	Exhaust fan
09-018	1	Bridge crane

13 – Coal Grinding Plant

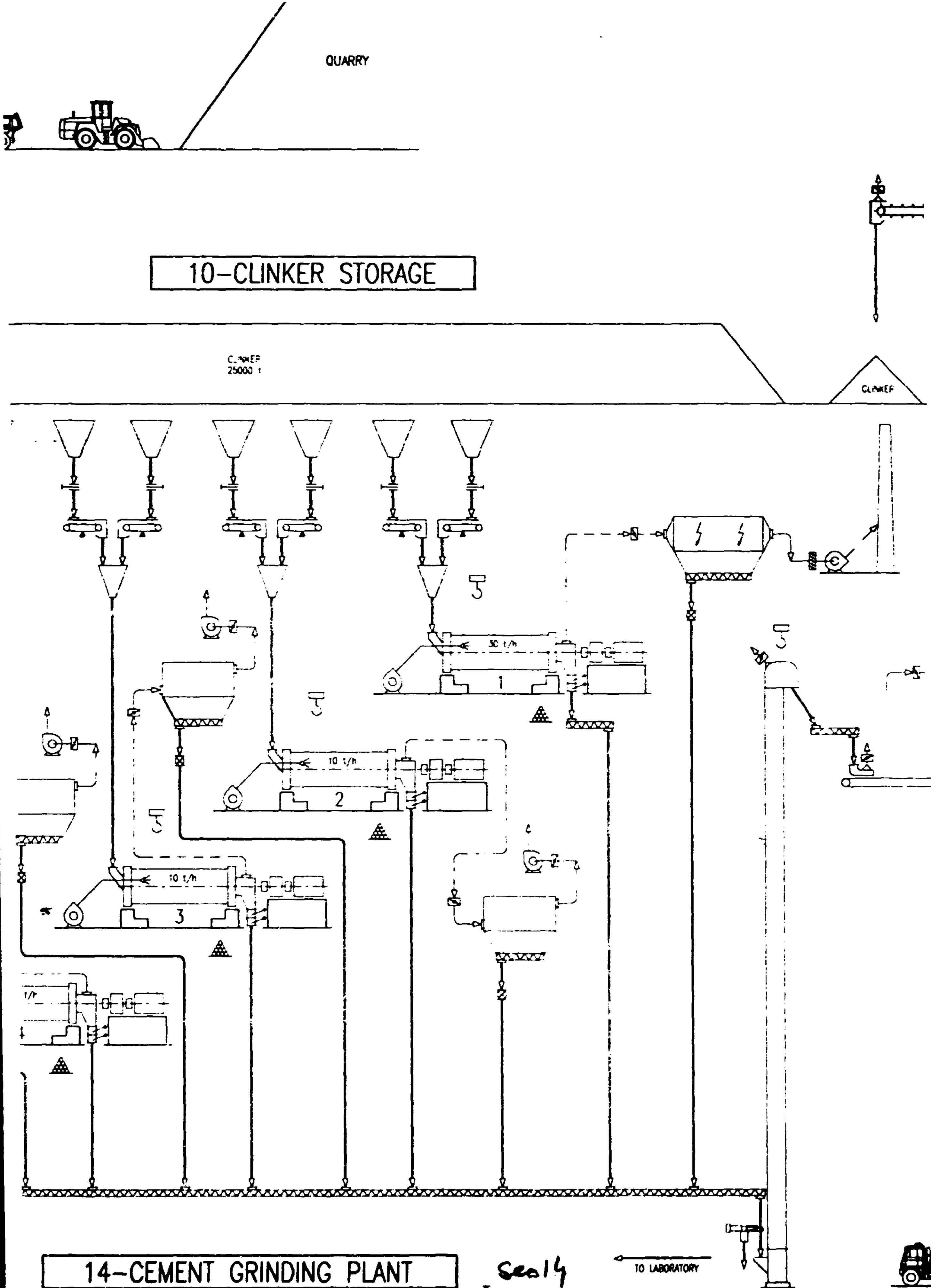
Item	Q'ty	Name
13-001	1	Hopper
13-002	1	Belt conveyer
13-003	1	Magnetic separator
13-004	1	Fabric filter
13-005	1	Exhaust fan
13-006	1	Coal bin with load cell
13-007	1	Apron feeder
13-008	1	Double screw conveyer feeder
13-009	1	Roller mill
13-010	1	Fabric filter
13-011	1	Exhaust fan
13-012	1	Rotary feeder
13-013	1	Screw conveyer
13-014	1	Sampler
13-015	1	Pulverized coal silo with load cell
13-016	1	Fabric filter with exhaust fan
13-017	set	Weighing and feeding equipment for coal powder
13-018	2	Air compressor
13-019	set	Firefighting system
13-020	1	Air compressor
13-021	1	Compressed air receiver
13-022	1	Electric hoist, 100 kN
13-023	1	Electric hoist, 50 kN
13-024	1	Belt conveyer
13-025	1	Drought fan

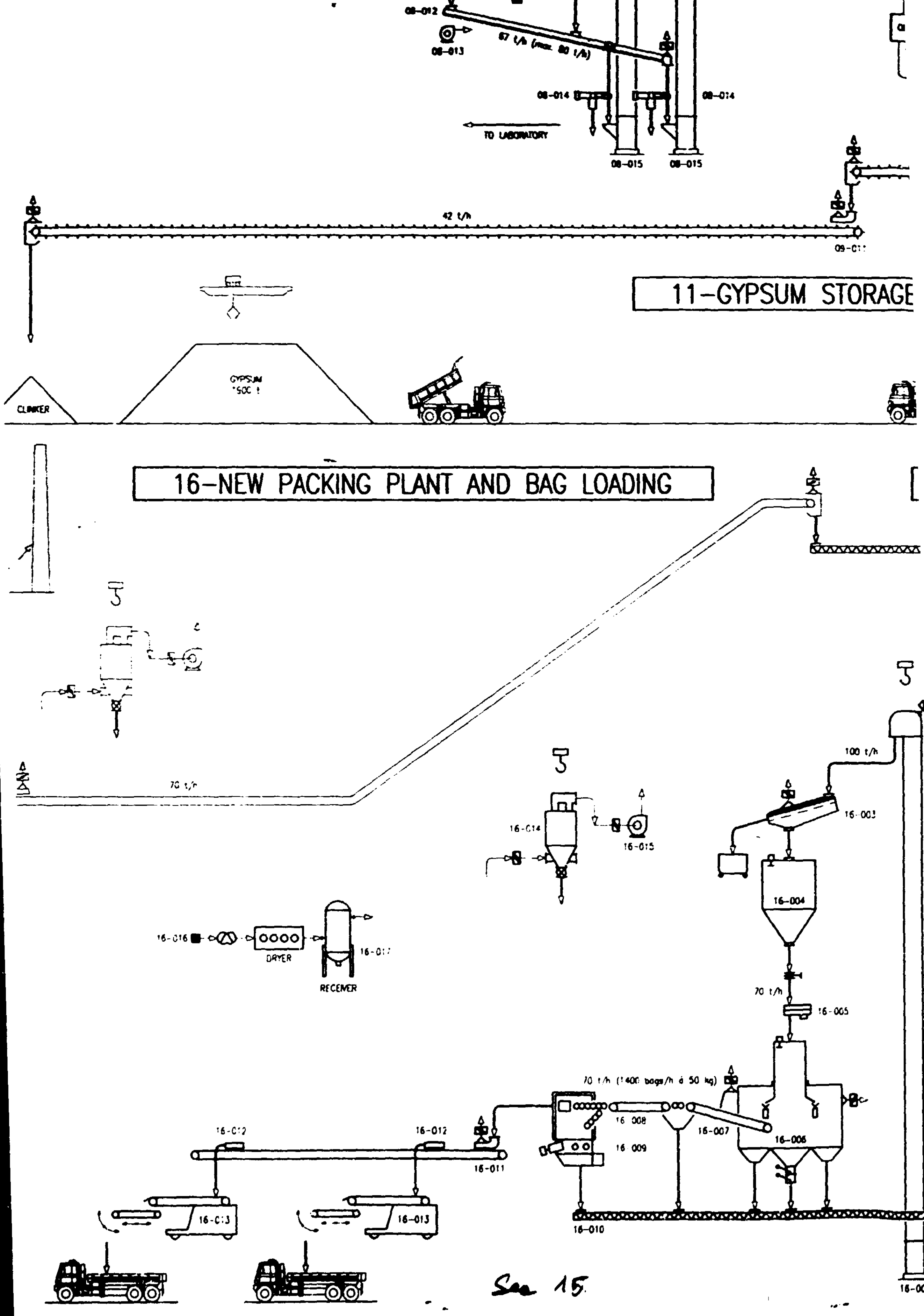
15 – Cement Silos and Dispatch of Bulk Cement

Item	Q'ty	Name
15-001	1	Screw conveyer
15-002	set	Silo discharger with set of gates
15-003	1	Loading head


06-STORAGE OF PHYLLYTE
06-004
06-005
PHYLLYTE
2000 t
PHYLLYTE
06-001
50 t/h
06-002
06-003
10 t/h
4
10 t/h
5
14–

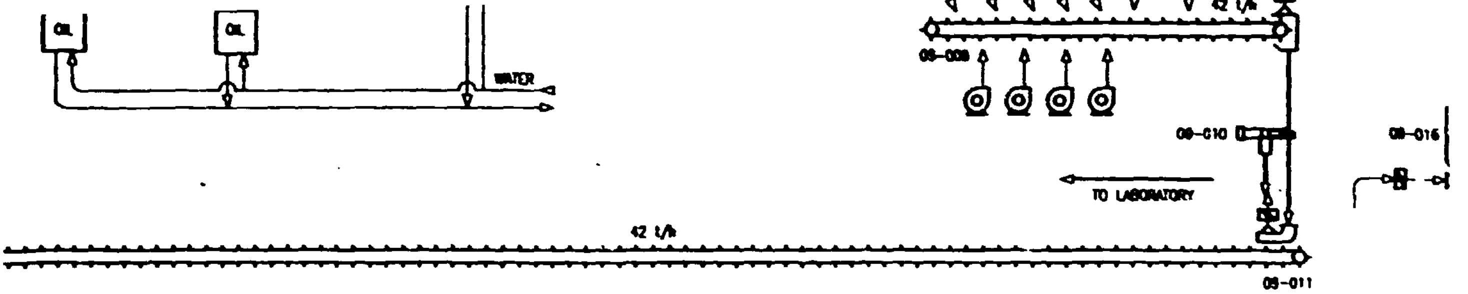
Sea 13


QUARRY
10-CLINKER STORAGE
CLINKER
25000 t
CLINKER
30 t/h
1
10 t/h
2
10 t/h
3
14-CEMENT GRINDING PLANT
See 14
TO LABORATORY

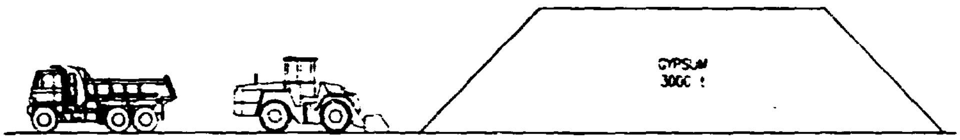


08-012
08-013
67 t/h (max. 80 t/h)
08-014
TO LABORATORY
08-015
42 t/h
11-GYPSUM STORAGE
CLINKER
GYPSUM
16-NEW PACKING PLANT AND BAG LOADING
70 t/h
100 t/h
16-003
16-004
16-005
16-014
16-015
16-016
DRYER
RECEIVER
70 t/h (1400 bags/h à 50 kg)
16-008
16-009
16-007
16-006
16-012
16-011
16-013
16-010

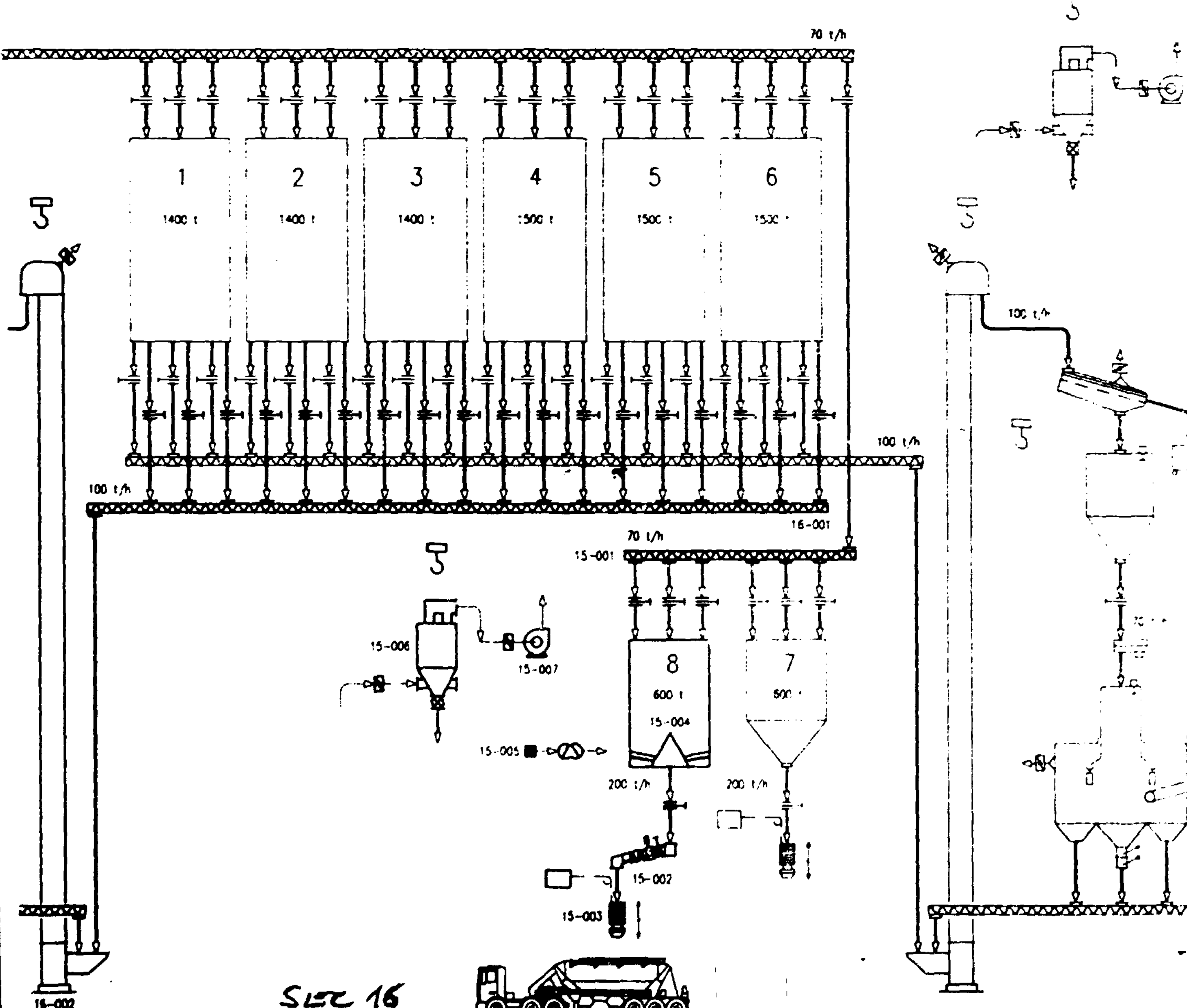
See 15.



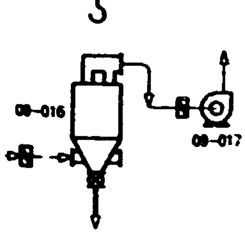
RAGE



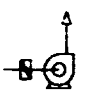
15-CEMENT SILOS AND DISPATCH OF BULK CEMENT

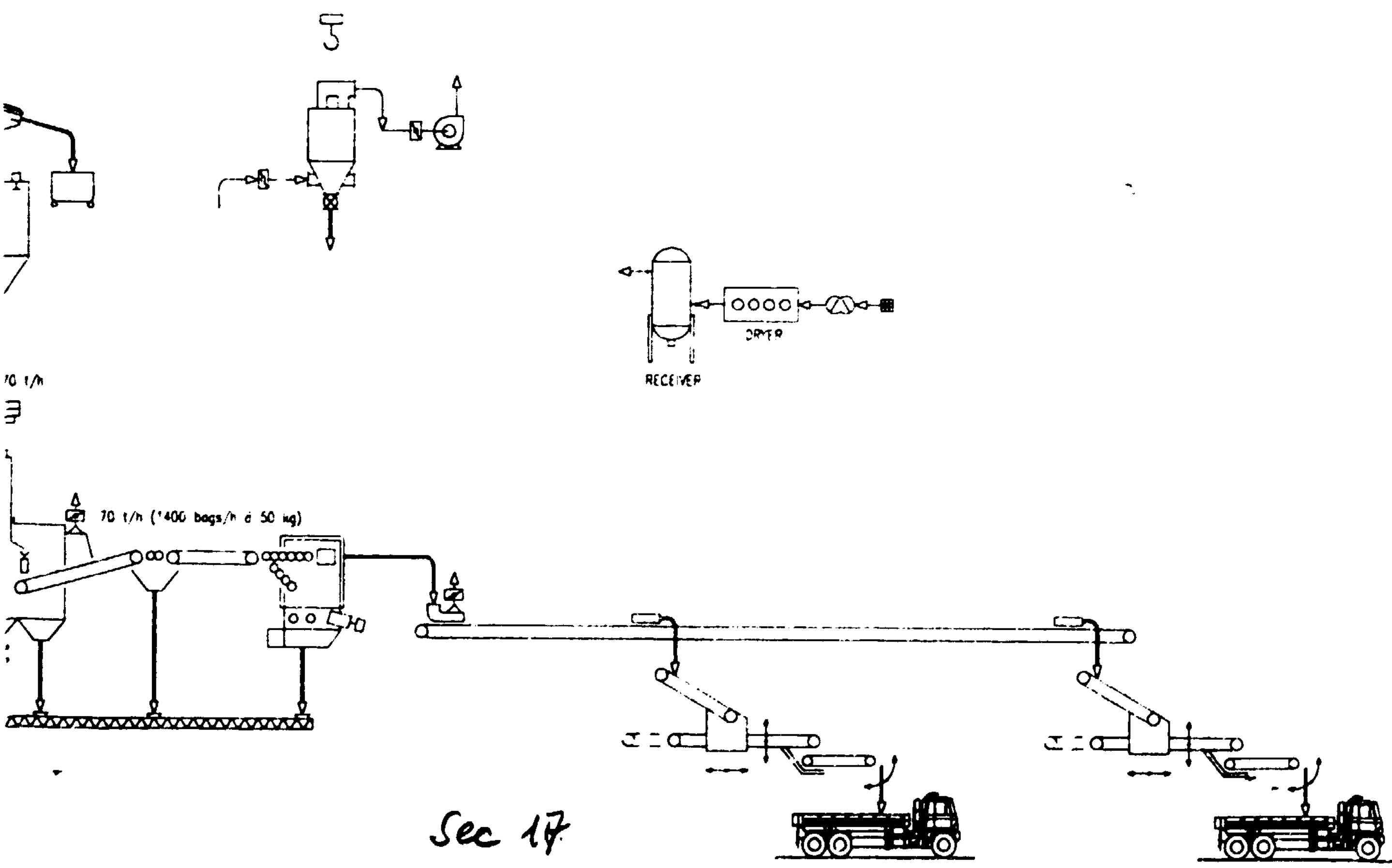


SEE 16



16–EXIST PACKING PLANT AND BAG LOADING





Sec 17

Item	Q'ty	Name
09-001	1	Preheater
09-002	set	Air blasters
09-003	1	Compressor station with compressed air receiver
09-004	1	Rotary kiln
09-005	1	Burner of rotary kiln
09-006	1	Primary air fan
09-007	1	Grate cooler with cooling fans
09-008	1	Clinker impact crusher
09-009	1	Chain conveyer
09-010	1	Sampler
09-011	2	Chain conveyer
09-012	1	Cooler of gas from grate cooler
09-013	1	Fabric filter
09-014	1	Exhaust fan
09-015	1	Steel chimney
09-016	1	Fabric filter
09-017	1	Exhaust fan
09-018	1	Bridge crane

13 – Coal Grinding Plant

Item	Q'ty	Name
13-001	1	Hopper
13-002	1	Belt conveyer
13-003	1	Magnetic separator
13-004	1	Fabric filter
13-005	1	Exhaust fan
13-006	1	Coal bin with load cell
13-007	1	Apron feeder
13-008	1	Double screw conveyer feeder
13-009	1	Roller mill
13-010	1	Fabric filter
13-011	1	Exhaust fan
13-012	1	Rotary feeder
13-013	1	Screw conveyer
13-014	1	Sampler
13-015	1	Pulverized coal silo with load cell
13-016	1	Fabric filter with exhaust fan
13-017	set	Weighing and feeding equipment for coal powder
13-018	2	Air compressor
13-019	set	Firefighting system
13-020	1	Air compressor
13-021	1	Compressed air receiver
13-022	1	Electric hoist, 100 kN
13-023	1	Electric hoist, 50 kN
13-024	1	Belt conveyer
13-025	1	Draught fan

15 – Cement Silos and Dispatch of Bulk Cement

Item	Q'ty	Name
15-001		Screw conveyer
15-002	set	Silo discharger with set of gates
15-003	1	Loading head
15-004	1	Silo aeration
15-005	1	Blower
15-006	1	Fabric filter
15-007	1	Exhaust fan

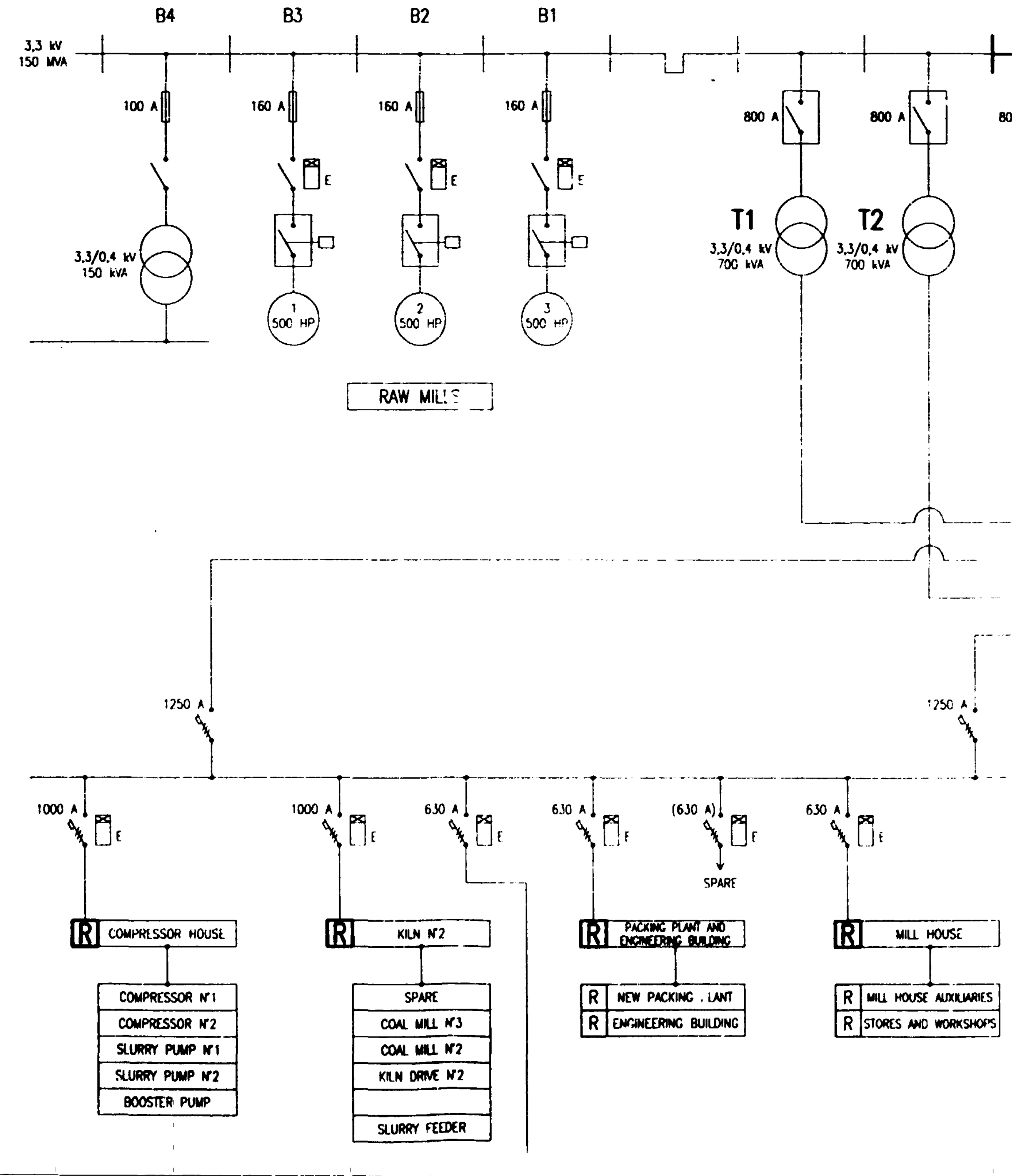
16 – New Packing Plant and Bag Loading

Item	Q'ty	Name
16-001	1	Screw conveyer
16-002	1	Bucket elevator
16-003	1	Vibrating screen
16-004	1	Feed bin
16-005	1	Vertical double rotary feeder
16-006	1	Eight-spout packing machine
16-007	1	Belt conveyer
16-008	1	Belt conveyer
16-009	1	Machine for the slitting of bags
16-010	1	Screw conveyer
16-011	1	Belt conveyer
16-012	2	Bag tripper
16-013	2	Truck loading
16-014	1	Fabric filter
16-015	1	Exhaust fan
16-016	1	Air compressor
16-017	1	Compressed air receiver
16-018	1	Electric hoist, 32 kN

Sec 18

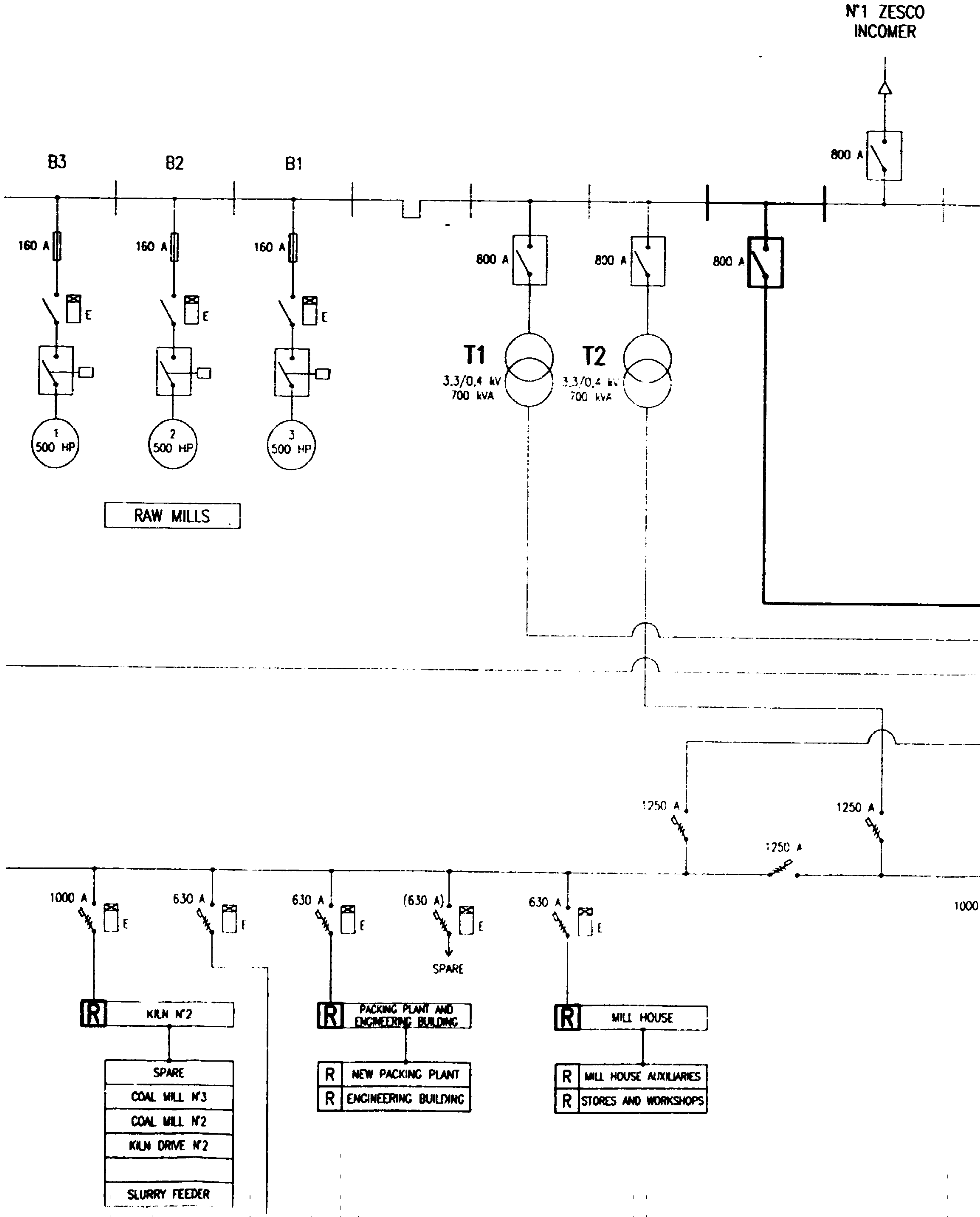
UNIDO VIENNA	KERAMOPROJEKT a.s. TRENČÍN	DATE: JANUARY 1996
EXPANSION OF THE CHILANGA CEMENT PLANT		FILES NO: 1-16
FLOW SHEET		SCALE: NOT
		DRAWING NO: 3

Sec 1



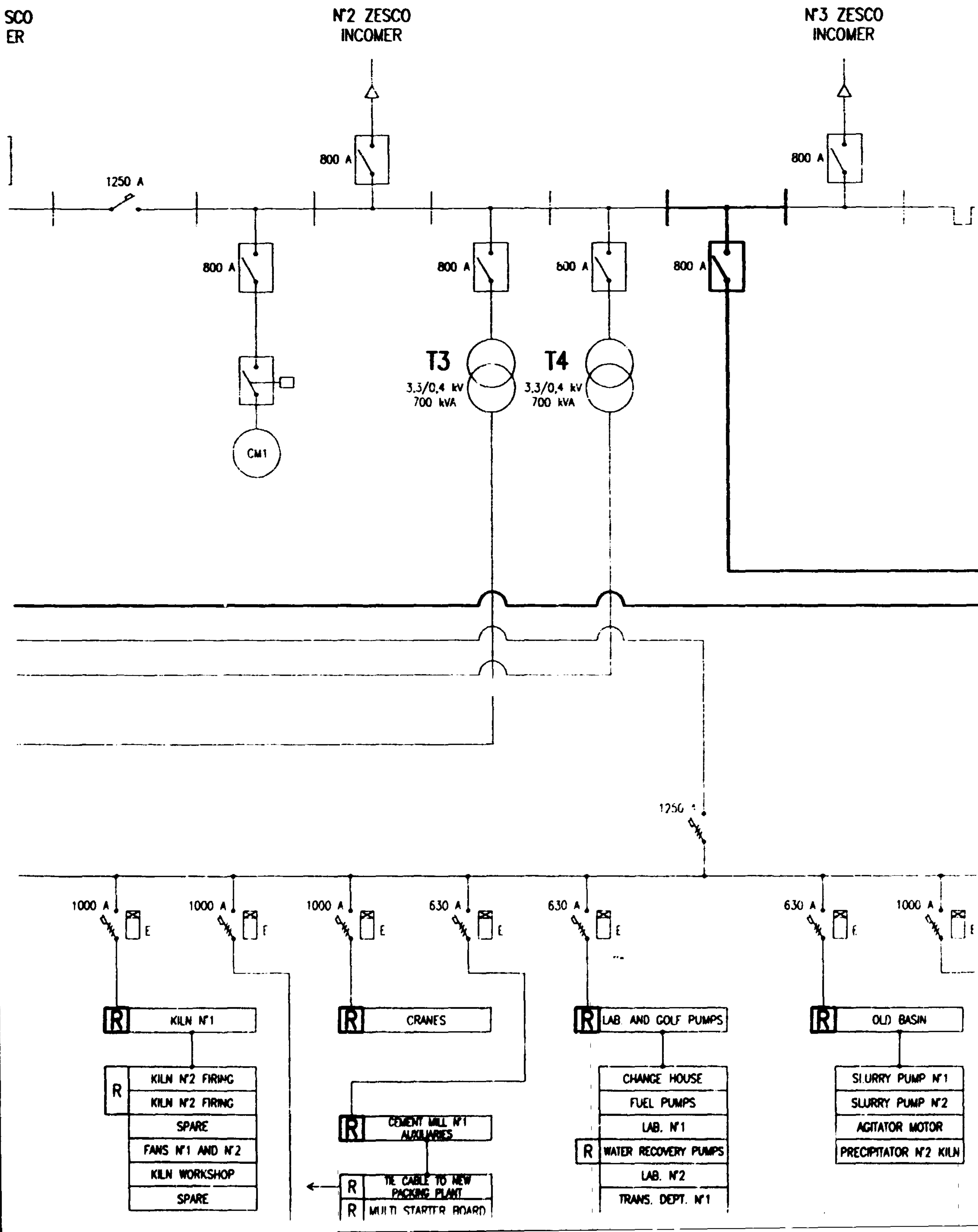
B4
B3
B2
B1
3,3 kV
150 MVA
100 A
160 A
160 A
160 A
800 A
800 A
3,3/0,4 kV
150 kVA
1
500 HP
2
500 HP
3
500 HP
T1
3,3/0,4 kV
700 kVA
T2
3,3/0,4 kV
700 kVA
RAW MILLS
1250 A
1250 A
1000 A
1000 A
630 A
630 A
(630 A)
630 A
SPARE
COMPRESSOR HOUSE
COMPRESSOR N°1
COMPRESSOR N°2
SLURRY PUMP N°1
SLURRY PUMP N°2
BOOSTER PUMP
KILN N°2
SPARE
COAL MILL N°3
COAL MILL N°2
KILN DRIVE N°2
SLURRY FEEDER
PACKING PLANT AND ENGINEERING BUILDING
NEW PACKING PLANT
ENGINEERING BUILDING
MILL HOUSE
MILL HOUSE AUXILIARIES
STORES AND WORKSHOPS

