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RECOVERY AND TREATMENT OF APATITE AND TITANIFEROUS MAGNETITE BY CONCENTRATING AND SMELTING

November 22, 1974

NOTE: This file was donated by Mr. Doug Hunter, Earthunt Resources Inc. to Dr. Ron Sage, Ontario Geological Survey, March/91.

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SUMMARY

The mineral property owned by Multi Minerals Limited situated near Nemegos, Ontario, and comprising 51 contiguous patented mining claims totalling 2,369 acres, has been leased on a long term basis by Mertec Resource Development Limited, for the purpose of mineral recovery.

A review of prior data has been carried out including exploration, drilling, metallurgical testing and technical analysis, dealing with this property. However, time available to complete this preliminary feasibility study has not allowed for the expansion of previous drilling or geological knowledge. Additional data will be required before substantial commitment of capital funds. Some of this work has already been contracted.

The locations of the mine/concentrator and the smelter have been examined and no extraordinary site difficulties are apparent. The locations are close to populated communities which will provide a source of labour and housing facilities. The topography lends itself to provision for transportation and access requirements. Climatic conditions in the area are not subject to extremes which would make for impossible working conditions during any significant part of the year.

The geology of the mining property has been subject to intensive examination over the years. There are several known anomalies of interest and others which, while indicated, have never been investigated. The so-called Anomaly No. 6 will be the ore source for commencement of mining operations. It contains about 4.2 million tons of recoverable ore containing about 69.6% titaniferous magnetite and about 21.8% apatite. It is proposed to mine and separate these minerals, to sell the apatite and convert the titaniferous magnetite to iron or steel and titania-bearing slag. This ore body will have a life of about 9 years and, prior to exhaustion, it is proposed to open up Anomalies Nos. 3 and 4. These anomalies are estimated to contain some 13 million tons of recoverable ore which carries about 15.7% titaniferous magnetite and about 21.5% apatite. The ore in Anomaly No. 6 will be recovered by ramping into the ore and will be by contract. It is anticipated Anomalies Nos. 3 and 4 will also be mined by this method.

SUMMARY

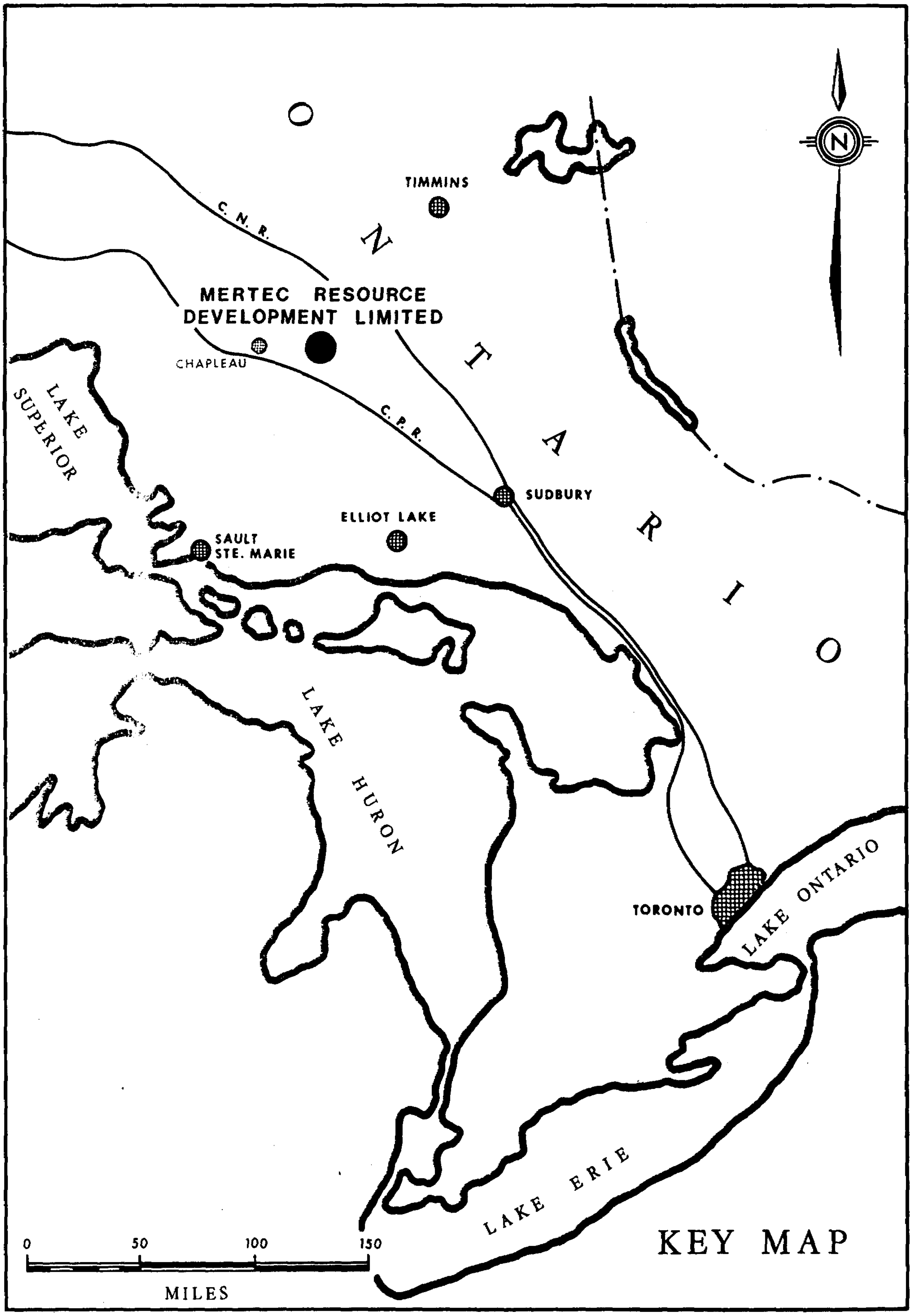
Concentration of the ore has been demonstrated at pilot plant scale at the Department of Mines and Technical Surveys, Ottawa and by International Nickel Company, Copper Cliff. Concentrator design is in accordance with the results achieved in these investigations. About 66,000 net tons of apatite concentrate per year grading about 75% BPL will be dispatched by rail to consumers in the fertilizer industry.

Titaniferous magnetite concentrates, amounting to about 300,000 net tons per year will be pelletized, indurated and shipped by rail to the smelting facility. After mixing with coal and fluxing agents, this material will be charged into an electric furnace and converted into metallic iron. The iron may be processed through a pig machine and sold to consumers of pig iron or alternatively, it can be further treated in a refining furnace and converted to steel. The steel could be passed through a continuous billet casting machine and sold to the trade as steel billets.

A market survey has been carried out and it has been determined that there are serious shortages of pig iron, steel billets and apatite, not only in Canada, but world-wide. Several reputable companies expressed serious interest in contracting for periods of five or more years for the total output of these products, subject to quality and reliability of delivery.

Pricing of the various products of the operation has been treated conservatively for purposes of the financial study. Pig iron, considered equivalent in quality to contemplated production, is manufactured and sold by Quebec Iron and Titanium Corporation at $160.00 per net ton. This study uses a figure of $150.00 per net ton. Billets are not regularly offered or quoted for sale, but price indications of from $150.00 to $200.00 per net ton have been secured from reputable buyers. For the purposes of this study, a figure of $160.00 per net ton has been used. Apatite concentrates have been valued at $45.00 per net ton against a published price list indicating $48.00 to $55.00 as applying to phosphate rock of similar quality originating in Florida.

Capital requirements for the entire complex, inclusive of mine, concentrator, briquetter, smelter, services, land, engineering and project management fees, are estimated at $49 million for steel production and $38 million if pig iron is the end product.


ONTARIO
TIMMINS
C.N.R.
MERTEC RESOURCE
DEVELOPMENT LIMITED
CHAPLEAU
C.P.R.
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ELLIOT LAKE
SAULT STE. MARIE
LAKE HURON
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KEY MAP

RECOMMENDATIONS

1. Confirm financial support anticipated from Federal and Provincial Governmental agencies.

2. Ensure suitable outside financing, as may be required, for the total project.

3. Obtain approval of environmental protection plans and water diversion from Ontario Ministry of the Environment.

4. Construct adequate dam facilities to divert the stream flowing over Anomaly No. 6

5. Conduct a modest diamond drill programme at Anomaly No. 6 to confirm ore and rock competance at a cost of about $50,000.00.

6. Obtain confirmation of cost of rail spur from Canadian Pacific Railway.

7. Obtain confirmation of costs of power line from Ontario Hydro Electric Power Commission or private contractor.

8. Observe and review smelting test work to be carried out on titaniferous magnetite concentrates by United States Bureau of Mines, Albany, Oregon; Lectromelt Corporation, Pittsburgh, Pennsylvania, to assist in monitoring the process.

9. Proceed with smelting facilities to production and sale of pig iron, but lay out plant for future addition of steel billet facilities if technically or financially advantageous.

10. Acquire technically trained and capable management personnel early in the building programme, to ensure availability of competant operating staff and to enable familiarization with all details of plant design and construction.

CONCLUSIONS

1. An extensive diamond drilling program carried out several years ago has revealed the existance of numerous anomalies on claims leased by Mertec from Multi Minerals.

2. One ore body known as Anomaly No. 6 contains some 4.2 million net tons of recoverable titaniferous magnetite-apatite ore, high in iron content.

3. Two additional ore bodies known as Anomalies Nos. 3 and 4 contain some 23 million net tons of titaniferous magnetite-apatite ore but substantially lower in iron than Anomaly No. 6.

4. A process for concentrating the mineral components and a method to produce pig iron or steel have been examined and are considered to be technically viable.

5. A net capital investment of about $38 million will be required to provide facilities to recover apatite and pig iron. This figure escalates to $49 million if a decision is taken to convert the pig iron to steel billets.

6. Financial studies based on capital required and including capitalization of debt interest, indicate a satisfactory return on investment.

7. The project may qualify for financial assistance from Federal and Provincial Government agencies.

8. Market surveys reveal all of the products contemplated for manufacture are in short supply and can be readily absorbed in Canadian or foreign markets well into the foreseeable future.

9. Price indications for products arising from the proposed operations are presently firm and are indicated as being under upward pressure during the remainder of this decade.

1. INTRODUCTION

A test program to establish and confirm metallurgical and chemistry controls for purity of metal and slag in the pyrometallurgical separation of iron and titania in the titaniferous magnetite will be carried out at the research facilities of the U.S. Bureau of Mines at Albany, Oregon. This work will be supervised and observed by metallurgists of Scrivener Engineering Limited and Lectromelt Corporation, Pittsburgh, Pa., the latter company a subsidiary of Pennsylvania Engineering Corporation. Titaniferous magnetite concentrates used in this investigation were produced by International Nickel Company from a bulk sample of ore from Anomaly No. 6.

Samples of apatite concentrate recovered during the pilot plant operation conducted by International Nickel Company were supplied to several potential buyers. Tests were carried out and reports in greater or lesser detail were received. Correspondence covering these investigations are included in Appendix C.

1. INTRODUCTION

Scrivener Engineering Limited, at the request of Mertec Resource Development Limited, has undertaken this study to determine the feasibility of recovering various minerals from the Multi Minerals Limited property located near Nemegos, Ontario.

No new work was done on the geology and no additional diamond drilling was carried out. There has been a multiplicity of reports prepared on the deposit, a list is included in Appendix A. These reports are on file but do not form an integral part of this feasibility study. However, the content has been used extensively in developing the conclusions and recommendations which have been reached.

It should be understood the responsibility for mining will be undertaken by outside contract. While a section has been prepared to cover this phase of the operation, this was not the responsibility of Scrivener Engineering Limited. The data included was prepared and submitted by MacIsaac Mining and Tunnelling Company Limited as a result of close examination of the property and a study carried out by International Nickel Company of Canada Limited. It is planned that ore will be mined by contract and delivered to the concentrator as required and in accordance with an agreement between the parties. A proposed letter agreement is included in Appendix F.

In addition to reports prepared in past years, consultation with Messrs A.H. Ross and Associates in respect of ore dressing and with Pennsylvania Engineering Corporation in respect of smelting has been instrumental in designing the processes herein described. Scrivener Engineering Limited has co-ordinated the recommendations of these consultants, has made such input to their work as was felt necessary and useful and has, in general, acted as Project Manager.

The market survey information was developed by Mertec Resource Development Limited and Scrivener Engineering Limited from direct contact with potential purchasers of the various products. Supporting the conclusions in respect of price and demand, letters from prospective consumers are included in Appendix C.

2. DEVELOPMENT COMPANY

Mertec Resource Development Limited is a privately held company incorporated in Ontario. The primary objective of the Company is the development of selected mining properties having immediate commercial potential, as opposed to those having longer term exploration opportunities. It is also the intent of the Company to form partnerships or joint ventures with other companies which have specific technological capabilities in areas in which, from time to time, the Company may become interested.

The officers and directors of Mertec are as follows:-

Peter A. Crossgrove	-	President and Director
George R. Eaton	-	Vice President and Director
Frederick S. Eaton	-	Director
J. Bruce Pearson	-	Secretary Treasurer

The head office of Mertec Resource Development Limited is located in Sudbury, Ontario, and the mailing address is:-

P.O. Box 2248
Station 'A'
Sudbury, Ontario
P3A 4S1

The property near Nemegos, Ontario, is held by Mertec under the terms of lease agreements with Multi Minerals Limited. These agreements, copies of which are included in this report as Appendix D, provides that Mertec has exclusive rights to mine, process and further explore for all commercial minerals located on the claims described in the lease.

3. MARKET STUDY

Commencing late in 1972, Canada entered into an era of unprecedented capital investment and industrial activity. This appears to have occurred as a result of a number of inter-related factors:

a) Insufficient facilities investment during 1967-1972.

b) Rapid growth of the country's labour force, both native-born and immigrant.

c) Improved competative position for Canadian industry as a result of world currency realignments.

d) World demand for natural resources.

e) Social pressures and priorities in Canada.

f) Influence of a world-wide demand for a better life standard.

Concern has been expressed in some quarters regarding contintuation of this growth and if this boom will lead to an inevitable down-turn. Forecasts for capital expenditures in Canada to 1980 do not indicate a drop in confidence. In fact, substantially increased figures are predicted in the Federal Department of Industry, Trade and Commerce up-dating of the October 1973 figures for capital investment intentions, prepared in April, 1974.

While some easing in demand for steel mill products is indicated during the last quarter of 1974, steel producers in Canada remain solidly booked and demand continues strong. Overseas prices have declined but still exceed domestic levels and Canadian mills could advantageously enter the export market if surpluses were to develop. However, the steel plant inventory position is at such low-level, rebuilding would have first priority. These facts are confirmed in public statements by the three major Canadian steel producers and is reflected in their financial reports for nine months operations 1974.

The Mertec Project, considered in the light of the above-noted points, is particularly relevant in that it relates to the development of a natural resource, the production of two materials important to world needs of today - steel and a basic component for the fertilizer industry.

3. MARKET STUDY

3.1 Steel

The Canadian steel industry has always had a reputation as being competent when measured by world standards. However, through the 1950's and into the 1960's, because of the inroads of low-priced foreign products, Canada was encouraged to produce only part of the demand and had an insignificant export position. This situation was influenced by the strength of the U.S. currency (to which Canada was tied) which encouraged most overseas steel producers to push products into North America. In these circumstances, return on capital invested in steel facilities was not sufficiently attractive and companies had difficulty in justifying major additions. This disincentive led to delay of further facilities of a substantial nature.

The realignment of world currencies reduced the relative value of U.S. and Canadian currencies in world money markets. Current steel production costs and selling prices are such that return on investment is attractive and growth is underway in Canada and elsewhere. This is in the context of vastly increased world demand, a demand which at this time seems insatiable.

The International Iron and Steel Institute is forecasting a growth in world demand for steel of 4.5% per year up to 1980 and 4% per year thereafter until 1985. Canadian steel needs are growing faster than these estimates and this build-up in demand prevents Canada from looking for support from import material because foreign producers have their own deficiencies to meet and third world requirements to satisfy. In 1971 steel imports into Canada amounted to about 17 per cent of the market and this is forecast to decline to 12 per cent by 1984. To provide for this growth, the three major steel producers expect and plan to increase their current capacity of some 12 million tons to 21 million tons by 1984. Expenditures to accommodate these expansions are estimated in current dollars at more than 3 billion dollars before the end of the next decade.

In an environment such as this, the production of steel from Nemegos magnetite ore fills a very apparent need. Meetings and discussions with companies involved in the steel business have confirmed this fact.

3.1 Steel (cont.)

The Steel Company of Canada, Hamilton, Ontario, has expressed an interest in steel billets and are prepared to enter into an agreement for long term supply. The material is of particular interest because it will exercise no pressures on the scrap market where shortages and high prices are a source of concern to all Canadian steel makers.

Newman Steel, Oakville, Ontario, a steel service centre and merchandiser of new steel, has agreed that there is a substantial market for steel billets and is also prepared to enter into an agreement to market the Mertec output.

Steel billets are not recognized as a usual item in the trade and there is no regularly published price list or market price. There is, however, a demand for the product by mills having a greater rolling capability than melting capacity and from others who operate custom rolling facilities. This market is not peculiar to Canada but exists also in the United States and overseas.

Current prices for billets of a size, quality and tonnage comparative with Mertec proposed production, will range between $150.00 and $200.00 per net ton with higher prices applying in certain foreign markets.