Sec 2

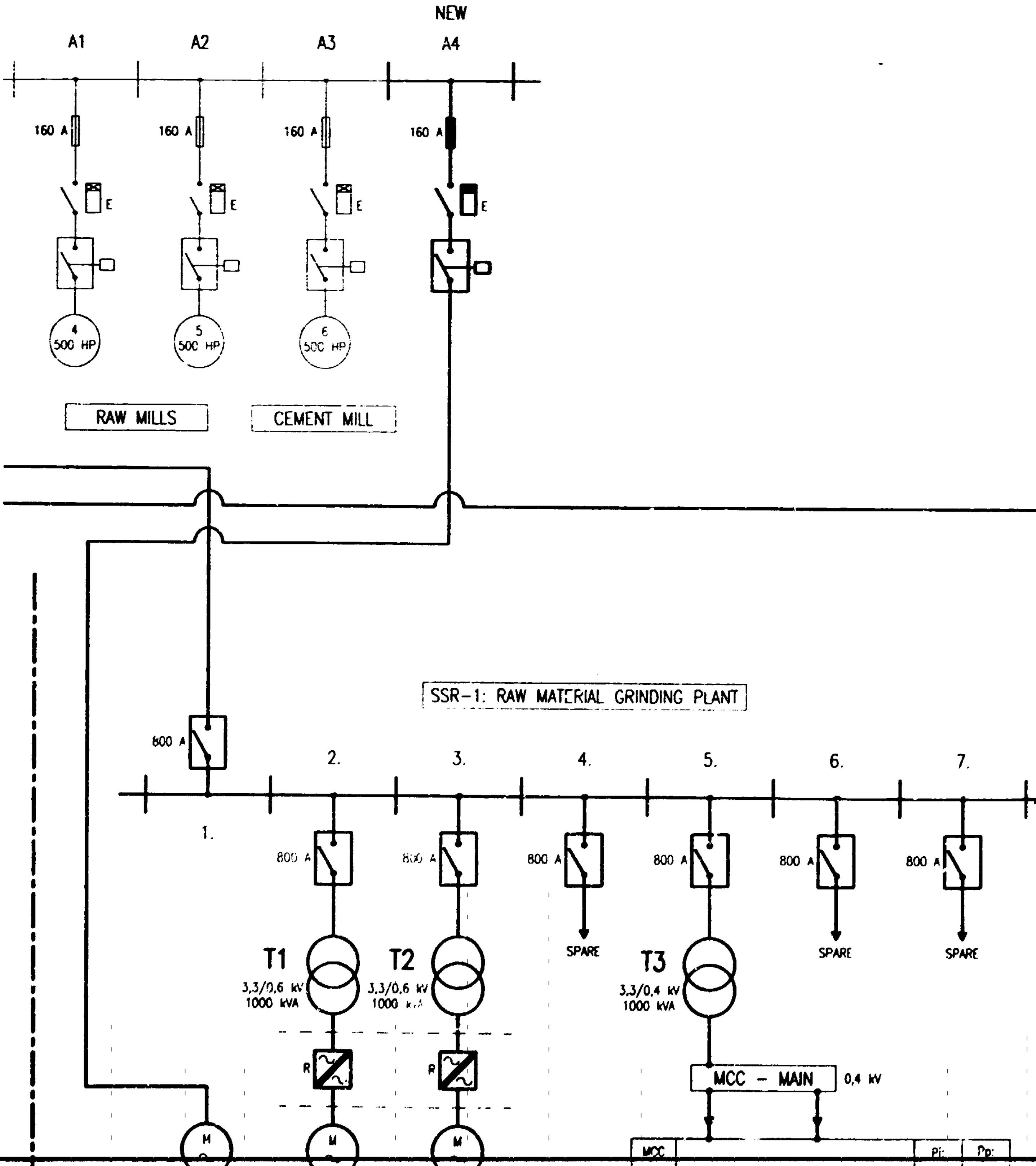


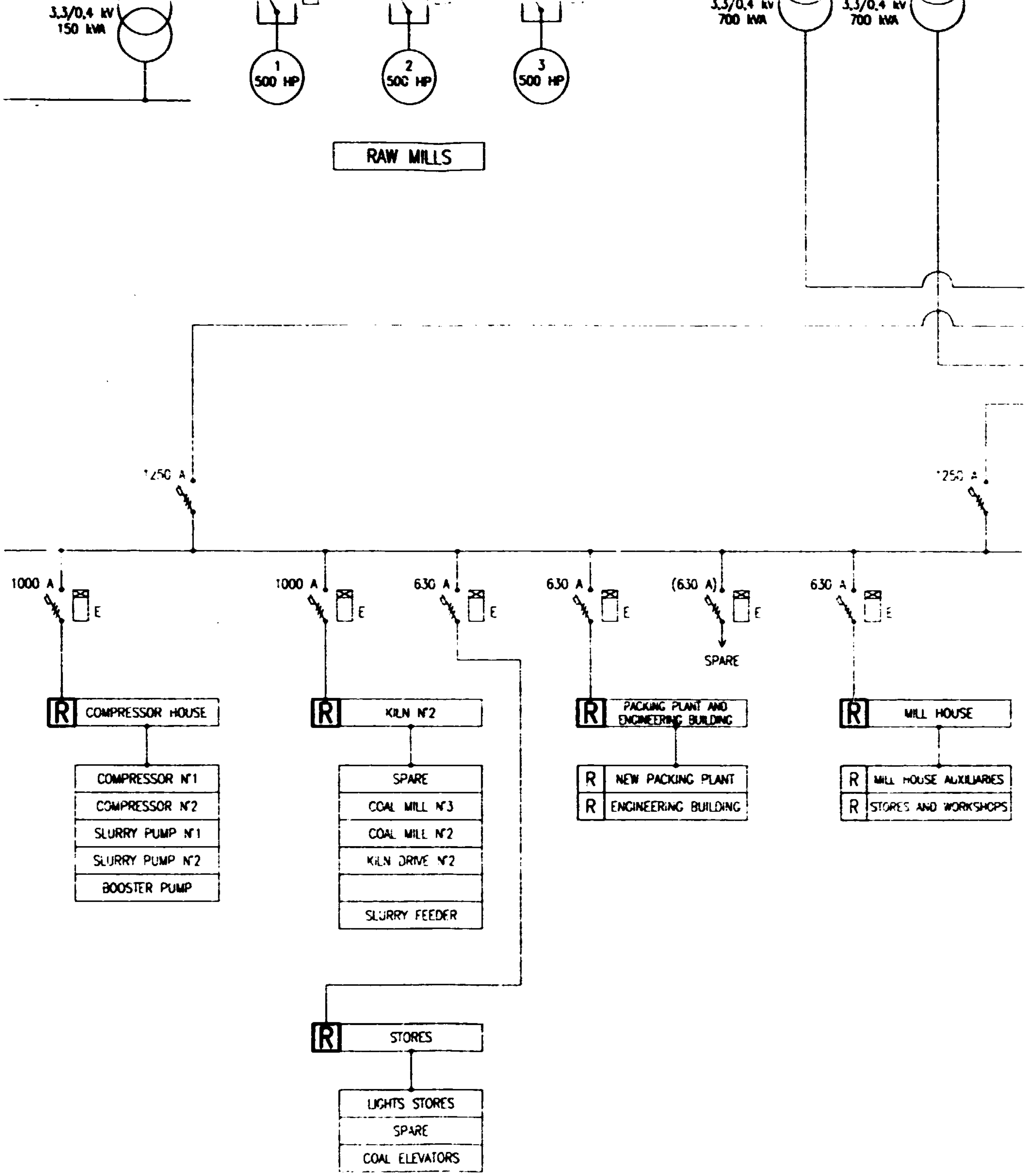
N°1 ZESCO
INCOMER
800 A
B3
B2
B1
160 A
160 A
160 A
E
E
E
1
500 HP
2
500 HP
3
500 HP
RAW MILLS
800 A
800 A
800 A
T1
3,3/0,4 kV
700 kVA
T2
3,3/0,4 kV
700 kVA
1250 A
1250 A
1250 A
1000 A
630 A
630 A
(630 A)
630 A
1000
SPARE
R
KILN N°2
SPARE
COAL MILL N°3
COAL MILL N°2
KILN DRIVE N°2
SLURRY FEEDER
R
PACKING PLANT AND ENGINEERING BUILDING
R
NEW PACKING PLANT
R
ENGINEERING BUILDING
R
MILL HOUSE
R
MILL HOUSE AUXILIARIES
R
STORES AND WORKSHOPS

Sec 3

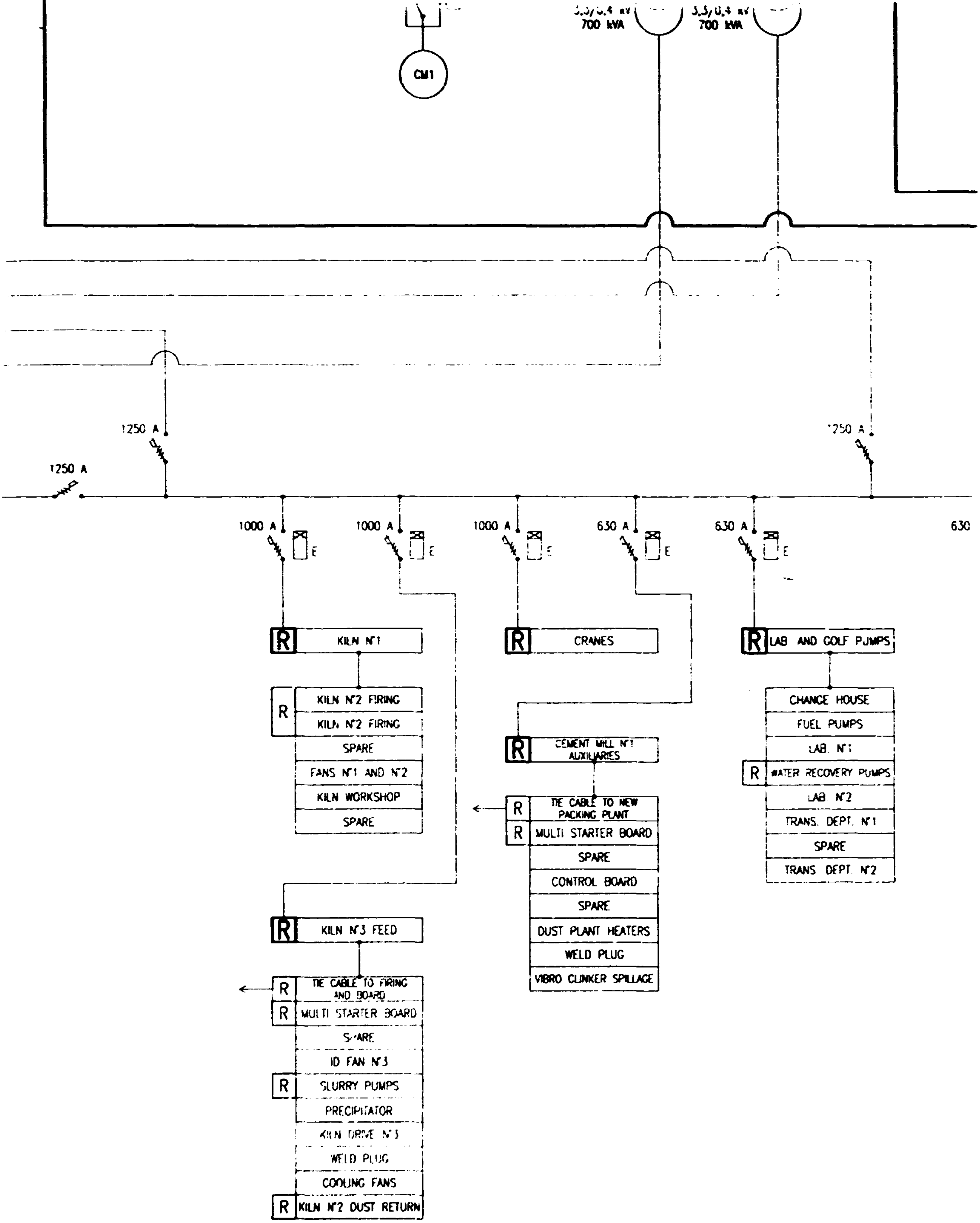

SCO
ER
N°2 ZESCO INCOMER
N°3 ZESCO INCOMER
800 A
1250 A
800 A
800 A
600 A
800 A
CM1
T3
3,3/0,4 kV
700 kVA
T4
3,3/0,4 kV
700 kVA
1250 A
1000 A
1000 A
1000 A
630 A
630 A
630 A
1000 A
E
KILN N°1
KILN N°2 FIRING
KILN N°2 FIRING
SPARE
FANS N°1 AND N°2
KILN WORKSHOP
SPARE
CRANES
CEMENT MILL N°1 AUXILIARIES
TIE CABLE TO NEW PACKING PLANT
MULTI STARTER BOARD
LAB. AND GOLF PUMPS
CHANGE HOUSE
FUEL PUMPS
LAB. N°1
WATER RECOVERY PUMPS
LAB. N°2
TRANS. DEPT. N°1
OLD BASIN
SLURRY PUMP N°1
SLURRY PUMP N°2
AGITATOR MOTOR
PRECIPITATOR N°2 KILN
R

Sea 4

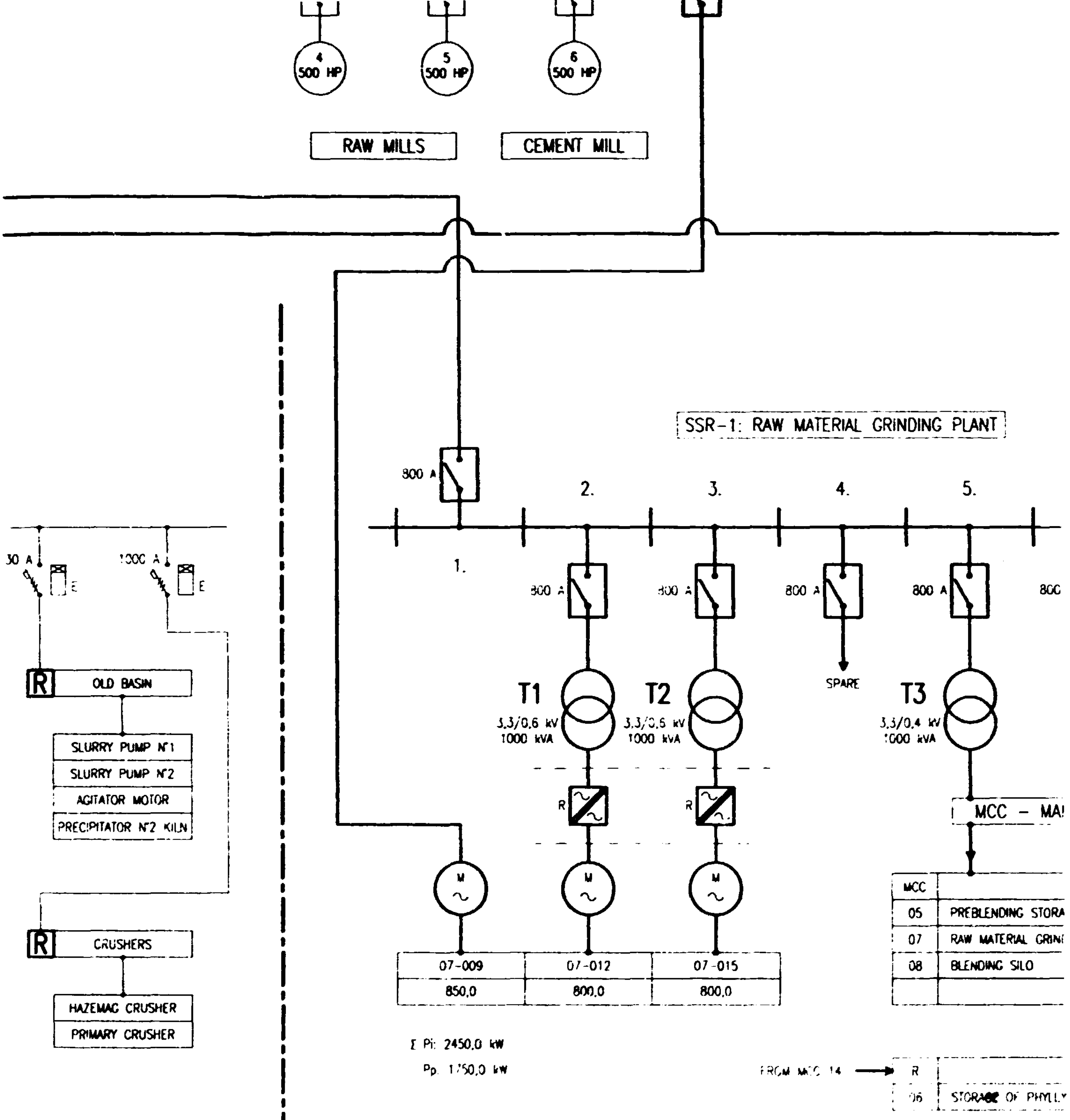

NEW
A1
A2
A3
A4
160 A
160 A
160 A
160 A
E
E
E
E
4
500 HP
5
500 HP
6
500 HP
RAW MILLS
CEMENT MILL
SSR-1: RAW MATERIAL GRINDING PLANT
800 A
1.
2.
3.
4.
5.
6.
7.
800 A
800 A
800 A
800 A
800 A
800 A
SPARE
SPARE
SPARE
T1
3,3/0,6 kV
1000 kVA
T2
3,3/0,6 kV
T3
3,3/0,4 kV
1000 kVA
R
R
MCC – MAIN
0,4 kV
M
M
M
MCC


3,3/0,4 kV
150 kVA
1
500 HP
2
500 HP
3
500 HP
3,3/0,4 kV
700 kVA
3,3/0,4 kV
700 kVA
RAW MILLS
1250 A
1250 A
1000 A
1000 A
630 A
630 A
(630 A)
630 A
E
SPARE
R
COMPRESSOR HOUSE
COMPRESSOR N°1
COMPRESSOR N°2
SLURRY PUMP N°1
SLURRY PUMP N°2
BOOSTER PUMP
KILN N°2
SPARE
COAL MILL N°3
COAL MILL N°2
KILN DRIVE N°2
SLURRY FEEDER
PACKING PLANT AND ENGINEERING BUILDING
NEW PACKING PLANT
ENGINEERING BUILDING
MILL HOUSE
MILL HOUSE AUXILIARIES
STORES AND WORKSHOPS
STORES
LIGHTS STORES
SPARE
COAL ELEVATORS

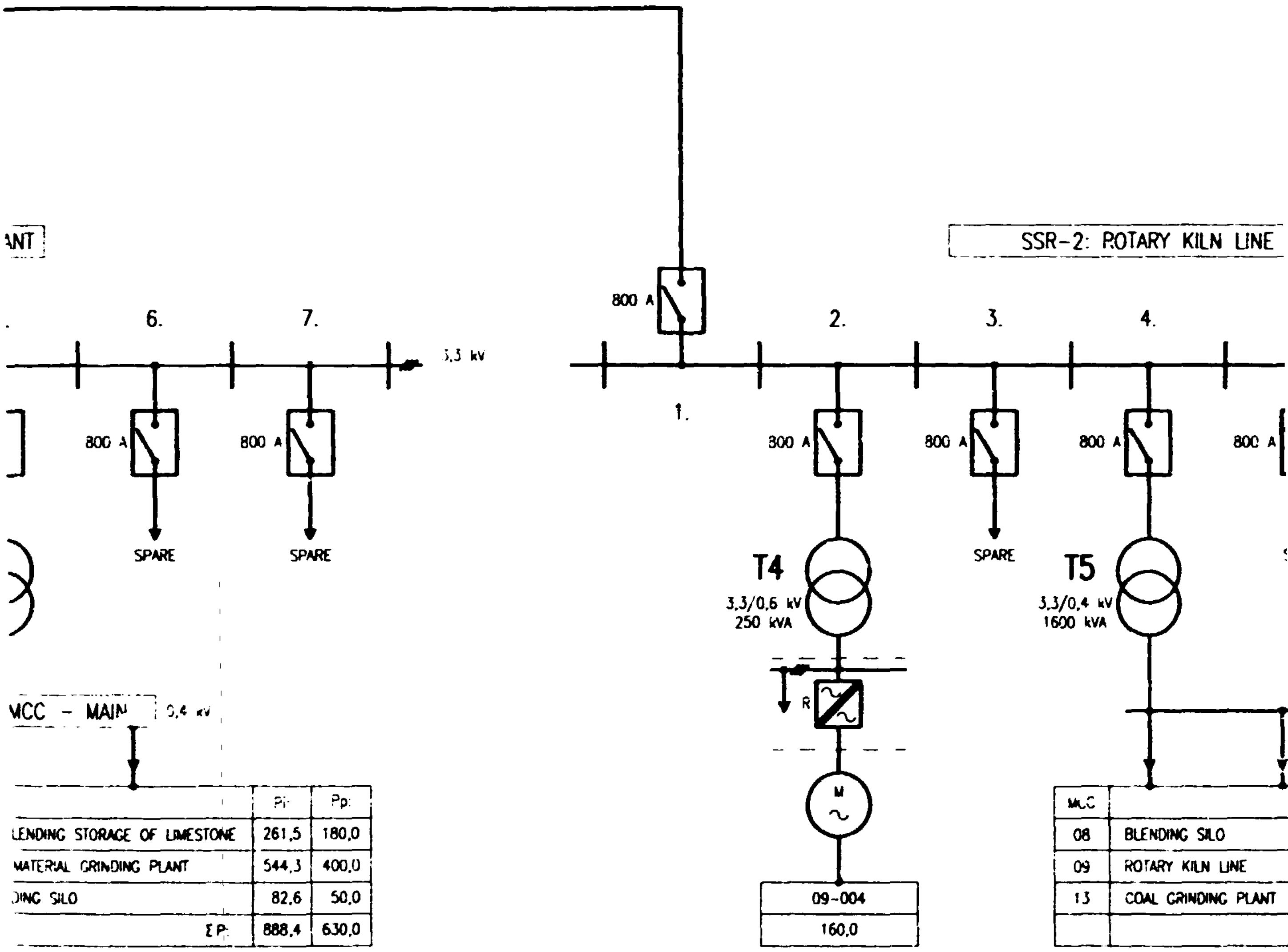
See 5


3,3/0,4 kV
700 kVA
3,3/0,4 kV
700 kVA
CM1
1250 A
1250 A
1250 A
1000 A
1000 A
1000 A
630 A
630 A
630
E
KILN N°1
KILN N°2 FIRING
KILN N°2 FIRING
SPARE
FANS N°1 AND N°2
KILN WORKSHOP
SPARE
CRANES
CEMENT MILL N°1 AUXILIARIES
TIE CABLE TO NEW PACKING PLANT
MULTI STARTER BOARD
SPARE
CONTROL BOARD
SPARE
DUST PLANT HEATERS
WELD PLUG
VIBRO CLINKER SPILLAGE
LAB AND GOLF PUMPS
CHANGE HOUSE
FUEL PUMPS
LAB. N°1
WATER RECOVERY PUMPS
LAB. N°2
TRANS. DEPT. N°1
SPARE
TRANS. DEPT. N°2
KILN N°3 FEED
TIE CABLE TO FIRING AND BOARD
MULTI STARTER BOARD
SPARE
ID FAN N°3
SLURRY PUMPS
PRECIPITATOR
KILN DRIVE N°3
WELD PLUG
COOLING FANS
KILN N°2 DUST RETURN
R

Sec 6


4 500 HP
5 500 HP
6 500 HP
RAW MILLS
CEMENT MILL
SSR-1: RAW MATERIAL GRINDING PLANT
800 A
2.
3.
4.
5.
1.
30 A
1000 A
OLD BASIN
SLURRY PUMP N°1
SLURRY PUMP N°2
AGITATOR MOTOR
PRECIPITATOR N°2 KILN
CRUSHERS
HAZEMAG CRUSHER
PRIMARY CRUSHER
800 A
800 A
800 A
800 A
SPARE
T1
3,3/0,6 kV
1000 kVA
T2
3,3/0,6 kV
1000 kVA
T3
3,3/0,4 kV
1000 kVA
R
MCC - MA
07-009
850,0
07-012
800,0
07-015
800,0
Σ Pi: 2450,0 kW
Pp: 1750,0 kW
MCC
05 PREBLENDING STORA
07 RAW MATERIAL GRIN
08 BLENDING SILO
FROM MCC 14
06 STORAGE OF PHYLL

sec 7



	Pi	Pp
LENDING STORAGE OF LIMESTONE	261,5	180,0
MATERIAL GRINDING PLANT	544,3	400,0
DING SILO	82,6	50,0
ΣPi	888,4	630,0

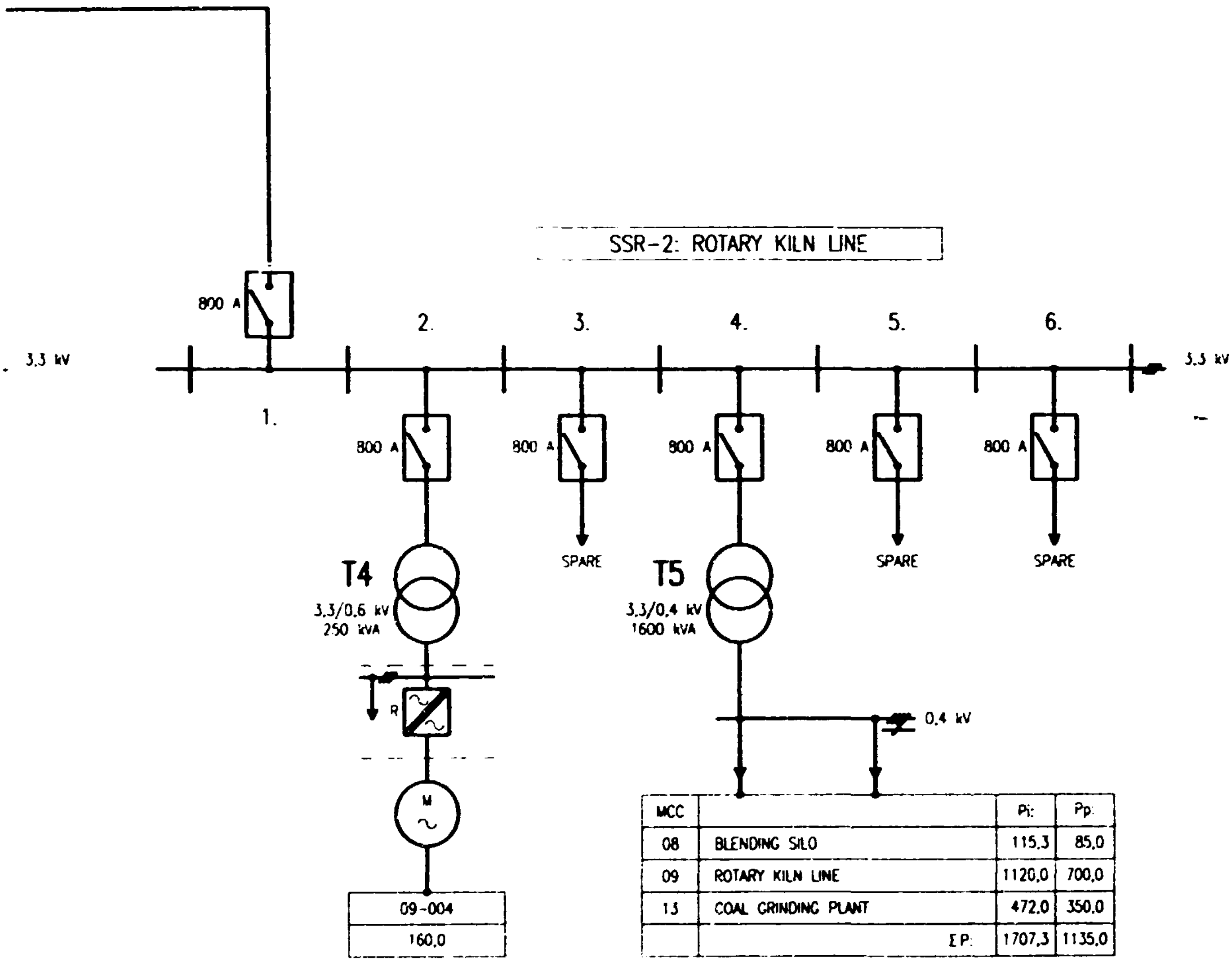
	Pi	Pp
AGE OF PHYLLYTE	38,5	25,0

MCC	
08	BLENDING SILO
09	ROTARY KILN LINE
13	COAL GRINDING PLANT

R	
15	STORAGE OF PHYLLYTE
16	STORAGE OF PHYLLYTE

Seo 8

UNIDO VIENNA	KERAMOPROJEKT a.s.
EXPANSION OF THE CHILANGA CEMENT PLANT	
ONE LINE POWER DISTRIBUTION DIAGRAM	



MCC		Pi:	Pp:
08	BLENDING SILO	115,3	85,0
09	ROTARY KILN LINE	1120,0	700,0
13	COAL GRINDING PLANT	472,0	350,0
	ΣP:	1707,3	1135,0

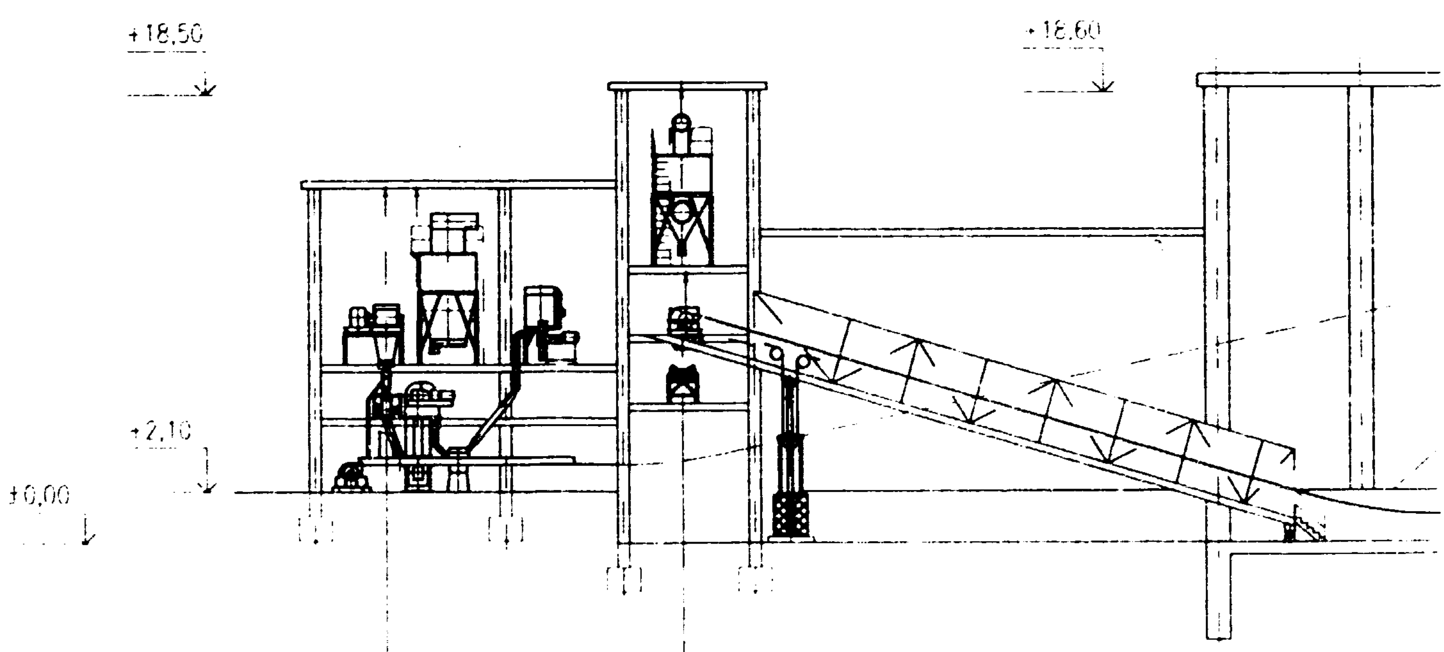
FROM MCC 14 (16)

R		Pi:	Pp:
15	STORAGE OF PHYLLYTE	71,3	50,0
16	STORAGE OF PHYLLYTE	277,5	200,0
	ΣP:	348,8	250,0

Sec. 9

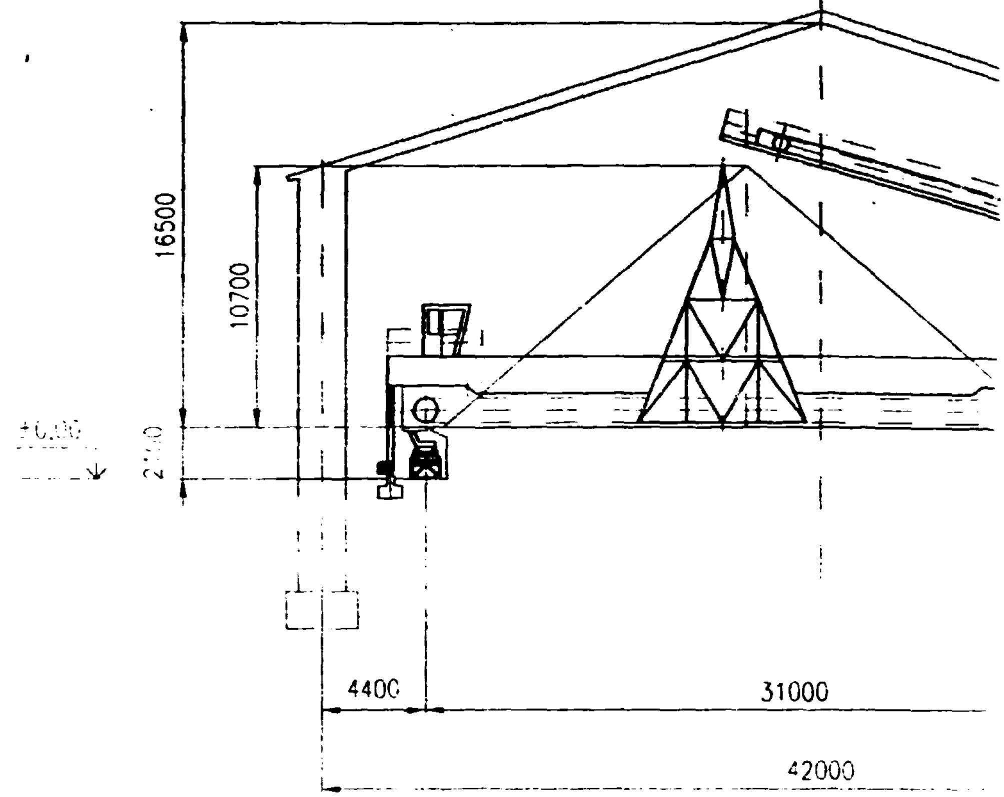
UNIDO VIENNA	KERAMOPROJEKT a.s. TRENČÍN	DATE: JANUARY 1996
EXPANSION OF THE CHILANGA CEMENT PLANT		FILES NO:
ONE LINE POWER DISTRIBUTION DIAGRAM		SCALE: NOT
		DRAWING NO: 4