For the purpose of this study, a price of $200.00 per net ton f.o.b. plant has been used. It is expected this will be a floor price for a five-year contract with escalation for increases in costs of certain materials, labour, taxes, etc.

3.2 Pig Iron

An alternative possibility for Mertec is the production and sale of pig iron instead of steel billets. This material could be produced by curtailing the operation at the smelting furnace and pouring the iron into a pig casting machine. Pig iron is a conventional product in commerce and follows regularly published price lists. Production arises generally from major steel company blast furnace operations and additionally in Canada from Quebec Iron and Titanium Corporation.

3.2 Pig Iron (cont.)

Recently the pricing of pig iron has been under strong upward pressure and increased demand is forecast well into the future. So this alternative may be adequately assessed, conversations have been held with parties interested in buying such a product.

The present price of pig iron in Canada for domestic use is $112.50 per net ton f.o.b. plant. An early price increase is anticipated. The published price in the United States is about $155.00 per net ton depending upon grade. In Japan a delivered price of about $200.00 per net ton prevails. This equates to about $170.00 per net ton at a Canadian ocean or seaway port. Quebec Iron and Titanium Corporation, which produces a product similar to that contemplated by Mertec, sells a major portion of output in the United States at $160.00 per net ton f.o.b. plant. For the purposes of this study a selling price of $150.00 per net ton has been used.

Intermetco Limited, Hamilton, Ontario, is a long-established merchant broker dealing with the steel and iron industry. It is possible to negotiate with this company a long term contract (five years) with a base price subject to escalation for certain materials, labour, taxes, etc., and backed by contractual arrangements with substantial end users.

Norore Corporation, a United States company located in New York, has world-wide connections in the metal business. This company is prepared to enter into a long term (five years) contractual arrangement supported by back to back agreements with ultimate foreign users.

The Steel Company of Canada has a preference for steel billets, but could have an interest in pig iron and further discussions are scheduled.

Letters confirming discussions from the companies noted are included in Appendix C.

3.3 Phosphate Fertilizer

There is a world-wide shortage of phosphate rock which is basic to the manufacture of phosphate fertilizer. Production of the rock is mainly in the control of a few countries. In 1973, the following production figures were achieved.

3.3 Phosphate Fertilizer (cont.)

1973 Phosphate Rock Production	Millions Metric Tons	% World Production
United States	394	39
Morocco	161	16
USSR/East Europe	252	25

Total world production of 101 million metric tons in 1973 must be increased to at least 140 million metric tons and demand may rise even higher to 150 million metric tons. All indications point to serious shortages of phosphate rock until the end of this decade, when it is possible a delicate balance will be achieved. At worst, shortages could persist into the 80's and in either case, prices are likely to remain high or move even higher.

Canada is not, at this time, a producer of phosphate rock and the geology of this country is most unlikely to host the massive sedimentary type deposits found in Florida and Morocco. Recent Canadian requirements for phosphate rock to serve the fertilizer and other applications are as follows:-

Year	Millions Metric Tons	Millions Value	Value/ton
1972	3.0	$18.2	$6.06
1973	3.6	$23.2	$6.44
1974 (6 mos.)	1.8	$16.8	$9.33

The tonnages indicated are almost exclusively supplied from the United States and in a large part, are handled through Phosphate Rock Export Association located in Tampa, Florida. A copy of the current price list published by the Association is included in Appendix C.

The substantial advance in prices is indicated in the above table. These prices are influenced by significant cost increases: higher severence taxes, environmental protection costs, increased mine to port rail charges, power and gas costs and outages, plus higher than expected inflation of basic costs.

3.3 Phosphate Fertilizer (cont.)

The world shortage now being experienced, compounded by rapidly escalating pricing structures and the fact that Canada is a non-producer, would seem to indicate a ready market for the 66,000 net tons of phosphate concentrates to be produced by Mertec. Based on preliminary pilot plant work carried out by International Nickel and with reference to the Phosphate Rock Export Association price list, the Mertec apatite concentrates could have a value of between \$48.00 and \$55.00 per metric ton. In the financial calculations a figure of \$45.00 per net ton has been used for conservatism.

4. PROPERTY

4.1 Location

The property is located in McNaught and Lackner Townships, District of Sudbury, Ontario. Six miles of good gravel road connect the property with Nemegos station on the main line of the Canadian Pacific Railway. The town of Chapleau is approximately 26 miles to the northwest; and may be reached from Nemegos by road or rail. Sudbury is about 165 miles south-east by rail from Nemegos.

Nemegos is connected with the Northern Ontario highway system which provides access to the cities of Sudbury, Timmins and Sault Ste. Marie, all of which have scheduled air service with Toronto. The highway system also provides access to the lake ports.

4.2 Claims

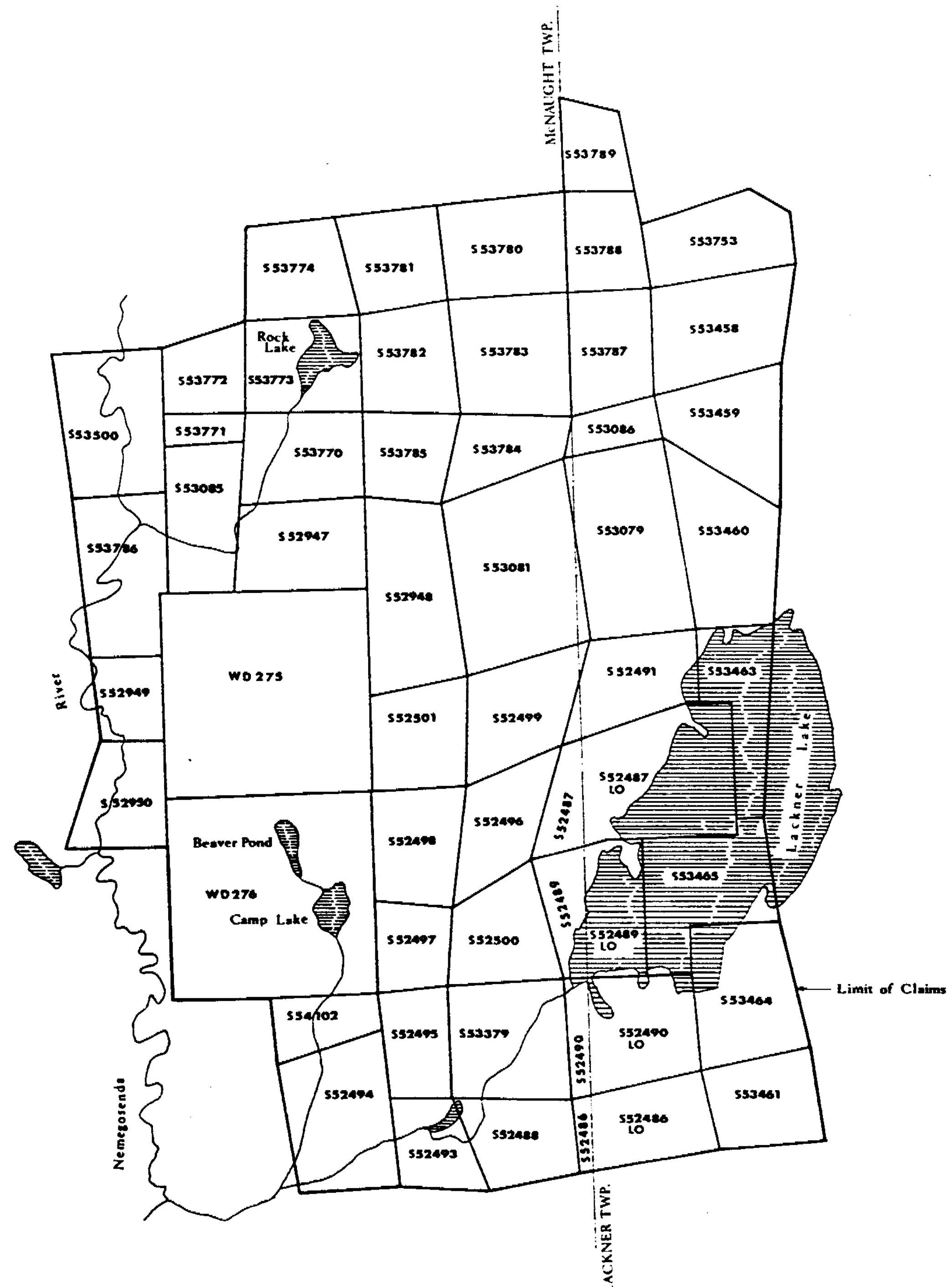
The property contains 51 contiguous patented mining claims, totalling 2,369 acres in extent. The good standing of these claims has been investigated and substantiated by Messrs Shibley, Righton and McCutcheon, Solicitors to Mertec. The 51 claim numbers are as follows:

WD275	S53085-53-86	S53463-53465
WD276	S53079	S53500
S52486-52491	S53081	S53770-53774
S52493-52501	S53379	S53780-53789
S52947-52950	S53458-53461	S54102
S73753		

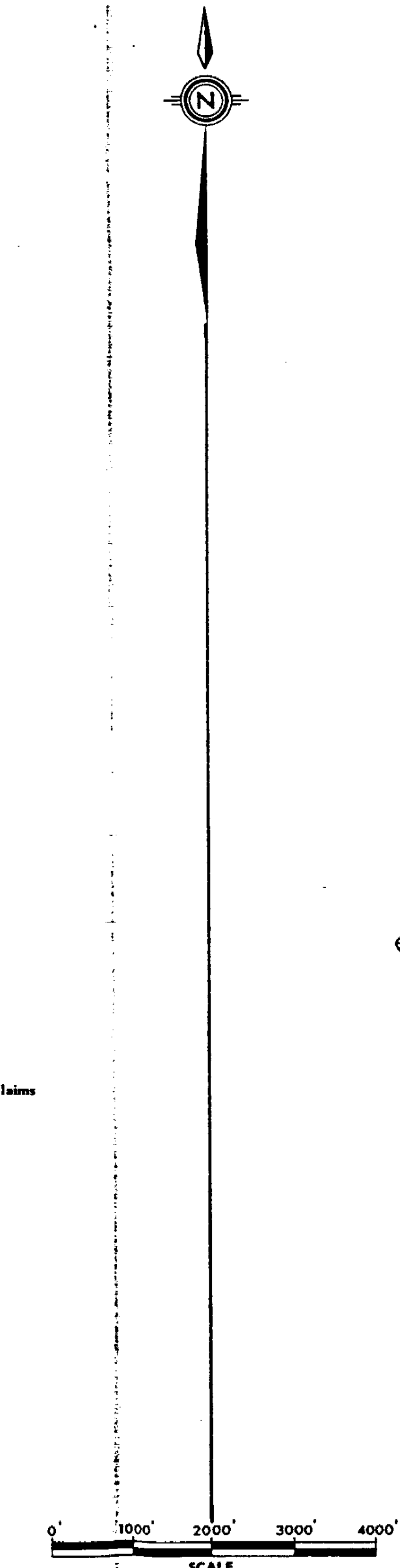
4.3 Topography

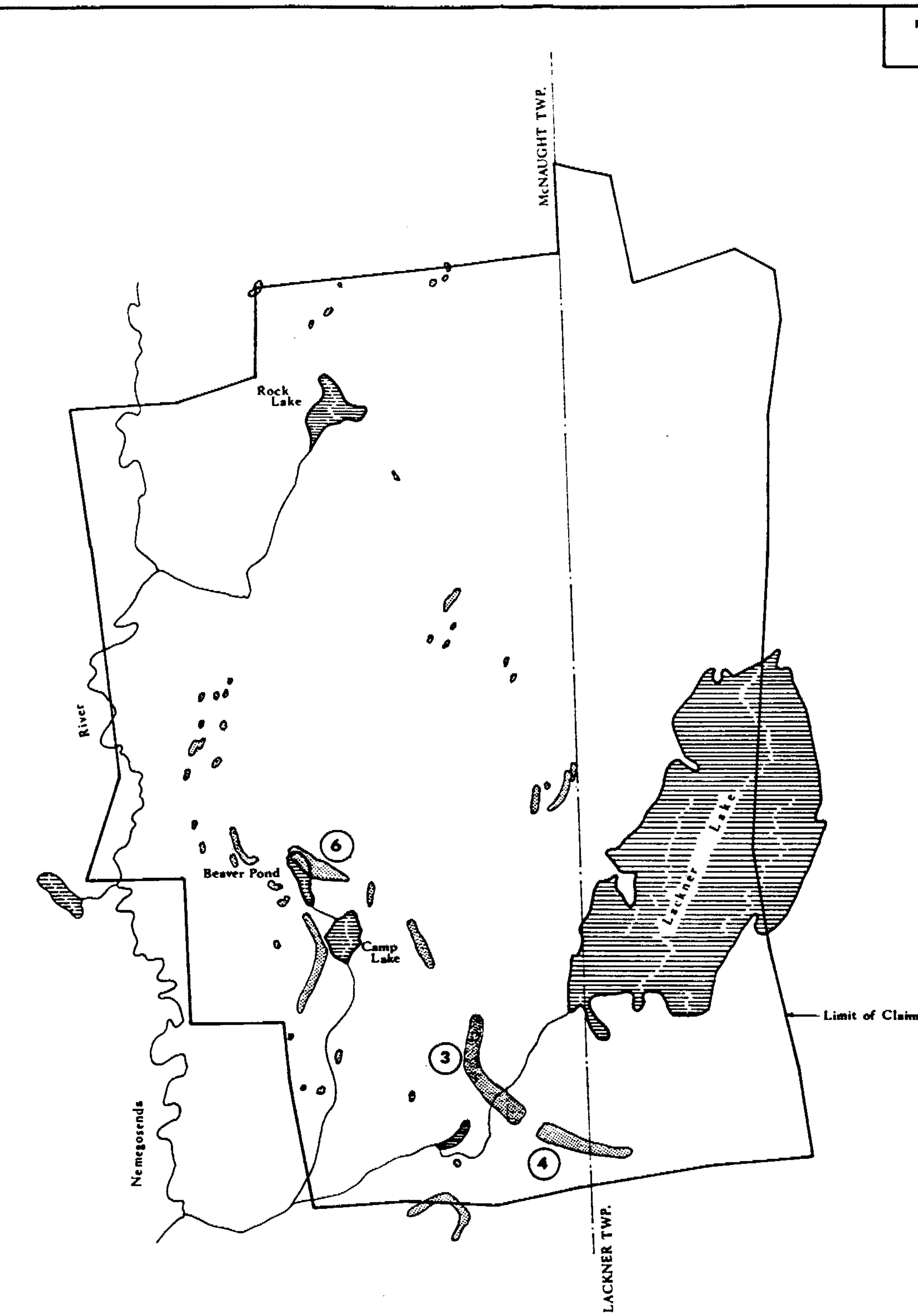
The topography is typical of the Canadian Precambrian shield, no elevation being greater than about 150 feet above the valley floors. Overburden is widespread, but not heavy, probably not averaging over 20 feet.

RETRACED FROM INFORMATION PROVIDED BY MULTI – MINERALS LIMITED



CLAIM LOCATION MAP





MINERAL ZONES

REFERENCE DWG. NO.	DESCRIPTION	REFERENCE DWG. NO.	DESCRIPTION	REVISIONS NO.	BY	DATE	DESCRIPTION	REVISIONS NO.	BY	DATE	DESCRIPTION	REVISIONS NO.	BY	DATE	DESCRIPTION

Scrivener ENGINEERING

DRAWN: WL Spencer
SCALE: As Noted
DATE: SEP74
CHECKED:
APPROVED:
APPROVED:

CLIENT: MERTEC RESOURCE DEVELOPMENT LIMITED
Sudbury Ontario

PROJECT: RECOVERY and TREATMENT of MAGNETITE – APATITE CONCENTRATES

DRAWING: MINERAL ZONES CLAIM LOCATION MAP

DRAWING NUMBER: 5699·103

REV.: P

4.4 Geology

A ring complex of alkaline rocks with carbonate rock and magnetite-apatite bodies lies within the gneisses of the Temiskaming sub-province of the Canadian Shield in McNaught and Lackner Townships, near Nemegos, northern Ontario. The complex consists of three concentric rings of alkaline rock; an outer ring, 3 miles in diameter and composed of coarse nepheline syenite; a middle ring of foliated malignite and ijolite traversed by magnetite veins and including a body of carbonate rock; and an inner ring of coarse nepheline syenite.

The bodies of carbonate rock and apatite-magnetite dip steeply towards the centre of the complex. Lamprophyre dikes cut all rocks and dip at low angles away from the centre of the complex.

In summary, the Lackner complex is predominantly made up of a coarse-grained, light coloured nepheline syenite, within which is enclosed a band of darker, foliated malignite and ijolite, which is locally brecciated. Bodies of magnetite-apatite mineralization and of niobium mineralization occur within the complex, largely in the foliated rocks. These mineralized bodies give rise to magnetite anomalies.

The Lackner complex is one of ten such alkaline complexes located along a trench between Moosonee and Sault Ste. Marie, Ontario. Outcrops within the Lackner complex are scarce.