SEC 1

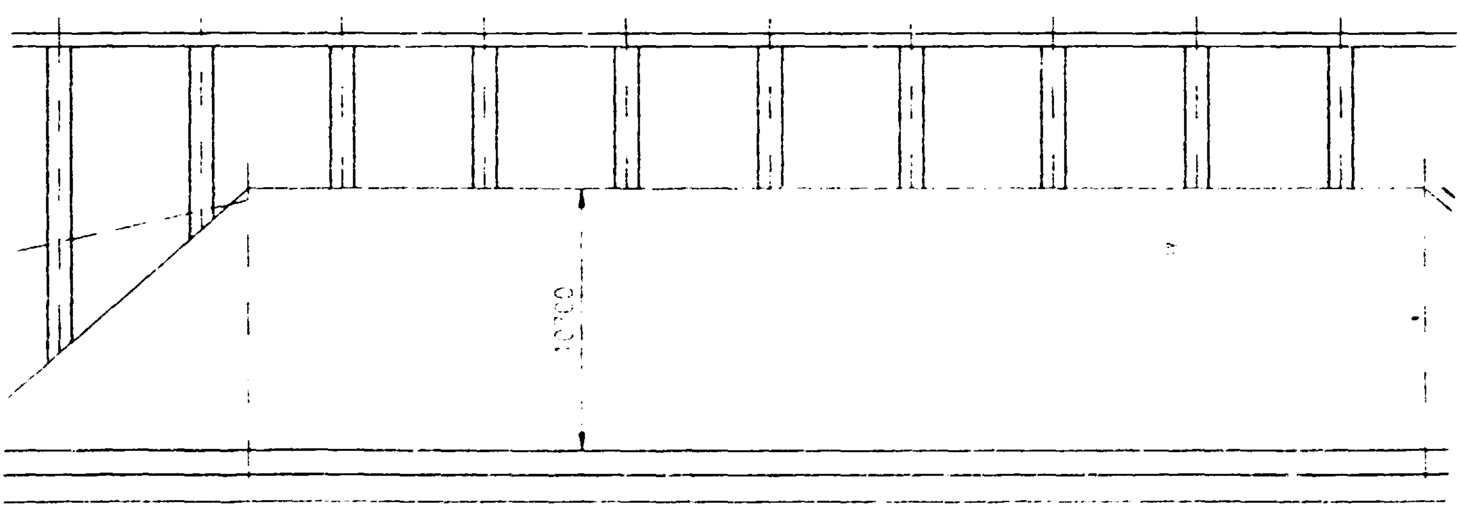


SEC 5

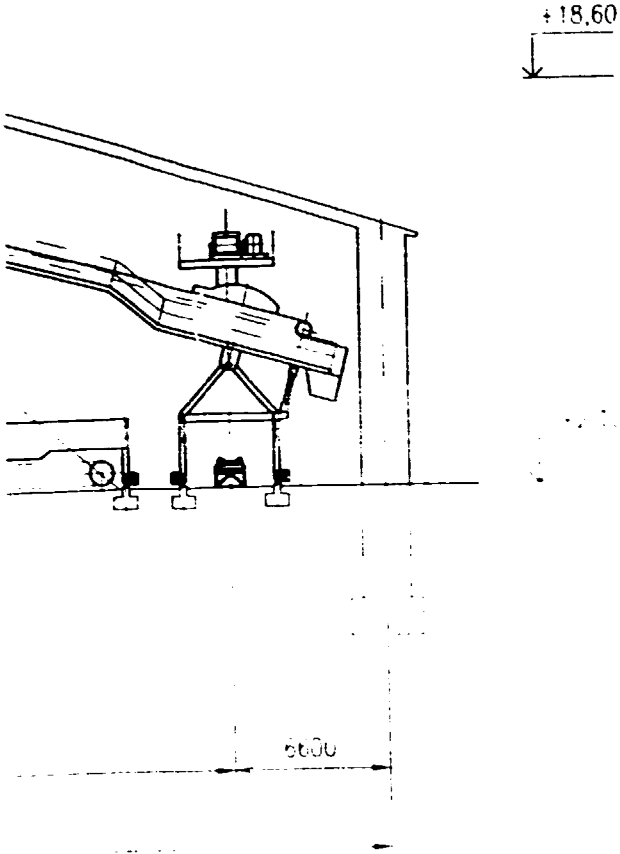
SEC 2



SECTION A-A

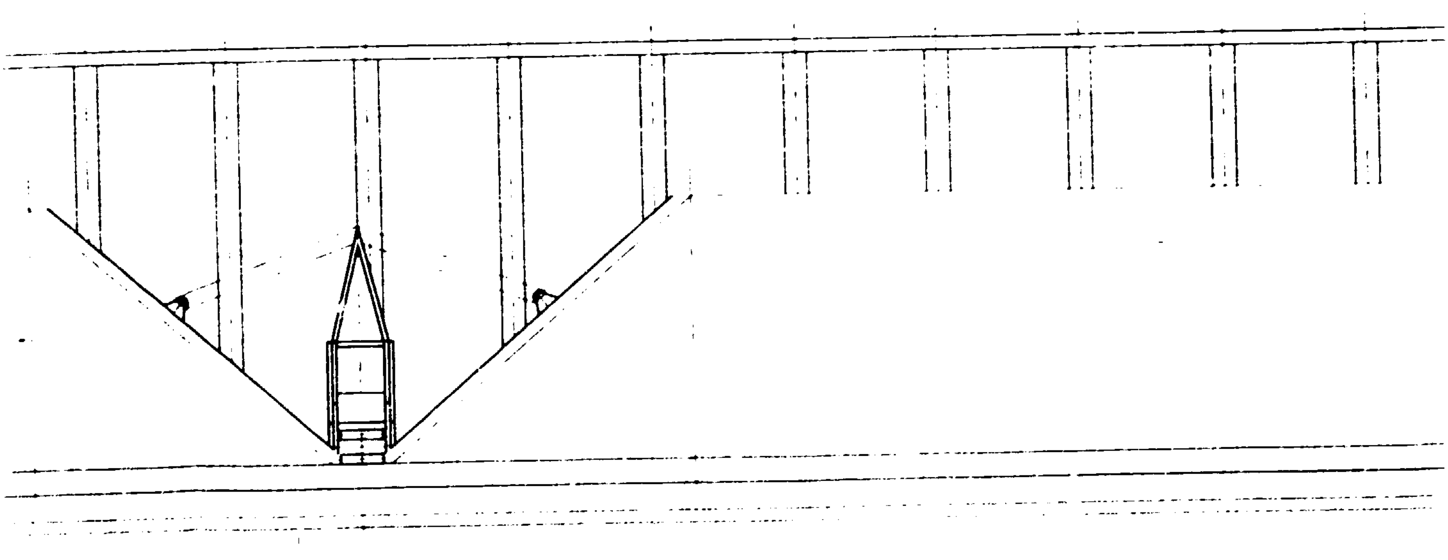


SEC 6



SEC 3

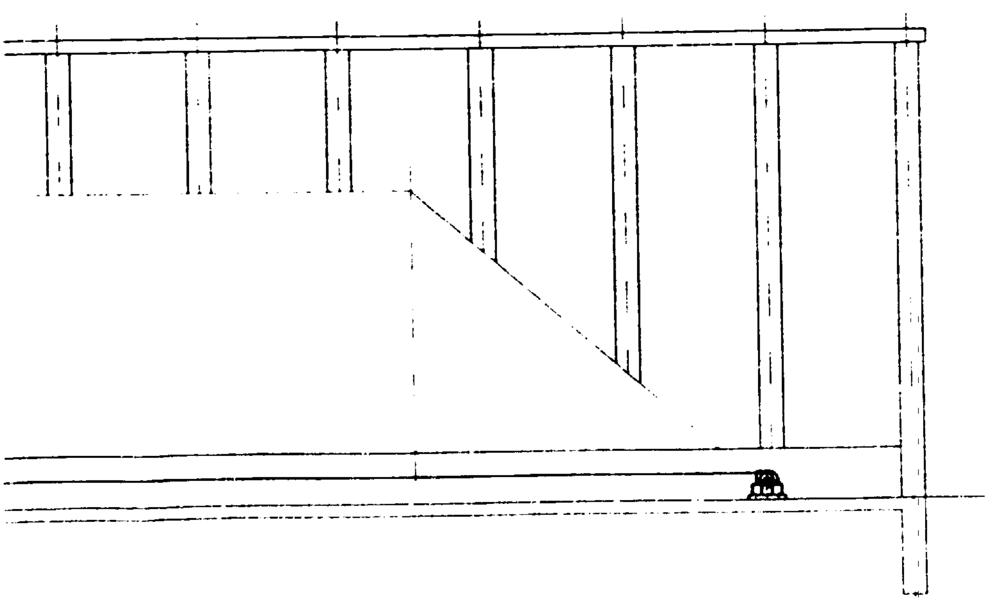
A



SEC 7

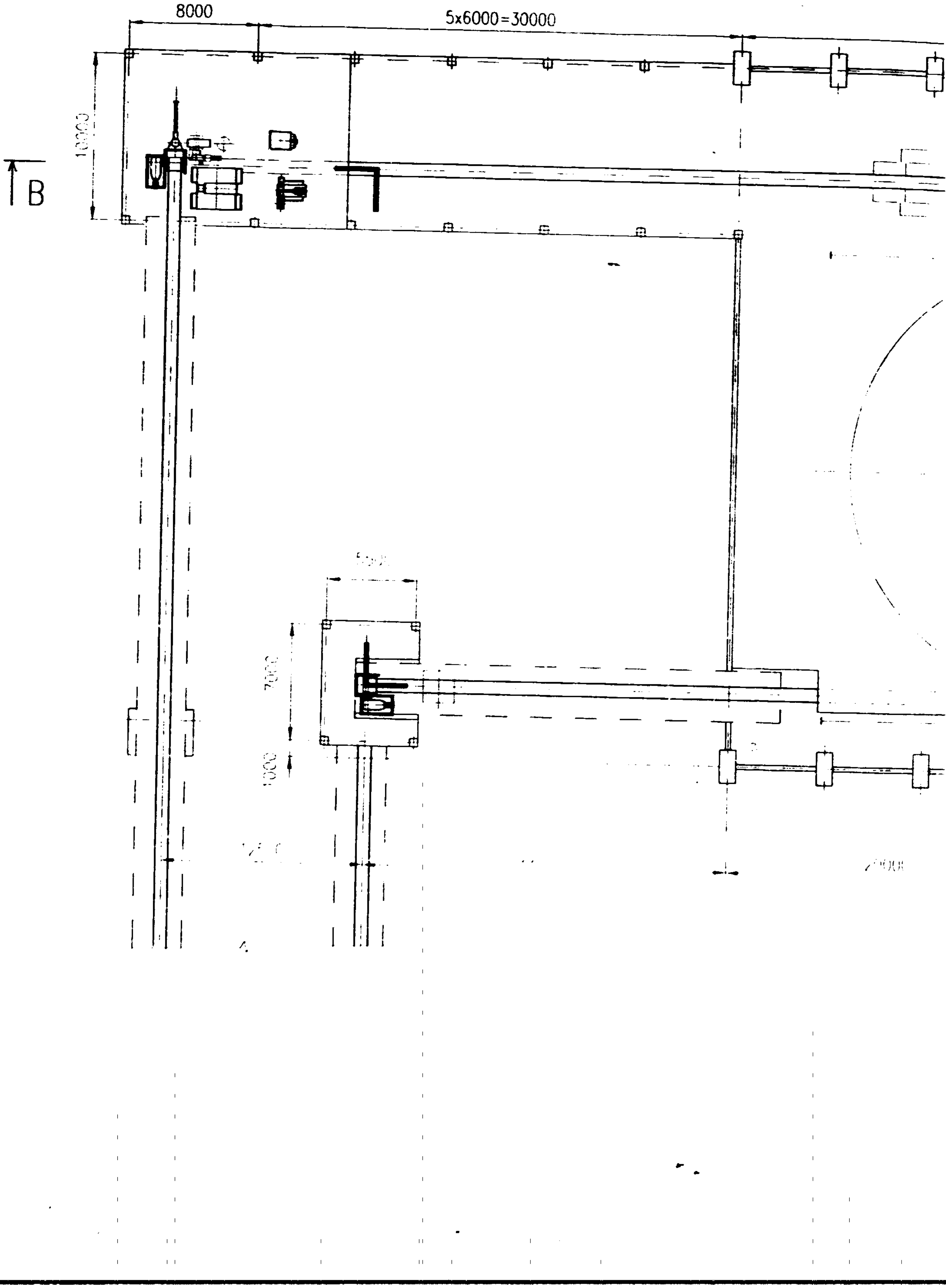
B

SECH

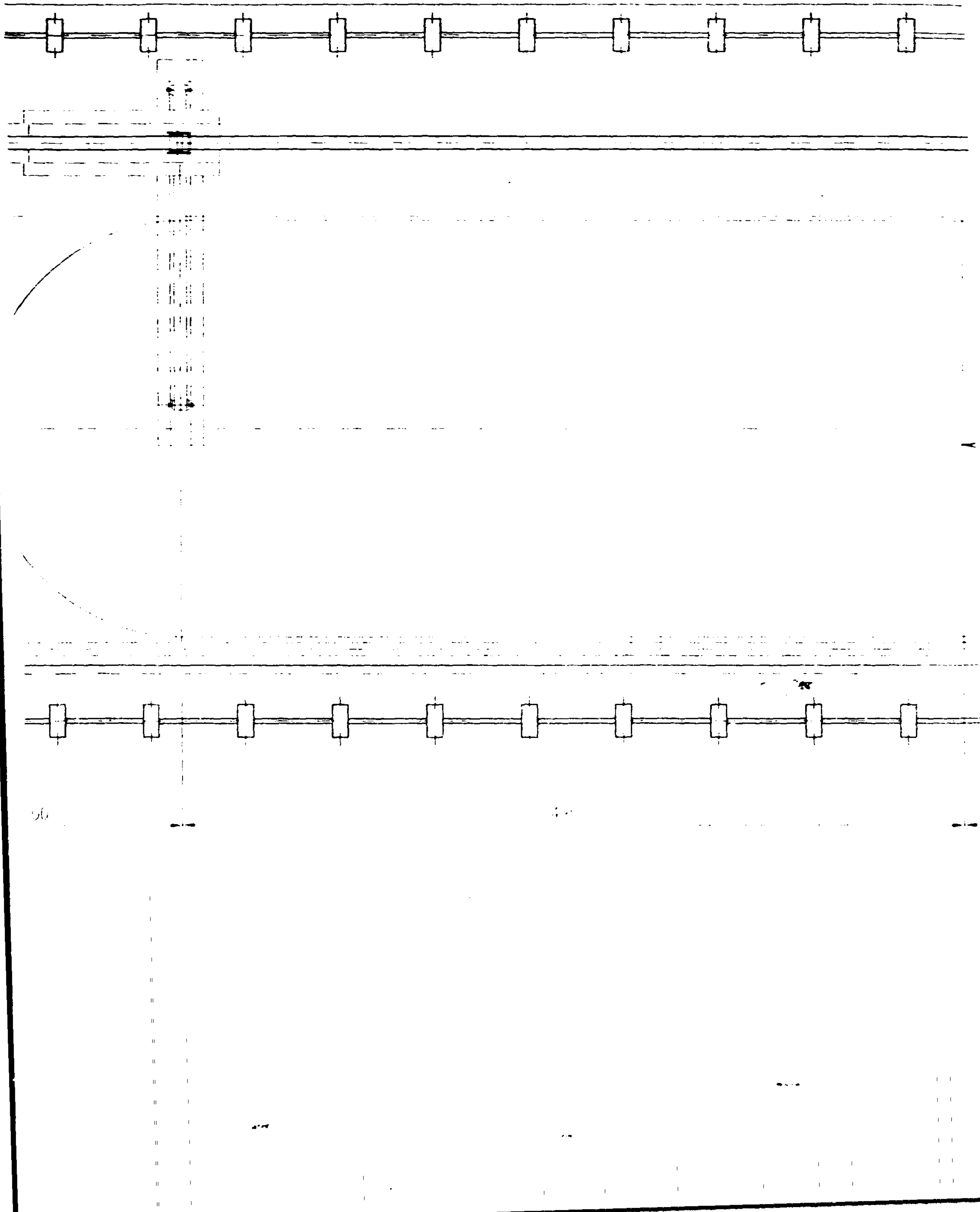


SEC 8

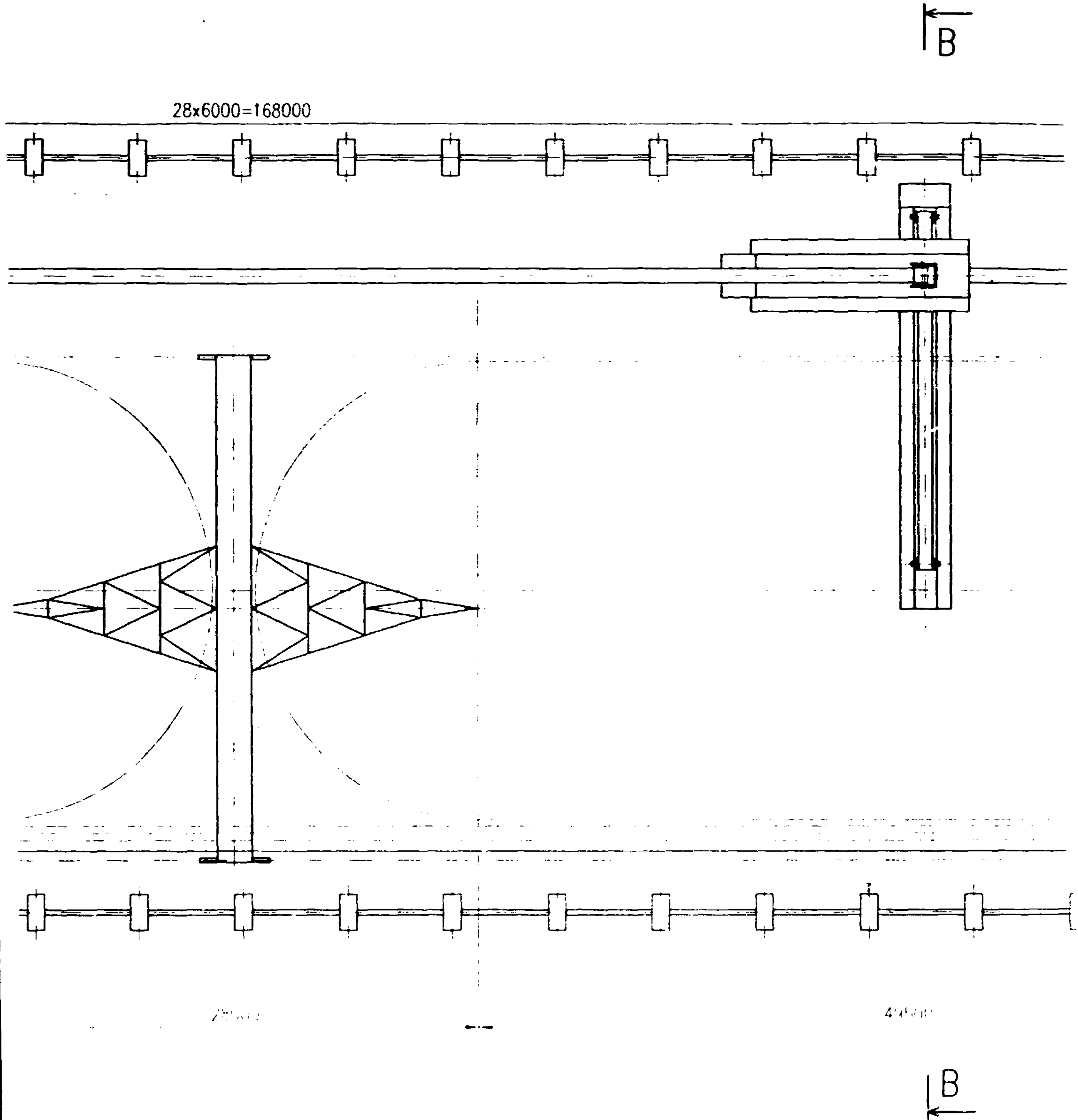
SEC 5

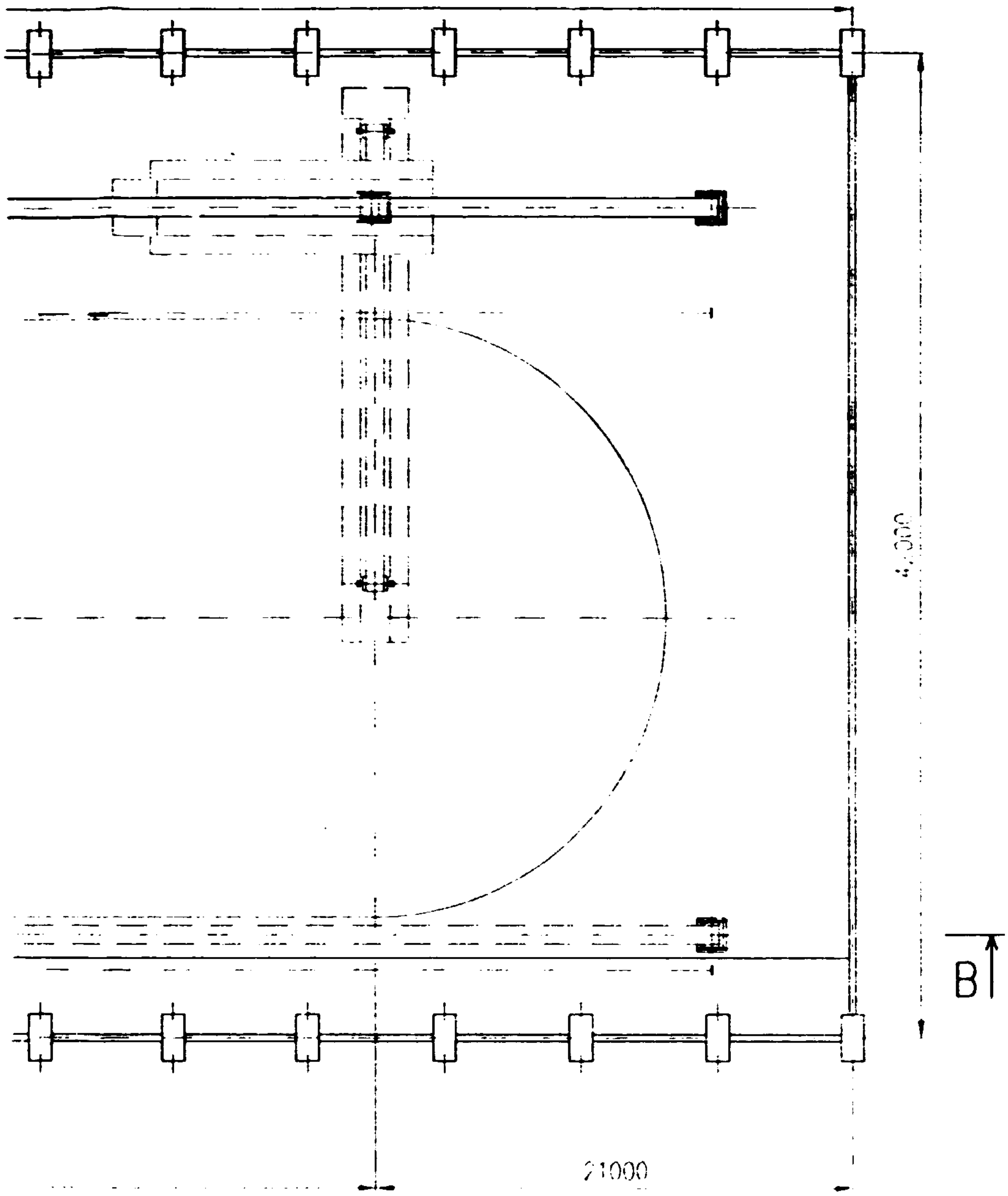


SEC 6



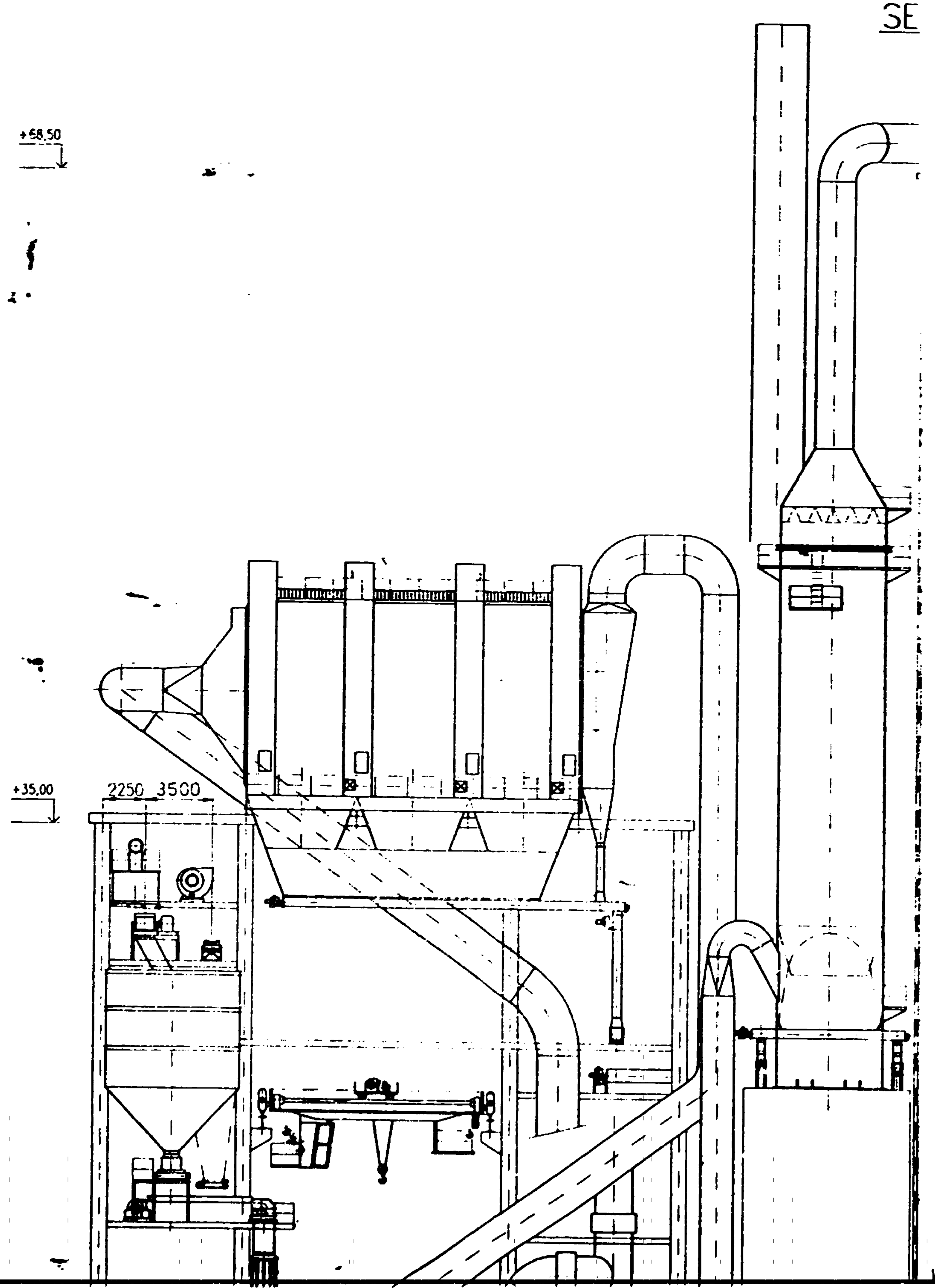
SEC 7





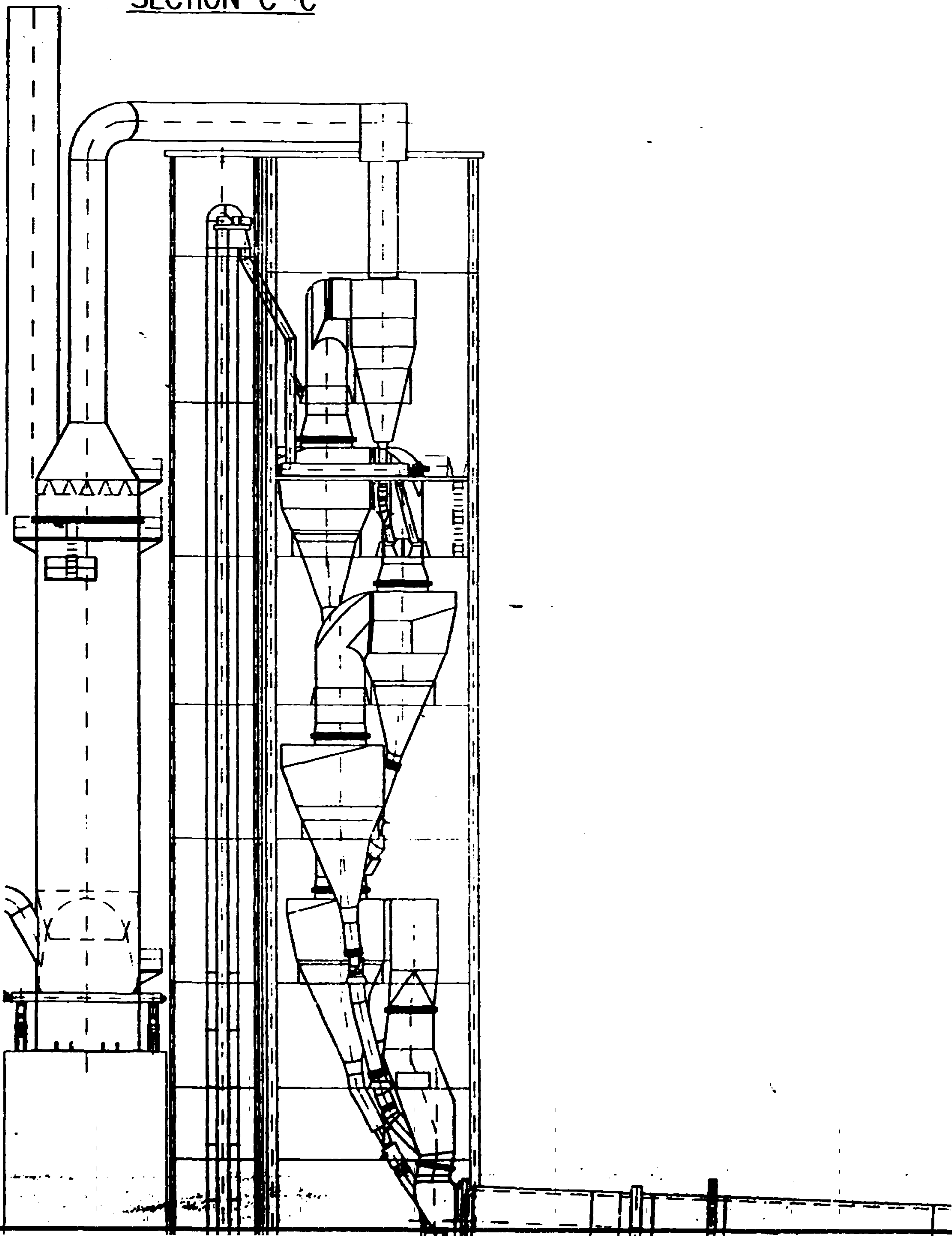
UNIDO VIENNA	KERAMOPROJEKT a.s. TRENČÍN	DATE: JANUARY 199
EXPANSION OF THE CHILANGA CEMENT PLANT		FILES NO: 05
PREBLENDING STORAGE OF LIMESTONE		SCALE: 1:300
		DRAWING NO: 5

SEC 1

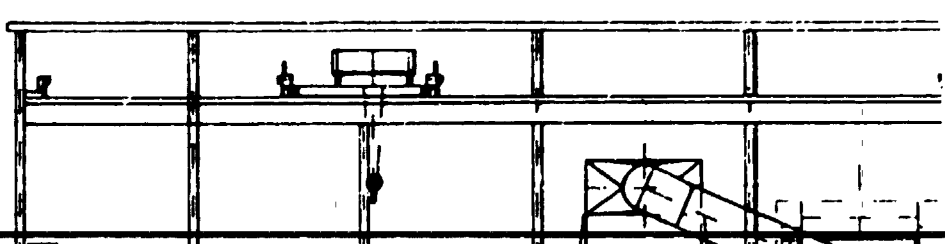


sec 2

SECTION C-C



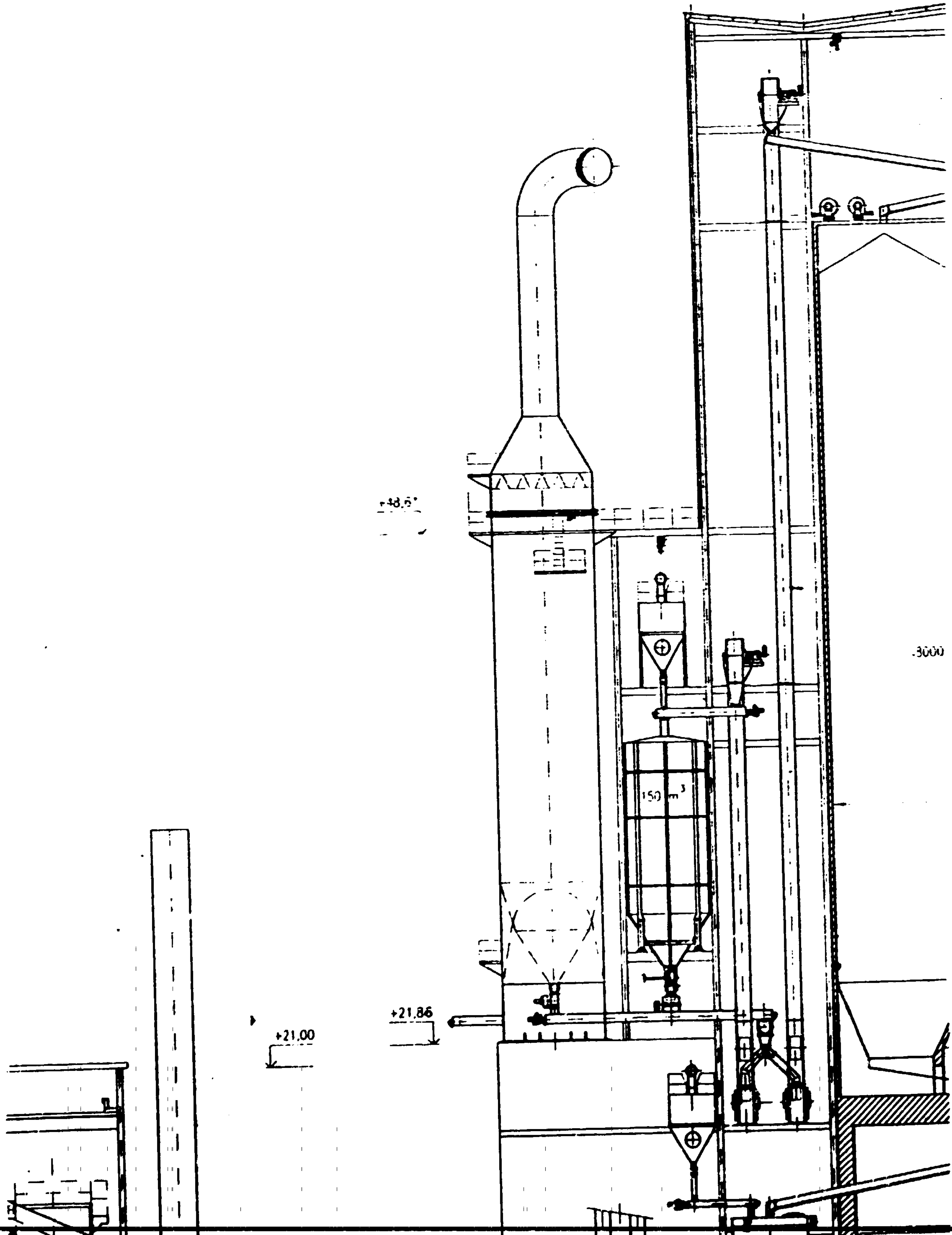
SEC 3



3

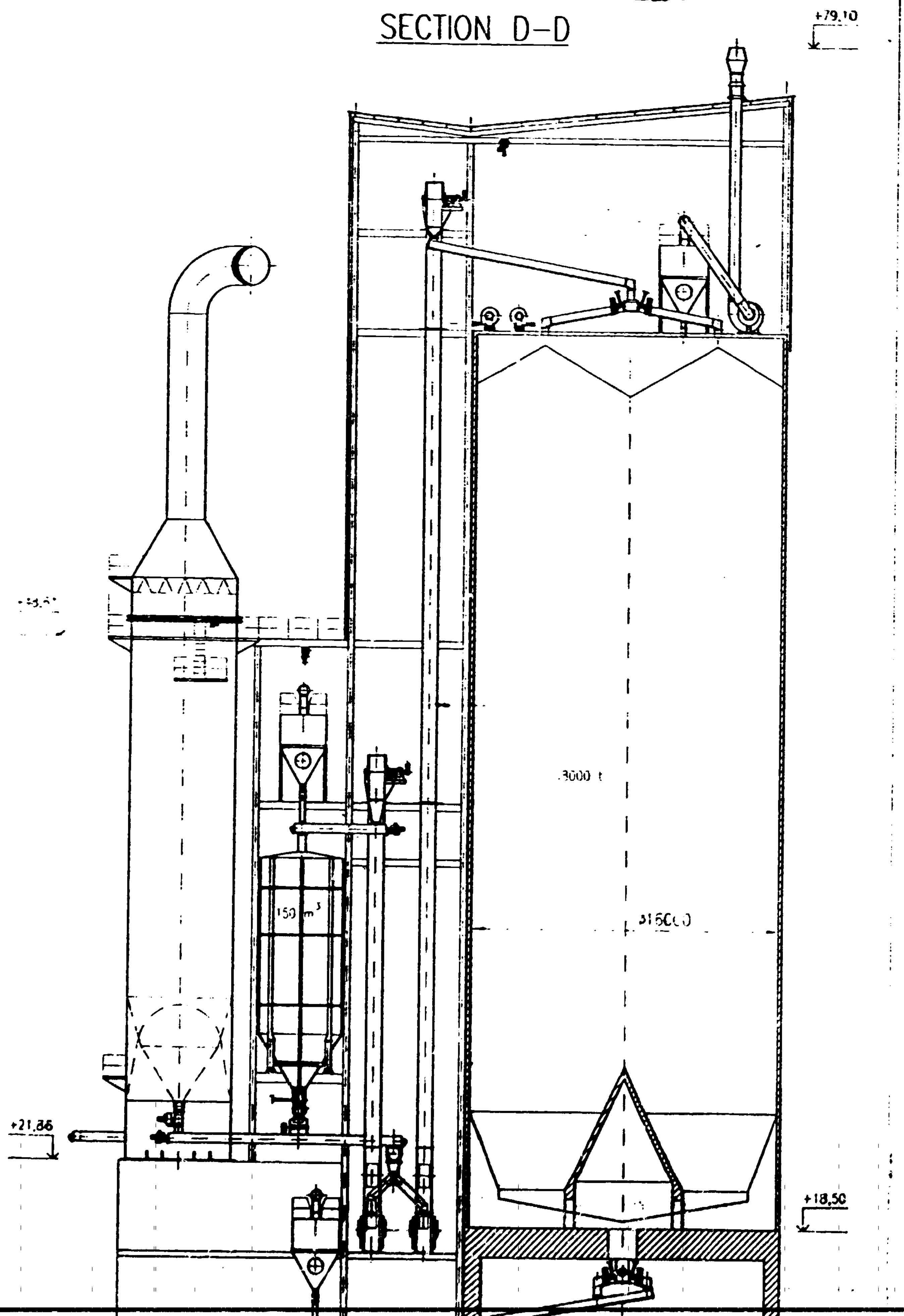
SEC 4

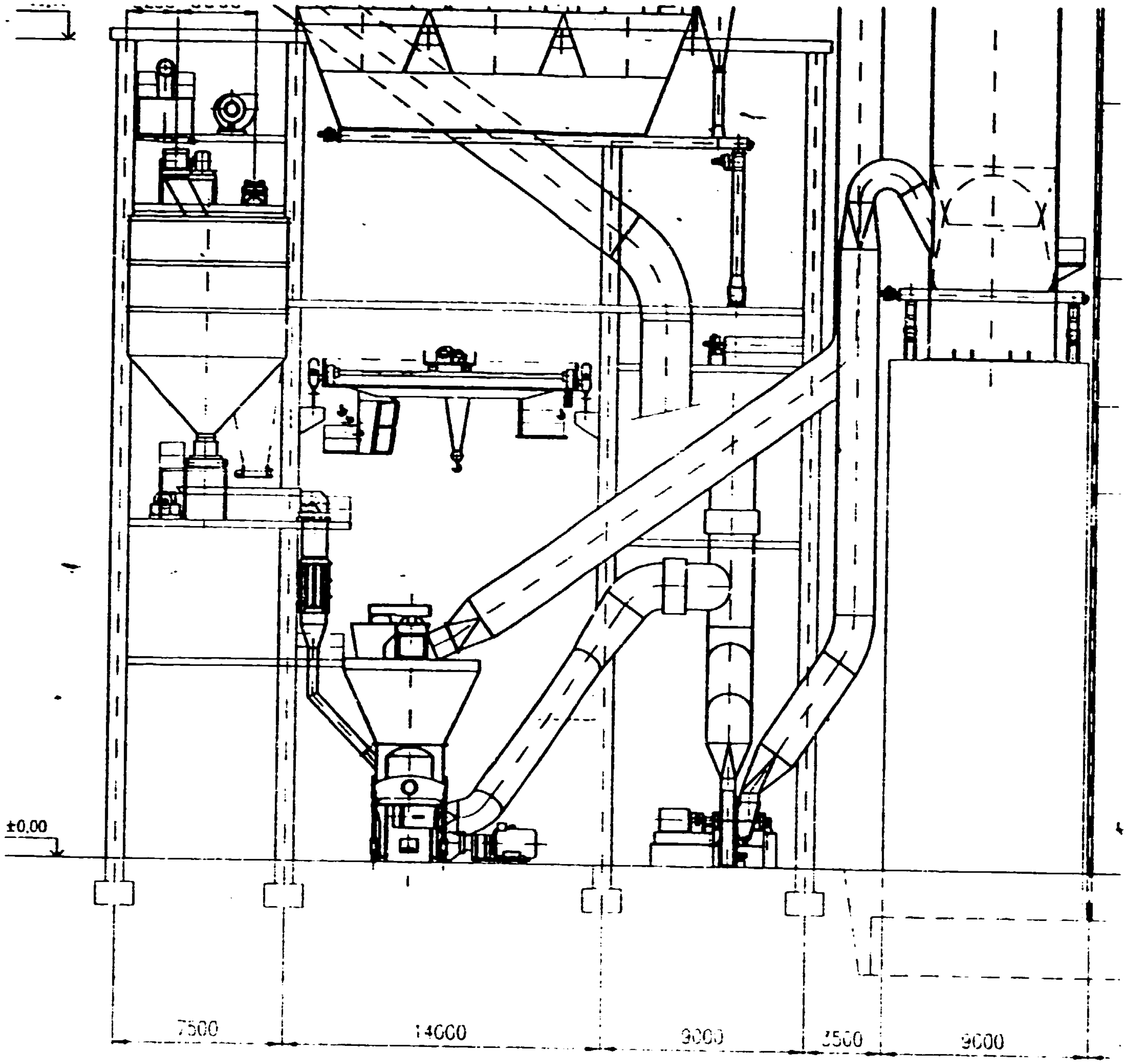
SECTION D-D



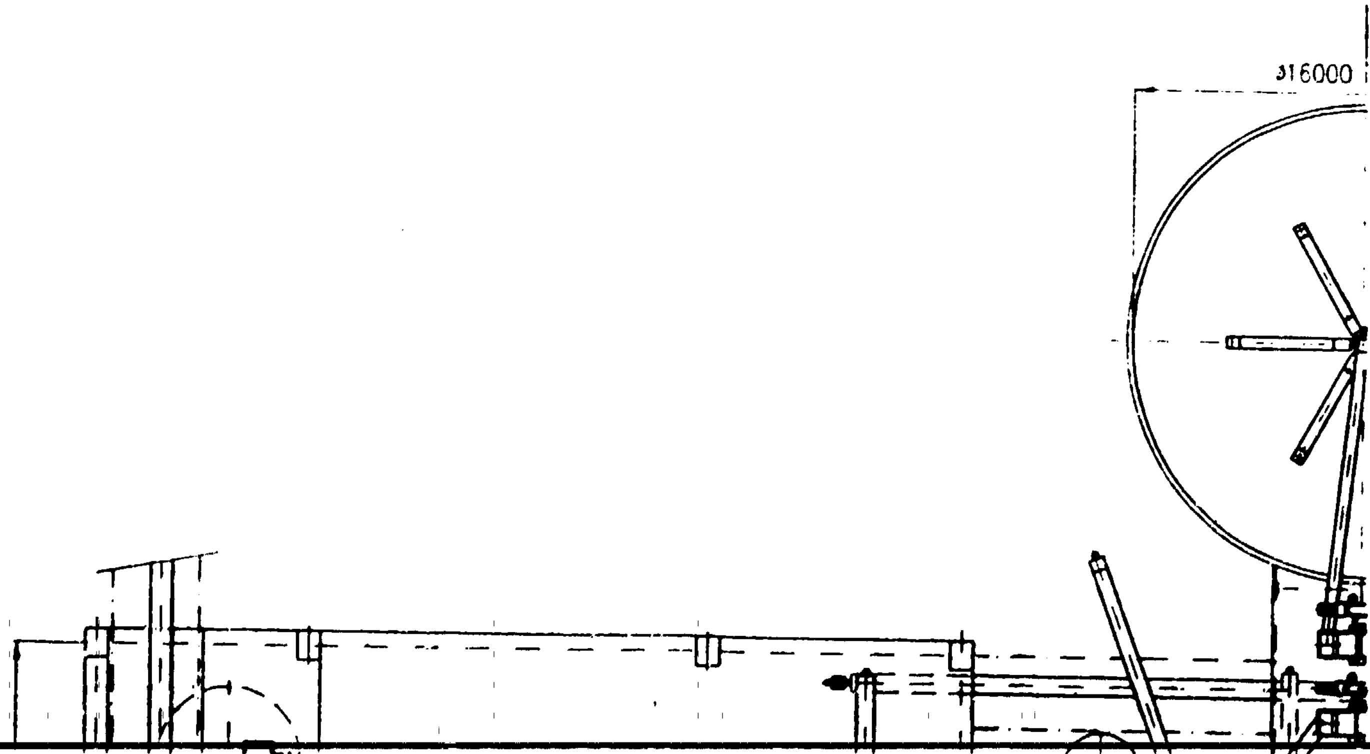
SEC 5

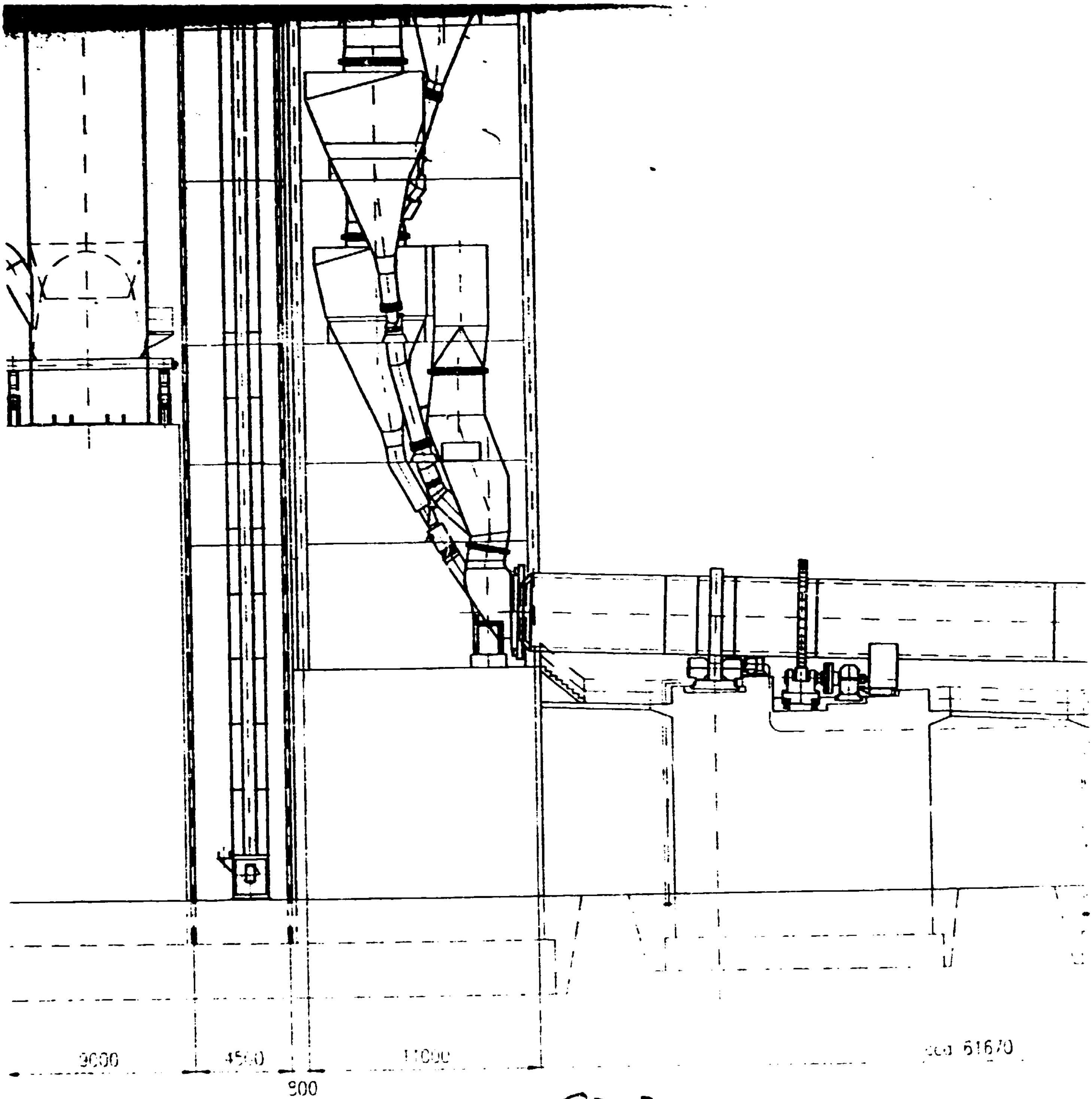
SECTION D-D

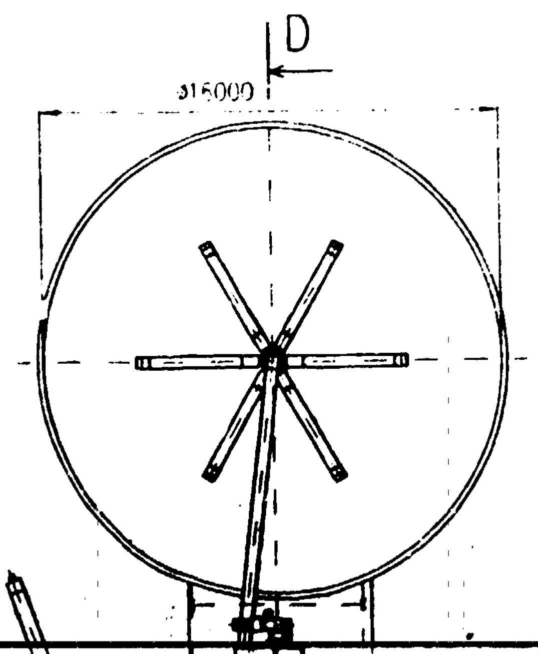


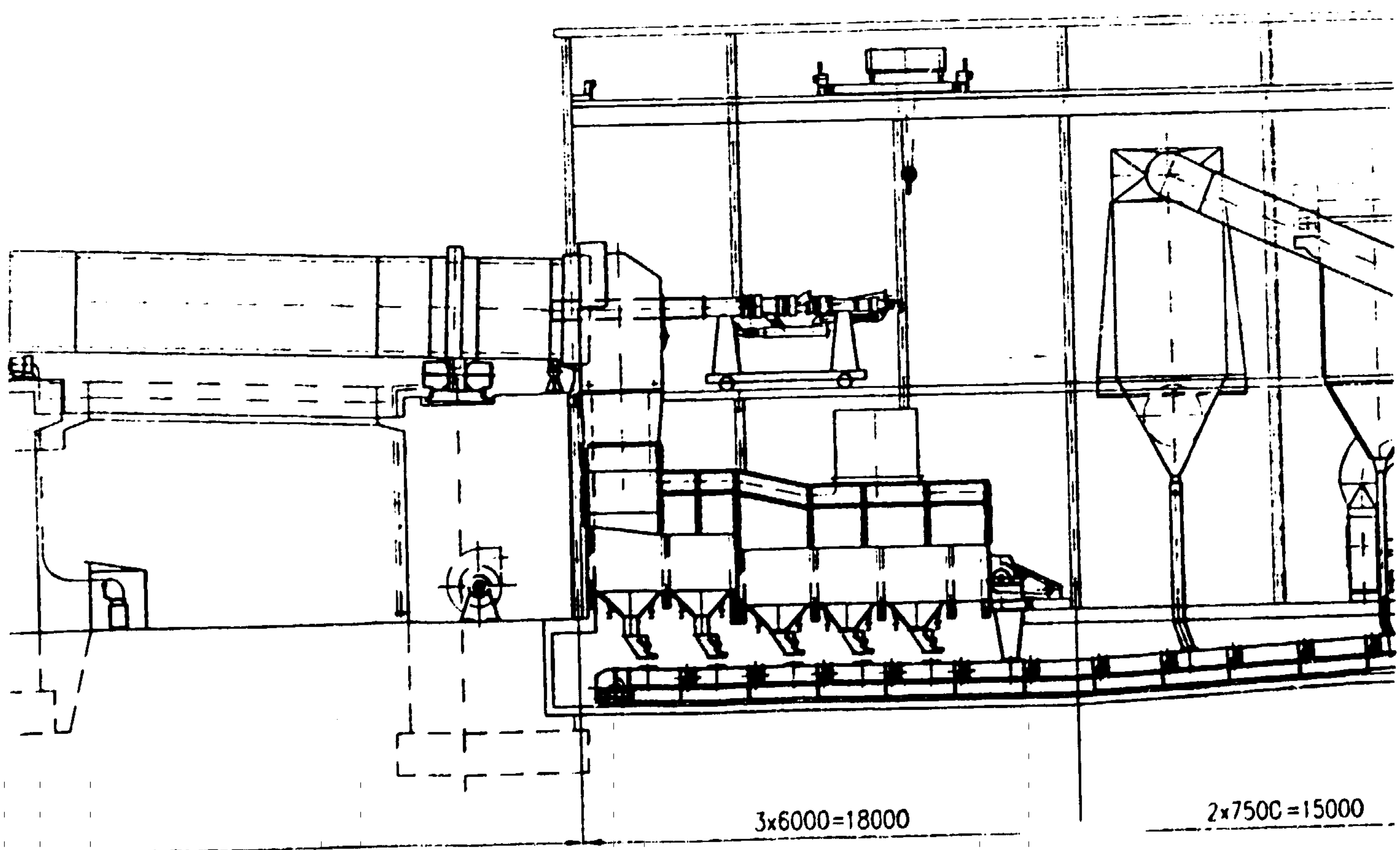


Sec 6

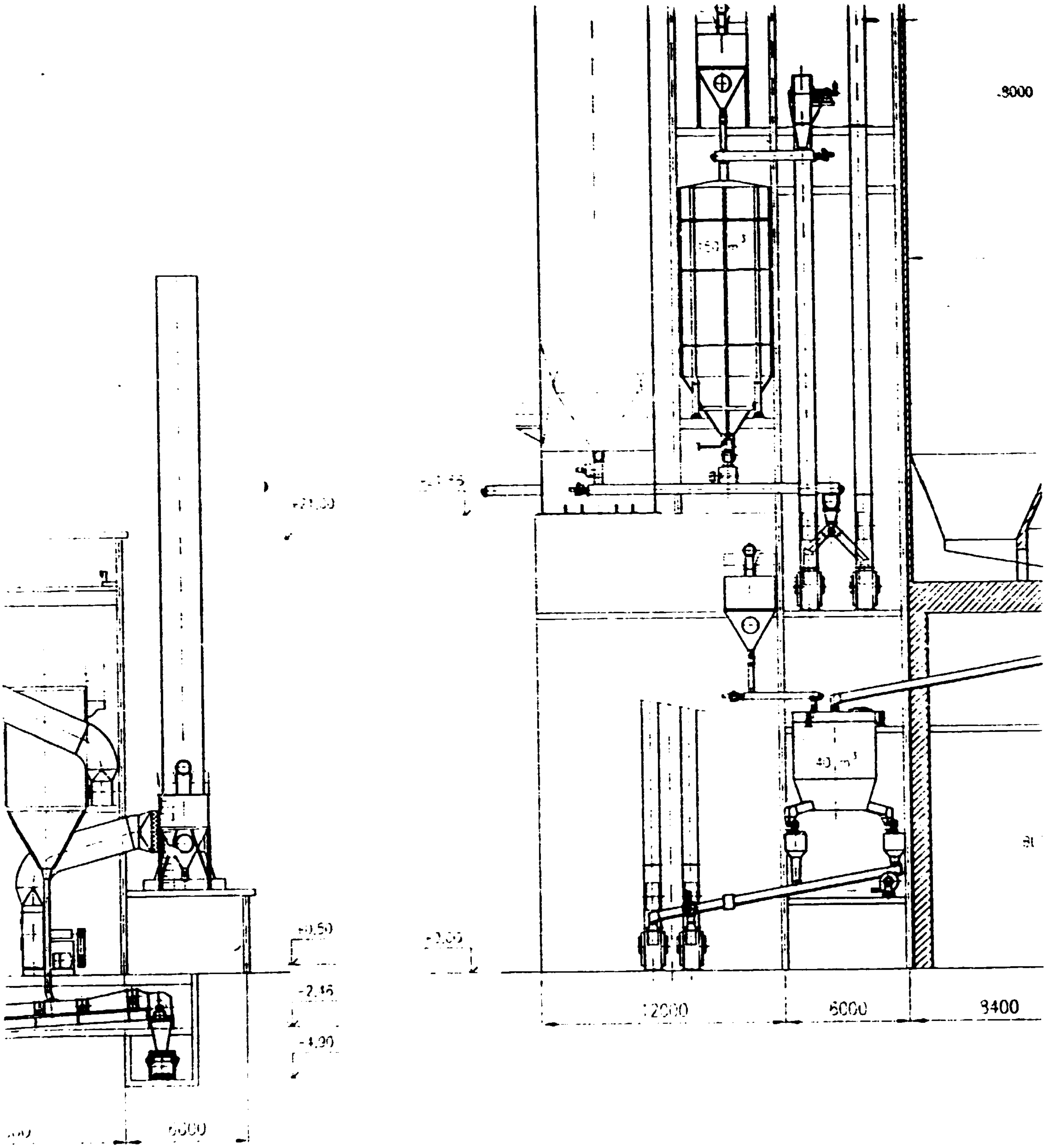



9000
4500
11000
900
ca 61670
D
Ø16000

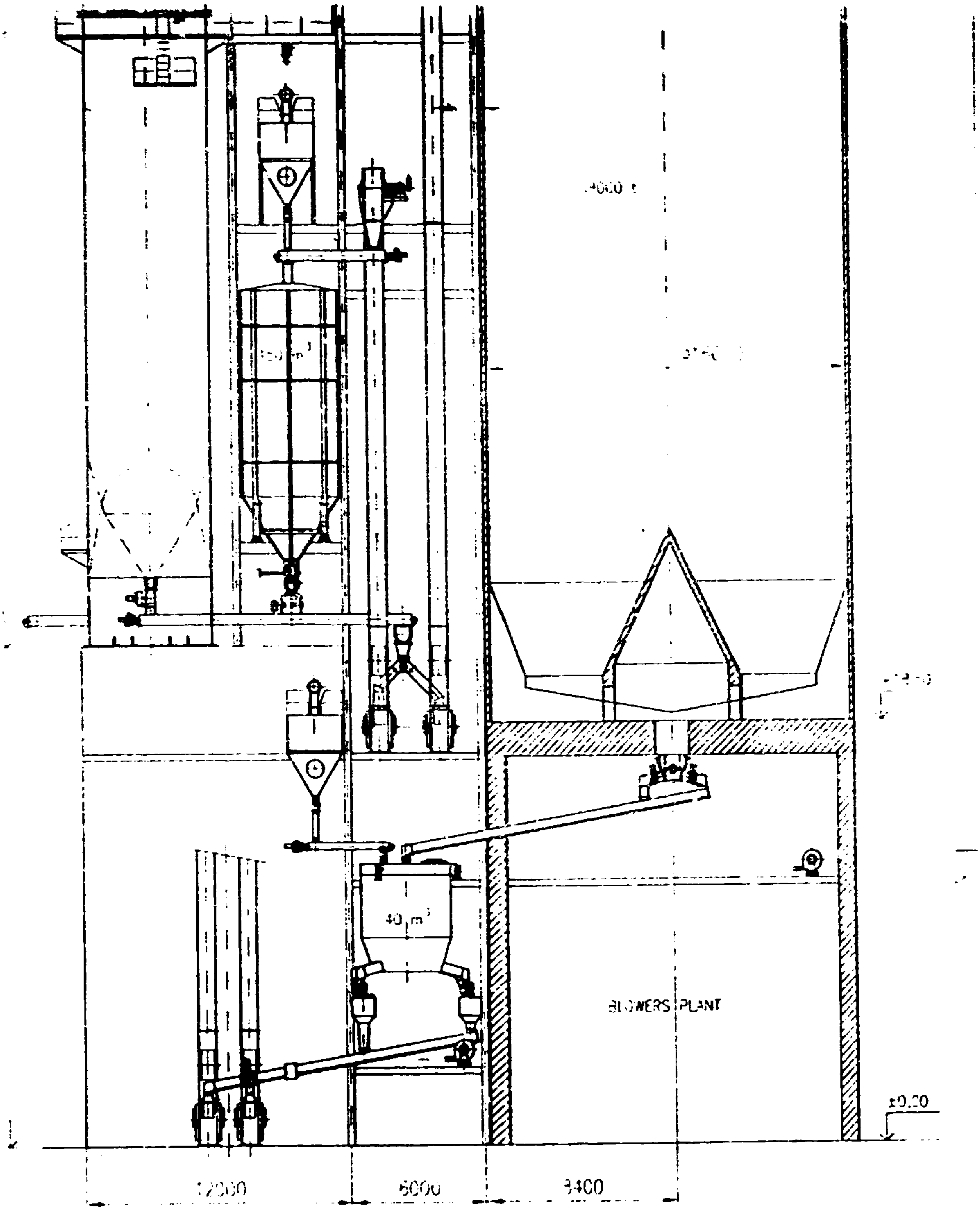




SEC 8

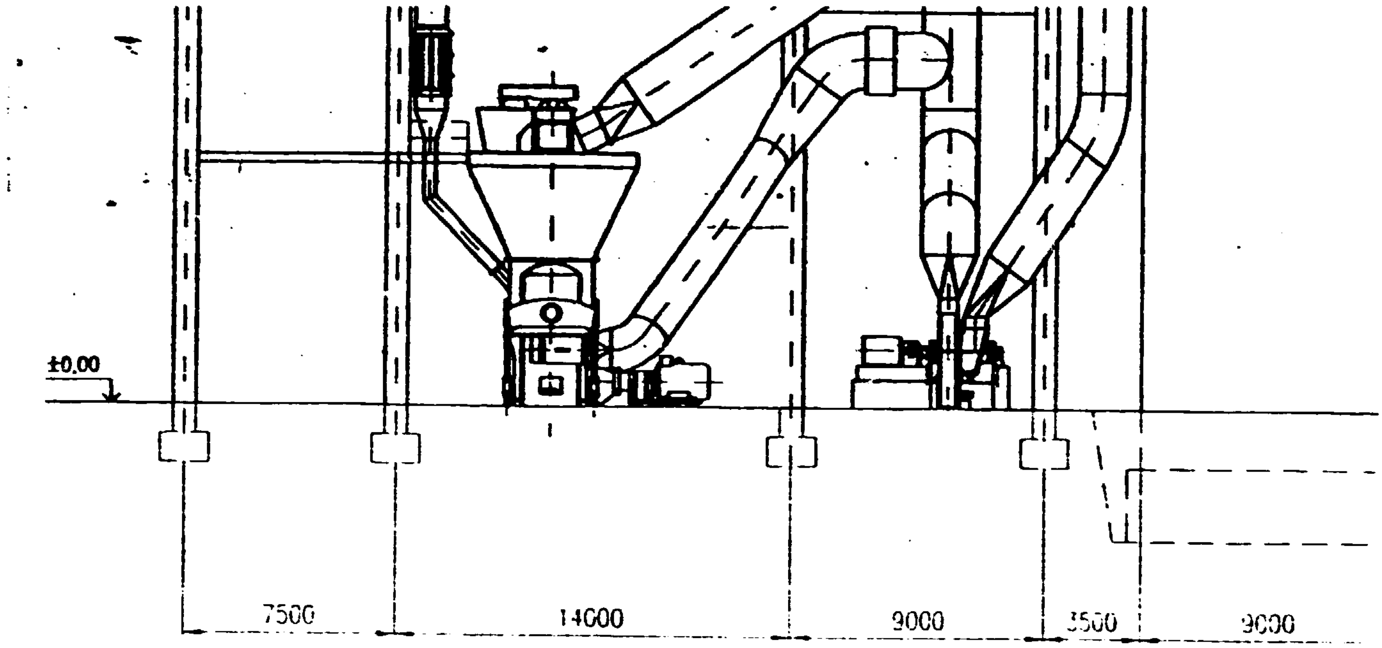


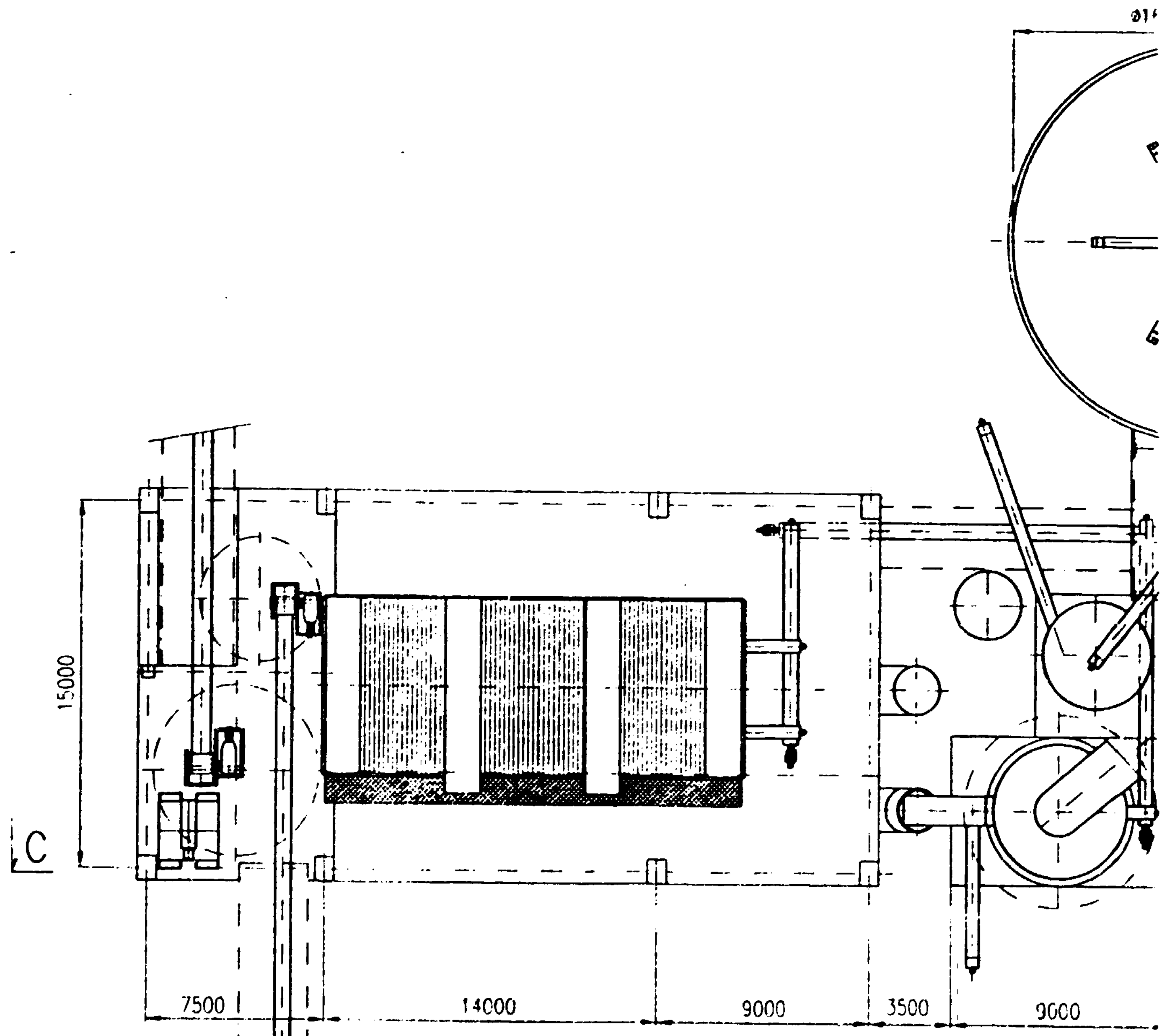
SEC 9



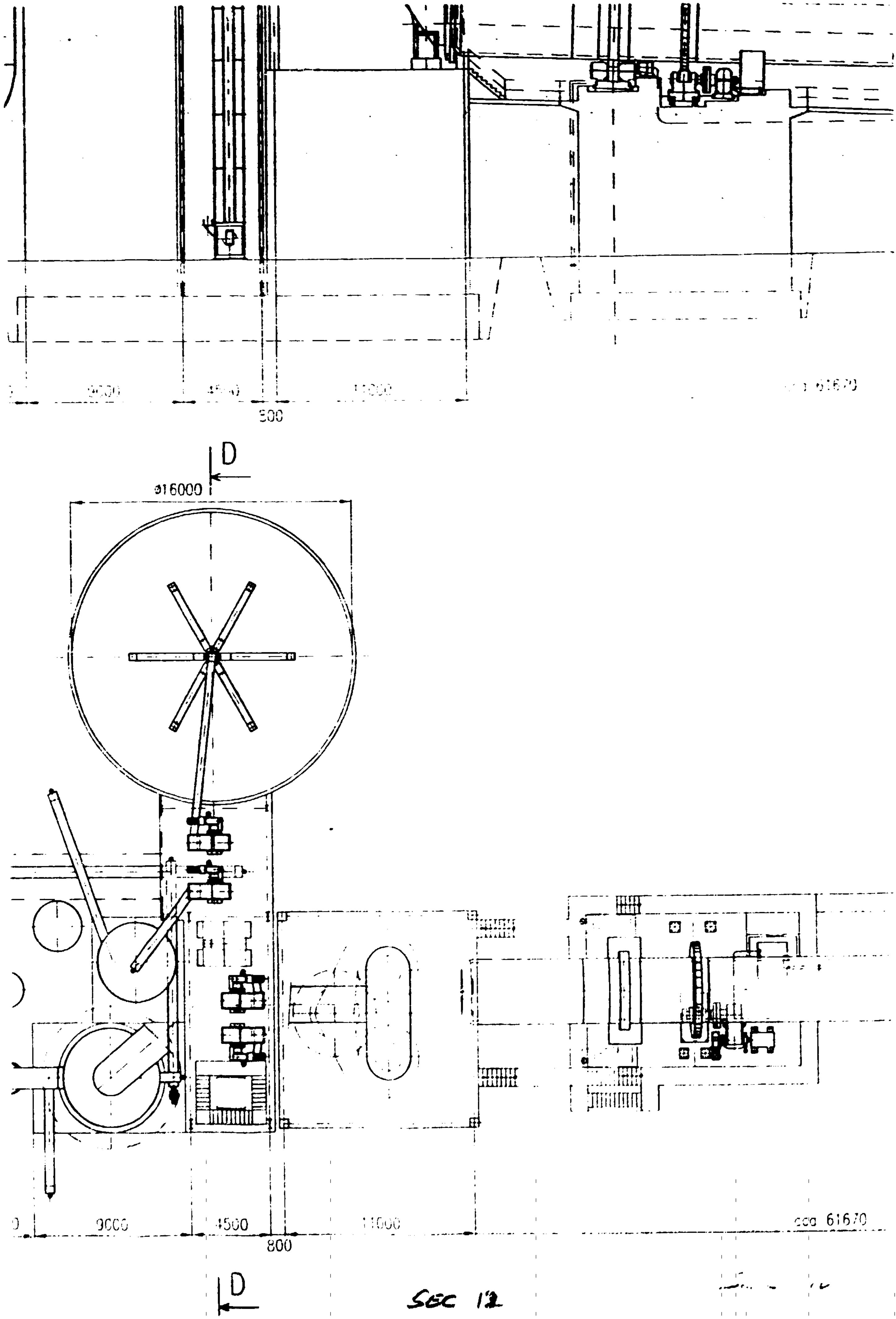
10

SEC 10

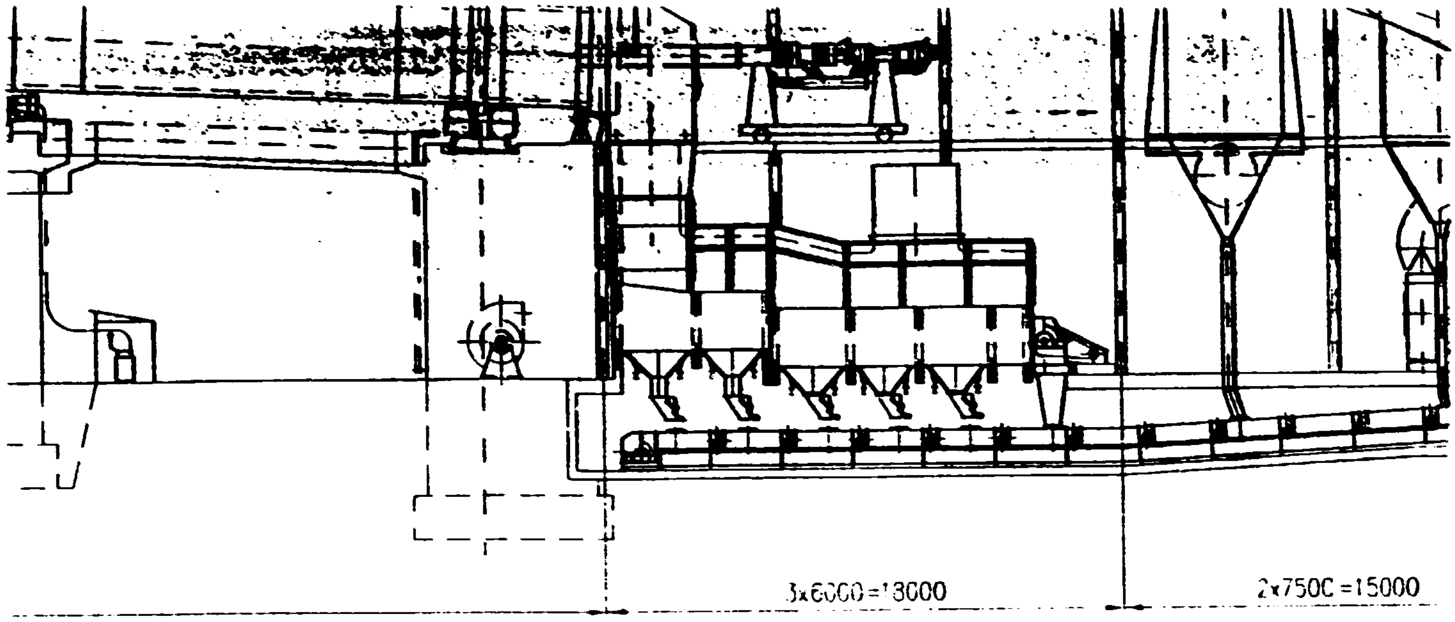

±0,00
7500
14000
9000
3500
9000

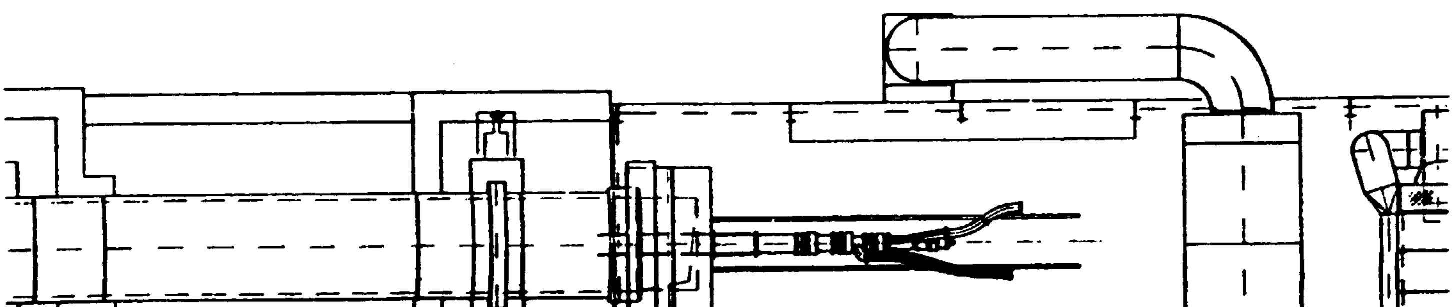

15000
C
7500
14000
9000
3500
9000

SES 17

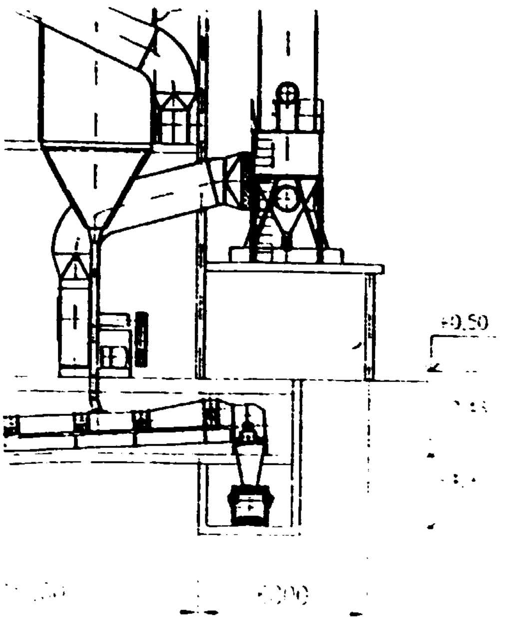


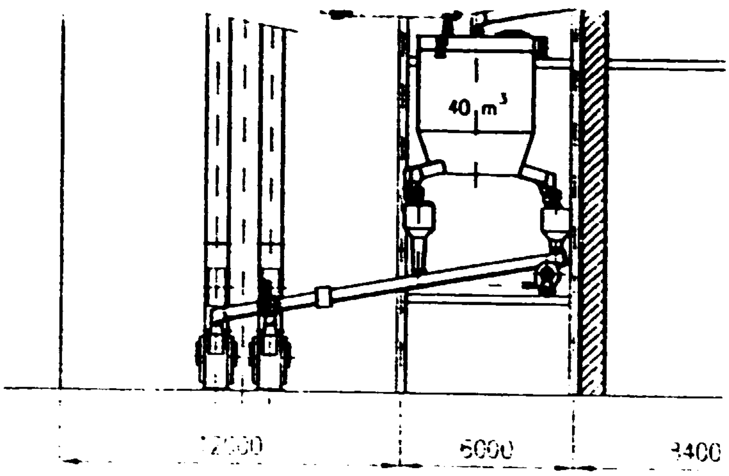
SEC 12

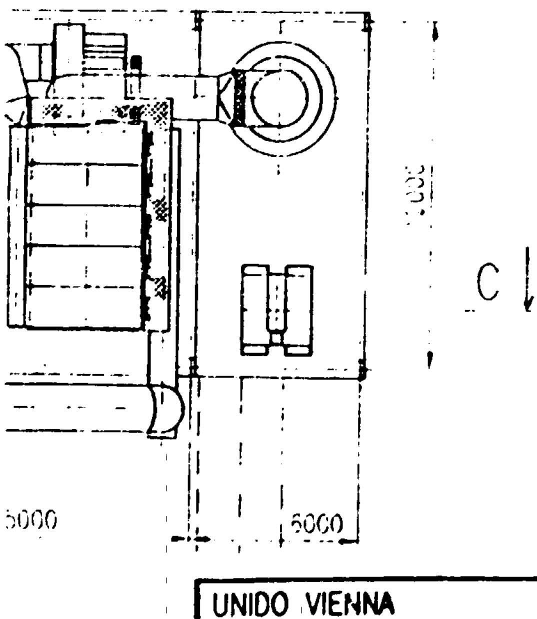




SEC 13





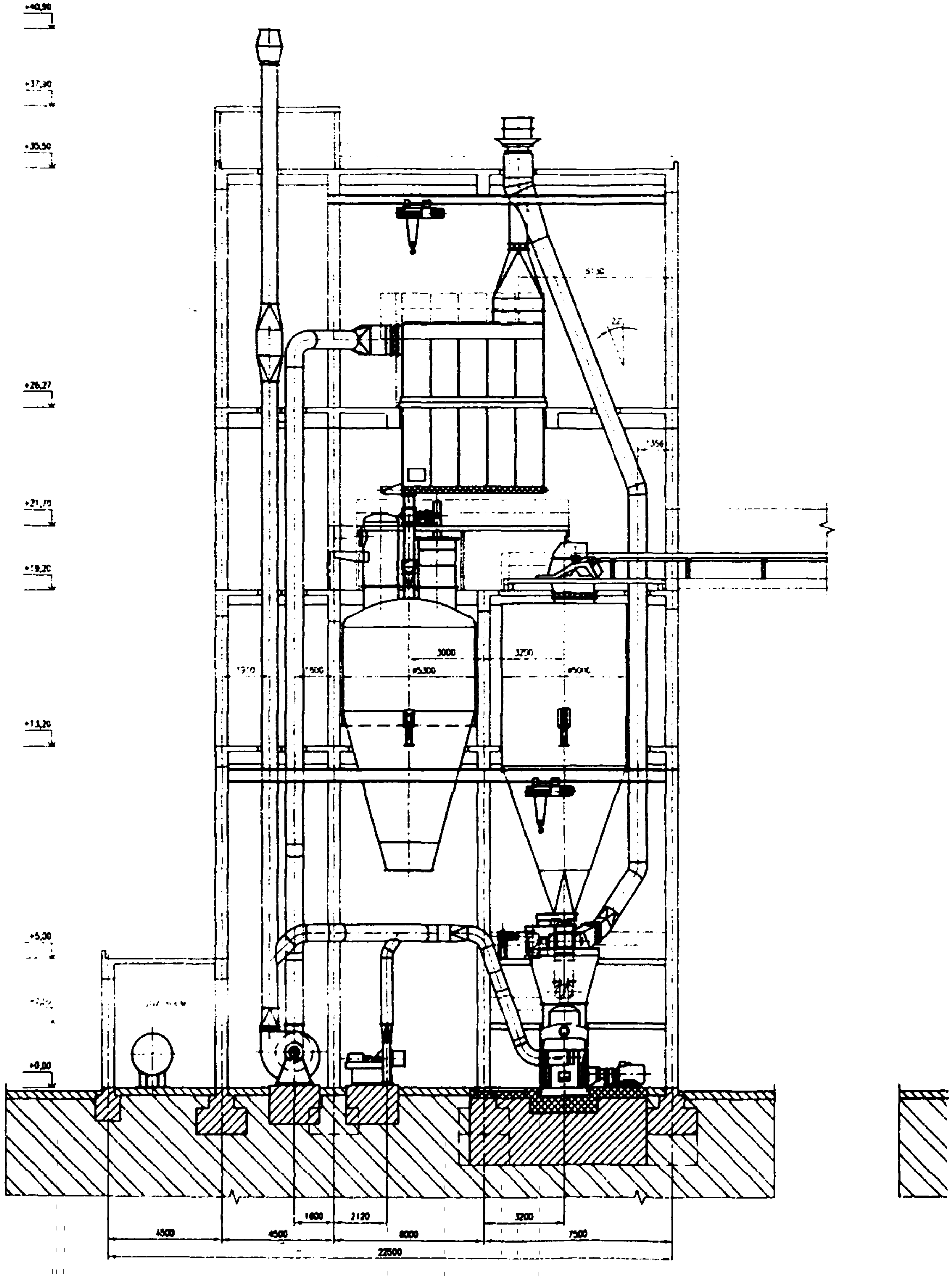


SEC 14

UNIDO VIENNA	KERAMOPROJEKT a.s. TRENČÍN	DATE: JANUARY 1996
EXPANSION OF THE CHILANGA CEMENT PLANT		FILES NO: 07. 03. 09