4.5 Ore Bodies

Magnetite, apatite and pyrochlore show a strong tendency to occur together within the Lackner complex. The result is that deposits of these minerals give rise to magnetic anomalies, on which are often superimposed radioactive highs, and indeed most of the known deposits have been found by exploring such anomalies. A description of the known deposits follows:

No. 6

Magnetite-apatite mass about 800 feet long, 200 feet wide, extending to 500 feet vertical depth. Made up of about 69.6% titaniferous magnetite and about 21.8% apatite, with minor silicates and sulfides. Pyrochlore not visible, but present. The mass appears to have replaced a local breccia zone.

4.5 Ore Bodies (cont.)

Nos. 3 and 4

Apatite-magnetite-pyrochlore zones separated by a lean section. Length is 1,450 feet, width 150 - 400 feet, tested to 1000 feet depth. Extension of zones southeast along strike indicated by widely spaced drilling.

No. 8

Low grade magnetite-apatite-pyrochlore body 1,400 feet long, 1,000 feet wide, tested to 800 foot depth. Made up of about 10% magnetite, 3% apatite, and 0.25% columbite. Pyrochlore occurs as tiny crystals along fractures and in aggregates, and often cannot be seen.

Other Anomalies

Limited investigation has been carried out on anomalies designated as No. 1, No. 5, No. 9, No. 10, McVittie, Tooth and No. 6 Fracture Zone. Insufficient work has been done to determine whether any of these ore bodies are of economic consequence. Several other magnetic and/or radiometric anomalies, known to exist on the property have received no serious attention. At some future date, it would appear desirable to carry out a detailed study of the potential of these lesser known deposits.

4.6 Mineralogy

In general it may be stated the magnetite occurs as the titaniferous variety. Ilmenite is found as exsolution lamellae on the crystal planes of the magnetite.

The apatite occurs as the variety which contains fluorine (fluorapatite).

Pyrochlore is a complex mineral carrying niobium (columbium), titanium, thorium, uranium, and rare earths.

Pyrrhotite accompanied by traces of chalcopyrite, occurs in the mineralized areas in amounts of from 1% to 2%.

4.6 Mineralogy (cont.)

An analysis of apatite flotation concentrate made in 1967 showed total rare earths as oxides to be 4.10% of the sample. The predominant element was cerium, followed by neodymium, lanthanum, thulium, praseodymium, samarium, ytterbium and trace amounts of gadolinium, dysprosium, erbium, yttrium, lutetium, terbium, holmium and europium.

5. DIAMOND DRILL REVIEW

5.1 Resume of Diamond Drilling

During the period 1950 to 1959, 89,384 feet were diamond drilled in 199 drill holes on the Multi Minerals Nemegos property. Of this footage, 20,308 feet (55 holes) were drilled by Nemegos Uranium Corporation in the period 1950 to 1953; and 69,076 feet (144 holes) were drilled by Multi Minerals Limited during the period 1953 to 1959.

5.2 Anomaly No. 6

Prior to 1953, a limited amount of diamond drilling within Anomaly No. 6 Zone indicated that this was composed of a relatively homogeneous mixture of magnetite and apatite. Sufficient sampling had been done to establish that titaniferous magnetite composed about 69.6% of this mass; with the balance being mainly apatite with minor amounts of silicate minerals and sulphides. Because of the relatively uniform composition of this body, it was decided to do sectional drilling of Anomaly No. 6, and to assay composite samples of drill core from this zone. Shortly after the commencement of drilling, niobium-bearing pyrochlore was identified in nepheline fractures, and it was decided to assay all samples for niobium.

To assess Anomaly No. 6, 26 holes were diamond drilled on 5 sections (Sections 1W, 2W, 3W, 4W and 5W). In order to calculate the grade of this deposit with a view to open pit operation, the core from the 26 drill holes was split.

For sampling purposes, the approximate surface or datum level was taken at 1000 feet. Six composite samples, comprising a block from rock surface to 300 feet below rock surface (elevation 1000 to elevation 700, respectively), with each sample representing a 50 foot vertical interval, were made up and assayed. Samples were forwarded to Swastika Laboratories Limited and assayed for soluble iron, titanium and phosphorous. Pulps were then forwarded to X-Ray Assay Laboratories Limited and assayed for niobium using the "X-Ray Fluorescence Analysis" method. Final results were reported as percentages of (1) titaniferous magnetite, (2) apatite and (3) niobium pentoxide. The results were as follows:-

5.2 Anomaly No. 6 (cont.)

SAMPLE NO.	ELEVATION	LENGTH & WEIGHT OF CORE SAMPLE	ESTIMATED TONNAGE	% TITANIFEROUS MAGNETITE	% APATITE
1	Surface-950	566 ft. - 220 lbs	262,550	69.06	21.47
2	950 - 900	933 ft. - 413 lbs	616,400	69.19	23.27
3	900 - 850	671 ft. - 350 lbs	726,950	68.94	22.11
4	850 - 800	804 ft. - 455 lbs	641,050	69.71	21.90
5	800 - 750	598 ft. - 320 lbs	561,000	71.11	20.27
6	750 - 700	242 ft. - 130 lbs	468,300	69.49	21.85
	TOTAL	3,814 ft. - 1,888 lbs	3,276,250		

The above data demonstrates the uniformity of mineral distribution throughout the mass to this depth (300 feet).

One assay of a composite of the 6 samples gave 0.21% niobium pentoxide.

To a depth of 500 feet, the estimates for Anomaly No. 6, including the North and South offsets are as follows:-

	TITANIFEROUS MAGNETITE		APATITE		NIOBIUM PENTOXIDE
TOTAL TONS	%	TONS	%	TONS	%
5,024,250	69.60	3,496,800	21.88	1,099,310	0.173

Anomaly No. 6 has a maximum length, at rock surface, of 800 feet; and a maximum horizontal surface width of 230 feet.

5.3 Anomalies Nos. 3 and 4

Anomalies Nos. 3 and 4 were investigated by 16 diamond drill holes, drilled along four sections. Forty-five samples were assayed (2,833 feet of split core). The drilling indicates two zones of enrichment separated by a lean section. The length is 1,450 feet, width 150 to 400 feet; and the magnetite-apatite mineralization has been tested to a depth of 1,000 feet without apparent decrease in width or grade at that horizon.

5.3 Anomalies Nos. 3 and 4 (cont.)

The southeast extension of Anomalies Nos. 3 and 4, was tested by 5 drill holes on 3 widely-spaced sections. The magnetic anomaly and, presumably, the magnetite-apatite mineralization extends eastward several hundred feet beyond the limits of the diamond drilling.

To a depth of 1,000 feet, the following tonnages and grades are indicated:-

BLOCK	MINERALIZED MATERIAL (000 tons)	TITANIFEROUS MAGNETITE (000 tons)		APATITE (000 tons)		NIOBIUM PENTOXIDE
		%	tons	%	tons	%
Main	23,305	14.0	3,271	21.5	5,023	0.205
Southeast Extension	9,000	12.7	1,144	21.3	1,857	0.174
TOTAL	32,305	13.7	4,515	21.3	6,880	0.198

5.4 Anomaly No. 8

This zone was explored by diamond drilling in order to outline a higher grade niobium zone. In 1954, the deposit was intersected by 19 drill holes on 7 sections spaced at 200 foot intervals. Further fill-in drilling was done in 1955 (8 holes).

Containing 10% magnetite, 3% apatite and 0.25% niobium pentoxide, this body has been outlined for a length of 1,400 feet, a width of 1,000 feet and to a depth of 800 feet. Its potential is approximately 1,000,000 tons per vertical foot.

5.5 Anomalies Nos. 1, 5, 9 and 10

The above four anomalies were investigated by a combined total of 14 holes. They are of little economic interest at this stage.

5.6 McVittie Anomaly

A zone of magnetite in stringers, veins and blobs with only scant apatite and erratic occurrences of pyrochlore, this deposit, 1,400 feet long, 400 feet wide and 400 feet deep was tested by 8 diamond drill holes spaced at 200 foot intervals.

5.7 Tooth Anomaly

Two drill holes on this anomaly gave low niobium pentoxide values.

5.8 Pyrochlore Fracture Zone

This magnetite-pyrochlore body adjoins the south boundary of the magnetite-apatite mass of Anomaly No. 6.

A total of 5 diamond drill holes outline a zone 300 feet long, 200 feet wide and 200 feet deep, containing 1,200,000 tons with an average grade of 0.28% niobium pentoxide. Crystalline magnetite of the vein type averaging about 30%. Apatite content is less than 1%.

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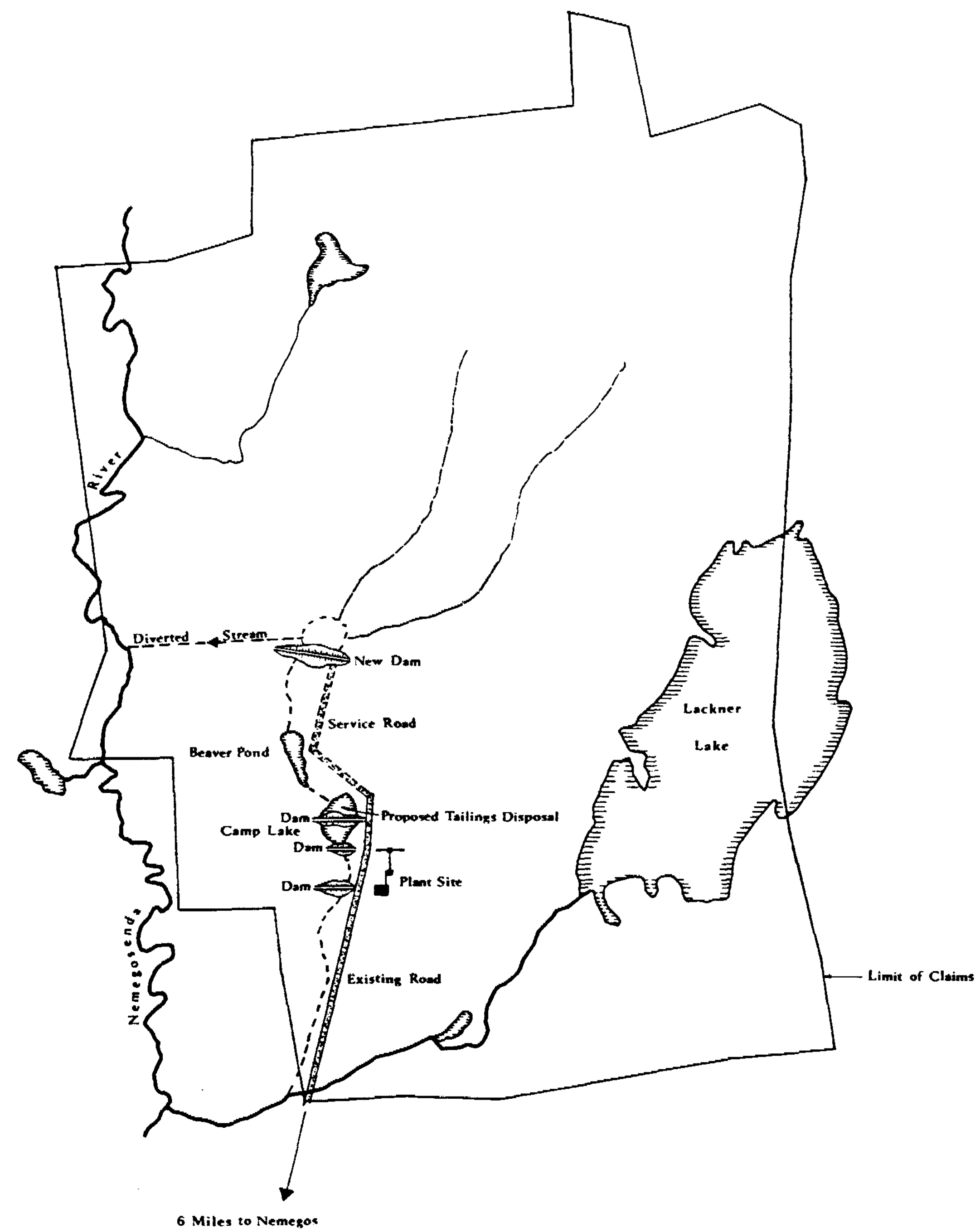
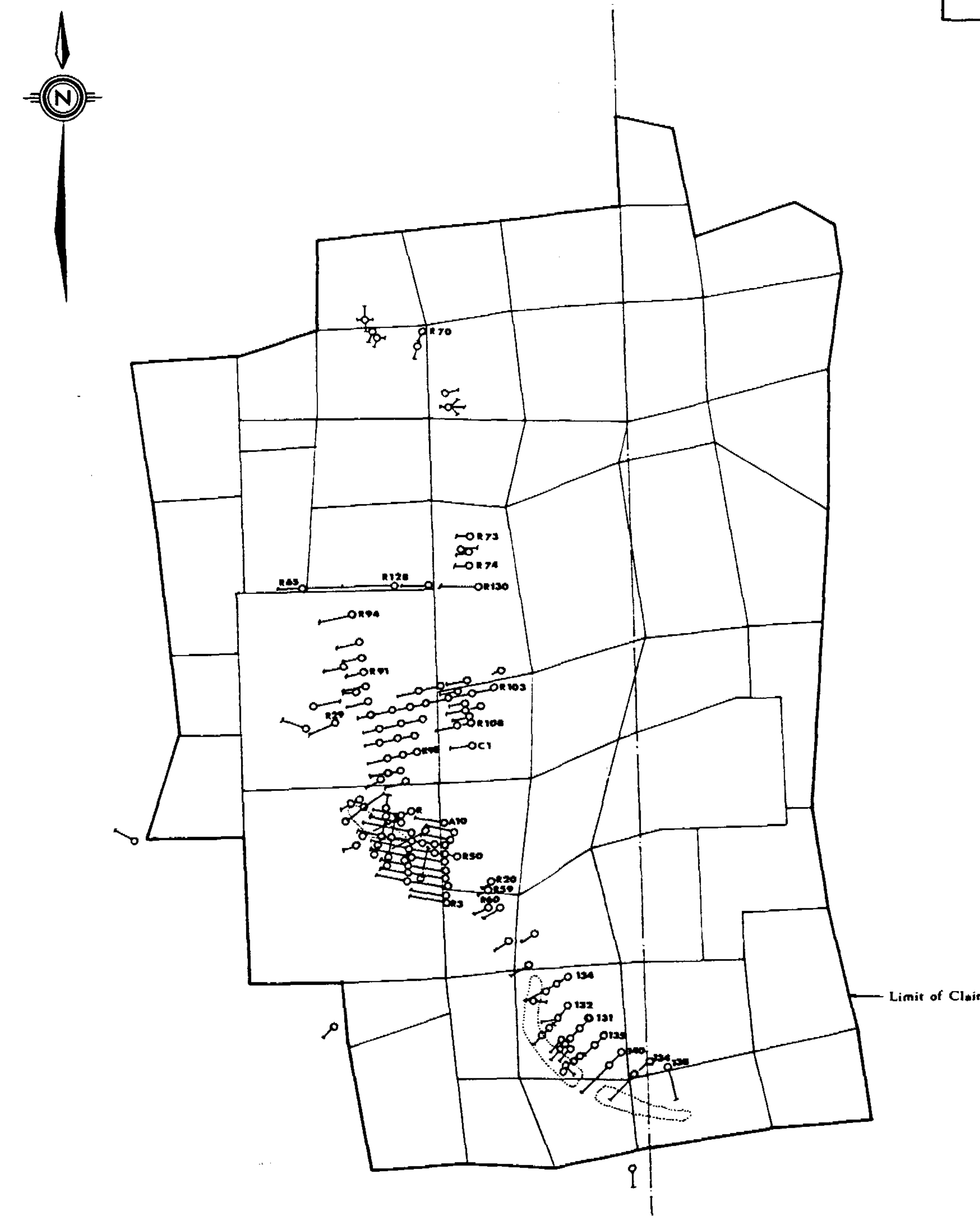


PROPOSED WATER DIVERSION



BORE HOLE LOCATIONS

Scrivener Engineering	DRAWN WL Spencer SCALE As Noted DATE SEP 74 CHECKED APPROVED APPROVED	CLIENT MERTEC RESOURCE DEVELOPMENT LIMITED Sudbury Ontario PROJECT RECOVERY and TREATMENT of MAGNETITE — APATITE CONCENTRATES	DRAWING BORE HOLE LOCATIONS DRAWING NUMBER 5699·105	REV. P

REFERENCE DWG. NO	DESCRIPTION	REFERENCE DWG. NO	DESCRIPTION	REVISIONS NO	BY	DATE	DESCRIPTION	REVISIONS NO	BY	DATE	DESCRIPTION	REVISIONS NO	BY	DATE	DESCRIPTION

6. MINING

6.1 Anomaly No. 6

Justification for the establishment of the mine-mill-smelter complex is based upon the initial mining of No. 6 ore body which contains about 4.2 million tons of recoverable titaniferous magnetite-apatite ore. As this ore approaches exhaustion in about 9 years, the Anomalies Nos. 3 and 4 will be brought into production. Other potential ore bodies located on the property will be investigated and exploited if economically viable.

As noted in the section dealing with Property, there is a variety of minerals present in the deposit. The most prominent are titaniferous magnetite (Fe_3O_4: $FeTiO_3$), apatite ($Ca_3P_2O_5(F)$), niobium pentoxide (Nb_2O_5) and rare earths (cerium, neodymium, lanthanum, thulium, praseodymium, samarium, ytterbium and others).

6.2 Mine Area

The mineralized zone is in a relatively flat area, and outcrops on surface. To the north, a beaver pond fed by a small creek provides a wet, silty cover. Rock waste from mine development would be used in building a dam to redirect the creek flow to another watershed and to provide for mill site preparation and tailings ponds dams. This would require moving the material a distance of some 6000 feet.

A small lake (about 6 acres) adjoins the property within about 200 feet of the proposed operation. When the creek feeding the existing water course is dammed, this lake will drain. It is considered possible the natural reservoir which will then be exposed could be converted into a site for tailings disposal and water recycling.

6.3 Tonnage and Grade Estimates

The mining property comprising all claims previously listed is held by Mertec Resource Development Limited under a long term lease with Multi-Minerals Limited (see Appendix D). The mine layout, development and operation will be carried out by contract and ore will be delivered for processing to the primary 36 inch x 42 inch jaw crusher located close to the mill. All permanent buildings, stationary and moving equipment associated with the mining operation, will be purchased, maintained and operated as a responsibility of the contractor.

6.3 Tonnage and Grade Estimates (cont.)

All assumptions and data dealing with the mining operation have been supplied by, and are the responsibility of, Pioneer Construction Incorporated and MacIsaac Mining and Tunnelling Company, Sudbury, Ontario.

Length at surface	800' maximum
Horizontal width at surface	230' maximum
Vertical depth	500' calculated
Dip	The main axis is vertical. Two walls dip inward about 60° and the third is vertical.
Sections drilled	5
Holes drilled	26
Samples assayed	6 (composite)
Footage of core assayed	3,813
Tonnage factor	7 cu. ft. per net ton

	Mineralized Material	Titaniferous Magnetite %	Tons	Apatite %	Tons
Total	5,024,250	69.60	3,496,800	21.88	1,099,310

These ore reserve figures are confirmed from calculations made by Pioneer Construction Incorporated and MacIsaac Mining and Tunnelling Company Limited (Appendix F).

6.4 Mining Method

The system of mining proposed for No. 6 Anomaly is in accordance with recommendations of MacIsaac Mining and Tunnelling Company Limited.

Blast hole mining in two lifts would be employed, with a surface crown pillar to maintain workable conditions. A ramp, suitable for trackless diesel equipment, would be driven to gain access to the ore body and would serve as the haulage drift. The ramp would be driven at minus 16% to 20%, to the first level and 200 feet below surface, where level development would begin. The ramp would continue down to the second level

6.4 Mining Method (cont.)

350 feet below surface. These two levels would be the main or extraction levels. Extraction drifts and boxholes driven in the ore on these two levels would be used for ore recovery. Above the box-holes the ore body would be silled out to provide an opening for the long hole rings. Two sub levels driven at appropriate intervals above the main first level would each have two drill drifts from where all the long hole drilling would be done. A slot raise 150 feet long would be the initial opening into which a slot, the full width of the ore body, would be blasted. Mining would then retreat along the strike of the ore body with blasting being done from the drill drifts in the two sub levels. Scooptrams, mucking the draw points, would load into tele-trams hauling up the ramp to surface. The second lift would be mined similar to the first but with only one sub level required, as drilling could be done from the first level. The first level boxhole pillars would be recovered at the same time as the second lift is mined. The crown pillar would be recovered upon completion of the second lift providing there are no plans for continued mining. Surface stipping of the crown pillar area would be required before the crown pillar is blasted down. The second level boxhole pillars would then be recovered.

The usual mining services would be required. A compressor installation would be set up, as would a mine drainage and pumping system. A suit-able location for mine water would be required. Hydro electric power and fresh water would be furnished by the company. Fresh air would be forced into the mine via a fresh air raise, through the workings, and exhausted up the ramp. Ventilating air would be heated in winter with electricity furnished by the company.

A complete surface shop would be set up to service the diesel and drilling equipment. In addition, a changehouse, office, and warehouse should be sufficient for the mining contractor's needs.

6.5 Anomalies Nos. 3 and 4

These ore bodies have been explored with a modest diamond drilling programme. There were 16 drill holes put down in four sections of which some 2800 feet of core were assayed. Inferred mineralized material is calculated by MacIsaac at 27 million tons to a depth of 1000 feet.

6.5 Anomalies Nos. 3 and 4 (cont.)

This material is estimated to analyse about 14.0% titaniferous magnetite, about 21.5% apatite and 0.205 niobium pentoxide. The anomalies extend for some 1450 feet at surface with horizontal widths varying between 150 feet and 400 feet. Overburden is from 20 to 40 feet and mining methods could be similar to those planned for No.6 Anomaly to a depth of 350 feet. Recoverable ore to this depth is estimated at about 7 million tons. Optimum methods to recover the ore below 350 feet will require further study as need for this material becomes more urgent.

It is anticipated these anomalies will be exploited, as the No. 6 ore body becomes depleted, at a rate of about one million tons per year. This should not require major modification to the concentrator buildings but will necessitate duplication of some equipment.

7. PROCESS

As mentioned elsewhere in this report, the ore found in Number 6 ore body is mineralogically complex, containing a variety of elements. In general, it is approximately 69.6% titaniferous magnetite (Fe_3O_4: $FeTiO_3$), and 21.8% apatite ($Ca_3P_2O_5(F)$). In addition, also present is 0.173% niobium pentoxide (Nb_2O_5) and 2.7% rare earths (cerium 38% plus lanthanum, neodymium, praseodymium, samarium, yttrium, thorium, etc.)

While niobium and rare earths are in substantial demand, and if recovered could provide an enhanced value for the total project, it is not considered feasible to devise a means of acquiring these elements in the initial stages of the proposed operation. When the process, which has been designed to secure the major elements, is operating effectively, a research and development program might well be undertaken to more accurately assess methods by which these additional values may be recovered.

Run of mine rock will be delivered to the primary crusher from which, in turn, the material will be passed to secondary and tertiary crushers and thence to a grinding circuit. After grinding to a particle size of approximately 200 mesh the material, in the form of a slurry, is subject to a flotation treatment for the removal of the sulphur-bearing pyrrhotite (FeS_2) which is discarded. Following this flotation step, a magnetic separation is carried out which results in the concentration and recovery of the titaniferous magnetite.

The non-magnetic portion retains all of the apatite and certain gangue constituents which have no value. These non-magnetics are treated by flotation to collect the apatite. Residual gangue materials at this point are discarded to the tailings pond. The apatite is filtered, dried and dispatched to the ultimate consumer.

The magnetic concentrate, which is still in the form of a slurry, is filtered, dried and passed through an agglomerating process. The purpose of this step is to reduce material losses and other problems in handling such a finely divided product and also to improve product characteristics for further processing.

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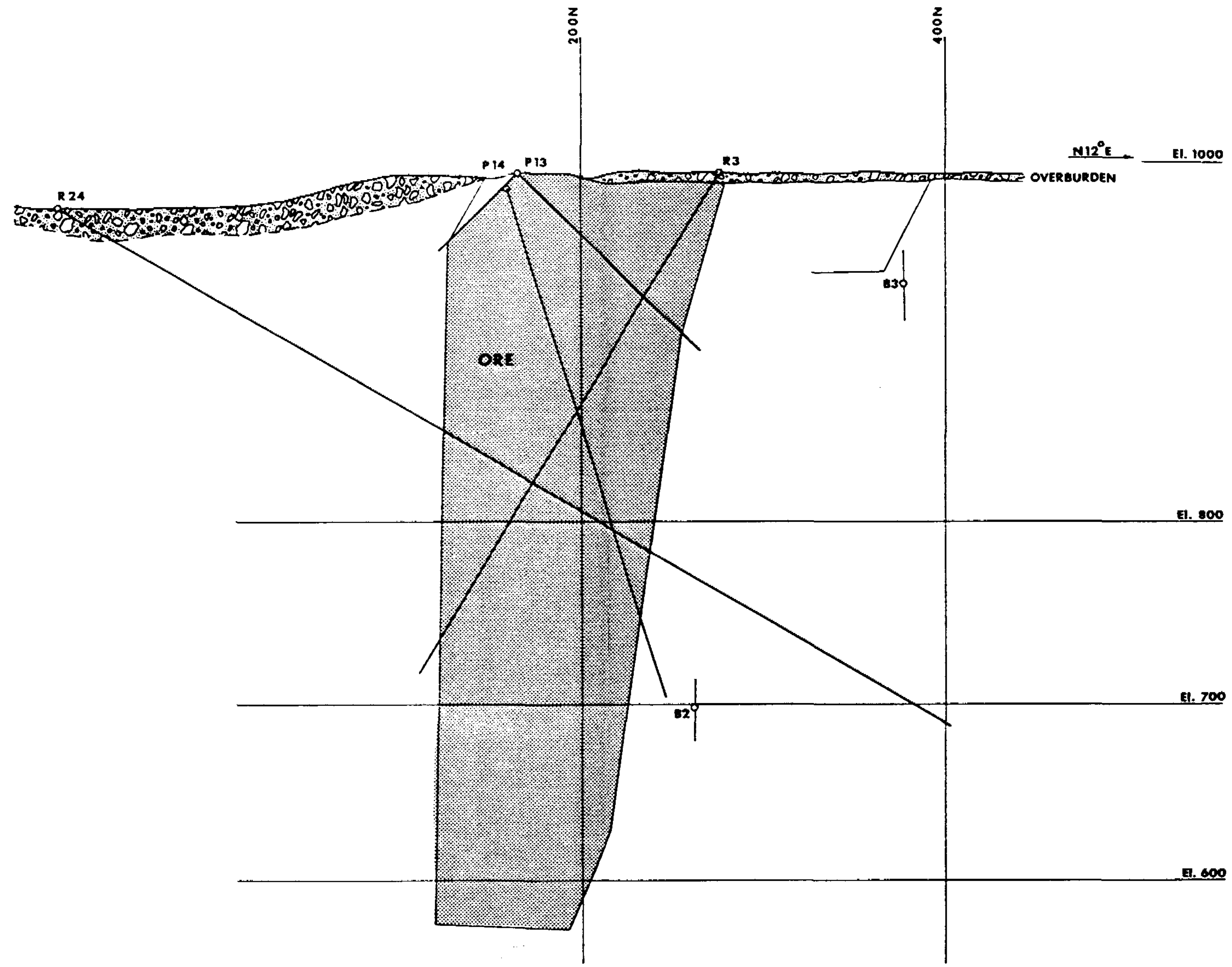
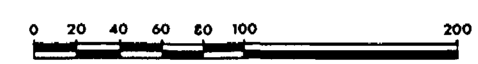


No. 6 ORE BODY
LOOKING N78°W



Scale 1inch = 40 feet

REFERENCE	DWG. NO. / DESCRIPTION
REVISIONS	NO / BY / DATE / DESCRIPTION

Scrivener ENGINEERING

DRAWN: WL Spencer	CLIENT: MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury, Ontario	DRAWING: No. 6 ORE BODY	
SCALE: As Noted			
DATE: SEP 74			
CHECKED	PROJECT: RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES	DRAWING NUMBER: 5699·104	REV. P
APPROVED			
APPROVED			

7. PROCESS

The titaniferous magnetite concentrates in the form of briquets are dispatched by rail to the smelting plant, to be located in the Sudbury area. Discharge from rail cars to storage bins and thence to the smelting furnace is mechanized.

The Mertec concept provides for the conversion of the magnetite to steel billets and this study has been carried out with this assumption. However, there is an option that the process be curtailed at the pig iron stage and arrangements be concluded for tne sale of this product. At the same time, the plant site layout will be planned to foresee future production of billets or eventually the rolling of bars, rods or light structural members.

In the early stages of discussions dealing with the treatment of magnetite concentrates, an unrealistic pricing imbalance existed between the sales value of pig iron and billets. After the study was well advanced, the natural forces of the market place tended to correct this imbalance and make the alternative pig iron possibility economically more attractive.

There are certain evident advantages in limiting the project to a pig iron capability. The capital investment will be approximately $11 million less. In addition, the technical requirements and controls are substantially minimized by elimination of the steel refining and casting stages. In commencing operations for such a technically oriented process, particularly from a green field site, acquisition of technologists and know-how frequently is a formidable task.

A comparison of the financial viability of pig iron alone compared with a pig iron-billet project is included in the financial study.

The smelting process is carried out in a high-powered electric furnace designed to operate 24 hours per day and seven days per week. The titaniferous magnetite is charged to the furnace automatically, together with metallurgical coal and certain slag-making constituents. The six electrodes, with which the furnace is equipped, penetrate into the slag layer and through resistance, generate a high temperature reaction between the coal and the magnetite which removes oxygen resulting in the production of iron and a titania-bearing slag. These two constituents are separated by specific gravity differential and are removed from the furnace in a molten state to pouring ladles or to casting equipment. The oxygen removed is discharged as CO and CO_2 through dust collectors to the atmosphere.

The iron, while molten, will be treated for reduction of sulphur before being poured into a pig casting machine. The pigs so formed will be loaded directly to rail cars for shipment to the market.

An extension to this procedure could provide for the molten iron to be poured directly from the smelting furnace into an electric refining furnace. A metallurgical treatment could convert the iron into steel of suitable specification, which would then be poured into a casting machine to produce a continuous 4" square billet. These billets would be cut to the desired length after solidification and loaded for delivery to the customer.

It is conceivable at some future date a further step could be introduced whereby a structural or bar mill could be added. This would enable conversion of the billets to a finished product. Such a step would serve to up-grade the sales value of the output and give the operation a broader scope.

The methods and practices described are not unique and are carried out in similar operations elsewhere. Equipment requirements and specifications are in accordance with those generally used in related processes. The smelting furnace may be considered as custom-built with respect to size, but the process is known and practiced in established facilities in Canada and other countries.

8. CONCENTRATOR

A.H. Ross and Associates were retained by Mertec, to consider the results of bench and pilot plant testing of Multi-Minerals ore by International Nickel Company, and other relevent data for the purpose of designing treatment methods and equipment specifications. Subject to the information which was developed, the ore reserves available, and production recommendations of Mertec, facilities to treat 1500 tons of ore per day have been planned. A daily output of 930 tons magnetite concentrates and 200 tons apatite concentrates for 325 days per year is anticipated.

The background data used in reaching the design criteria is contained in the Ross Report, "Metallurgical Evaluation of an Apatite-Magnetite Deposit, Nemegos, Ontario", included in Appendix B.

Preliminary engineering design has been carried out by Scrivener Engineering Limited based on Ross recommendations and past experience with similar projects.

8.1 Crushing

Ore is delivered, by mining contract, from the mine to a 36 inch x 42 inch primary jaw crusher set to produce approximately 5 inch material. The trucks dump into a surge bin feeding a pan feeder equipped with a grizzly. Material passing over the grizzly enters the crusher, the undersize joining crushed product to be conveyed to the secondary crusher. A metal detector prevents tramp iron and steel from entering the $4\frac{1}{4}$ foot Symons standard cone crusher in the secondary crushing circuit. The product from this crusher is conveyed to a transfer tower. This conveyor also carries product from the tertiary crusher which is in closed circuit with a 5 foot x 10 foot single deck vibrating screen with 5/8 inch slots. Oversize is sent to the tertiary crusher, a $4\frac{1}{4}$ foot short head cone. Undersize from the screen is carried to a 4000 ton fine ore bin.

The crusher circuit is designed to handle 200 tons per hour of ore from the mine. A single shift operation will provide sufficient feed to operate the mill on a continuous basis.

Dust control in the crushing operation is designed into the process through hoods and ducts at all points where dusting conditions are encountered. Suction to serve this system is provided by a 40 HP fan located adjacent to the crusher building.

8.2 Grinding

Ore from the fine ore bin is drawn through slot feeders into a $9\frac{1}{2}$ foot diameter by 12 foot long rod mill at a controlled rate of 63 tons per hour. The mill is charged with 3 inch diameter steel rods and is driven by a 500 HP synchronous motor. Water is added to the mill so that grinding is carried out at 75% to 80% solids.

Discharge from the rod mill is pumped to Kreb cyclone classifiers. The overflow, sized about 95% - 65 mesh and 40% solids, goes directly by gravity to the sulphide flotation system. The underflow from the cyclones.at about 70% solids goes to an $11\frac{1}{2}$ foot diameter x 15 foot long ball mill using 2-inch diameter steel balls and operated by a 1000 HP synchronous motor. Discharge from the ball mill, together with discharge from the rod mill, is recirculated to the cyclones.

8.3 Sulphide Flotation, Magnetic Separation and Regrinding

Overflow pulp from the Kreb cyclone classifiers is conditioned with flotation reagents and treated in twelve 100 cu. ft. Denver flotation cells. The sulphide froth consisting mainly of pyrrhotite is discarded to tailings. This constituent consists of about 2% of feed to the mill. The residual product discharged from the flotation cells is diluted to 25% solids and pumped into a 36 inch by 72 inch revolving double drum magnetic separator. Magnetic material is discharged and pumped to a regrinding circuit. The non-magnetic reject is carried to a desliming thickener.

The regrinding process is carried out in a $10\frac{1}{2}$ foot diameter by 12 foot long ball mill using 1-inch steel balls, powered by a 500 HP synchronous motor. This mill is closed circuit with a cyclone classifier. The underflow product of the cyclone, about 55% to 60% solids, is returned to the ball mill. The overflow, about 80% - 200 mesh and 25% solids, is carried by gravity to a three-stage 30 inch by 72 inch magnetic drum separator. Cleaning is carried out at each stage by flushing gangue from the concentrate. Pulp density is maintained at about 25% solids. Final magnetic concentrate from the last drum is washed and pumped to a dewatering thickener.