RAW MATERIAL GRINDING PLANT, BLENDING SILO, ROTARY KILN LINE		SCALE: 1:250
		DRAWING NO: 6

SEC 1

SECTION E-E

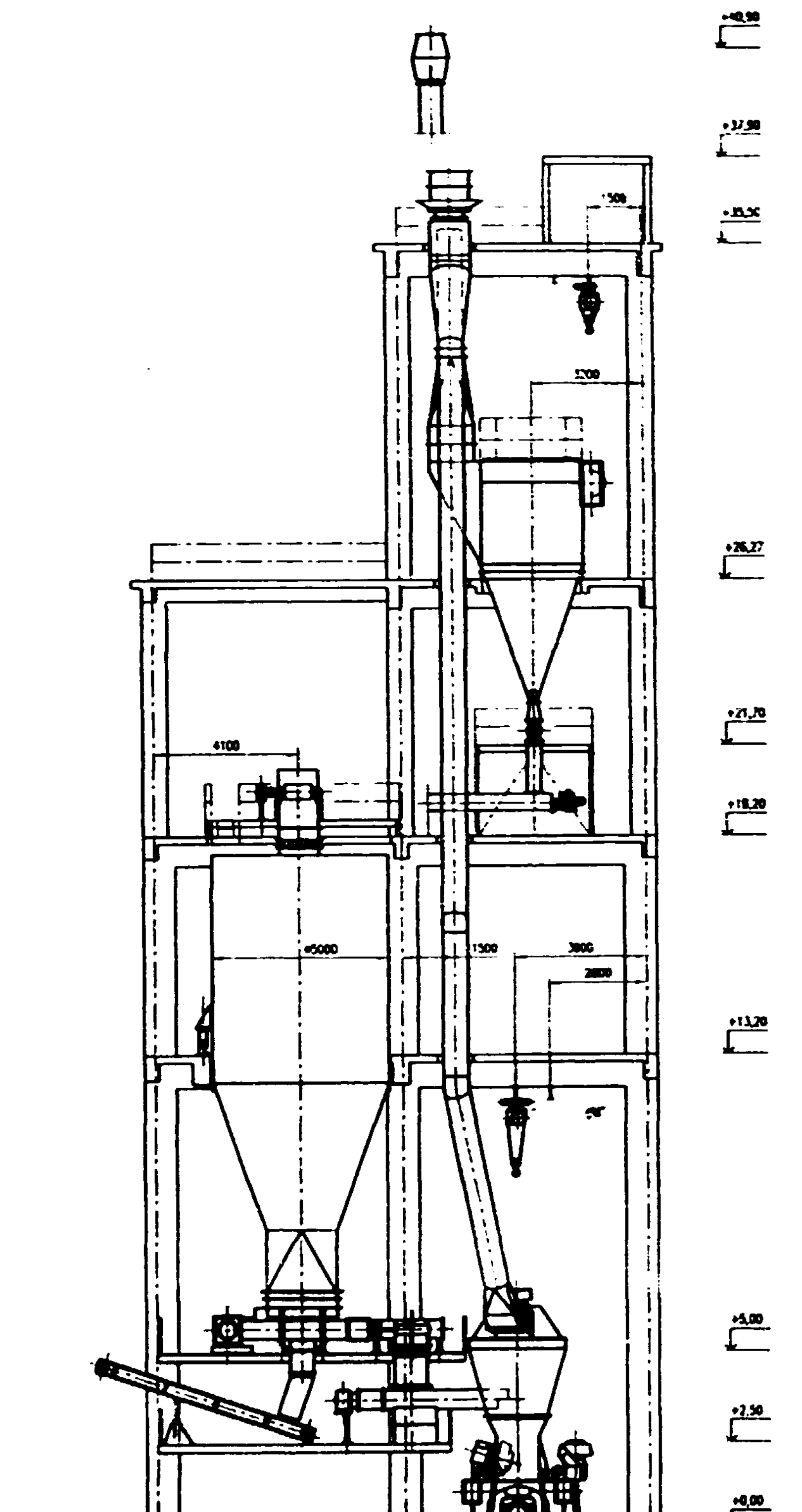


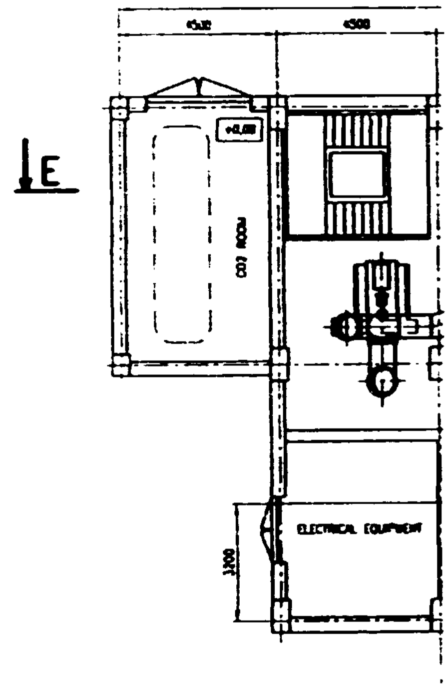
SEC 2

SEC 3

SECTION F-F

M 1:200



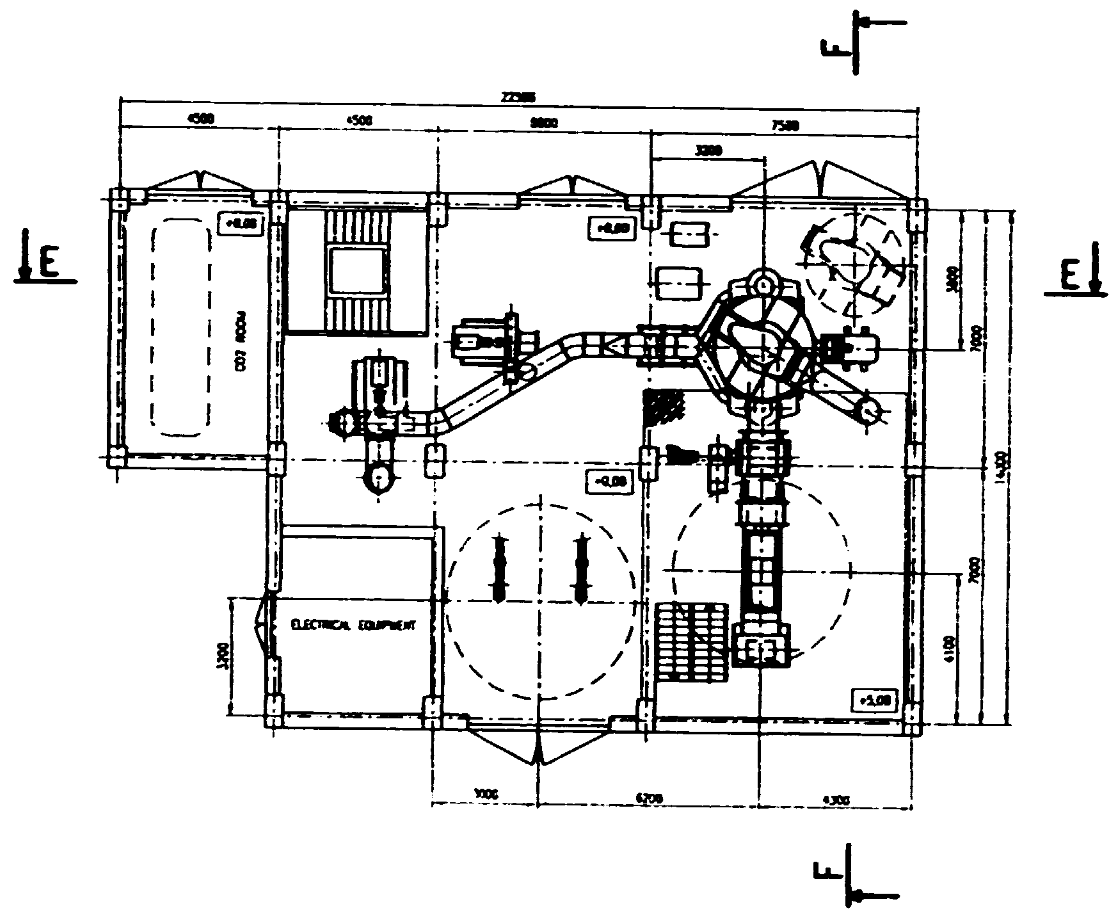


UNIDO VIENNA

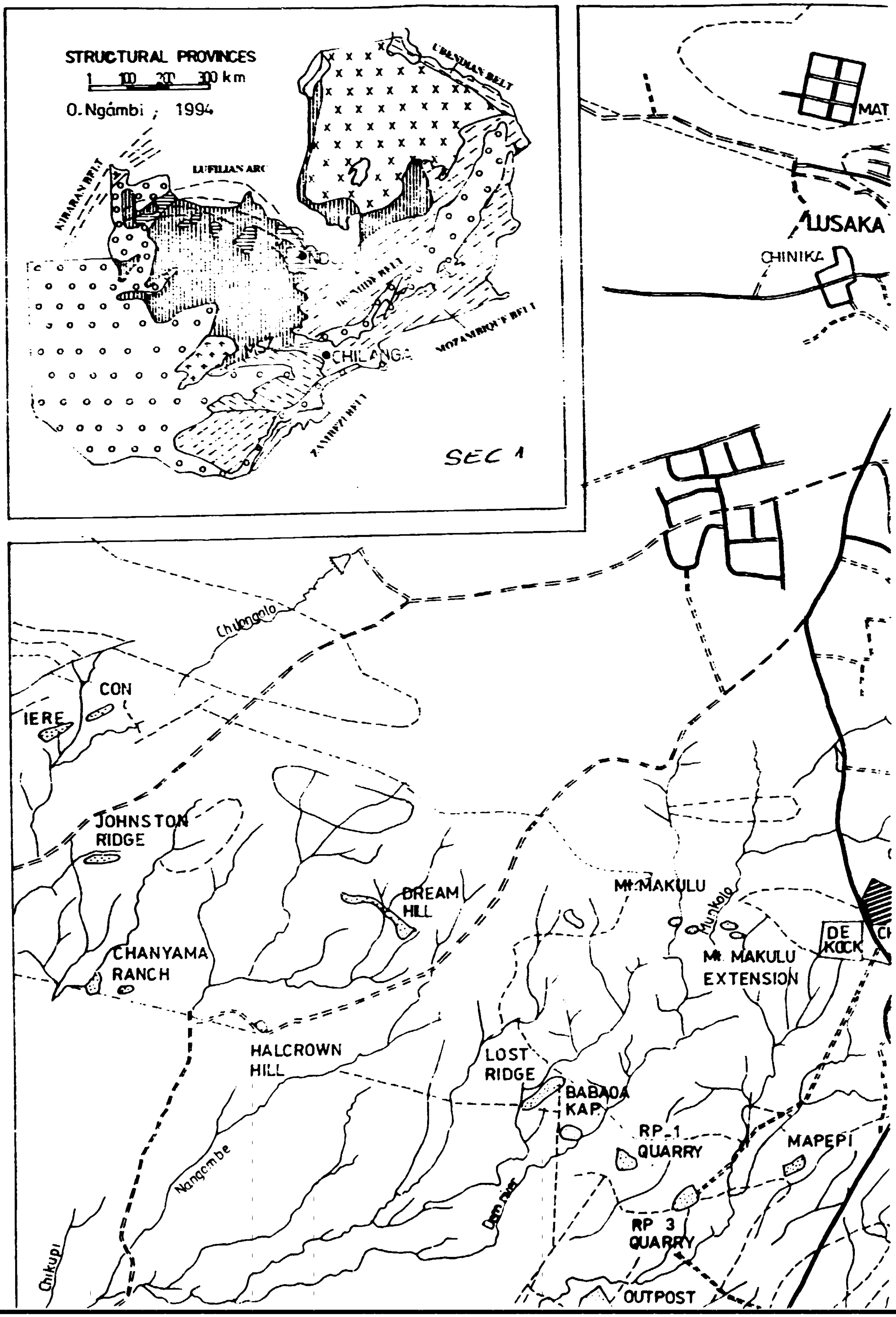
EXPANSION OF THE CHILANGA CE

COAL GRINDING PLANT

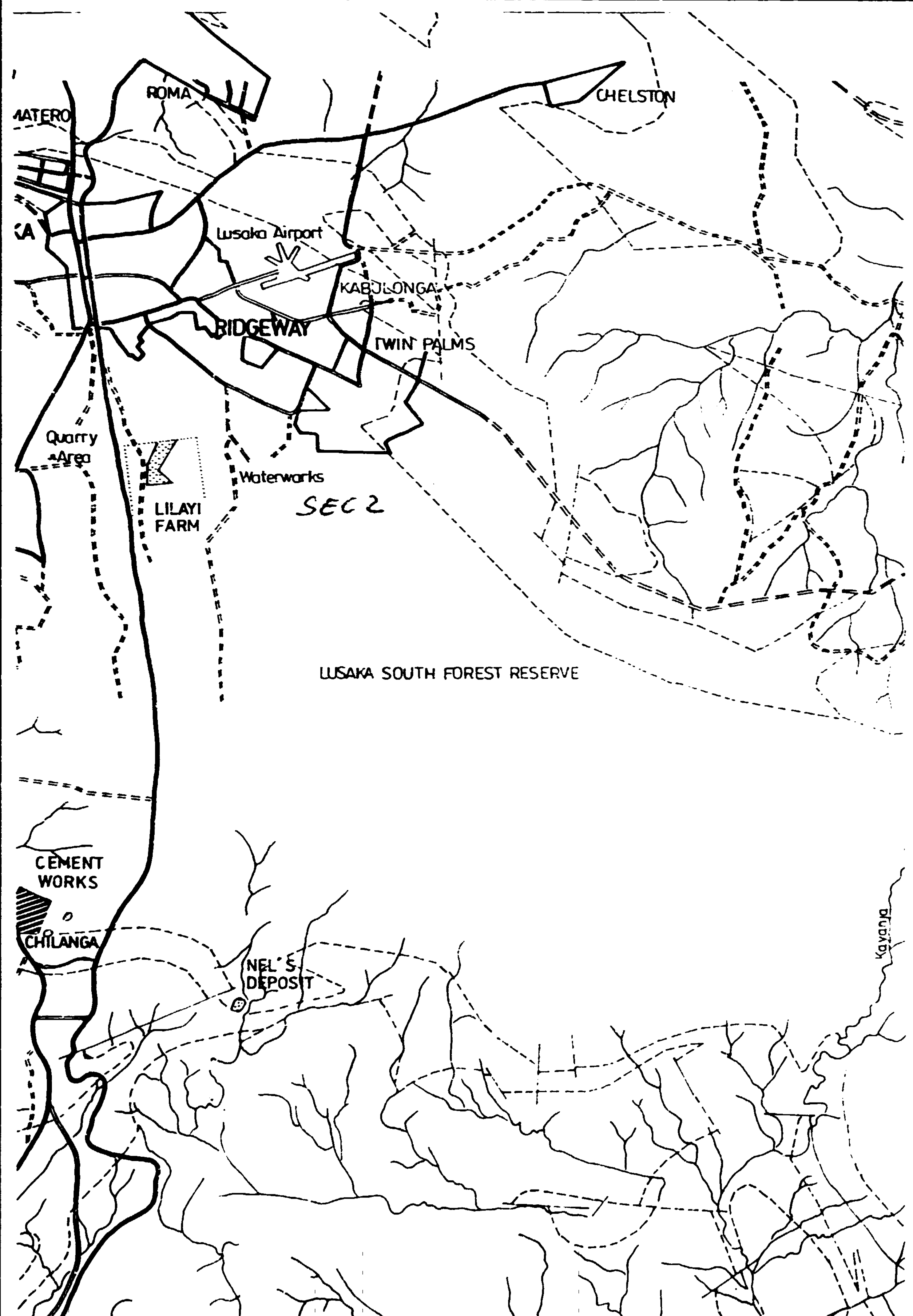
SEC 3



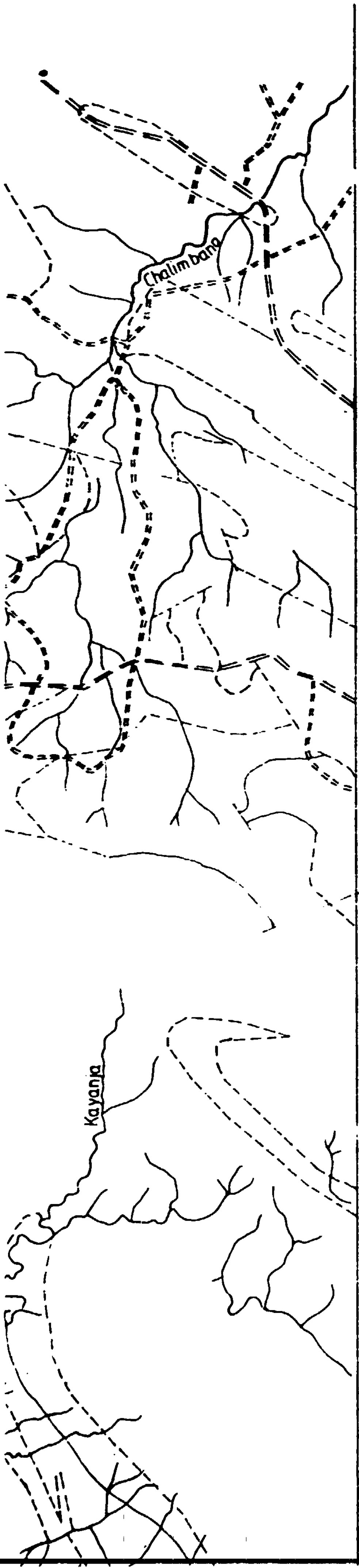
UNIDO VIENNA	KERAMOPROJEKT a.s. TRENČÍN	DATE: JANUARY 1996
EXPANSION OF THE CHILANGA CEMENT PLANT		FILES NO: 13
COAL GRINDING PLANT		SCALE: 1:200
		DRAWING NO: 7



STRUCTURAL PROVINCES
1 100 200 300 km
O. Ngámbi ; 1994
LUFILIAN ARC
KIBARAN BELT
UBENDIAN BELT
MOZAMBIQUE BELT
ZAMBEZI BELT
CHILANGA
SEC 1
MAT
LUSAKA
CHINIKA
Chulongolo
CON
IERE
JOHNSTON RIDGE
DREAM HILL
CHANYAMA RANCH
HALCROWN HILL
LOST RIDGE
Mt MAKULU
Munkolo
Mt MAKULU EXTENSION
DE KOCK
BABADA KAP
RP 1 QUARRY
MAPEPI
RP 3 QUARRY
OUTPOST
Nangombe
Chikupi



MATERO
ROMA
CHELSTON
KA
Lusaka Airport
KABULONGA
RIDGEWAY
TWIN PALMS
Quarry Area
LILAYI FARM
Waterworks
SEC 2
LUSAKA SOUTH FOREST RESERVE
CEMENT WORKS
CHILANGA
NEL'S DEPOSIT
Kayanja



Legend :

Granite

Undiffer

Bangwe

Katang:

Karoo a

MSZ Mwemł

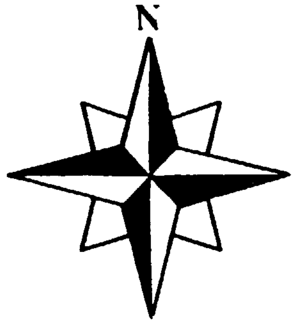
Limest

Limest

Cemen

UNIDO VIENNA	KERAMOPROJEKT

SEC 4



Legend :

Granite

Undifferentianed Basement Complex

Bangweulu Block

Katanga and possible equivalents

Karoo and Cretaceous rock

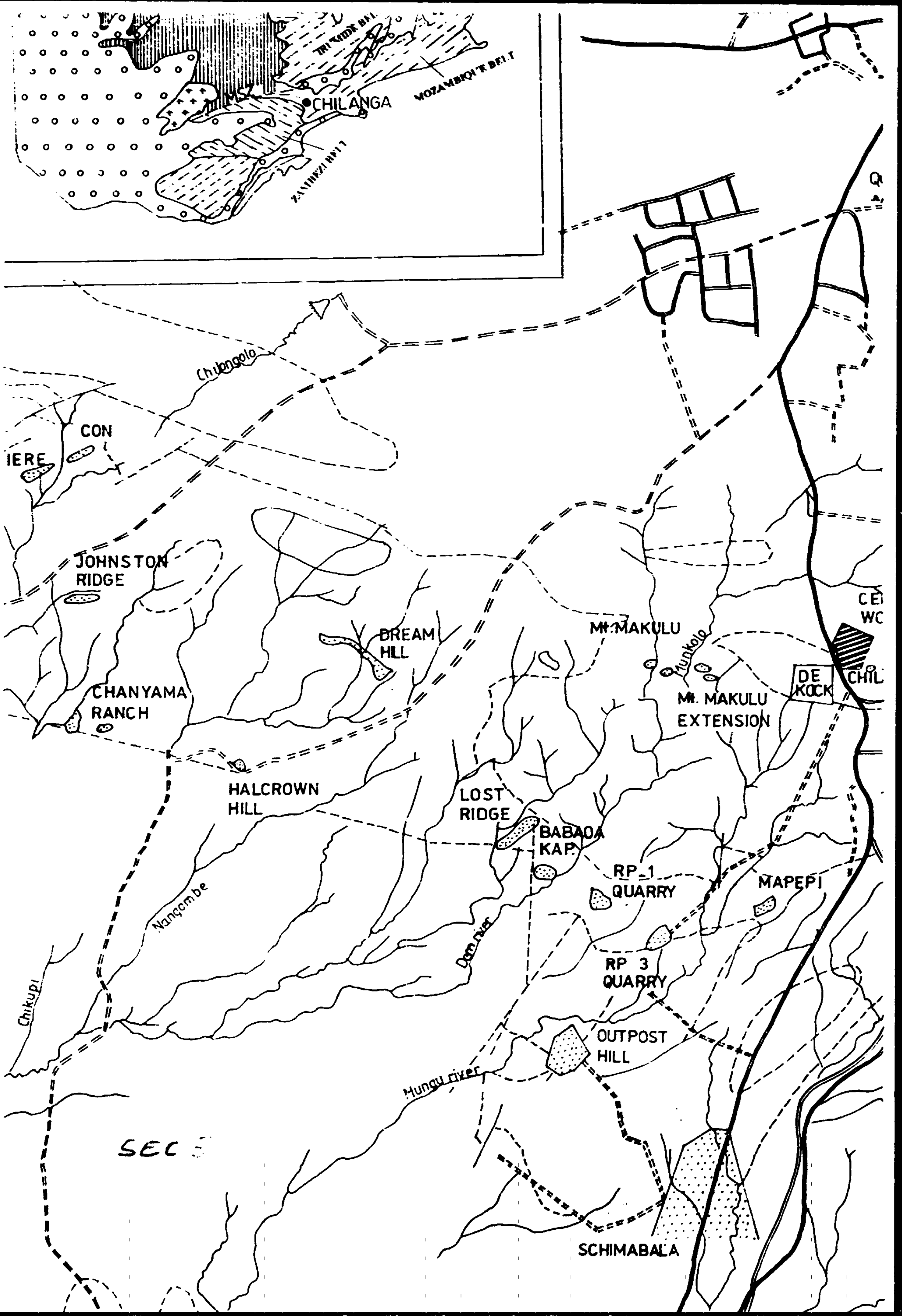
MSZ Mwembeshi Shear Zone

Limestone / Dolomite

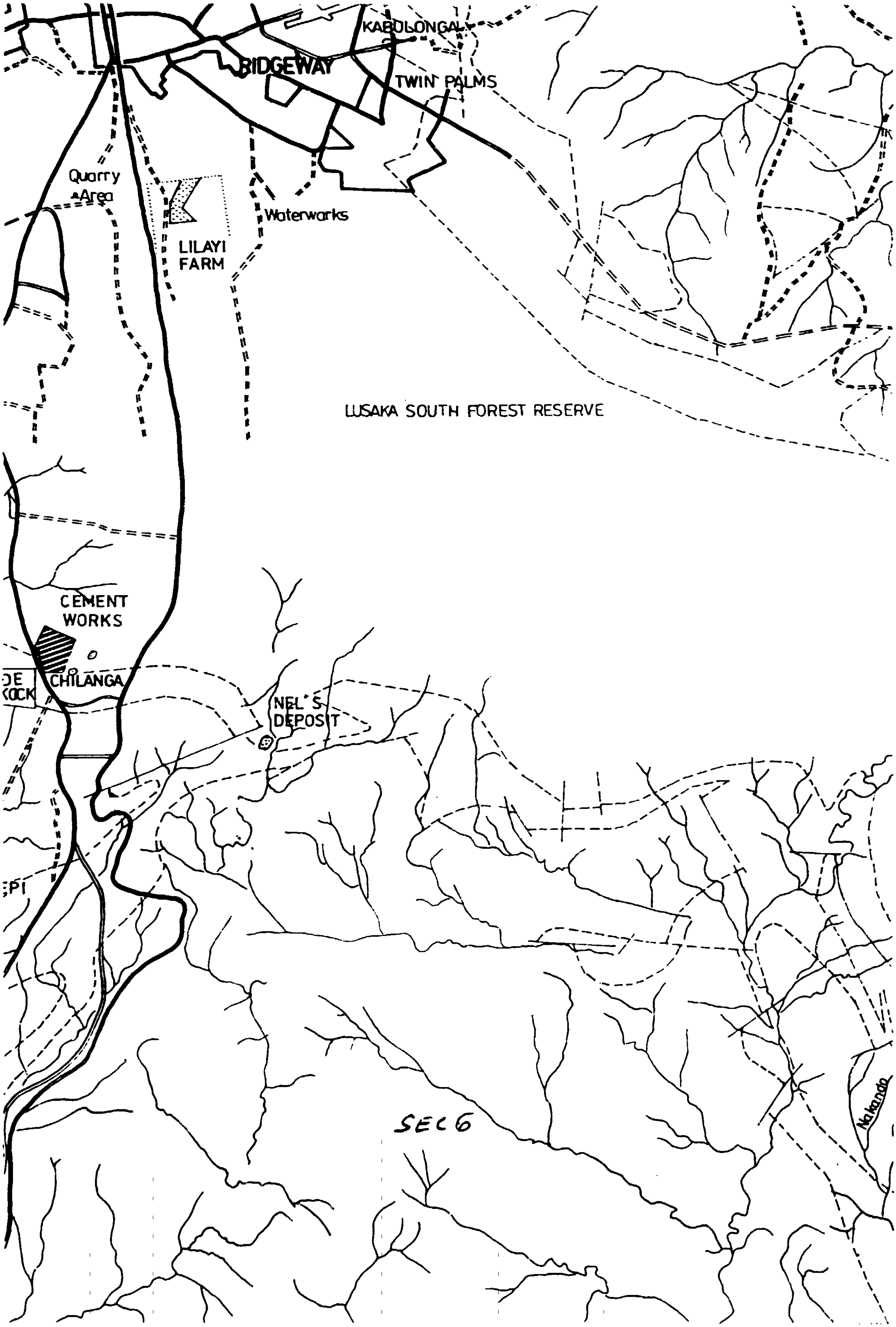
Limestone Deposit

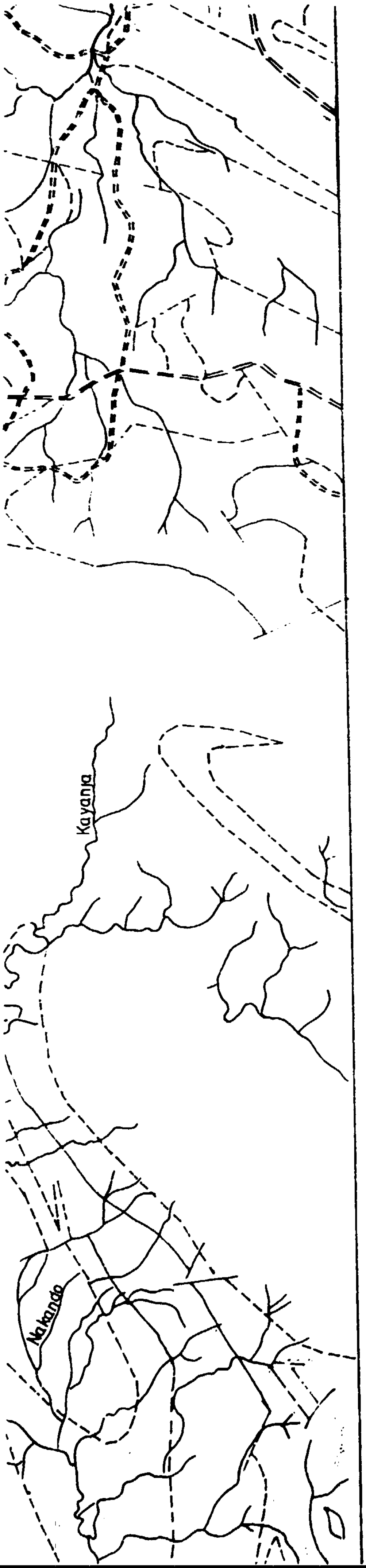
Cement Plant

UNIDO VIENNA	KERAMOPROJEKT	Date : JANUARY



MOZAMBIQUE BELT
CHILANGA
MSZ
ZAMBEZI BELT
Chilongolo
CON
IERE
JOHNSTON
RIDGE
DREAM
HILL
CHANYAMA
RANCH
HALCROWN
HILL
Mt. MAKULU
Munkolo
Mt. MAKULU
EXTENSION
DE
KOCK
CHIL
LOST
RIDGE
BABAOA
KAP.
RP_1
QUARRY
MAPEPI
Nangombe
Dam river
RP 3
QUARRY
Chikupi
OUTPOST
HILL
Mungu river
SEC
SCHIMABALA


KABULONGA
RIDGEWAY
TWIN PALMS
Quarry Area
LILAYI FARM
Waterworks
LUSAKA SOUTH FOREST RESERVE
CEMENT WORKS
CHILANGA
NEL'S DEPOSIT
SEC 6
Nakando

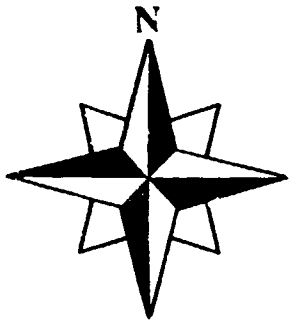


Legend :

- Granite
- Undiffer
- Bangwei
- Katanga
- Karoo a
- MSZ Mwemb
- Limesto
- Limestc
- Cement

UNIDO VIENNA	KERAMOPROJEKT a. s. TRENČÍN PROGEO Ltd. ŽILINA
EXPANSION OF THE CHILANGA CEMENT PLANT	
Geological Map of Zambia and Reserves Limestone Resources in Chilanga Area	

SEC 7



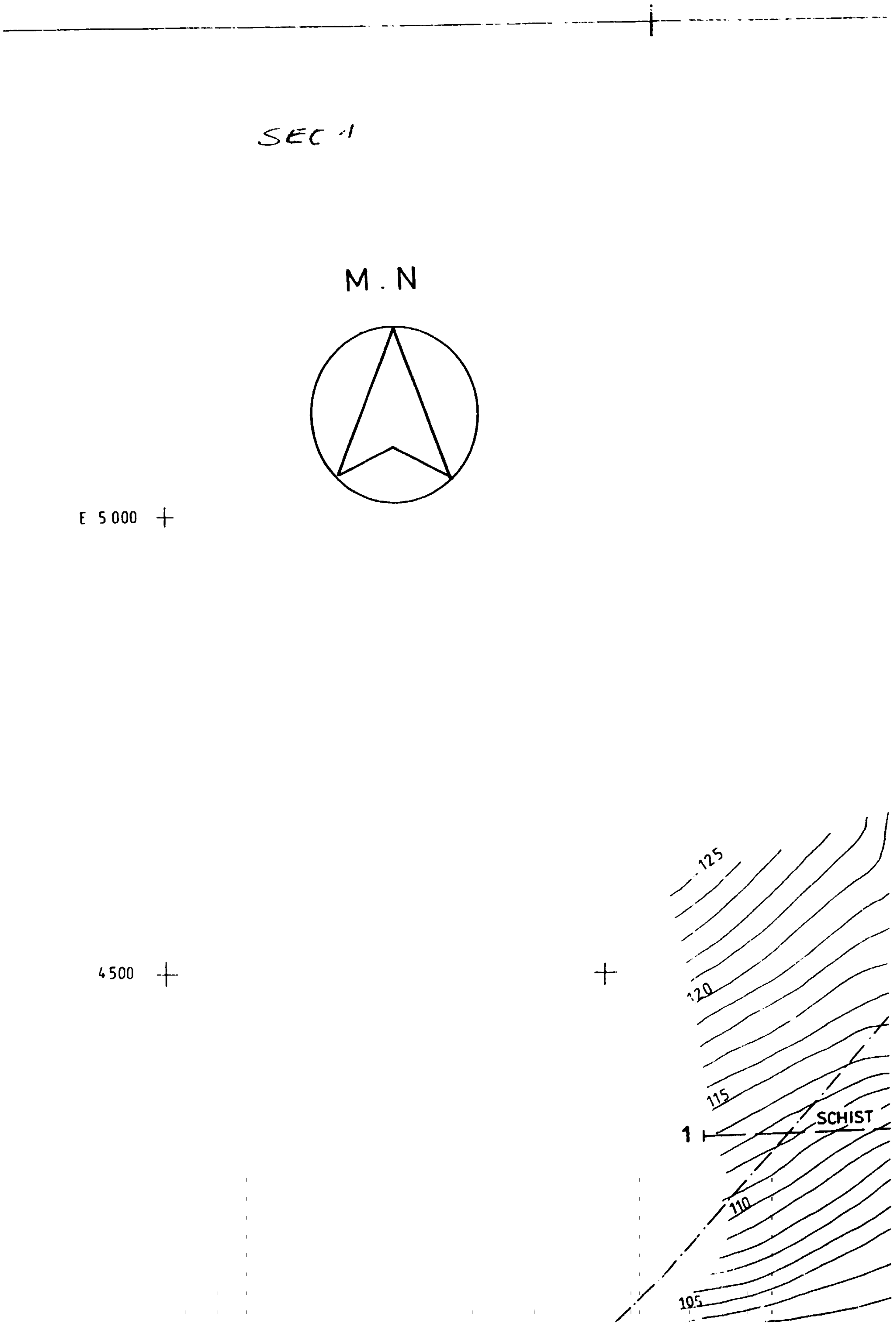
Legend :

+ + + + +	Granite
	Undifferentianed Basement Complex
x x x	Bangweulu Block
	Katanga and possible equivalents
o o o o o	Karoo and Cretaceous rock
MSZ	Mwembeshi Shear Zone
	Limestone / Dolomite
	Limestone Deposit
●	Cement Plant

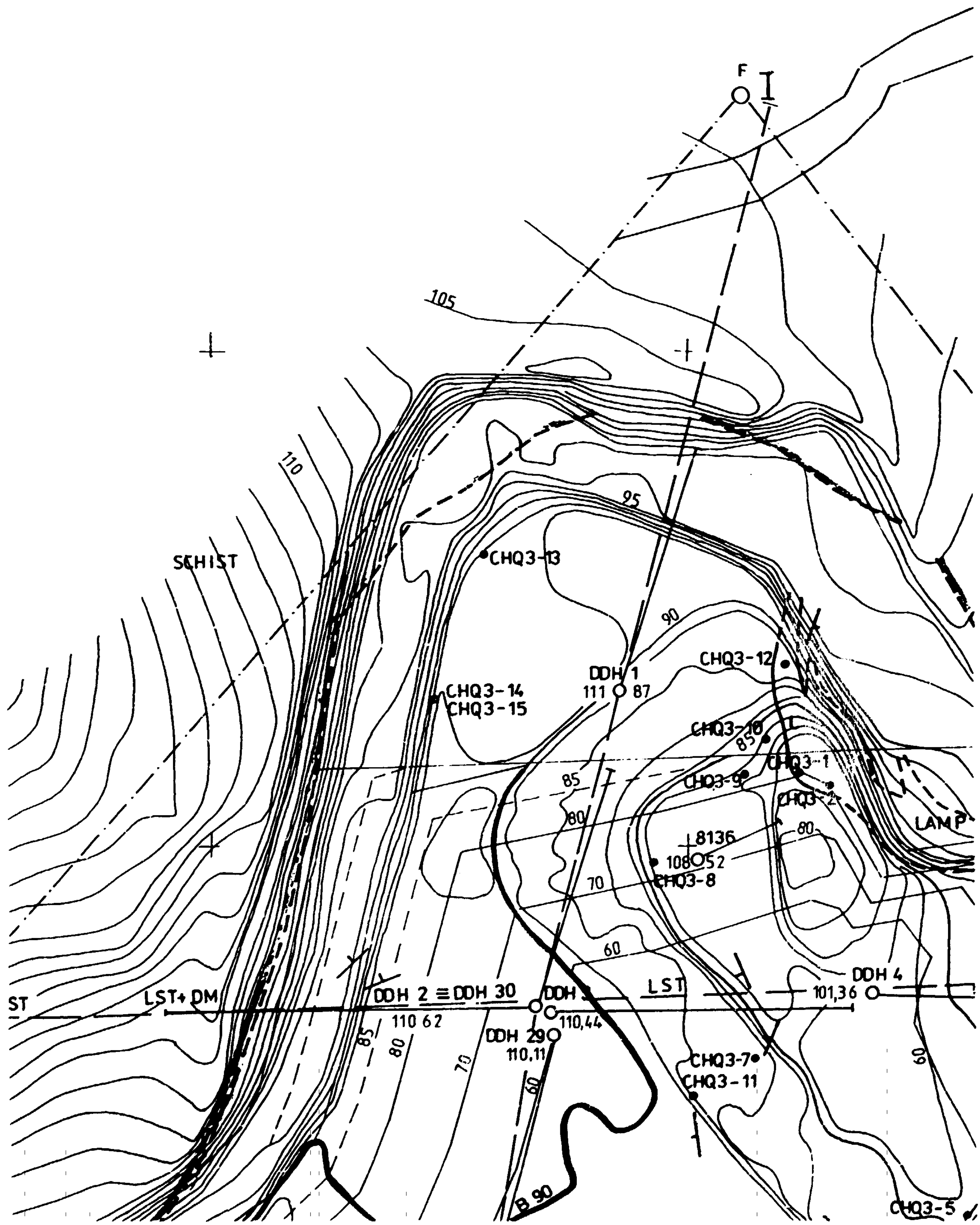
UNIDO VIENNA	KERAMOPROJEKT a. s. TRENČÍN PROGEO Ltd. ŽILINA	Date : JANUARY 1996
EXPANSION OF THE CHILANGA CEMENT PLANT		Scale : 1: 100 000
Geological Map of Zambia and Reserves Limestone Resources in Chilanga Area		Drawing No: 8

~~EE 7~~

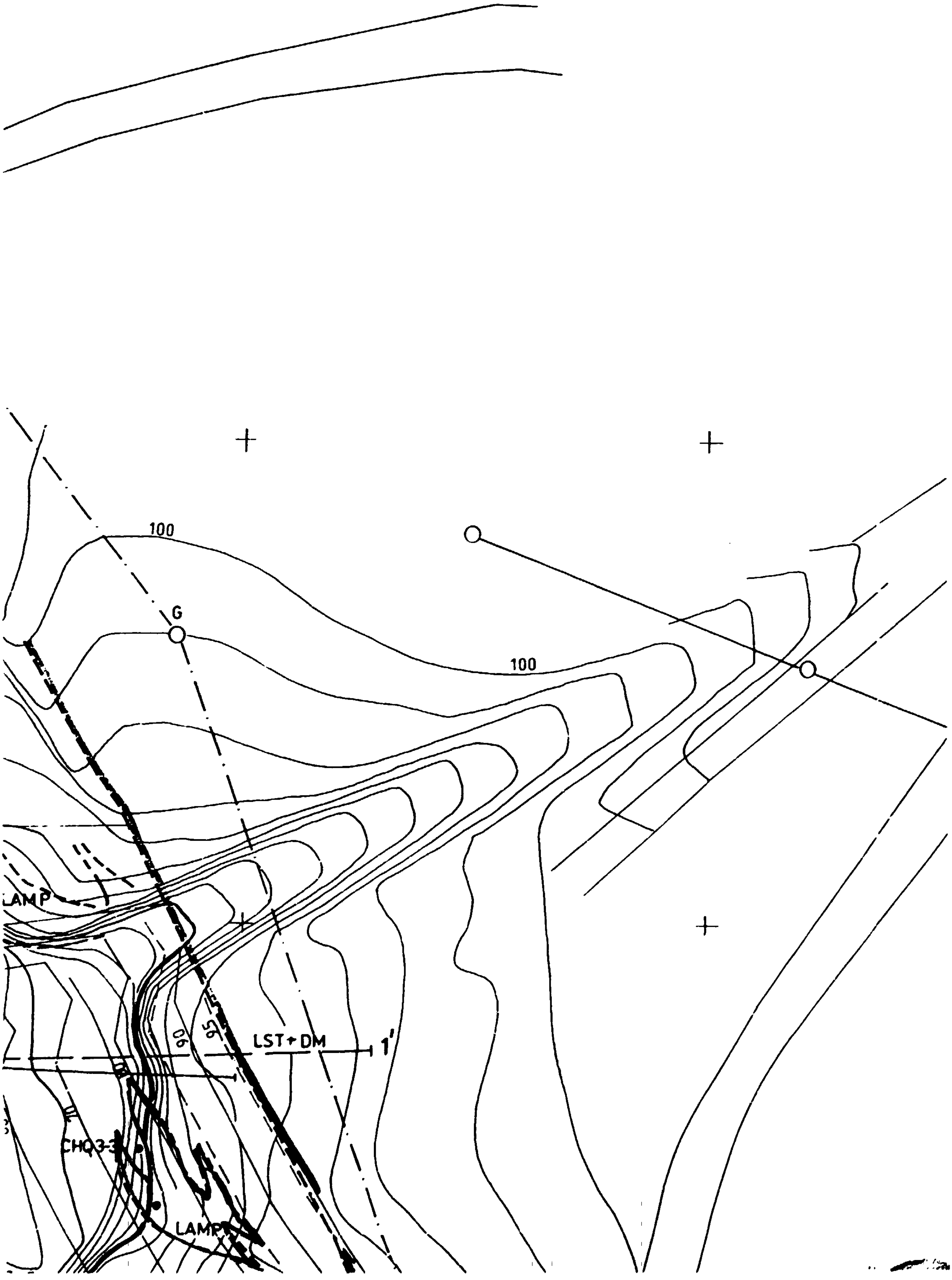
SEC 8


SEC 1
M.N
E 5000
4500
125
120
115
110
105
SCHIST
1

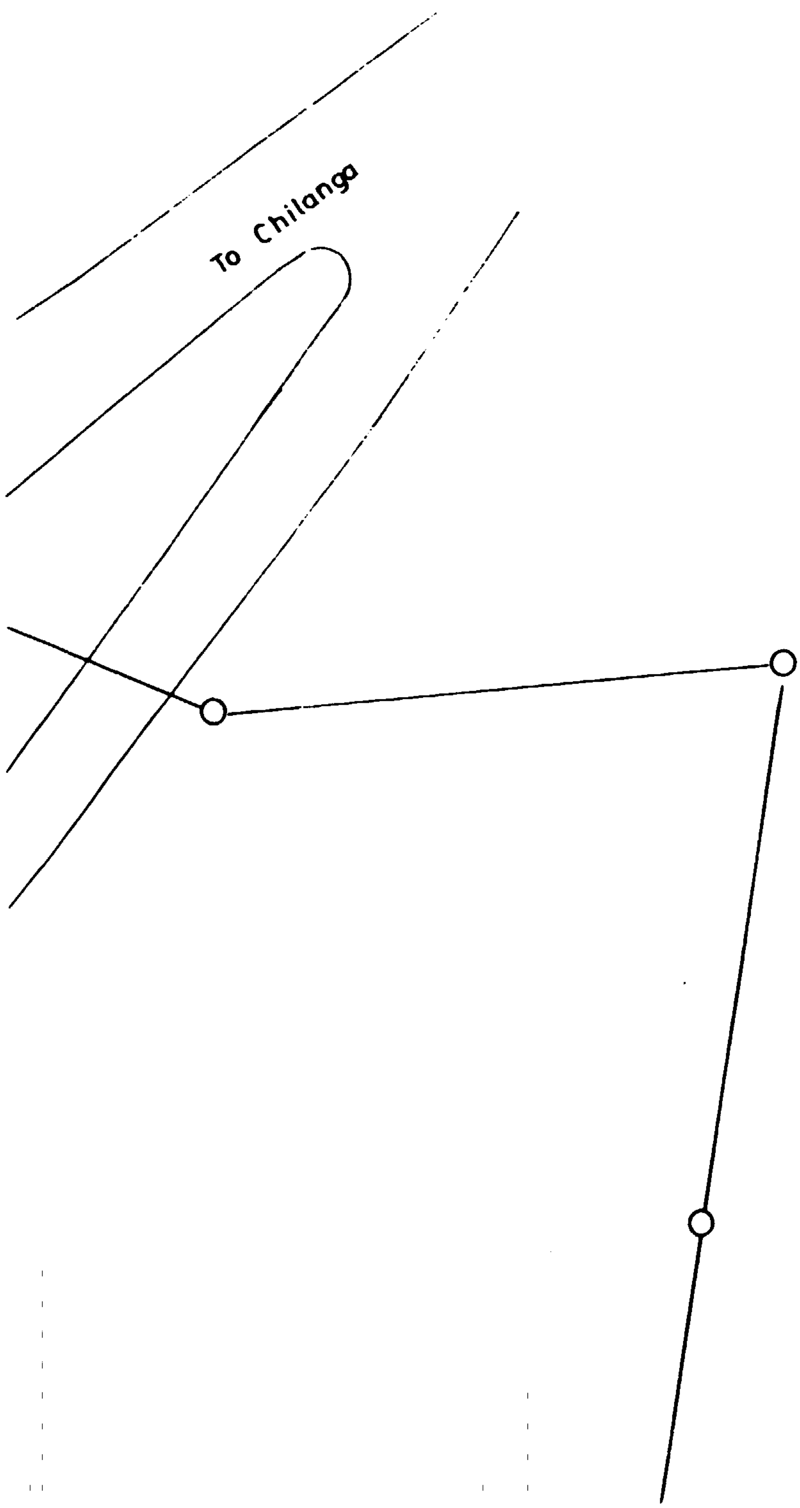
SEC 2

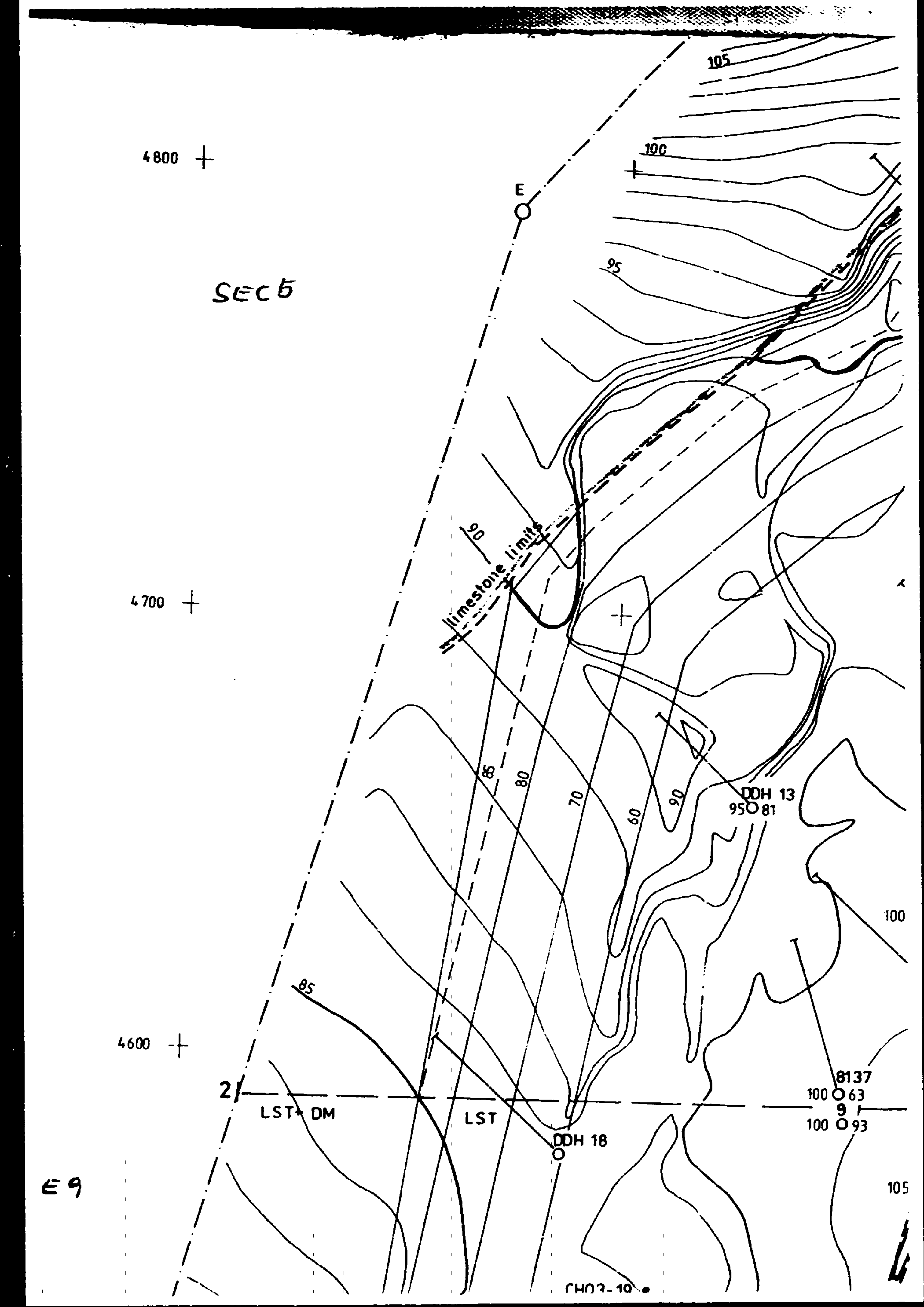

F
105
110
95
90
85
80
70
60
SCHIST
CHQ3-13
CHQ3-12
CHQ3-14
CHQ3-15
DDH 1
111 87
CHQ3-10
CHQ3-1
CHQ3-9
CHQ3-2
LAMP
8136
108 52
CHQ3-8
LST+DM
DDH 2 ≡ DDH 30
110 62
DDH 3
110,44
DDH 29
110,11
LST
DDH 4
101,36
CHQ3-7
CHQ3-11
B 90
CHQ3-5
ST