8.4 Apatite Flotation

The non-magnetic tailings from the magnetic separation units are pumped to a 45 foot diameter desliming thickener which removes sub-micron apatite and magnetite fines. Removal of these fines is essential to assist the subsequent flotation of the apatite. The overflow from the thickener containing these slimes is pumped to the tailings pond for settling and water reclaimation. The underflow at about 50% solids is pumped to conditioners where flotation reagents are added. From the conditioners, at about 25% solids, the material goes to ten 50 cu. foot Denver flotation cells. The apatite concentrate is recovered from the cells as froth and is pumped to the thickener for dewatering. Flotation tailings are sent to the tailings pond.

8.5 Dewatering and Drying

Cleaner magnetic concentrate is dewatered in a 20 foot diameter thickener. The overflow is pumped to the tailings pond for settling and water reclaimation or may be recycled directly to the regrind circuit. The underflow product, about 65% solids, is processed through a drum filter. The water is returned to the regrind circuit. The solids, about 6% to 7% moisture, are briquetted for shipment.

Apatite concentrate is dewatered in a 25 foot diameter thickener. The overflow is returned to the apatite flotation circuit. The underflow is filtered with the water recycled to flotation. The solids at about 11% or 12% moisture are dried and loaded for shipment.

8.6 Engineering and Construction Schedule

The schedule for erection appears on the following page. The extended period of some 27 months results mainly from slow equipment delivery, an improvement may be achieved if reconditioned machinery could be acquired. Capital expenditure would also be substantially reduced by this means. Engineering is programmed to be largely complete in seven months. It is scheduled in such a way that preliminary construction could be undertaken in about four months.

8.7 Cost Estimate - Concentration, Agglomeration and Services

1. Crushing Plant

Building:	$ 487,131
Excavation, Backfill, Concrete, Structural Steel, Roofing and Siding	
Mechanical Equipment and Services:	$ 578,249
36" x 42" Jaw Crusher, 4¼ Cone Crushers (2), Vibrating feeder, Material Handling, Dust Collection, Piping, Electrical and Instrumentation	
TOTAL	$1,065,380

2. Transfer Tower

Building:	$ 129,399
Excavation, Backfill, Concrete, Structural Steel, Roofing and Siding and Galleries	
Mechanical Equipment and Services:	$ 93,638
Conveyors, Chutes and Electrical	
TOTAL	$ 223,037

8.7 Cost Estimate (cont.)

3. Fine Ore Bin

Building:	$ 499,761
Excavation, Backfill, Concrete, Structural Steel, Roofing and Siding and Bin Plate	
Mechanical Equipment and Services:	$ 181,389
Conveyors, Slot Feeders, Dust Collection, Chutes and Electrical	
TOTAL	$ 681,150

4. Concentrator Building

Building:	$ 924,220
Excavation, Backfill, Concrete, Structural Steel, Roofing and Siding and Masonry	
Mechanical Equipment and Services:	$2,364,029
3 Mills, Flotation Equipment Thickeners, Conveyors, Pumps, Filters, Process Piping, Service Piping, Assay Lab. Equipment, Machine Shop Equipment, Heating and Ventilation, Compressor, Office, Change House, Electrical, Instrumentation	
TOTAL	$3,288,249

8.7 Cost Estimate (cont.)

5. Agglomeration, Dryer and Load-Out

Building:	$ 370,607
Excavation, Backfill, Concrete, Structural Steel, Roofing and Siding and Galleries	
Mechanical Equipment and Services:	$2,878,230
Pug Mills (3), Dryers (3), Briquetting Machines (3), Conveying System, Dust Collection Additive Bins (6), Load-Out Bins, Car Puller, Electrical and Instrumentation	
TOTAL	$3,248,837

6. Main Substation

Building:	$ 39,880
Excavation, Backfill, Concrete, Structural Steel, Roofing and Siding	
Mechanical Equipment and Services:	$ 175,600
Electrical Equipment	
TOTAL	$ 215,480

8.7 Cost Estimate (cont.)

7. Sewage Disposal System

Building:		--
Mechanical Equipment and Services:	$	41,068
Package Sewage Plant, Piping and Electrical		
TOTAL	$	41,068

8. Fuel Oil Supply System

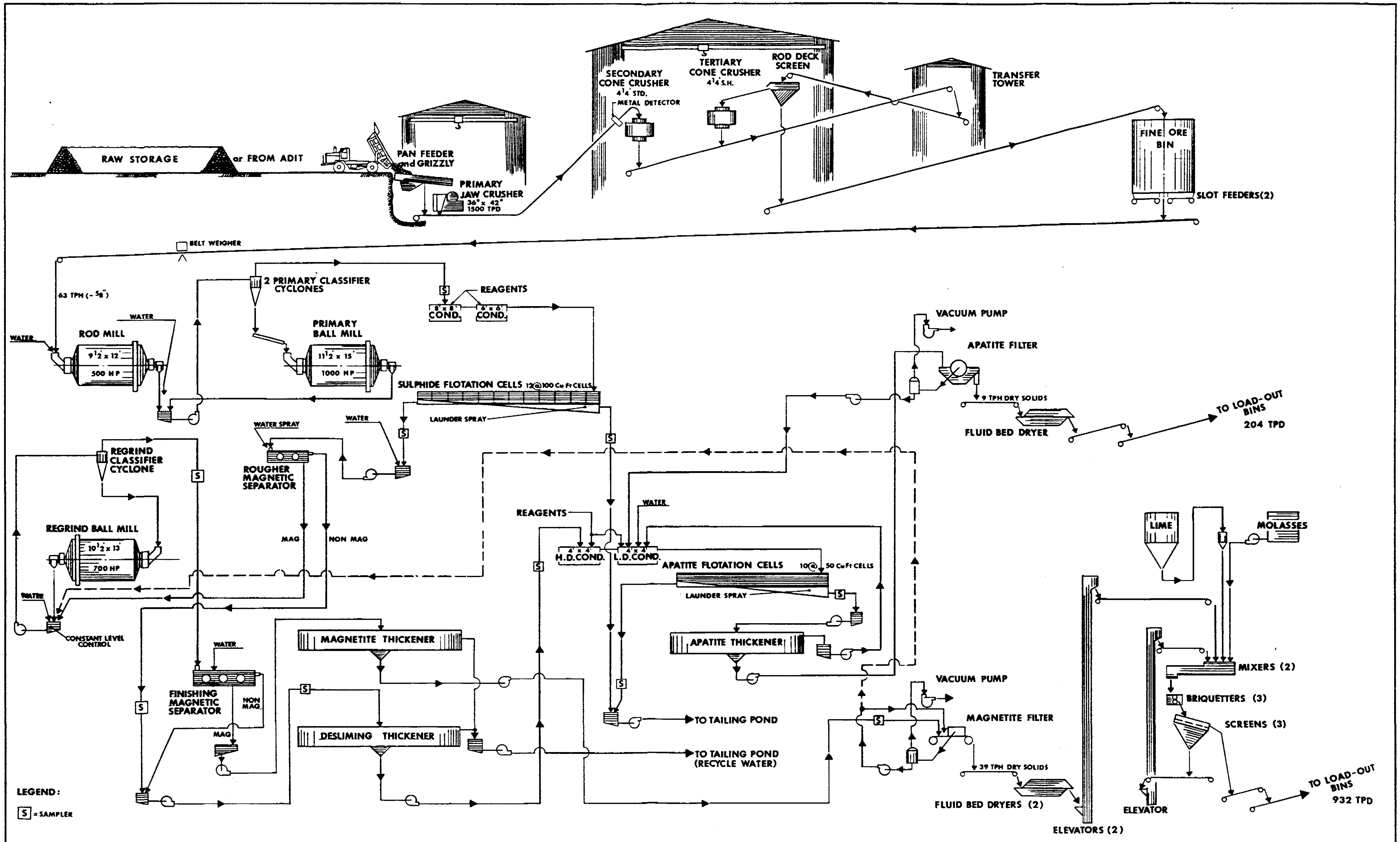
Building:	$	13,700
Excavation, Concrete, Pre-Fab. Building		
Mechanical Equipment and Services:	$	75,275
20,000-Gal. Tanks (2), Diking, Drainage, Piping, Tank Heaters, Electrical		
TOTAL	$	88,975

9. Guest House

TOTAL	$	25,000

8.7 Cost Estimate (cont.)

10.	Railway Line (C.P.R. Estimate)	
	TOTAL	$1,000,000
11.	Car Park (80 Cars)	$ 25,000
	Grading, Sub Base, Outlets for Cars	
	TOTAL	$ 25,000
12.	Power Line - 115 KV (OHEPC estimate)	
	TOTAL	$ 773,000
13.	Site Piping - Recycle and Fire Protection	
	Mechanical Equipment and Services:	$ 53,010
	10" dia. Recycle Main, 8" dia. Loop Main, Fire Hydrants, Hose Cabinets	
	TOTAL	$ 53,010



Scrivener ENGINEERING

DRAWN W.J. Spencer
SCALE None
DATE NOV 74

CLIENT MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury, Ontario

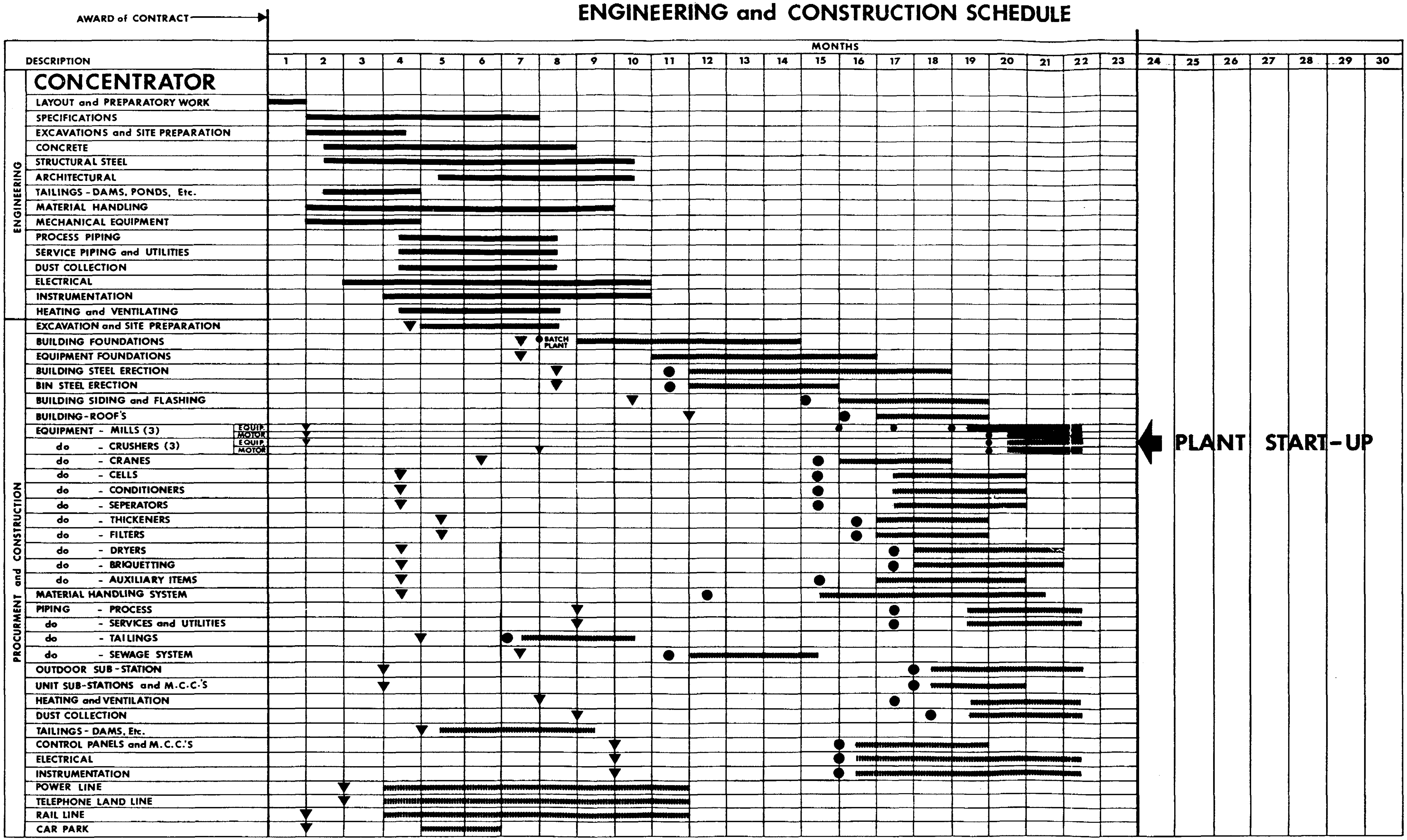
PROJECT RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

DRAWING PROCESS FLOW SHEET

DRAWING NUMBER 5699·100

REV. P

ENGINEERING and CONSTRUCTION SCHEDULE



LEGEND: ENGINEERING ▼ PURCHASE ORDER ● DELIVERED ON SITE CONSTRUCTION

REFERENCE		REFERENCE		REVISIONS		REVISIONS		REVISIONS	
DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION	NO. BY DATE	DESCRIPTION	NO. BY DATE	DESCRIPTION	NO. BY DATE	DESCRIPTION

Scrivener ENGINEERING

DRAWN: W. SPENCER
SCALE: None
DATE: OCT 74
CHECKED
APPROVED
APPROVED

CLIENT: MERTEC RESOURCE DEVELOPMENT LIMITED
Sudbury Ontario

PROJECT: RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

DRAWING: ENGINEERING & CONSTRUCTION SCHEDULE

DRAWING NUMBER: 5699 · 106

REV. P

9. AGGLOMERATION

Ferro-Tech Incorporated, Pittsburgh, Pennsylvania, was contracted to investigate agglomeration characteristics of titaniferous magnetite concentrates supplied from the International Nickel Company pilot plant test programme. The trials were conducted using pelletizing and briquetting techniques. It was determined the concentrates can be satisfactorily agglomerated by either of these methods. Results obtained from the series of tests, with laboratory-sized equipment, indicated the following physical properties could be anticipated.

Roll Briquetting

Binder - 3% lime plus 3% molasses

	Moist	Dried	Air Cure 24 hrs
Crushing strength	12.2 lbs	345.6 lbs	153.2 lbs
Drops/Height	38/18"	7.2/6'	18.0/6'
Moisture content	2.4%		

Based on the high strengths noted above, for the purposes of this feasibility study, binder additions of 2% lime and 2% molasses are considered to be adequate.

Disc Pelletizing

Binder - 3% corn starch plus water spray

	Dried
Crushing strength	120.6 lbs
Drops/Height	10.0/18"

Superior physical properties together with advantages of size and shape lead to the conclusion that briquetting should be adopted for the purposes of this study.

9. AGGLOMERATION

The process provides for concentrates from the filter to be passed through driers to reduce the moisture content. It is quite probably this step could be omitted since moisture content from the filter may be satisfactory. Screened lime and industrial grade molasses are used as binding agents and are added to the magnetite in a paddle mill mixer. The mixer discharges to a hopper serving a roll briquetting machine capable of processing 20 tons per hour. It is proposed that three of these machines be installed to provide adequate capacity and insurance against interruption of production. Green briquets pass over a screen for removal of fines which are returned to the paddle mill feed. The screened briquets move to bin storage facilities. A storage period of 24 hours is allowed to provide sufficient curing time during which drop and crushing strength are developed. Covered hopper railway cars are loaded directly from storage bins.

10. ENVIRONMENTAL PROTECTION

Mine and Concentrator

In carrying out this feasibility study, full consideration has been given to protection of the natural environment. Through an awareness of the factors involved and careful planning, the impact of the mining and processing facilities on the environment and the local ecology will be kept to a minimum. The short and long term effects on water quality, air pollution, soil erosion and wild life resources are of concern, as is the potential detraction from recreational, agricultural or commercial uses of the areas.

The mine site is located in a wooded area of low rocky hills. There are numerous lakes and streams in the region. The extent of clearing will be limited to an area required to accommodate mine and plant facilities and to provide for adequate fire breaks. Clearing will be carried out in proper fashion without leaving slash or other refuse behind. The same policies will apply in connection with the railway and power line rights of way which will be the responsibility of Canadian Pacific Railway and Ontario Hydro Power Commission.

The location of the Number 6 ore body and the facilities for concentrating and briquetting the ore is a relatively flat, low area with hills on two sides having elevations up to 50 feet. A minor watershed partially covers the mine site. It consists of a small stream feeding a beaver pond and a lake 6 acres in area, with the outflow leading to the Nemegosenda River. It is proposed to build a dam of waste rock and sand about 2000 feet north and east of the beaver pond to divert the feeder stream into a watershed to the north and west, which also leads into the Nemegosenda River. This will result in drainage of the pond and lake. Disposal of any material surplus to construction requirements will be carried out in full consideration of the environmental and aesthetic nature of the area.

10. ENVIRONMENTAL PROTECTION

It is planned to utilize the lake bed which will be exposed when draining is complete as a location for tailings ponds and the accumulation of waste water for treatment and recycling through the concentrator system Competent dams will be constructed at the outflow end of the lake bed to ensure that no concentrator or mine waters will enter the natural water system unless they have been neutralized to satisfy environmental requirements.