SEC 3

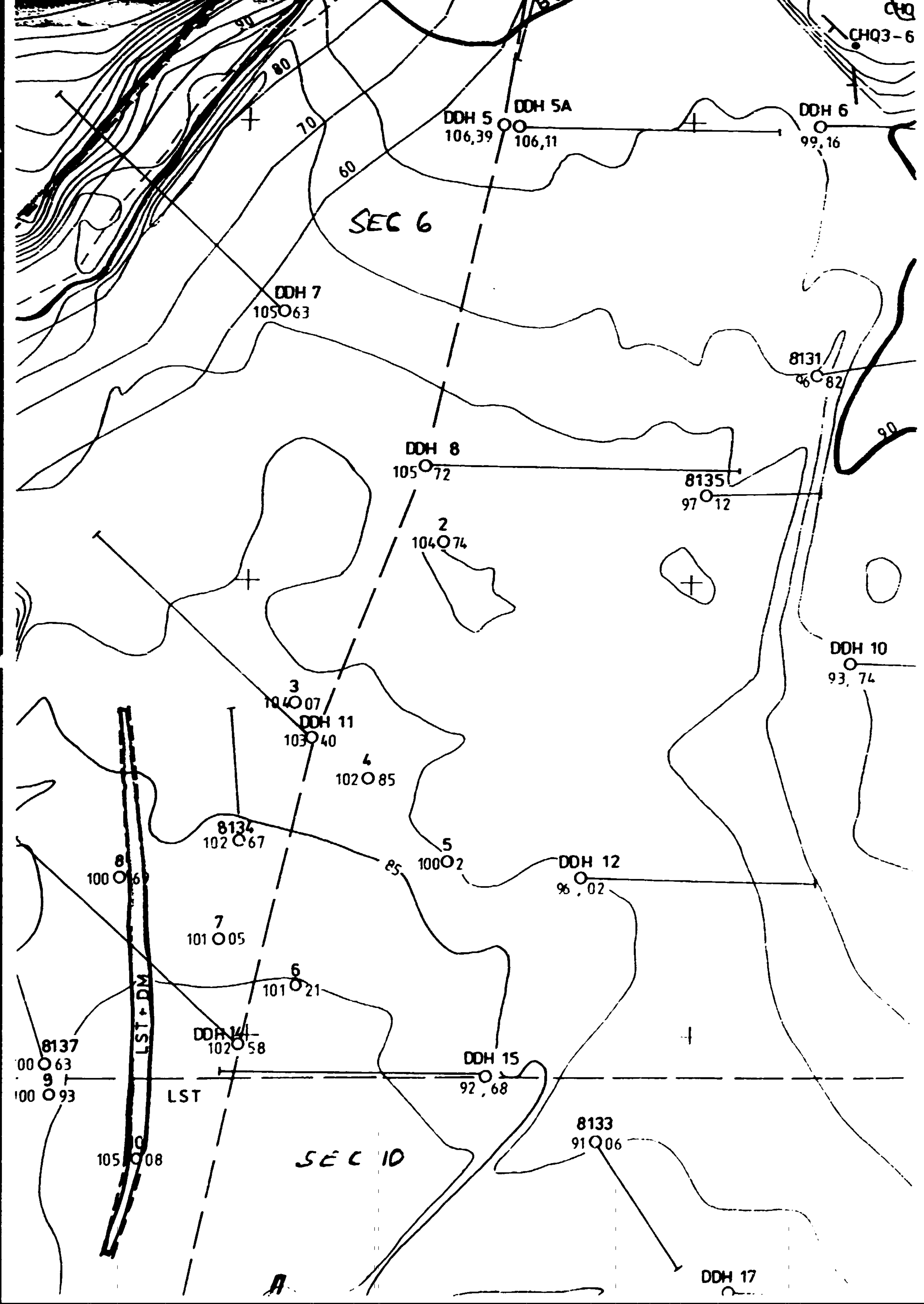


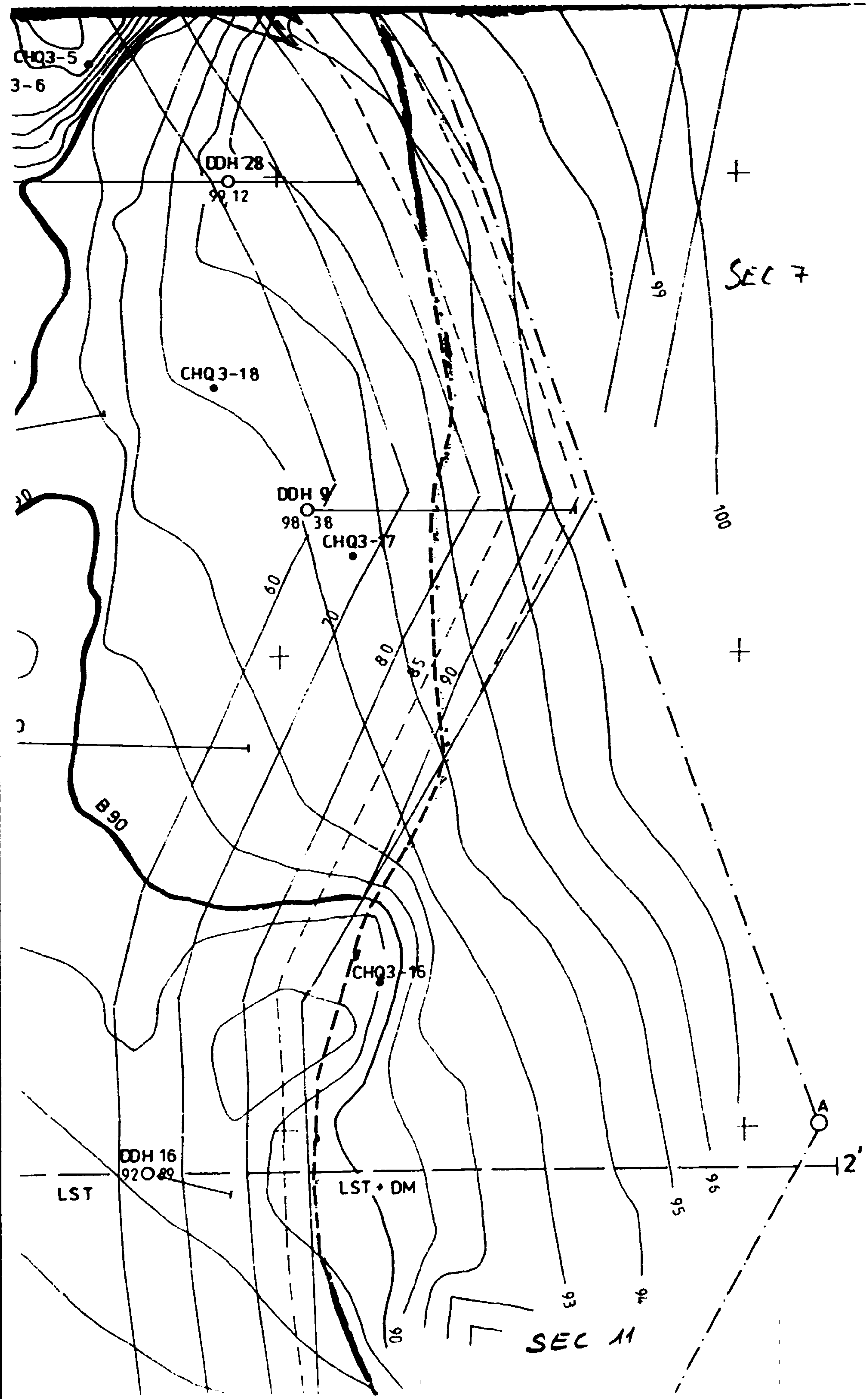
SEC 4



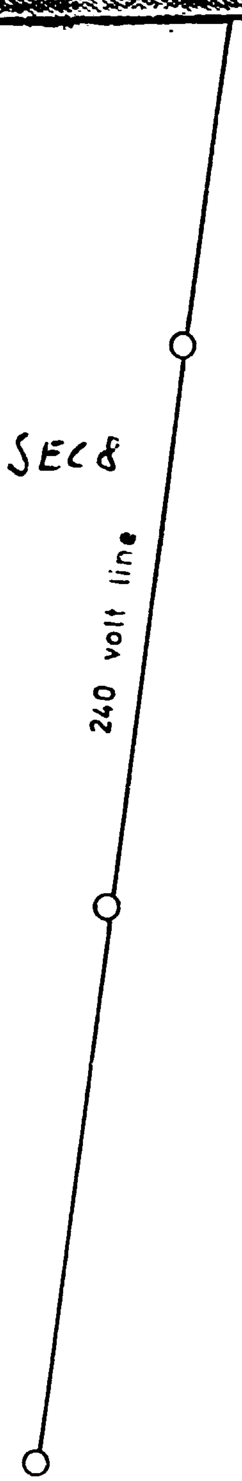


SEC 5
4800
4700
4600
E
105
100
95
90
limestone limits
85
80
70
60
90
DDH 13
95
81
100
8137
100
63
9
100
93
2
LST+ DM
LST
85
DDH 18
105
E 9
CH03-19

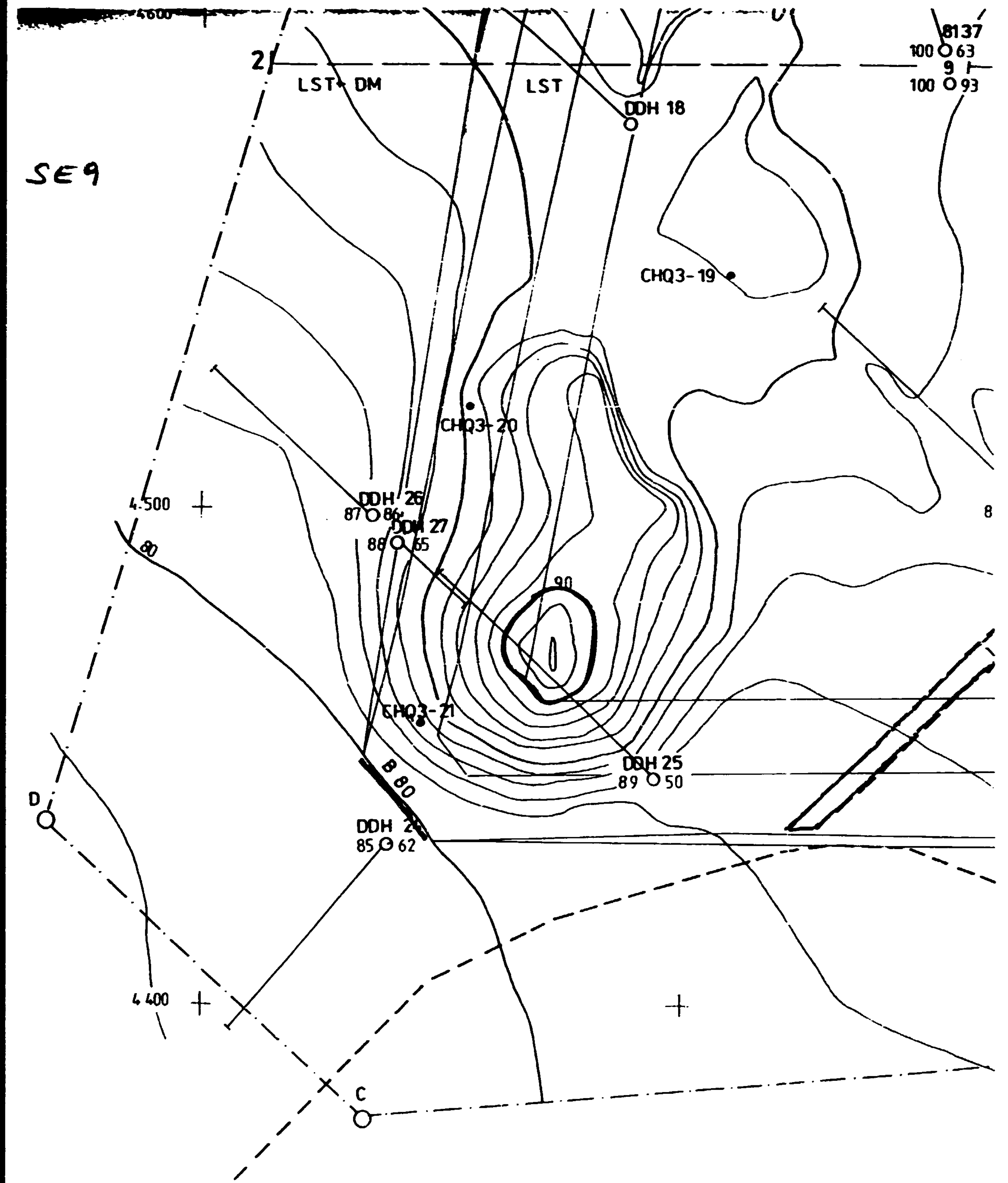

CHQ
CHQ3-6
90
80
70
60
DDH 5
106,39
DDH 5A
106,11
DDH 6
99,16
SEC 6
DDH 7
105 63
8131
96 82
90
DDH 8
105 72
8135
97 12
2
104 74
DDH 10
93, 74
3
104 07
DDH 11
103 40
4
102 85
8134
102 67
5
100 2
85
DDH 12
96, 02
7
101 05
6
101 21
LST + DM
8137
00 63
9
00 93
DDH 14
102 58
DDH 15
92, 68
LST
8133
91 06
SEC 10
105 08
DDH 17



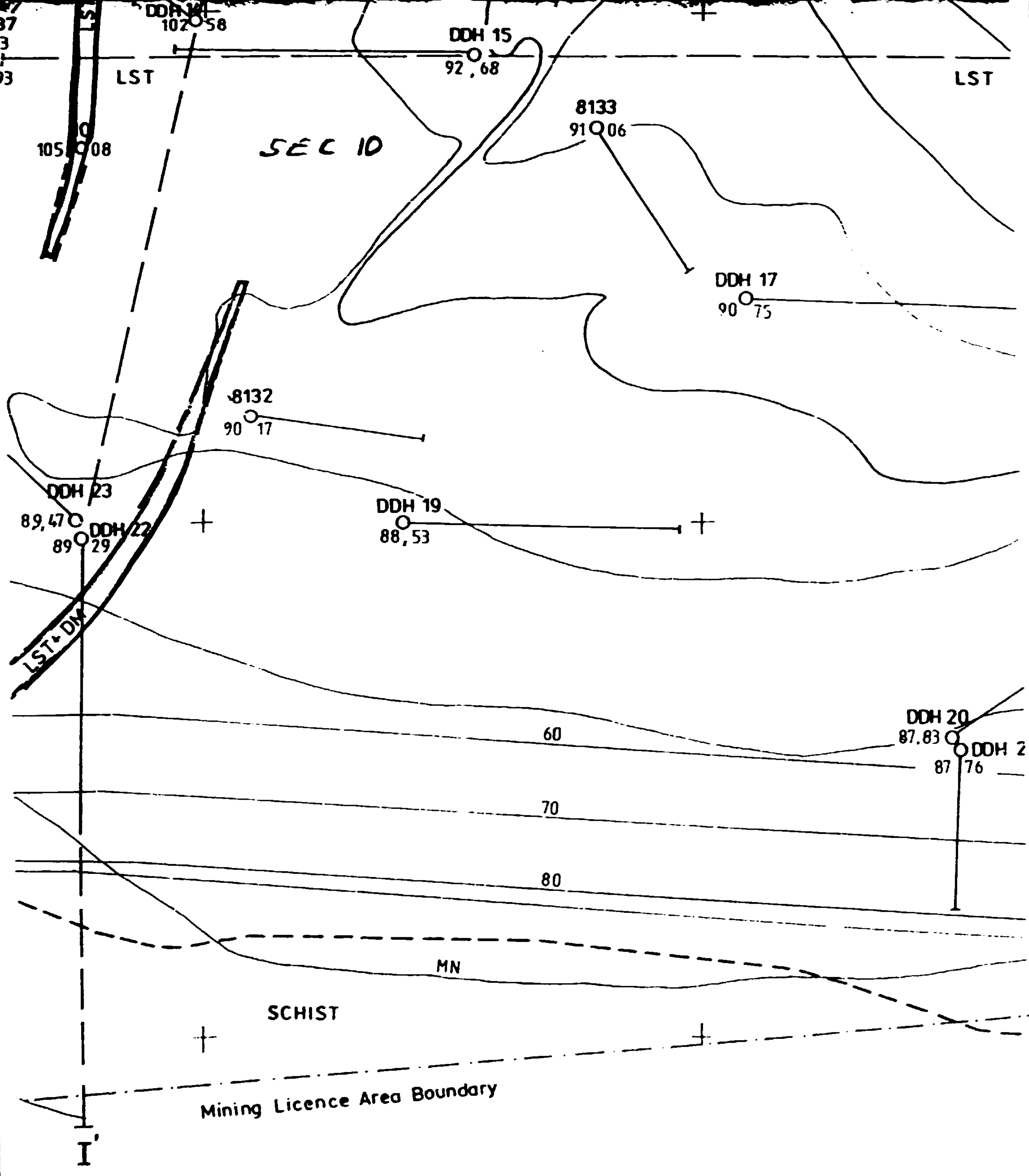
CHQ3-5
3-6
DDH 28
99.12
SEC 7
99
CHQ 3-18
DDH 9
98 38
CHQ3-17
100
60
70
80
85
90
B 90
CHQ3-16
A
DDH 16
92 89
LST
LST + DM
2'
95
95
93
94
90
SEC 11


SEC8
240 volt line

SE9

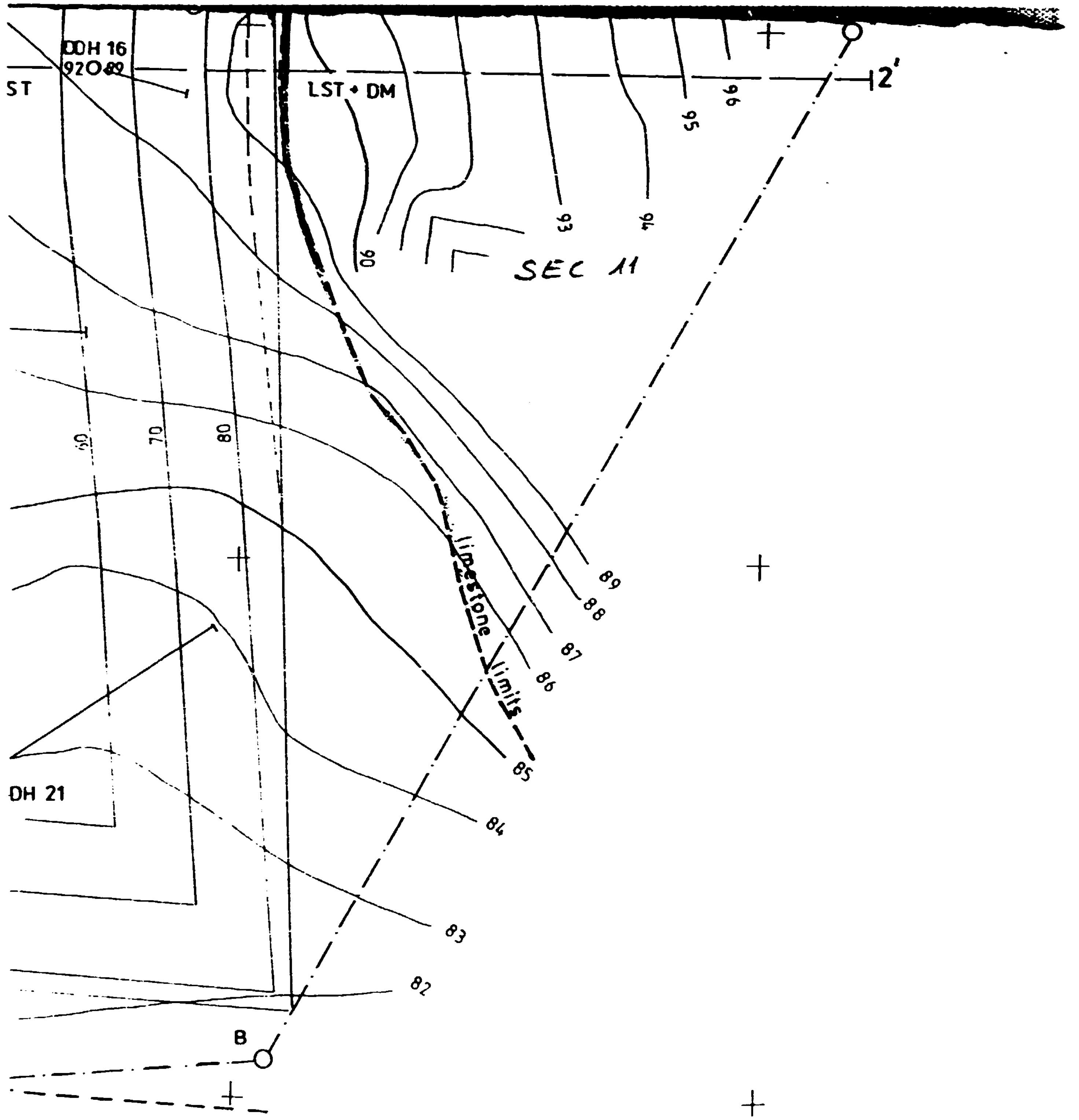

4600
2
LST+DM
LST
DDH 18
8137
100 63
9
100 93
CHQ3-19
CHQ3-20
DDH 26
87 86
DDH 27
88 65
4.500
80
90
CHQ3-21
DDH 25
89 50
B 80
D
85 62
4 400
C

SEC 4

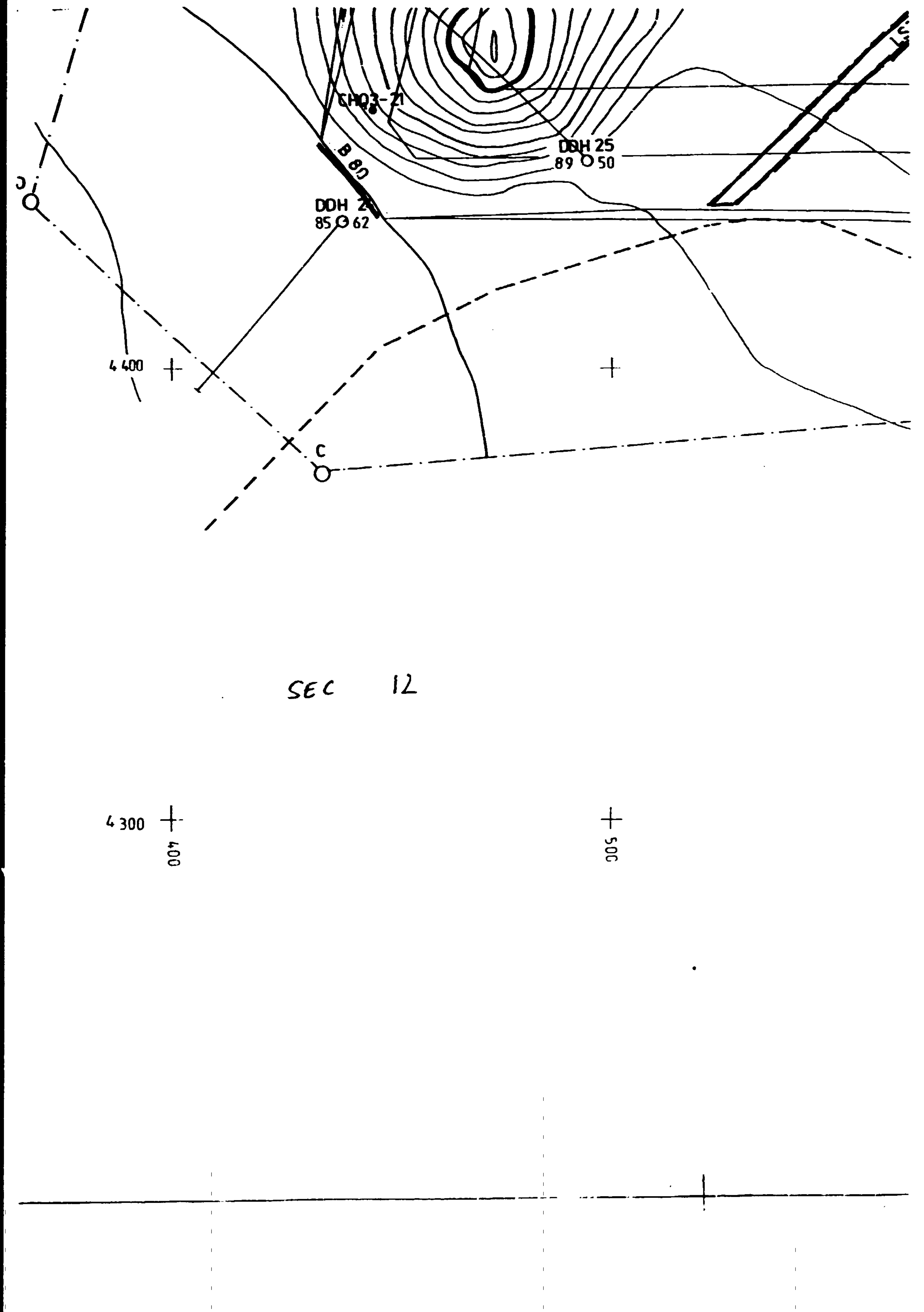


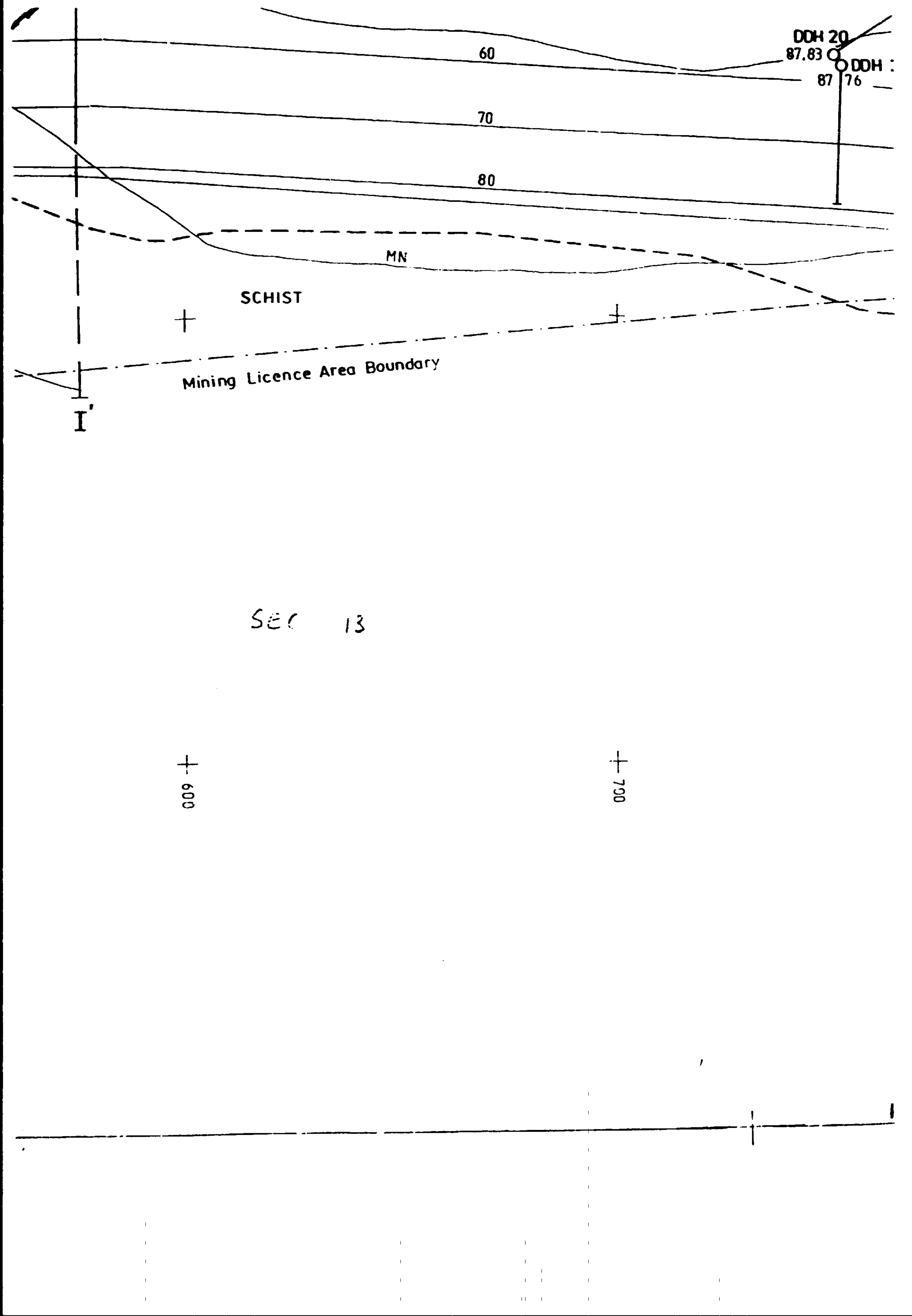
DDH 15
92,68
LST
LST
SEC 10
105 08
DDH 14
102 58
8133
91 06
DDH 17
90 75
8132
90 17
DDH 23
89,47
DDH 22
89 29
DDH 19
88,53
LST+DM
60
70
80
DDH 20
87,83
87 76
MN
SCHIST
Mining Licence Area Boundary
I'

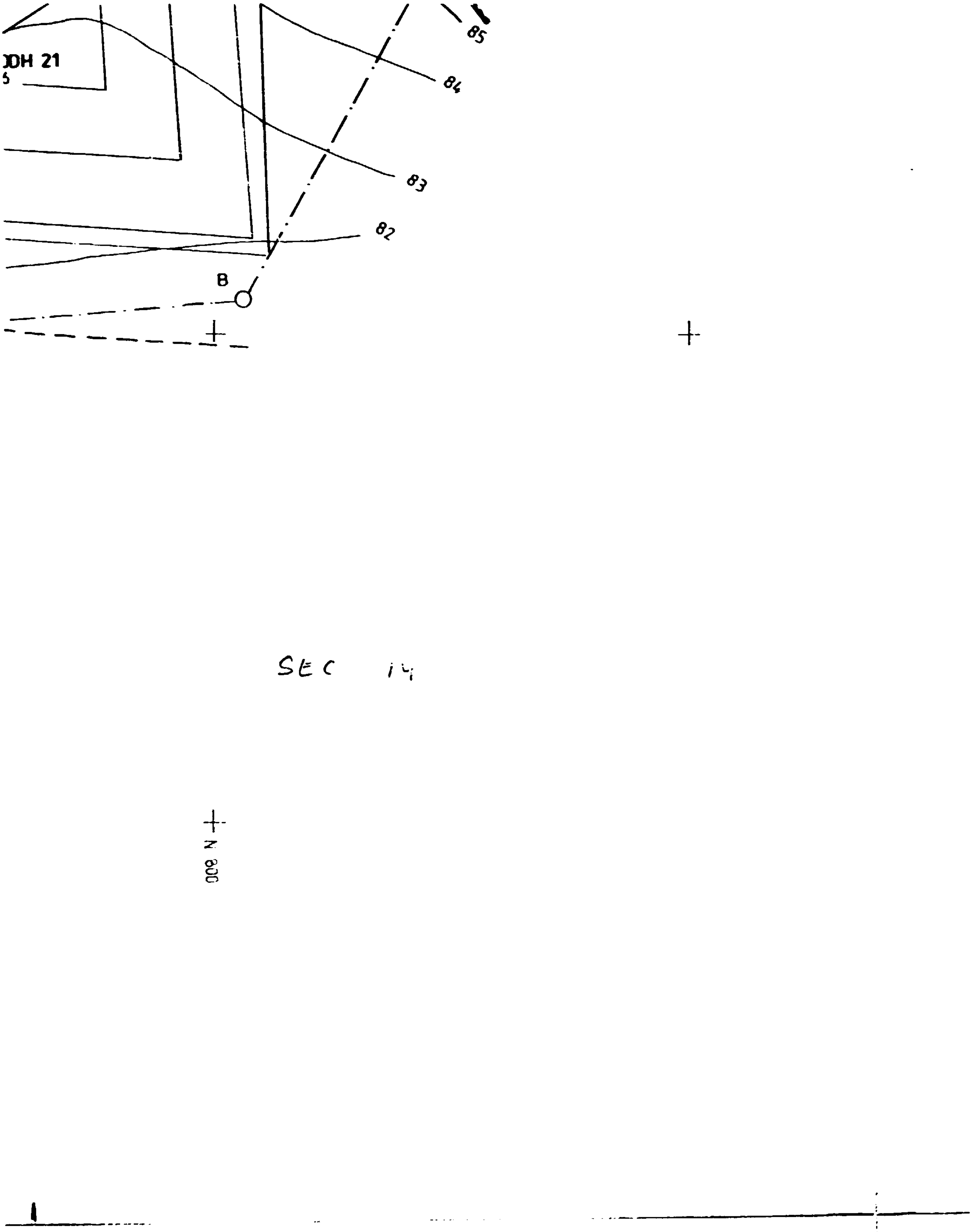
SEC 10


DDH 16
920 89
ST
LST + DM
2'
96
95
93
94
90
SEC 11
60
70
80
limestone limits
89
88
87
86
85
84
83
82
DH 21
B

SEC 11


CHQ3-21
DDH 25
89 50
B 80
DDH 24
85 62
C
4 400
SEC 12
4 300
400
500


DDH 20
87.83
DDH
87 76
60
70
80
MN
SCHIST
Mining Licence Area Boundary
I'
SEC 13
600
700



SEC 14

Legend :

A — B	Mining Licence Area Boundary
B 90	Mining Bench 90 m RL
60	Final Slope Isohypse 60m RL
	Reserves Limits
	Limestone limits
	Unsuitable Parts
LST+DM	1/ MgO > 3% upon one Bench
LAM	2/ Lamprophyre
LST	Limestone (Raw Material)
LAM	Lamprophyre (beyond Reserves Limits)
LST + DM	Limestone + Dolomite (beyond Reserves Limits)
	Geological Limits
I — I'	Geological and Technological Section
CH03-10	Sampling Site
DDH 21	Slope Bore Hole

SEC. 3

60	**Final Slope Isohypse 60m RL**
	Reserves Limits
	Limestone limits
	Unsuitable Parts
LST+DM	**1/ MgO > 3% upon one Bench**
LAM	**2/ Lamprophyre**
LST	**Limestone (Raw Material)**
LAM	**Lamprophyre (beyond Reserves Limits)**
LST + DM	**Limestone + Dolomite (beyond Reserves Limits)**
	Geological Limits
I — I'	**Geological and Technological Section**
[illegible]	**Sampling Site**
[illegible]	**Slope Bore Hole**
	Vertical Bore Hole

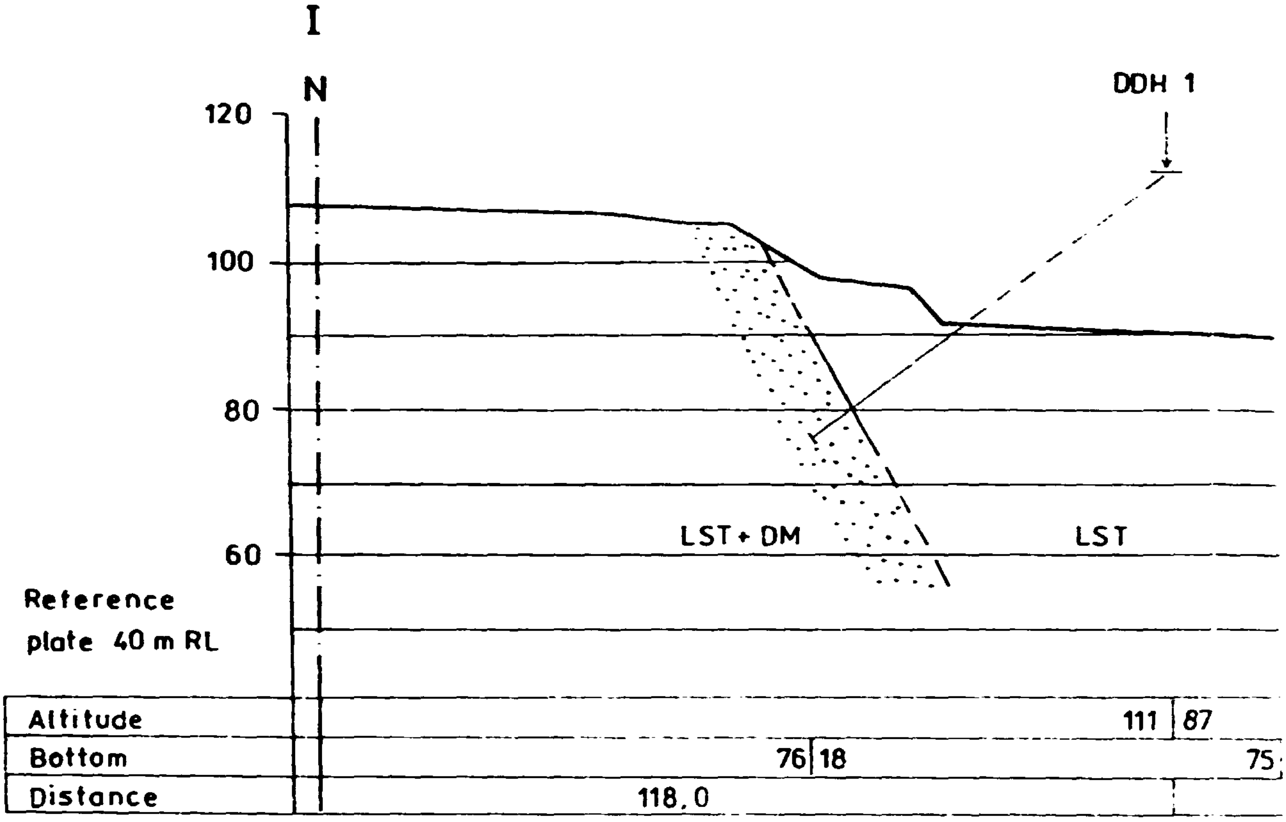
UNIDO VIENNA	KERAMOPROJEKT a. s. TRENČIN PROGEO Ltd. ŽILINA	Date	[illegible]
EXPANSION OF THE CHILANGA CEMENT PLANT Map of Reserves		Scale	1 : 1000
		Drawing No.	[illegible]

SEC 16

SEC 1

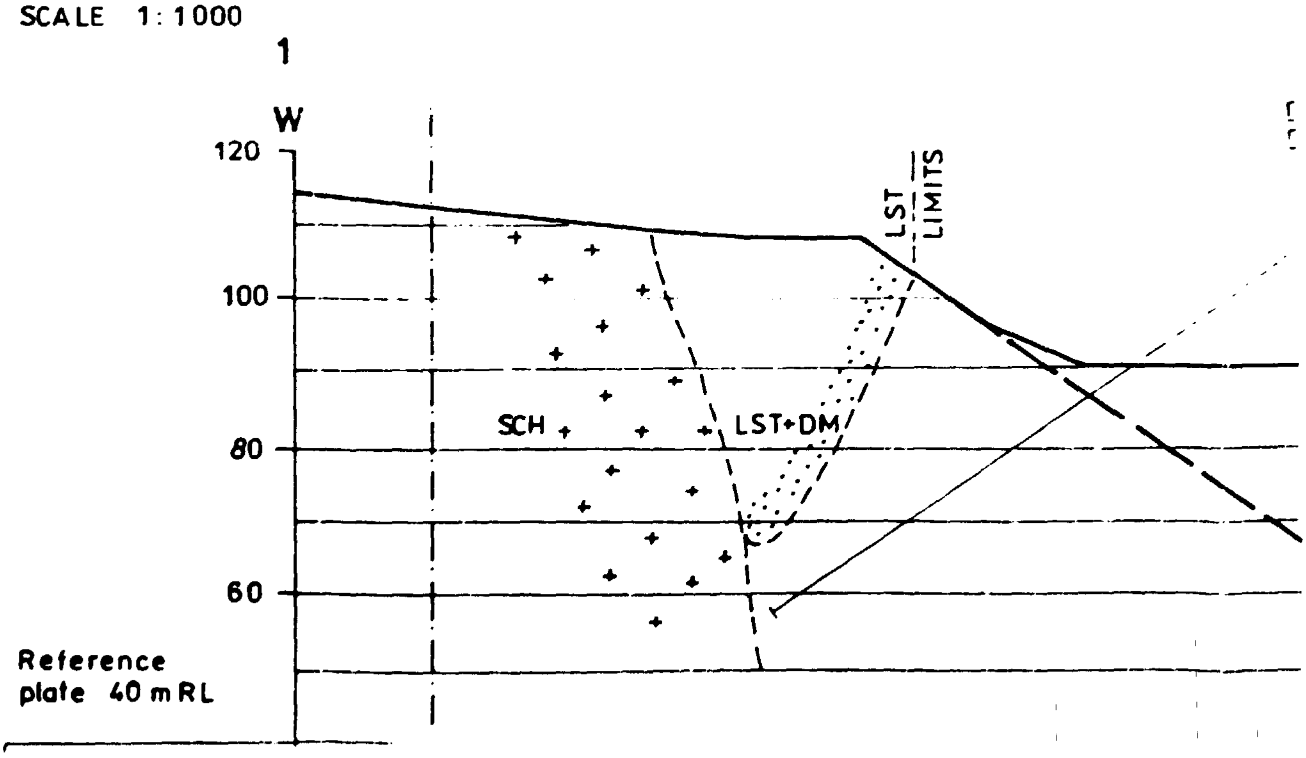
SECTION I - I'

SCALE 1:1000

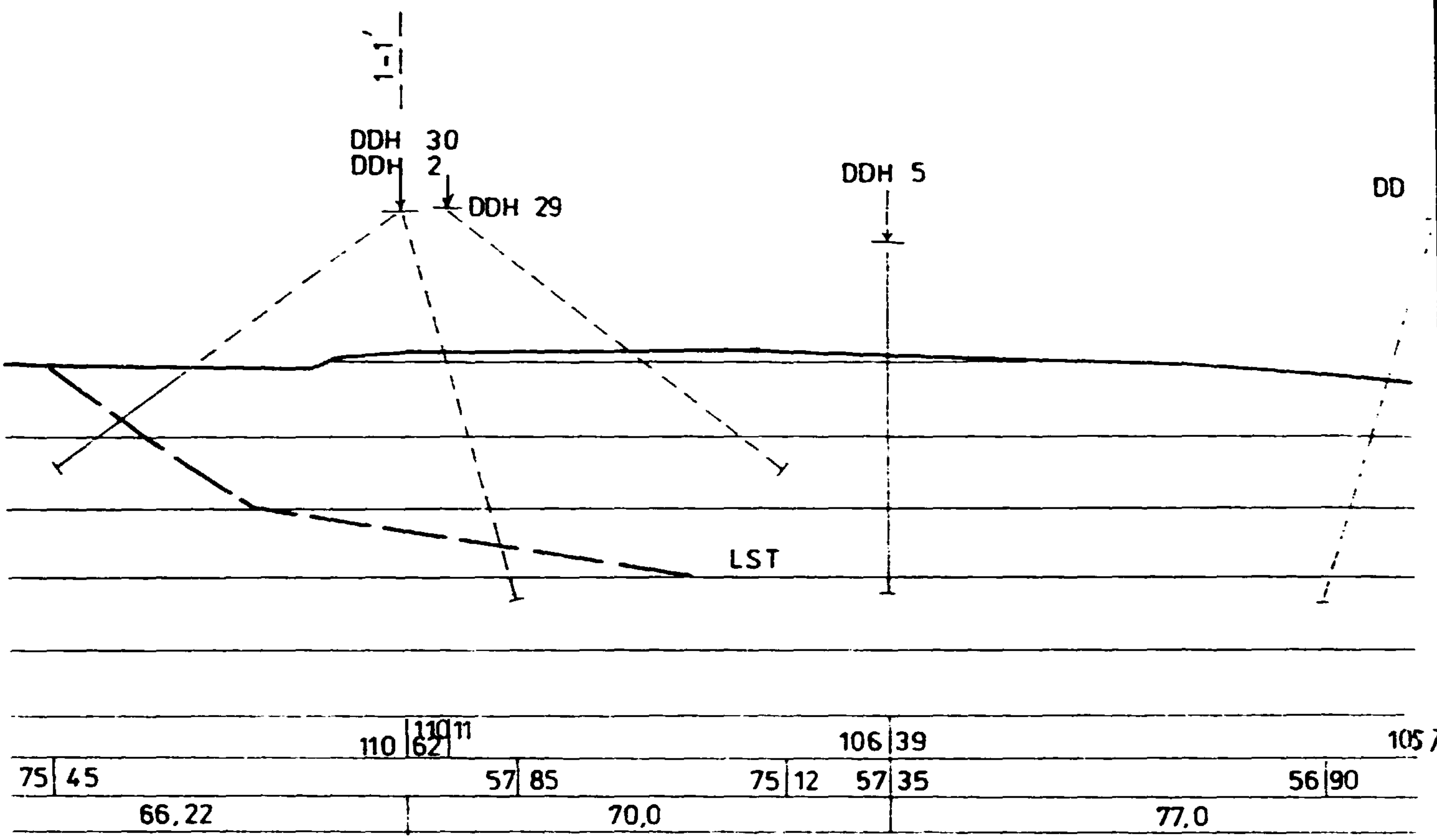


SECTION 1 - 1'

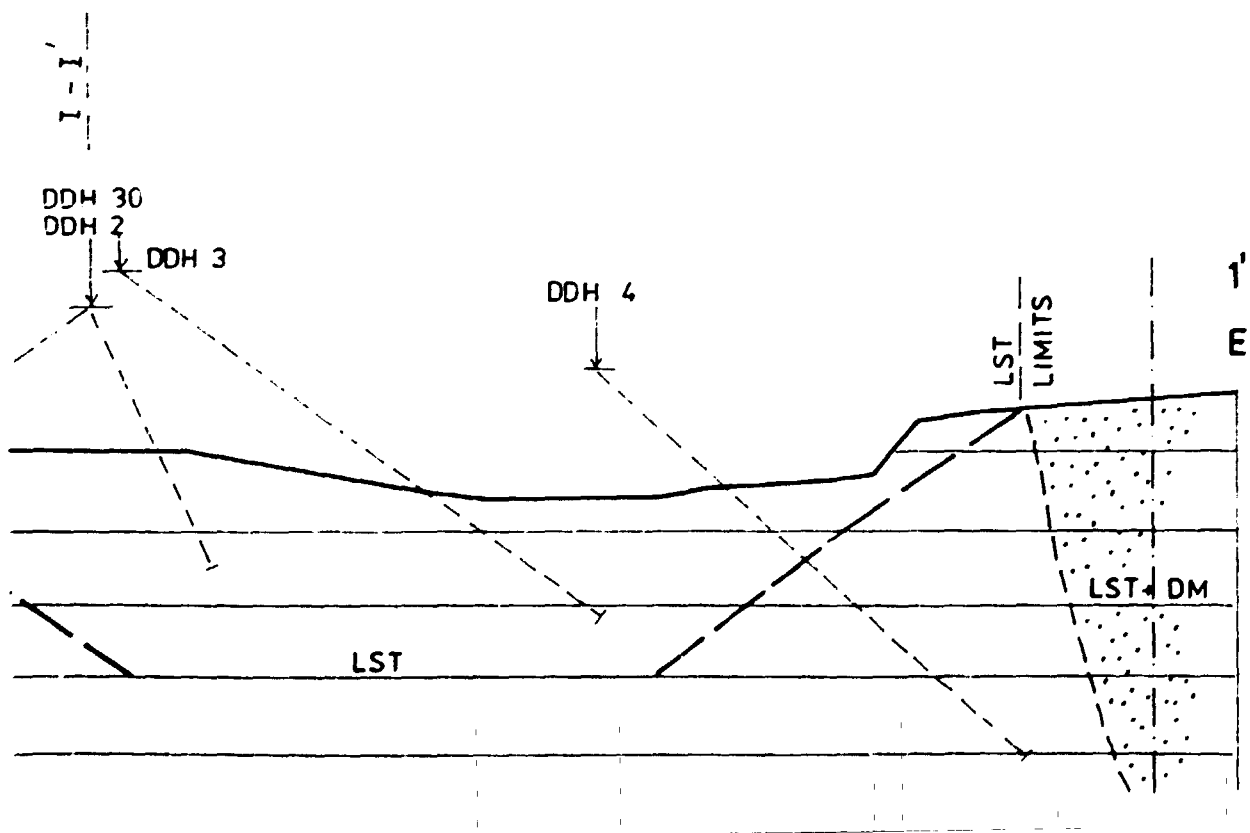
SCALE 1:1000



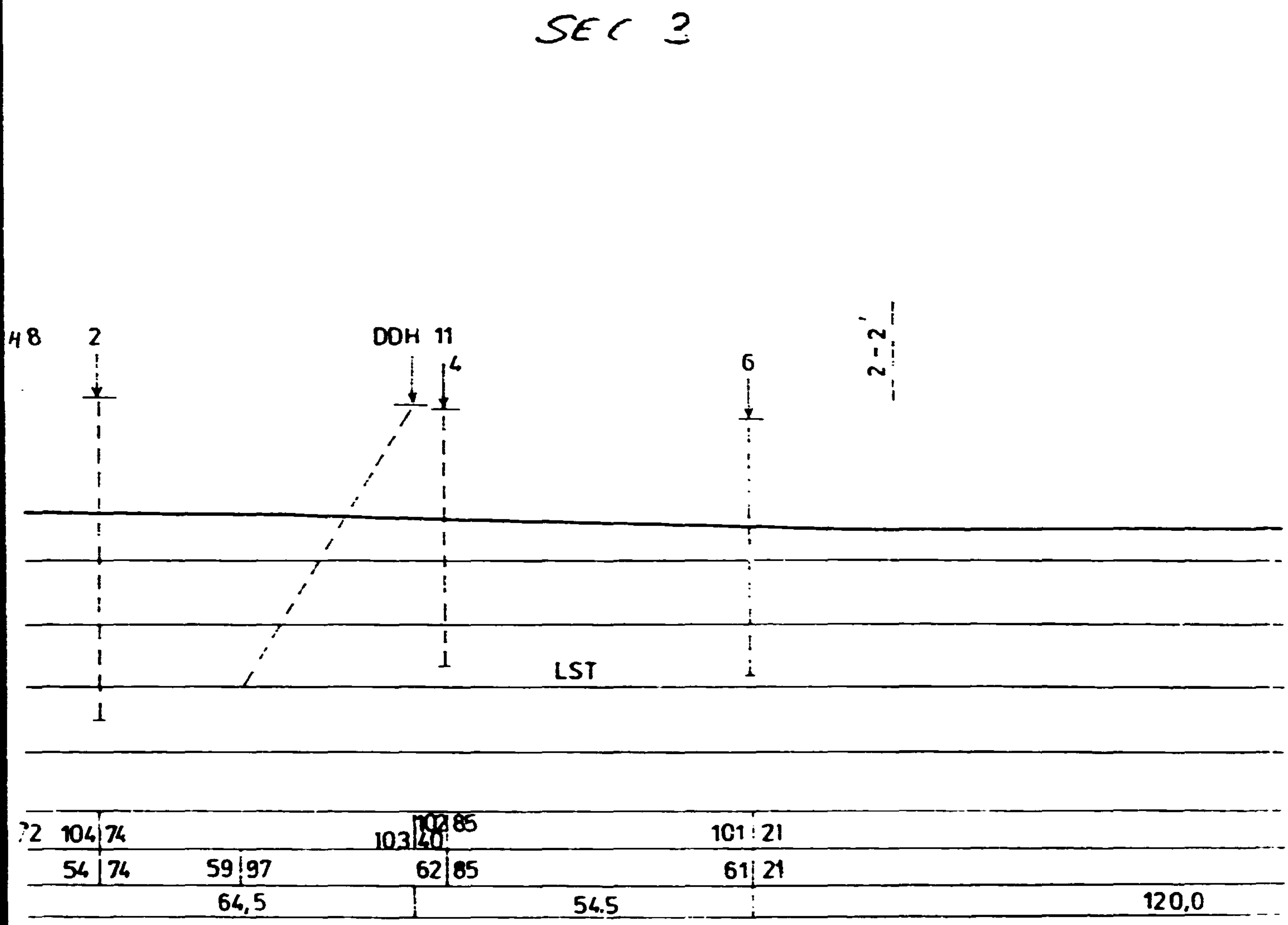
SEC 2



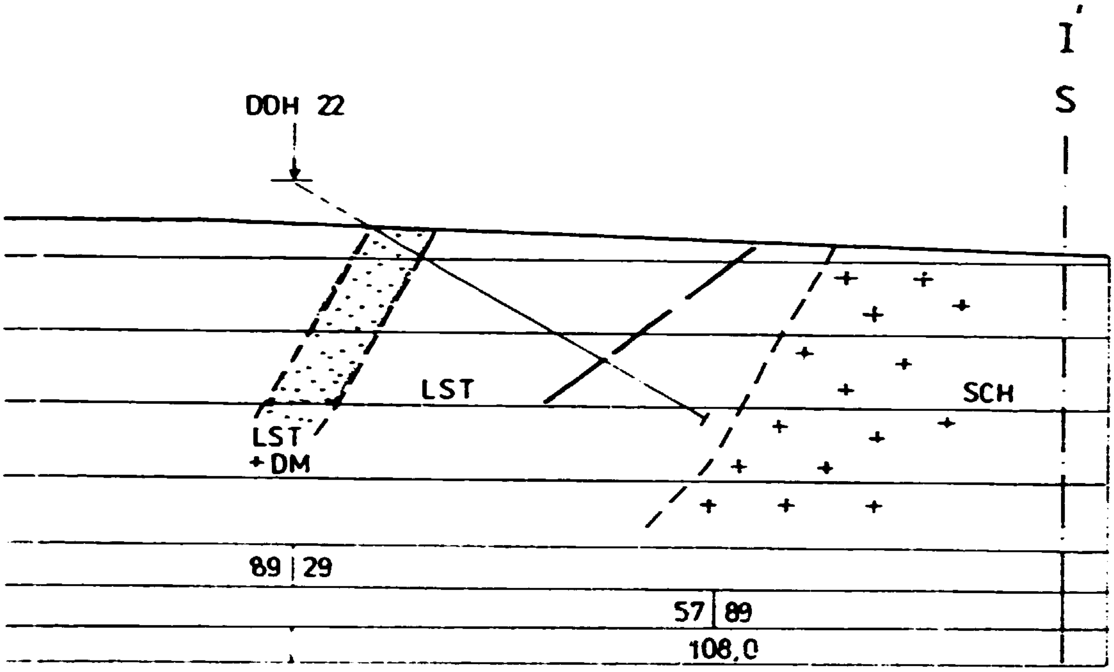
1-1'
DDH 30
DDH 2
DDH 29
DDH 5
DD
LST
110
110
62
11
106
39
105
75
45
57
85
75
12
57
35
56
90
66,22
70,0
77,0



I - I'
DDH 30
DDH 2
DDH 3
DDH 4
LST
LIMITS
1'
E
LST+DM
LST


SEC 3
48
2
DDH 11
4
6
2 - 2'
LST
72 104 74
103 40
102 85
101 21
54 74
59 97
62 85
61 21
64,5
54.5
120,0

SEC 4



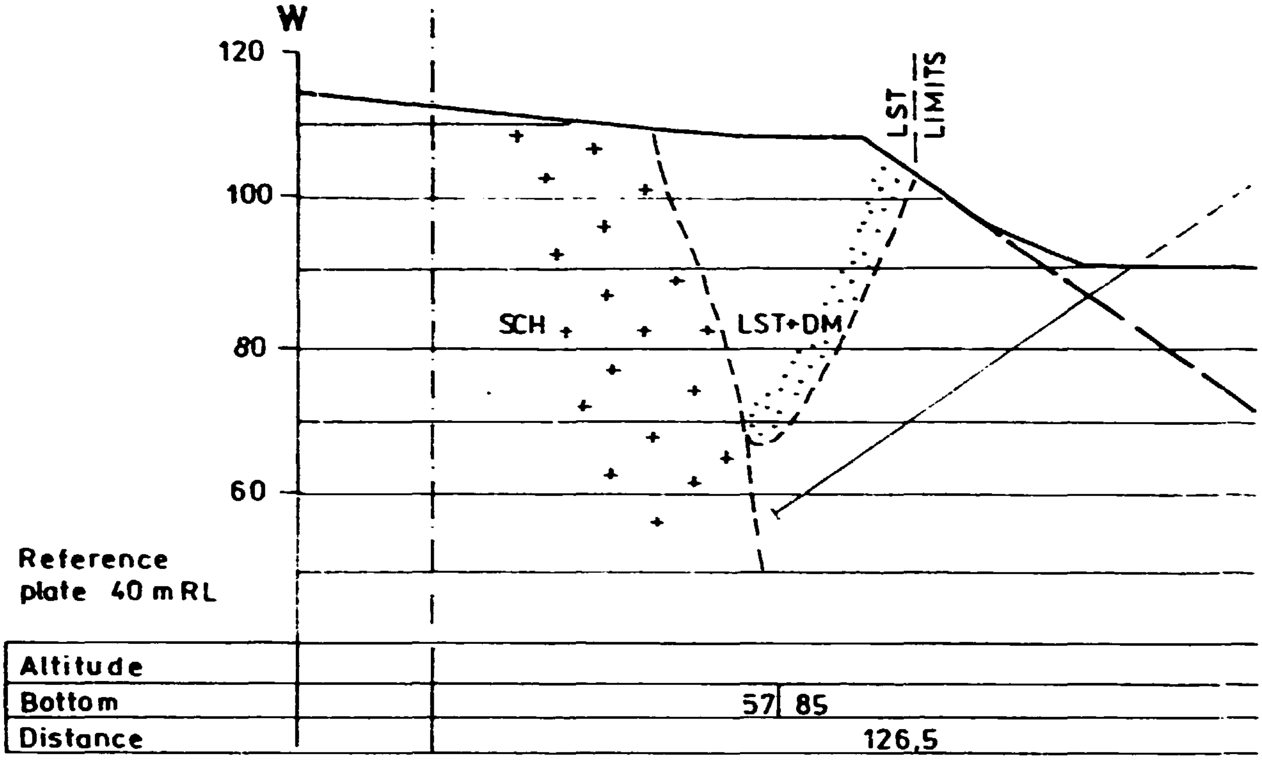
Legend :

—·—·— Mining Licence Area Boundary

—— —— Final Slope

70 ———— Mining Bench 70 m RL

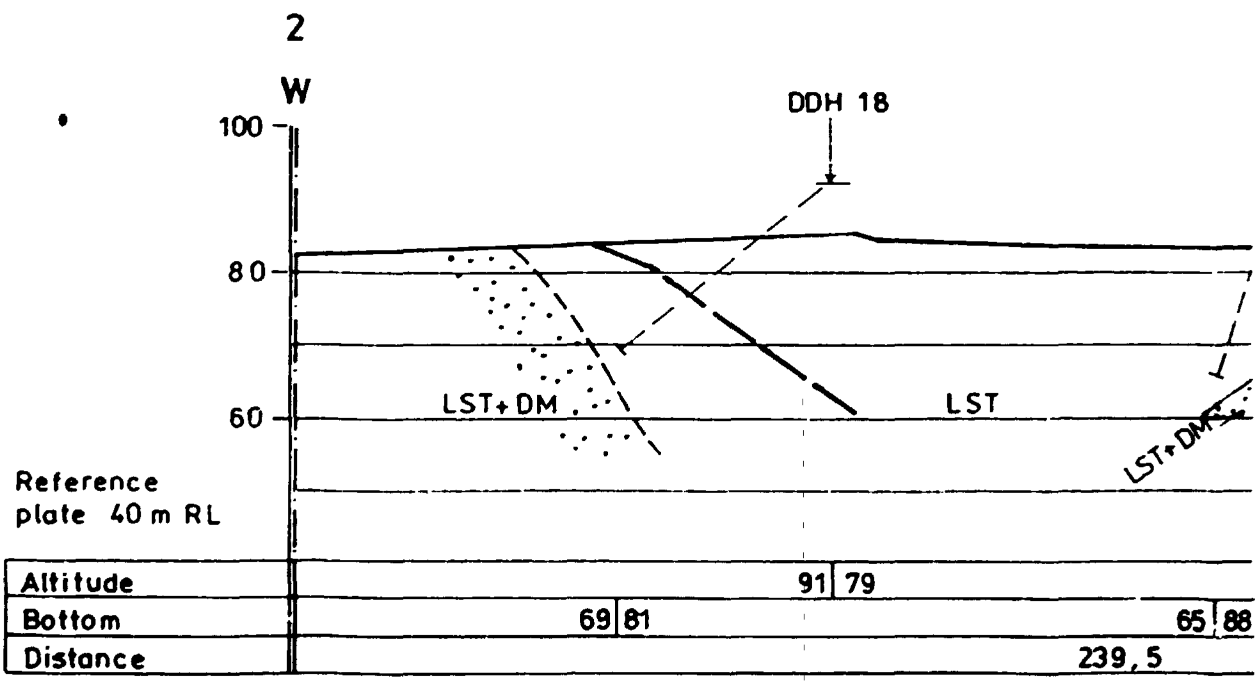
60 ———— Mining Bench 60 m RL

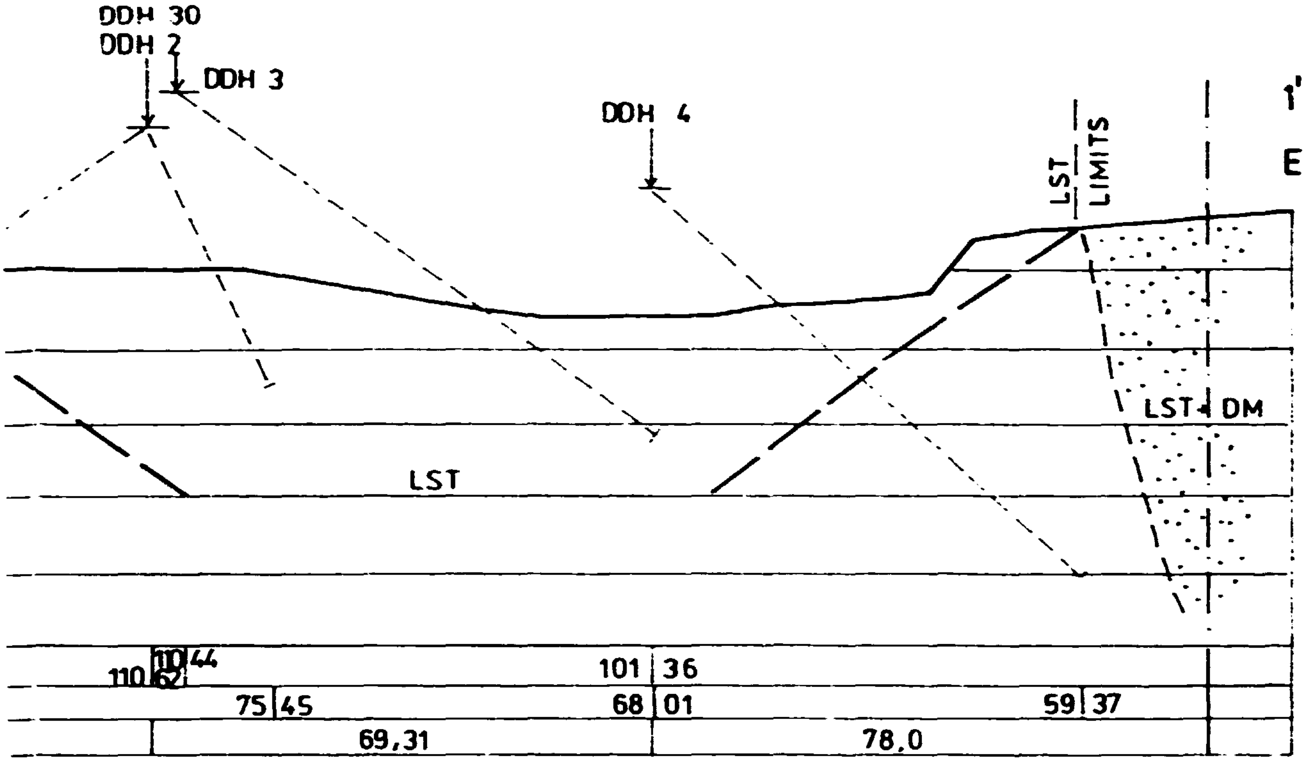


sec 5

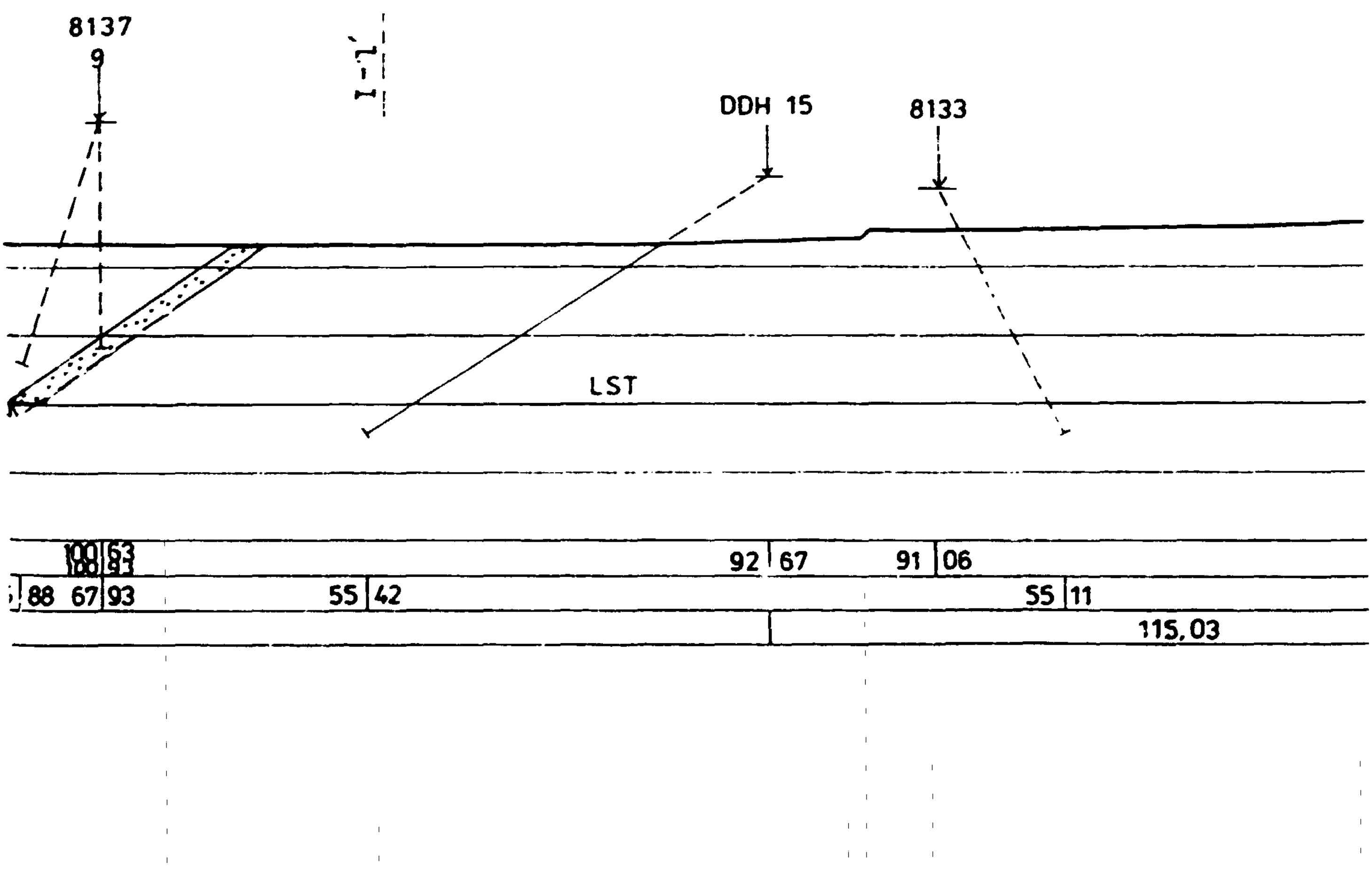
SECTION 2- 2'

SCALE 1:1 000

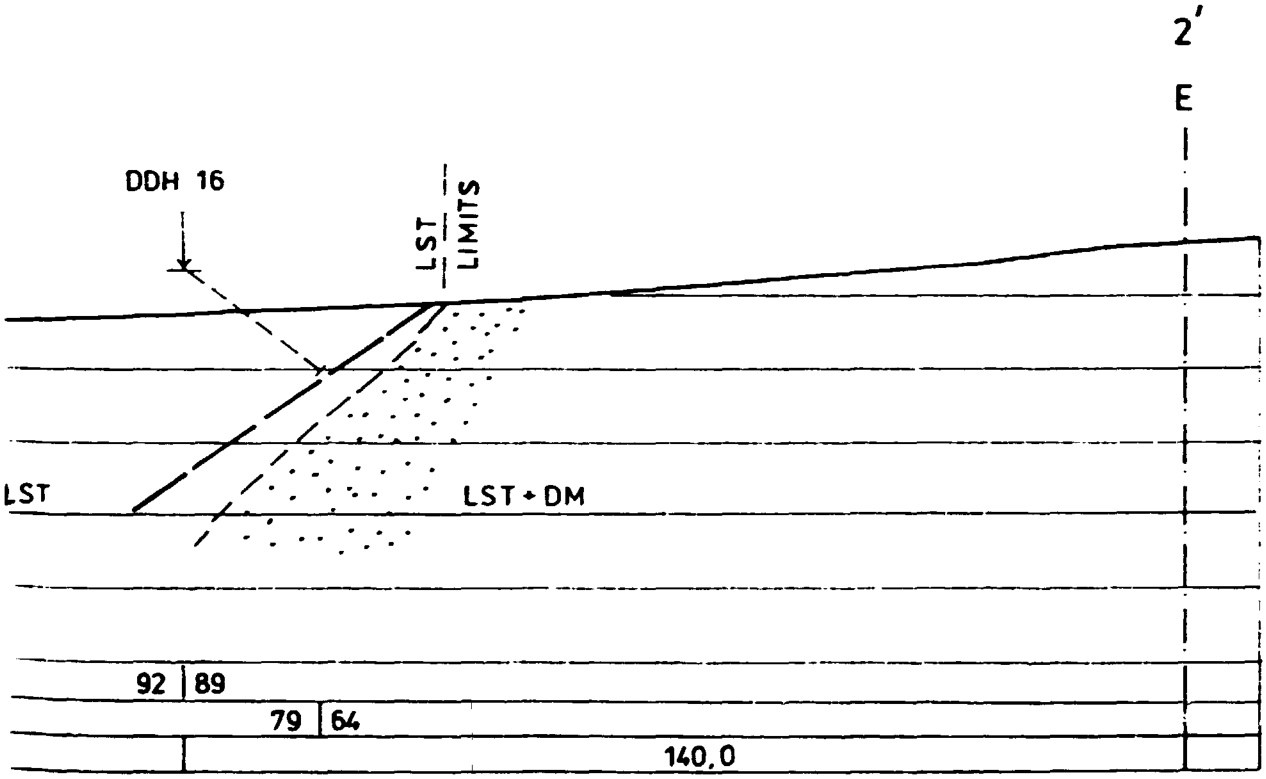



DDH 30
DDH 2
DDH 3
DDH 4
LST
LIMITS
1'
E
LST + DM
LST
110
110
62
44
101
36
75
45
68
01
59
37
69,31
78,0

SEC 6


8137
9
I-1'
DDH 15
8133
LST
100
100
63
93
92
67
91
06
88
67
93
55
42
55
11
115,03

Sec. 7



Legend :

—·—·—	Mining Licence Area Boundary
—— ——	Final Slope
70 ————	Mining Bench 70 m RI
60 ————	Mining Bench 60 m RI
————	Reserves Limits
LST	Limestone (Raw Material)
LST+DM	Unsuitable Parts 1/ MgO > 3% upon one Bench
+ + +	Schist
LST+DM	Limestone + Dolomite beyond Reserves Limits
DDH 21	Slope Bore Hole
7	Vertical Bore Hole

SEC 3

UNIDO VIENNA	KERAMOPROJEKT a. s. TRENČÍN PROGEO Ltd. ŽILINA	Date : JANUARY 1996
EXPANSION OF THE CHILANGA CEMENT PLANT		Scale : 1:1000
Geological and Technological Sections		Drawing No: 10