Air pollution control for both dust and fume will be pursued with determination to ensure that the most practical and effective methods are incorporated into the facilities design. Crushing equipment will be protected with adequate dust collection and where possible will be carried out with a water spray sufficient to further depress dust generation.

The concentrator process basically deals with finely ground materials in the form of a slurry. There is no dust or fume associated with this process and waste water will be handled in accordance with previous comments.

Subsequent to separation of the magnetite and apatite minerals contained in the ore, a drying and briquetting step will be carried out. The drying step will be protected for dust but will result in the evacuation of moisture to the atmosphere. Such moisture will contain no deleterious particulate matter or gases harmful to the environment. A briquetting process will be introduced to agglomerate the finely ground magnetite to about one inch particles so that the potentially dusty conditions arising in handling will be controlled. The actual briquetting equipment will be adequately protected for dust collection and the fines captured will be recirculated and recovered.

The drying of product and the heating of the concentrator buildings will be carried out with fuel oil. Products of combustion will be exhausted to the atmosphere by a stack but will conform with acceptable standards for this type of emission.

Sanitary wastes at the mine site will be appropriately treated, by such means as packaged treatment plants, prior to discharge of the waste water. Subject to regular check for quality, the effluent may be included with return water to the mill circuits.

Following shipment from the concentrator, the apatite will be delivered in covered hopper cars to consumers for conversion into phosphoric acid for fertilizers or other uses.

The magnetite briquets will move in covered hopper cars to the smelter site in Sudbury. As has been mentioned, the smelter will be an integral part of tne mine-concentrator-smelter complex with operational responsibility resting with the same owners.

Discharge of the magnetite briquets will be through the railway car bottom onto a moving belt to the storage area. Because of the character of the briquets, dusting will be minimal and since the unloading will take place in an exterior unconfined area, no hazard is indicated. It should be noted the material is not noxious. The storage area will be under cover and will not form part of the main building complex.

A complete description of precautions planned to protect against dust and gaseous air pollution from the smelting operation is included in that portion of the report specifically dealing with this part of the process.

Air quality will conform with the requirements of the Ontario Ministry of the Environment.

11. SERVICES AND UTILITIES

11.1 Introduction

The mining property, adjacent to which the concentrator will be built, is located about 6 miles by gravel road from Nemegos, a community of about 100 people, located on a main Ontario Highway number 129. About 26 miles north on the same road, is the town of Chapleau with a population of 3500 people. Both communities are on the main line of the Canadian Pacific Railway which connects them with Sudbury, about 165 miles south.

Essential services and housing for employees will be centred at these locations. It is not planned to provide living accommodation at the plant site.

11.2 Road

The road from Nemegos to the mine-site is well built but will require upgrading for year-round usage and to accommodate the loads imposed by the occasional heavy transport that will use this route to reach the plant. The cost of this work is included in the estimate.

11.3 Rail

Concentrates will move over a 6.4 mile railway spur which, including siding into the plant loading area, will be built by Canadian Pacific Railway from the main line at Nemegos. Some major deliveries such as oil supplies, molasses, lime, etc. will also probably use this service.

The siding will consist of two tracks, each to accommodate 12 cars 50 feet in length with a capacity of 100 tons. Service will be on a daily basis with 11 empty cars being delivered and the same number of loaded cars being removed.

Rail equipment will be covered hopper cars discharging from the bottom. Closure will be sufficiently tight to provide for satisfactory handling of fine material. These cars about 50 in number, will be exclusively in the service of Mertec. Each train of 11 cars is expected to load and discharge during a period of 24 hours at each end with a maximum turn-around period of 5 days.

Equipment will be provided for service at the siding to move cars as may be required during loading.

11.4 Oil

Consumption of oil for heating and process requirements will be approximately 1.5 million gallons per year.

Supply will be by rail car service and provisions for adequate tank storage will be made at an appropriate site location. A letter outlining the proposal of Canadian Pacific is included in Appendix G.

11.5 Electrical Power

Power will be purchased from Ontario Hydro Electric Power Commission at 115 KV, 3 phase, 60 hertz. This will require construction of a 16.7 mile transmission line by Ontario Hydro from the closest existing point of connection at Chapleau to the mine site.

A substation provided by Mertec will be located close to the building site and will contain facilities to terminate the 115 KV line, provide isolation and protection for a 3,750/5,000 KVA 115 KV-4.16 KV step down transformer. The substation will also contain 5 KV distribution switchgear to provide for distribution of power at 4.16 KV to the mine site, concentrator and briquetting plant.

The power will then be utilized at 4.16 KV for motors above 200 HP and unit substations will step down the voltage to 600 volts for motors 200 HP and below.

A central control room will be provided to operate the plant from one location.

Lighting and grounding will be installed consistant with modern practices and standards.

A 500 KW diesel driven generator will be installed to provide power for all essential services in the event of line power failure.

A letter from Ontario Hydro which outlines their proposal is included in Appendix H.

11.6 Water Supply

Fresh water requirements for mine and concentrator will be met by an 8-inch pipeline from Lackner Lake. The system will be provided with pumping capacity of 1000 U.S. gallons per minute.

A relatively minor portion of the raw water will be filtered and chlorinated for domestic service by a small treatment plant at the mine-site. Cooling and gland water for compressors will also be filtered.

Process water for plant use will be a combination of raw water and recycled water from tailings ponds.

The recycle pond will also be used as a fire protection water reservoir. It is proposed that an 8-inch diameter fire loop be pressurized by the recycle process water pumps. Should a fire occur, a diesel fire pump will be automatically activated.

11.7 Telephone

It will be necessary to string a telephone line to the site and this will probably follow the Hydro right of way from Chapleau. A minimal internal system will be provided to connect the office with various stations in the plant and the mine.

This chapter copied verbatim
from a report by Penn Eng.

12. SMELTER

12.1 INTRODUCTION, SUMMARY AND REVIEW

SECTION I <u>Introduction, Summary and Review</u>

The purpose of this Engineering Services Study is to provide to Mertec Resources, Ltd. basic conceptual engineering for a 180,000 ton per year billet producing facility intended to be located on a defined plot at the existing International Nickel Company's "Coniston" plant near Sudbury, Ontario, Canada.

The basic engineering package includes:

A. Definition of the plot with consideration for existing and future rights-of-way and easements based on information provided to PEC by Mertec Resources, Ltd.

B. Location of buildings, material storage areas, trackage and roadways with site sufficient raw material and finished product storage to satisfy Mertec's projected production requirements.

C. Preliminary sizing and designing of structures and their foundations with consideration for the local seismic and climatic conditions, their ultimate use and the function and size of the equipment to be housed within them. No consideration has been given to soil conditions at this time due to a lack of accurate information.

D. Preliminary selection of cranes and other plant material handling equipment with consideration for relative equipment positions, material quantities, flows and capacities in order that they integrate properly with the other equipment within their system and thus satisfy the overall material flow and plant production requirements.

E. Preliminary schedules defining the time required to engineer, procure and construct the facility as it is outlined in this study.

F. Preliminary pricing information in the form of a facility estimate based on the site preparation, buildings and

Introduction, Summary and Review (continued)

F. (continued)

equipment defined herein and in consideration of current field labor and field material costs.

Summary and Review

In summary, it is the purpose of this study to provide Mertec with technical information which, when combined with the work done by others, will serve as the basis for a valid decision on the viability of this project and also to provide them with sufficient basic engineering for the project upon which to proceed should their decision be affirmative. In evaluating this study and the ultimate production capabilities of the completed facility, consideration should be given to the following design constraints and criteria which were given to PEC by Mertec.

1. Facility would produce 180,000 ton per year of medium low carbon steel billets.

2. The continuous billet casting machine would produce 4" x 4" billets.

3. The site would be located in the "Sudbury - Coniston" area and would therefore have to be designed with consideration for the local climatic conditions.

4. Agglomeration of the ore concentrate would be done near the mine - mill site prior to shipment to the refining facility.

5. Covered yard storage to be incorporated to minimize moisture problems with raw material.

12.2 METALLURGICAL REQUIREMENTS AND PROCESS DESCRIPTION

SECTION II Metallurgical Requirements & Process Description

A. Raw Materials

It is Mertec's intention to mine and concentrate an ore body located at Nemegos, Ontario, Canada. This ore essentially contains magnetite, titania and apatite. Concentration at the mine site is necessary in order to remove the saleable apatite constituent. After concentration, it will be necessary to agglomerate the ore in some manner so that it will be in a form suitable for both shipment to the smelting site at Sudbury, Ontario and for handling by normal dry bulk material handling methods after its arrival there.

1. Ore Chemistry

The following is a representative assay of the ore:

Total Fe	48.20%
$T;O_2$	4.68
P	4.01
Titaniterous Magnetite	70.93
Apatite (42% P_2O_5)	21.77
SiO_2	2.03
FeS	2.29
MnO	1.06
Al_2O_3	1.41
CaO + F	12.82
MgO	.53
Alkalies	.31
H_2O	.35
Nb_2O_5	.17
S	.82

It is intended that the concentrator and smelter end products will be a saleable phosphorus bearing apatite, molten iron and a saleable high titania slag.

A. (continued)

2. Concentrate Chemistry

The material coming from the concentrating process is a filter cake containing finely ground (-200 mesh) particles and approximately 10 to 14% water.

As pointed out earlier, this slurry must be agglomerated at the mine site in a yet undefined manner in order to make possible its shipment to and subsequent handling at the smelter. Tests are scheduled in the near future to determine the best method of agglomeration. These tests will be conducted by Ferro-Tech, Inc. of Pittsburgh, Pennsylvania in their Research Laboratory at Grosse Ile, Michigan. It is hoped that these tests will reveal an economical method through either briquetting or pelletization that will yield a form with sufficient green strength to allow its shipping, handling and charging into the smelter without kiln firing.

A typical chemistry of the concentrate follows:

HCl soluble Fe	64.3%
Fe_3O_4	90.2
TiO_2	7.29
P	0.055
Mn	1.03
S	0.070
SiO_2	0.30
Nb_2O_5	0.15
Al_2O_3 (	
CaO (	Balance
MgO	

3. Coal Chemistry

Coal is used as the solid reductant in the smelting process. An ideal analysis is given below:

Volatile matter	17 - 18%
Fixed carbon	75 - 76

A. (continued)

Ash	6.4 - 6.7
Sulfur (max.)	1.0
Phosphorus	0.027
B.T.U./lb.	19,700
Ash fusion temperature	2700° F.

The analysis of the coal ultimately purchased for the process can vary considerably from the above analysis.

The coal ultimately selected for the process should represent the lowest cost per unit of fixed carbon. In addition, a comparative determination should be made whether the level of sulfur introduced into the process by the coal can be economically reduced during the process or it is more economical to purchase low sulfur coal at a premium price.

B. Process Chemistry

1. Material and Energy Balance

The basic design of the furnace is determined by the thermochemical requirements of the process, the material quantities involved and the electrical characteristics of the slag. The following is intended to describe these items in sufficient detail to quantify the principal design criteria of the electric furnace.

(a) Chemistry

A tabulation of the principal constituents of the daily material input and output of the furnace is shown in Table 1. The material balance is also depicted in Figure 1 for a product containing 1000 Kg of molten iron.

Almost complete reduction of the magnetite is expected. The gangue constituents, principally the manganese and niobium oxides, will combine with the titania to produce a slag having at least a 74% content of TiO_2.

B. (continued)

(a) Continued

The thermal requirements of the smelting process reflect the endothermic nature of the reduction of magnetite. The constituent energy units are depicted in Figure 2 and indicate that the chemical requirement indicate a net unit energy of 1.75 mwh per short ton. An allowance for furnace losses raises this figure to 1.85 mwh per short ton.

A furnace load of about 44 mw is required to produce 582 tons of metal per day.

(b) Electrical Characteristics

The electrical conductivity characteristics of the slag determine the volt-ampere rating of the furnace transformer.

The usual conductivity temperature relationship results in a negative gradient. That is, the conductivity increases with temperature and impliedly with power. Electrically this manifests itself in a nearly unvarying voltage between the tip of the electrode and the metallic bath below the slag.

The calculated reactance of the circuit is about one milliohms.

With these criteria it is possible to tabulate the electrical characteristics of the furnace, which are shown in Table II.

A furnace with six; 55" diameter electrodes, each carrying up to 110 Ka, is capable of handling the 44 mw load requirement. This load can be supplied by three 20 mva transformers. The expected power factor will be about 0.84.

C. Process Requirements

1. Raw Materials Required

To produce the finished billets, various raw and process materials must be added at the smelting and refining furnaces. Based on the desired production rate of 180,000 tons per year of finished billets, the following materials are required:

(a) Agglomerated Titaniferous Magnetite ore concentrate - 302,750 tons/year.
size: To be determined for either pellets or briquetts
estimated bulk density: 150 lb./cu. ft.

(b) Smelter Reductant Coal - 62,000 tons/year
size: 2" x down
estimated bulk density: 55 lbs./cu. ft.

(c) Burnt Lime - 4,595 tons/year
size: 1-1/2" x down
estimated bulk density: 65 lbs./cu. ft.

(d) Calcium Carbide - 960 tons/year
size: 1/16" x down
estimated bulk density: 139 lbs./cu. ft.

(e) Quartzite - 1,400 tons/year
size: 1-1/2" x down
estimated bulk density: 110 lbs./cu. ft.

(f) High Carbon-Standard Ferromanganese - 4,600 tons/year
size: 2" x down
estimated bulk density: 260 lbs./cu. ft.

(g) 50% Ferrosilicon - 2,320 tons/year
size: 2" x down
estimated bulk density: 160 lbs./cu. ft.

(h) Siliconmanganese - 600 tons/year
size: 2" x down
estimated bulk density: 245 lbs./cu. ft.

C. (continued)

In addition to the above raw materials, the following are also required to complete the process:

(i) 55" diameter carbon paste electrodes - 2,180 tons/year

(j) 14" diameter graphite electrodes - 500 tons/year

(k) Oxygen - 8,000 tons/year

(l) Argon gas - 475,200 cu. ft./year

(m) Nitrogen gas - unknown (smelting furnace purge)

2. Production Requirements

In order to produce the required tonnage of finished billets, predetermined amounts of raw materials must flow smoothly through the plant. To maintain this flow, the various design criteria listed below were taken into consideration in sizing the bulk material handling equipment for the smelting and refining furnaces, and for the continuous casting machine. Refer to Figure 3 for material requirements.

Plant equipment sizing and operation are based on the following:

(a) The bulk material handling equipment is sized to handle all the unloading requirements during one shift (daylight) per day, 333 days per year. This basis permits equipment to be of an economical size yet allows a built-in margin for necessary maintenance and lag periods. In this way, unloading of the railroad cars can be done during daylight hours only without accruing demurrage charges. Both coal and ore can be unloaded at the same time eliminating tie-ups of the coal or ore trains.

Sufficient bulk materials can be brought into the plant in 8 hours (one shift) to span a 3-1/2 day weekend period. Inside the plant, the material handling equipment sizing is based on the continuous feed requirements of the electric smelting furnace during a 24 hour period.

C. (continued)

(b) The remaining plant equipment is based upon either the maximum loadings encountered during operation, or the maximum feed rates and capacities needed to meet production requirements. The production rates of smelting furnace, refining furnace and casting machine are based on 8,000 operating hours/year (20 turns per week x 50 workweeks per year).

D. <u>Process Description</u> (Refer to Drawing 73-0501)

The large quantity bulk materials will be brought into the plant by the Canadian Pacific Railroad. Continuous operation of the rail facilities transporting the ore concentrate material will be necessary in order to meet the raw material feed requirements of the smelting operation. It is estimated that 4,200 (70 ton) ore cars will be required per year. It is also estimated that 1,000 (70 ton) coal cars will be required per year. All other bulk materials are expected to be trucked into the plant. The required quantities do not warrant rail transport.

As the rail transported raw materials are brought into the plant, they will be directed to their respective track unloading system. Because of the possible length of the trains, it may be necessary to store sections of the train on side spurs while other sections are unloaded. An engine will be required to position the hopper cars over the track unloading hoppers. Covered track unloading sheds have been provided to minimize the effects of weather on the unloading operation.

A material handling man will manually open the hopper car discharge gates to begin the unloading process. From the track hopper sheds, this man will be able to direct the material flow to either the covered yard storage building, or to the bulk storage bins. Position indicating lights will indicate the positions of the tripper conveyors inside the yard storage building. The tripper's flop gate position; the reclaim belt conveyor's flop gate position; which belt conveyor is running inside the material handling building; the belt

D. (continued)

conveyor's plow position; and the level of material inside the various storage bins will also be indicated.

Material flow for the agglomerated ore concentrate is shown on Drawing Number 73-0501. The ore would discharge into the track hopper (1). A vibrating pan conveyor (2) will be used to regulate and maintain a constant feed rate onto a belt conveyor (3) going to the yard storage building. This conveyor will discharge onto a tripper conveyor (4). If all storage bin level indicating lights indicate full conditions, the ore will be discharged inside the yard storage building. Should a storage bin indicate a low level condition, the belt tripper will be positioned at the center of the building near the yard hopper (5). The flop gate inside the tripper will be positioned to direct the material flow to the feed chute and carry the material directly into the yard hopper.

A vibrating pan conveyor (6) below the yard hopper will be used to regulate the material feed rate onto the reclaim belt conveyor (7). At the reclaim conveyor discharge, a flop gate (8) will be positioned to feed the ore onto the belt conveyor (9) feeding the ore bins (10). Dependent upon what storage bin requires filling, the material handling man will remotely lower a pneumatic cylinder operated plow to divert the material to that particular storage bin.

Material flow for the coal would be identical as that of the ore; (11), (12), (13), (14), (6), (7), (8), (15) and (16). Should both materials be unloaded simultaneously from their respective track hoppers, an electrical interlock will prevent both trippers (4) and (14) from unloading into the yard hopper (5) at the same time.

Materials stored in the yard storage building will be reclaimed by a track type front end loader. The material handling man will determine what materials are required at the storage bins (10) and (16) and direct the loader operator to shuttle material from their respective storage areas into the yard hopper feeding the reclaim conveyor. The design criteria for the covered yard storage was to provide a minimum of one months storage of agglomerated ore and

D. (continued)

coal. Bins located inside the storage bin building provide 3-1/2 days storage for weekend operation.

The smelting operation is a rather simple process composed of the following steps:

1. Weighing and mixing dry agglomerated ore, flux and coal to prepare a furnace feed mix.

2. Transferring of batches of this mix to gravity bins located above the furnace.

3. Sequential batch feeding of the mix to various points in the furnace at the rate required to balance the power input to the furnace.

4. Periodically tapping iron from the smelter in order to meet the scheduled requirements of the refining operation and to maintain the desired bath level.

5. Periodically tapping off the slag in order to maintain it at the desired depth.

6. Continuously exhausting the carbon monoxide-carbon dioxide ($CO-CO_2$) gases generated from the smelting reactions of the carbon and iron ore to a fume and gas handling facility, where the exhaust gases are cleaned of particulate material prior to entering the atmosphere.

To prepare the furnace feed mix, agglomerated ore concentrate and coal will be batched into weigh systems located below the storage bins. Batching will be done in electronic weigh hoppers (19); loading first the required agglomerated ore and then the necessary coal. Vibrating pan conveyors (17) and (18) are used to regulate and control the feed rates into the weigh hoppers. Each batching system is designed and sized to provide one batch every six minutes. Combined batching in this system is recommended to mix the furnace feed, however, these two independent systems permit individual batching of each material if desired.

D. (continued)

Burnt lime will be used as a fluxing-agent in the smelting furnace. Addition of the required flux will be through one of the batching systems (19), described above. Bulk storage of the flux will be in a concrete stave silo (20) adjacent to the storage bins. Transport of the required flux will be done with screw conveyors (21) from the silo and into one of the electronic batching systems used for the ore and coal. Lime transport will be by closed hopper trucks. An unloading station with the necessary piping and blowers will be provided. The silo is designed to provide seven (7) days storage capacity.

The ore concentrate, coal and burnt lime are collected on a belt conveyor (22) located below the weigh systems and will discharge into a skip tub assembly (23) located between the storage bins and the smelting furnace. A complete batch of coal, ore and flux is raised to the top of the smelting furnace and discharged into a surge bin (24) every six minutes. Below the surge bin, a flop gate assembly (25) will be used to direct the material flow to either side of the smelting furnace feed systems. Under normal conditions, material feed will discharge equally to both sides of the furnace.

Material from the surge bin will be distributed to twelve holding bins (26); six on each side of the smelting furnace. Material feed into the holding bins will be by belt conveyors (25). The material will be directed into the bins by V-type belt plows. Material level in the holding bins will control the plow operation. As material is conveyed from the surge bin, sequential loading is started at the first holding bin. Upon reaching the full bin condition, the belt plow is automatically raised and the material is directed to the next holding bin where the loading process is repeated. At the same time that these bins are being loaded, sequential material feed begins into the smelting furnace, starting with the first holding bin loaded. Furnace feed is controlled by furnace demand and is regulated by pneumatic cylinder operated slide gates (27) located below the holding bins.

D. (continued)

Dust cleaning for the material handling system will be accomplished by ventilation of fugitive dust emissions at material transfer points. These dust capture points include conveyor and chute discharge at the main bins, vibrating feeder discharge at the weigh hoppers, skip tub loading and discharge points, as well as the furnace charging points. The dust captured at these various transfer points will be conveyed to a fabric filter dust collector for gas cleaning and dust disposal.

A single electric smelting furnace (27) designed to utilize 60,000 KVA is proposed. This furnace is equipped with six 55" diameter electrodes of the continuous self-baking type that are designed to supply the required electrical energy to the ore smelting zones of the furnace. An appropriately designed power supply system consisting of three 20,000 KVA transformers and three heavy current secondary bus systems will transmit power from the high voltage supply substation to the electrodes. Each transformer serves one phase of the three phase power supply system, and transmits power to only two of the six electrodes. Thus each pair of electrodes and its transformer become in essence a single phase furnace. The optimum method of distribution of the heat generated by these three single phase units is to combine them in an in-line configuration.

The dimensions of the rectangular furnace is predicated upon the optimum use of power supplied to each electrode. This produces a bath of molten material within the furnace without overheating the refractories used to contain the reaction zones. This arrangement is best contained by a rectangular shaped furnace approximately 22 feet wide x 66 feet long.

A slag layer comprised of the various non-ferrous, non-metallic constituents of the ore concentrate and other furnace charge materials is formed as the furnace burden melts. This molten slag has a particular resistance to the flow of electricity, which varies with its chemical composition and temperature. Because of this

D. (continued)

characteristic, it can be used as a heat producing medium to furnish the required energy to the process in the same manner as any other electric resistance heating device. This mode of operation is more efficient in the distribution of heat to the reacting raw materials and the molten bath than using arc resistance, which radiates the energy not only to the bath and raw materials but also to other areas of the furnace such as the roof. Arc radiation reduces refractory life and lowers furnace efficiency.

A slag resistance smelting operation is easily controlled electrically and is characterized primarily by the quiet nature and steadiness of the operation. The electric smelting furnace as outlined above is a simple straightforward operation based on proven technology.

The smelting furnace is capable of handling a considerable variation of ore composition and is rather insensitive to changes in the concentrate. It is not dependent upon high cost coking coal, natural gas, or petroleum products and, in comparison to other iron producing facilities, offers the most flexibility in the choice of the solid carbon reductant.

The smelting furnace is slagged prior to tapping the molten iron into one of two outside slag pits (28). Two pits are used to permit alternate tapping and cooling of the slag before removal. These slag pits are sized so that layers 3" to 4" thick can be built-up on top of each other. This facilitates easy removal by a bucket loader. Upon completion of the slagging operation, a clay gun (29) is used to close the slag opening.

As the smelting process progresses, the metal separates from the slag and settles to the bottom of the furnace by virtue of its density. Molten iron is periodically tapped from the side of the furnace, or from the furnace end. Three tap holes are provided on the side of the furnace opposite the transformers. Their use is recommended for better control of the tapping process during the initial start-up of the smelting furnace. After sufficient

D. (continued)

practice in furnace tapping has been gained by the operating personnel, and the smelting practices have been established, end tapping of the furnace can be utilized. Although four taps have been provided, only one will be used per tap. A trolley mounted clay gun (30) is incorporated to close the metal tap hole after tapping.

Molten metal will be tapped into a 55 ton hot metal transfer ladle (31), positioned at a predetermined tap hole. A hot metal transfer car (32), is used to position the ladle at the tap hole. Only one 100 ton hot metal transfer car is required. Once the smelting furnace is running smoothly and end tapping has begun, the transfer car will be moved to the furnace end rails.

After tapping, the ladle transfer car will move the hot metal into the refining furnace aisle. Upon reaching the end of the transfer track, a cylinder operated swing chute (33), will be swung into position over the ladle. At the same time, a manual hose connection must be made to a porous plug, in the hot metal transfer ladle bottom.

The molten iron from the smelter will be treated in the ladle in order to reduce the sulfur content to an acceptable level. In order to do this, a predetermined amount of calcium carbide is added to remove the sulfur from the molten iron. This material is added at the same time that the argon gas is bubbled through the porous plug. The argon aids in the stirring of the calcium carbide into the iron to assure mixing and maximum removal of the sulfur.

The batching of the calcium carbide is done at the additive additions bin (39), and is described with the refining furnace and teeming ladle additive system. It is recommended that because of the small amount of argon required, it be purchased in portable cylinder containers; to be located near the swing chute on the main floor.

Additional equipment required to support the smelting furnace operations includes a 10 ton service crane, a wet scrubber-quencher gas cleaning system and a water cooling tower.

D. (continued)

A 10 ton service crane has been provided above the smelting furnace to position and shuttle 55" diameter electrode shells and carbon electrode blocks to the smelting furnace. This crane will span 60'-0" and will have a maximum lift of 80'-0" above ground level. A service opening and building door have been provided in the smelting furnace building for bringing this material to the 10 ton service crane. It is recommended that the smelting furnace electrode shells and carbon paste be purchased from an outside manufacturer.

The smelter gas cleaning system is located adjacent to the smelter building. The exhaust gases are carried into a quencher and gas scrubber through water cooled ductwork. Here the gases are reduced in temperature and scrubbed of particulate matter. The gases are then exhausted through a stack. A gas pilot and igniter are provided at the stack discharge, to burn-off the exhausting CO. The smelter will be ecologically acceptable and will not emit noxious fumes, since essentially only CO_2 will be the end gaseous product.

The quenching and scrubber water are pumped to the plant clarifier system. Duct cooling water, smelting furnace cooling water, and refining furnace cooling water are piped to a water cooling tower near the smelter building. Once the initial water cooled equipment is filled, only minimal make-up water will be required for make-up of windage and normal blowdown.

The iron is transferred directly to the refining furnace, while still molten, thus resulting in significant power savings in this furnace. This also reduces the time required to produce a heat of steel. Slag will be skimmed from the ladle before pouring the molten iron into the electric arc steel refining furnace.

A removable ladle bail will be used to pick up the ladle. Before removal of the ladle from the transfer car, the 25 ton auxiliary crane hood on the hot metal crane will be connected to the ladle tipping loops. The transfer ladle is then picked up by the hot metal crane main hook. The hot metal crane will have a 100 ton

D. (continued)

capacity main hook with a 25 ton auxiliary hook. This crane will span 70'-0" and will have a maximum lift of 55'-0" above ground.

The purpose of the refining furnace is to convert the molten iron from the smelter into steel of suitable chemistry and to introduce sufficient superheat into the steel to carry out the continuous casting process.

The refining furnace (34) will be a 50 net ton capacity, 15'0" Dia. three phase, electric arc furnace of the type commonly used for scrap melting. The major difference will be the reduced transformer capacity required, because of the hot metal charge. It will be powered by an 8000 KVA transformer instead of the 20,000 to 25,000 KVA transformer normally used on a scrap melting furnace of its capacity.

The steps in the refining cycle would normally be as follows:

1. Swing furnace roof and charge approximately 2.4 tons of revert scrap into the furnace with the melt shop crane using an electro magnet.
2. Charge approximately 48.5 tons of hot metal by lip pouring it into the furnace with the melt shop crane. This is to be done from the charging door side of the refining furnace.
3. Charge approximately 1.5 tons of mixed burnt lime and quartzite per heat, in order to make a synthetic slag.
4. Swing furnace roof closed and begin to simultaneously arc and blow oxygen. Oxygen blow time is approximately 48 minutes @ 1000 SCFM.
5. Work the heat for chemistry.
6. Tap the heat into the casting ladle and take it to the casting machine.

D. (continued)

A typical heat cycle is given below:

Item	Description	Unit Time	Elapsed Time
1.	Swing roof & charge scrap	5.0	5.0
2.	Charge hot metal	10.0	15.0
3.	Add flux & close roof	5.0	20.0
4.	Blowdown carbon	48.0	68.0
5.	Refine	9.0	77.0
6.	Tap	5.0	82.0
7.	Slip electrodes & patch refractories	10.0	92.0

Total Time = 92.0 minutes = 1.53 hours

(a) Oxygen Calculations:

Calculated carbon in hot metal = 2.50%

(-) Desired finished steel carbon (turndown) = 0.10%

Points of carbon to be removed = 2.40%

Furnace capacity = 50 N.T.

Calculated O_2 requirement = 4 SCF O_2 per net ton per point carbon removed

Maximum O_2 required = 240 x 50 x 4 = 48,000 SCF or approximately 2 tons/heat

Assumed maximum O_2 blowing rate = 1,000 SCFM

$$\frac{48{,}000 \text{ SCF}}{1{,}000 \text{ SCFM}} = 48 \text{ minutes maximum } O_2 \text{ blow time}$$

(b) Transformer Size Calculations:

Assumed 105 KWH/N.T. required energy = *

Furnace capacity (nominal) = 50 N.T.

Assumed power factor = 0.8

Desired refining time = 50 minutes - .83 hours

Required transformer KVA = $\frac{105 \times 50}{0.8 \times .83}$ = 7,906 KVA = 8000 KVA transformer

(* - per Lectromelt Corporation)

D. (continued)

(c) Furnace Yield Calculations:

Charge 100% hot metal

Hot metal composition

Fe - 97.3%

C - 2.5%

Fe in slag at 25% FeO = 0.31 tons

(Slag volume 1.5 tons at 3% of charge)

Oxidation loss 0.76 ton at 1.5%

Hence expected yield from charge to liquid steel is taken as 95%. Take heat size as 48 tons.

Charge weight = $\frac{48}{.95}$ = 50.52 tons

Recycled scrap available is 27 tons/day average.

12 heats/day

Hence recycle scrap available/heat = $\frac{27}{12}$ = 2.25 tons

Hot metal required = 50.52 - 2.25 = 48.27

Output from smelting furnace to be 24.25 tons/hour

Hot metal available per day = 582 tons

Recycled scrap per day = 27.0 tons

Total charge = 609 tons/day

Liquid steel output per day at 95% yield = 578 tons, available.

(d) Flux Requirements:

Since hot metal contains little or no silicon, synthetic slag will be required with a basicity ratio of 3 to 1.

At 3 tons of slag per 100 tons of molten metal, approximately 1.5 tons of slag will be required per heat.

Synthetic slag to be prepared from burnt lime and quartzite.

Burnt lime composition: CaO + Mgo = 95% CaO 92%

Quartzite is almost pure SiO_2

Hence 1.15 tons of burnt lime + .35 tons quartzite will be utilized to make 1.5 tons of synthetic slag for each heat.

D. (continued)

To meet the necessary burnt lime storage requirements, a storage silo (37) and unloading system similar to that at the storage bin building, has been provided. Addition of the flux will be by a fork lift truck operating on the refining furnace operating floor. A small portable dump hopper (35), will be positioned on a platform scale (36). Screw conveyors (38), will feed the burnt lime into the hopper until a desired weight or volume is reached. Quartzite is fed into the same dump hopper by a vibrating conveyor. Both will be added into the furnace over the bezel ring while the furnace roof is swung out of position.

Adjacent to the refining furnace will be the alloy batching system. Because of the low tonnages involved with the alloys, it is recommended that they be brought into the plant by truck. Covered storage has been provided at the yard storage building.

Alloys will be loaded by the bucket loader into portable drop bottom dump hoppers at the storage area. They will then be transferred by fork lift truck into the main plant. Once in the plant, they will be connected to a cable sling, raised by the hot metal crane into position over the alloy bins (39) and dumped. Alloys will be batched in the portable dump hoppers as described for the flux additions. Sufficient portable drop bottom and dump hoppers will be provided to prebatch the alloys.

Tapping of the hot metal is into a slide gate equipped hot metal teeming ladle. The ladle will be preheated before the tap. The hot metal ladle and ladle bail will be moved under the furnace tapping spout by the hot metal crane prior to tapping, and will move with the refining furnace as it is tilted. While the ladle is being filled, the preweighed alloy additives will be dumped from the portable hoppers into a floor hopper with a swing chute (41), discharging into the ladle.

A layer of refining furnace slag of 5" - 6" should be put on the ladle for insulation during the casting operation. The balance of the refining furnace slag will be dumped after the hot metal tapping, and prior to the next charging. A slag pit (42) has been

D. (continued)

provided on the ground floor. Periodic slag removal will be by the front end loader. Access has been provided through a door opening in the melt shop building, with sufficient spacing between the furnace support foundations to permit passage of the loader. Upon removal of the slag from the building, it will be discharged into a dump truck and hauled to a land fill site.

In conjunction with the refining furnace, a refining furnace gas cleaning system will be provided. A direct shell tap assembly with water cooled duct, will exhaust emissions from the furnace through the fourth hole. A quencher and gas scrubber are used to clean the gas before exhausting to atmosphere. The quenching and scrubbing water will be processed in the plant clarifying system.

After the tapping operation, the hot metal teeming ladle is transferred to the continuous casting machine (42) and positioned on a ladle pouring stand.

To form the molten steel into saleable billets, a continuous billet casting machine will be used. One (1) three-strand, lowhead, horizontal discharge type continuous billet casting machine (41) with automatic torch cut-off (44) will be installed.

The design criteria for this casting machine will be as follows:

Product	- Plain carbon, silicon killed steel billets
Number of strands	- Three (3)
Casting radius	- 18'-0"
Cutting device	- Automatic torch
Heat size	- 50 Net Tons
Billet size	- 4" x 4" square (cold)
Cut billet lengths	- 120" to 240" (nominal)
Machine speed range	- 25 IPM to 240 IPM
Average Casting Rates	- 4" sq. @ 16 Ton/Hour/Strand
Average Casting Speed	- 120 IPM

D. (continued)

A typical casting cycle is given below:

Description 4" Billets	Time Required (minutes)	Time Elapsed (minutes)
1. Position Tundish	2	2
2. Start Strands	3	5
3. Cast Heat (w/all strands operating)	63	68
4. Lance Tundish, change nozzle and reposition starter chain	20	88
Furnace Cycle Time (minutes)	120	
Casting Cycle Time (-minutes)	88	
Time available in excess of Furnace Cycle (minutes)	32	

The casting cycle time and time elements used are typical of similar continuous casters in operation.

The refining furnace will tap a heat every 2 hours. The caster sizing and throughput creates a 32 minute time lapse between casts. This lapse time will be needed from time-to-time for necessary maintenance and possible production slowdowns, caused by the early termination of a casting strand.

Typically, the casting process would be as follows:

The tundish receives the metal stream from the ladle and acts as a reservoir that distributes molten steel to the three molds. Ceramic nozzles in the tundish are used as metering devices to control the metal flow to the molds. The area (constant) of the nozzle bore and the molten metal head in the tundish control of the casting speed.

Before the cast, a refractory lined tundish should be preheated to approximately 2000° F surface temperature to insure initial metal flow through the nozzles and to minimize molten metal temperature drop. The tundish should be drained of all steel and slag after the cast has ended. It will be imperative to start lancing the tundish with oxygen as soon as possible after the cast in order to maintain the refractory lining in good condition and to enhance

D. (continued)

the possibility of reusing the tundish nozzles. The tundish must be inspected after each cast for lining damage to be repaired before reuse. Refractory lined launders are located above each mold to divert the metal flow away from the mold and into a slag box when necessary. Each launder should be cleaned of metal and slag after every cast.

The molten steel flows into water cooled copper cast molds. The molds provide the product size and the primary heat extraction needed to form the casting outer shell. To minimize sticking of the steel casting to the mold, a lubrication system provides lubricant to the inner surface of the mold. The lubricant flow should be carefully metered so that only a thin carbon residue remains on the mold surface. To assure separation of the solidified shell from the mold wall and to promote lubrication of the surfaces, the mold has an sinusoidal vertical motion produced by a motor driven oscillator. The molds are cooled by water circulated in a closed loop mold water system. The mold water will be treated to insure good heat transfer in the mold jacket by preventing the formation of boiler scale on the water side of the mold tube.

After the billet leaves the mold, it must be sprayed with water to further remove the heat energy contained in the liquid core. This is accomplished in the secondary cooling system with two spray zones. The used water flows into a scale pit and then recycles through the secondary cooling system.

The water sprays are arranged to provide the greatest volume of water near the top of the machine where the solidified shell is weakest, thinnest and where heat extraction is the most effective. The spray pattern has an important influence on the dimensional accuracy and internal quality of the cast section. The cooling intensity and water flow will be dependent on the surface temperature of the strand at the withdrawal unit, the casting speed and the grade being cast.

D. (continued)

At the end of the spray chamber, a withdrawal straightener units takes the arc out of the cast billet and provides the motive force for withdrawing the casting. This unit's driver rolls control the casting speed through a variable speed drive system. The straightening force is attained by hydraulically loading these rolls.

After the billet has been straightened, it is ready to be cut to the desired length by the torch cutting unit. The torch unit is mounted on a carriage that travels parallel to the casting direction. Forward motion and synchronization are accomplished by clamping the torch to the billet. The torch cutting head traverse is cam driven by the billets movement. After the cut, the torch cutting unit returns to its starting position to await the next cut.

The cut billets then runout on a discharge table and are transferred onto the cooling bed prior to removal. A discharge table (45) will have a pusher beam cross transfer mechanism at the end of the casting machine. The billets from all three strands will be swept at right angles to the casting direction and deposited onto the cooling bed (46) by simple push-off equipment. The cooling bed will be designed to hold and entire heat of billets. The cooling bed will be long enough to accept a single row of billets 20 feet and less or a double rows of billets 10 feet and less. The cooling bed will be divided by disappearing stops for double row discharge.

The removal of the cast billets from the cooling bed will be by magnets on the 10 ton service crane. The time required for the billets to cool to the recommended surface temperature for magnetic handling may require the billet to stay on the cooling bed until the start of the next heat.

Mold servicing would be on the intermediate caster platform, molds will be moved by the auxiliary hook on the hot metal crane.

Tundish relining will be accomplished on the ground floor adjacent to the casting machine. A lining maintenance stand will be provided which will allow the tundishes to be tilted to dump the used lining after it has been loosened from the shell. The used brick will be carried out of the shop by the bucket loader.

D. (continued)

In the event of a slide gate or ladle failure, the ladle will be carried away by the hot metal crane back to the refining furnace or be allowed to drain into a pit at the ground floor.

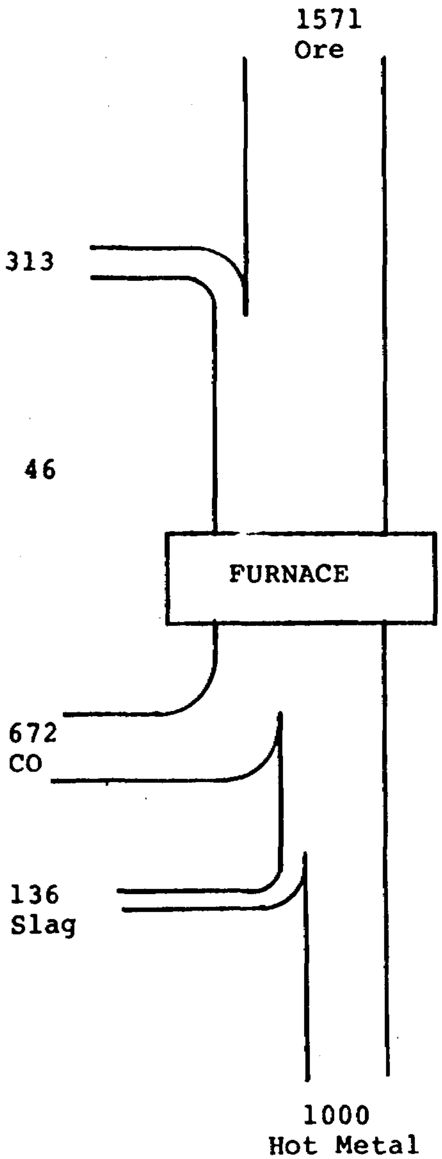
Scrap generated at the caster platform will be charged directly into the furnace. The scrap generated in the casting aisle will be accumulated at the end of the casting shop and periodically taken by truck to the melt shop, dumped and charged at a predetermined rate, into the refining furnace.

The finished billets will be stacked at the end of the casting building prior to shipment. Access doors have been provided at the caster building to provide truck access into the crane bay. Finished billets can be loaded directly into a truck trailer with the service crane. Should Mertec desire additional billet storage, outside storage should be considered. At that time, it is advisable a high capacity fork lift truck be purchased for carrying the billets to the outside storage area.

MERTEC MATERIAL & ENERGY BALANCE

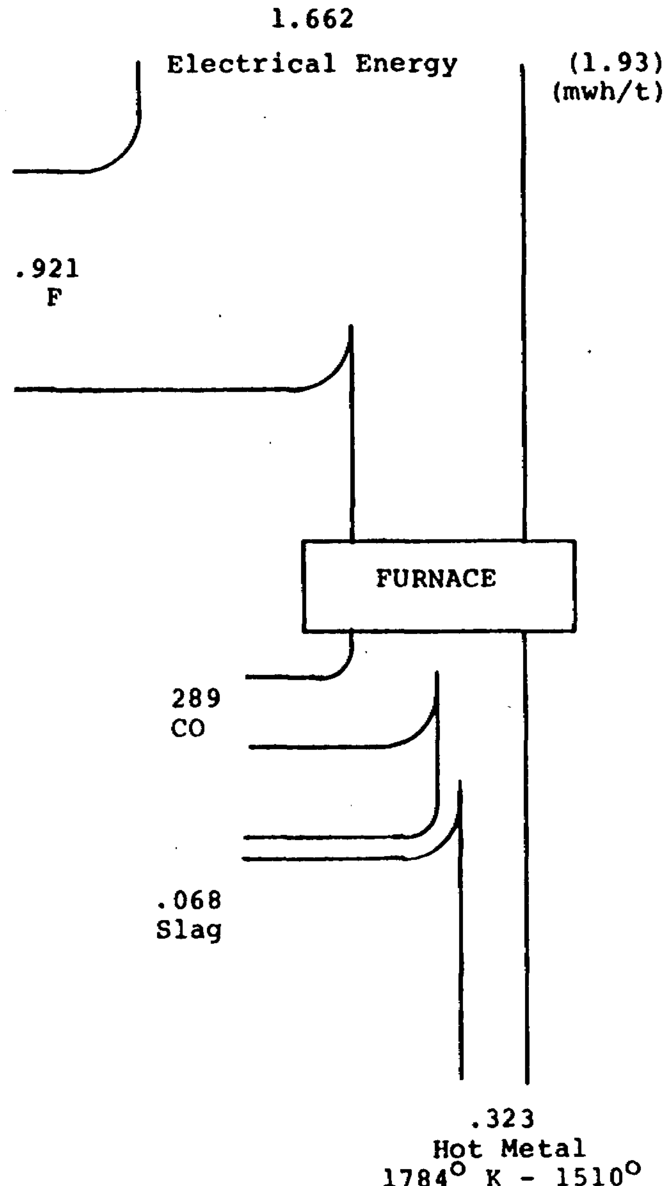
TITANIFEROUS MAGNETITE

FIGURE 1



Material Balance
(Quantities in Kg)

FIGURE 2



Net energy = 1.93 mwh/mt
Actual energy = 2.03 mwh/mt
1.85 mwh/st

Energy Balance
(Quantities in G cal)

Mertec Resources
Contract #6185
September 25, 1974
Revision #1
November 15, 1974

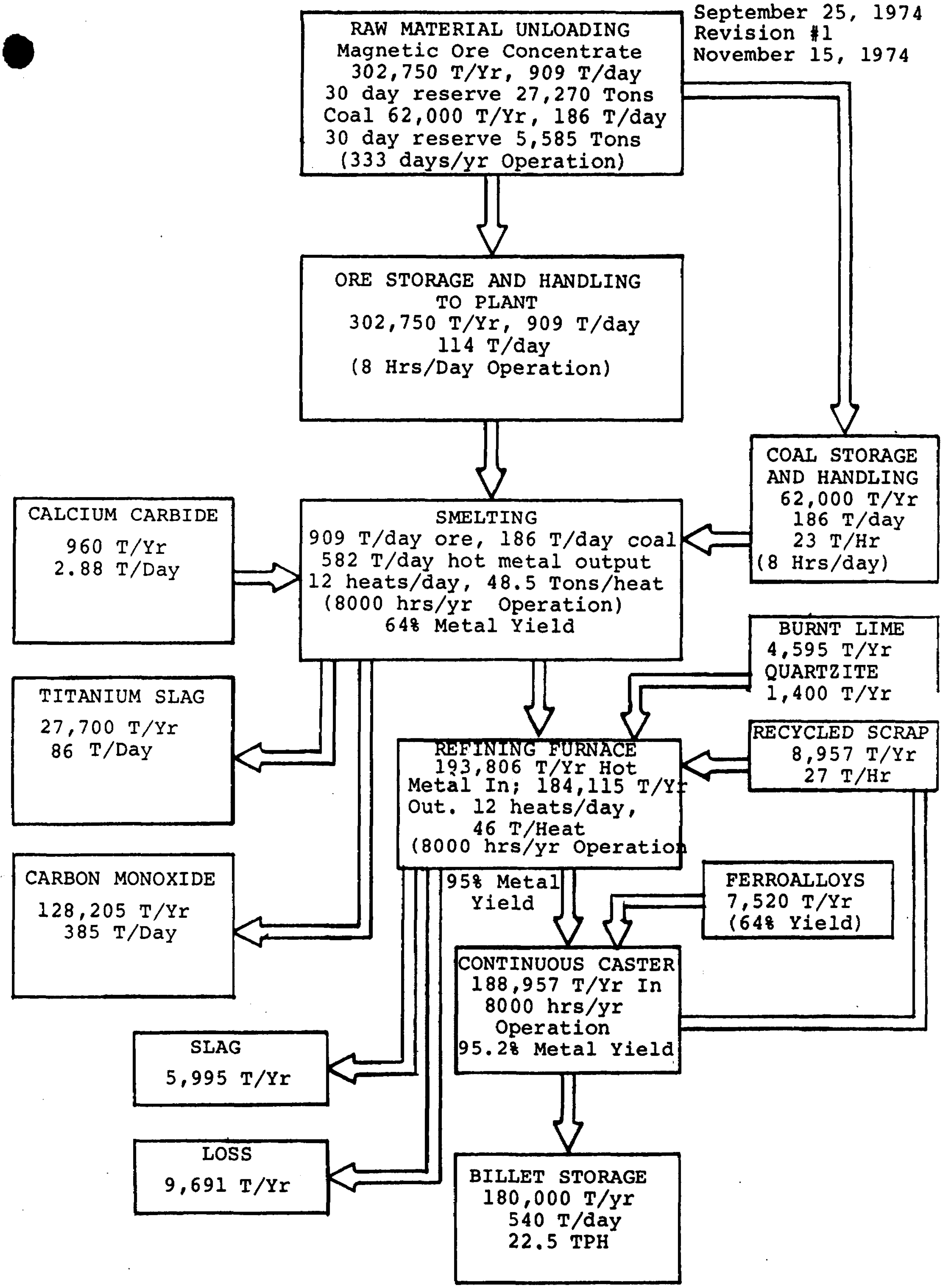


FIGURE III

TABLE I

MERTEC MATERIAL BALANCE

TITANIFEROUS MAGNETITE

Revision No. 1

November 15, 1974

Quantities in t/d

Figures in parentheses = %

		Fe	C	Fe_3O_4	TiO_2	SiO_2	Nb_2O_5	MnO	P_2O_5	S	
Ore	909	584 (64.3)		794 (90.2)	64 (7.29)	2.6 (0.30)	1.3 (0.15)	9.1 1.03	1.1 (0.125)	.6 (.07)	IN
F.C.	186										
Metal	581	565 (97.3)	(14.5) (2.5)							.6* (.1)	
Slag	86				62.2 (74.3)	2.6 (3.1)	1.3 (1.6)	8.8 (10.5)	1.1 (1.3)		OUT
CO	385										

*This figure will be increased because of S in coal.

TABLE II

Mertec Smelting - Titaniferous Magnetite

Primary Voltage = 13.8 KV Secondary Voltage (max) = 197

Elect. Dia. (in.) = 55 XL*1000 = 1 Furnace MW (max) = 48.9

Furnace MW	Trans Volts	Furnace MVA	Furnace MVAR	Power Factor	Primary Amps	K Factor
Secondary Voltage vs. Power @ constant electrode-to-hearth Voltage						
24	157.8	25.5	8.7	0.939	1068	0.237
26	159.4	27.9	10.2	0.93	1169	0.219
28	161.1	30.4	11.9	0.92	1272	0.203
30	162.9	32.9	13.6	0.91	1378	0.19
32	164.8	35.5	15.5	0.899	1487	0.178
34	166.8	38.2	17.5	0.888	1600	0.167
36	168.9	41	19.6	0.877	1715	0.158
38	171.1	43.8	21.9	0.866	1834	0.15
40	173.4	46.7	24.2	0.855	1956	0.142
42	175.8	49.7	26.7	0.843	2083	0.135
44	178.2	52.8	29.3	0.832	2212	0.129
46	180.7	56	32.1	0.82	2345	0.123
48	183.4	59.3	34.9	0.808	2483	0.118
Secondary Voltage vs. power @ constant power factor						
16	103.2	22.6	16	0.707	947	
Secondary Voltage vs. power @ constant current						
Secondary Current = 100 KA						
30	141.4	42.4	30	0.707	1775	
32	146.2	43.9	30	0.729	1835	
34	151.1	45.3	30	0.749	1896	
36	156.2	46.9	30	0.768	1960	
38	161.4	48.4	30	0.784	2026	
40	166.7	50	30	0.8	2092	
42	172	51.6	30	0.813	2159	
44	177.5	53.3	30	0.826	2228	
Secondary Current = 105 KA						
34	150.6	47.4	33.1	0.716	1985	
36	155.2	48.9	33.1	0.736	2045	
38	159.9	50.4	33.1	0.754	2107	
40	164.8	51.9	33.1	0.77	2172	
42	169.7	53.5	33.1	0.785	2236	
44	174.7	55	33.1	0.799	2302	
46	179.9	56.7	33.1	0.811	2371	

TABLE II (continued)

Furnace MW	Trans Volts	Furnace MVA	Furnace MVAR	Power Factor	Primary Amps
	Secondary Current = 110 KA				
36	154.9	51.1	36.3	0.704	2139
38	159.2	52.6	36.3	0.723	2198
40	163.7	54	36.3	0.74	2260
42	168.2	55.5	36.3	0.756	2322
44	172.9	57	36.3	0.771	2387
46	177.6	58.6	36.3	0.785	2452
48	182.4	60.2	36.3	0.797	2518

12.3 ENVIRONMENTAL PROTECTION

SECTION III Environmental Protection

A. Smelter Gas Cleaning System

1. System Description

The waste gas cleaning system will control particulate and carbon monoxide emissions from the smelting furnace. The gases will be extracted from an exhaust hole in the smelter roof, cleaned particulate matter in the quencher/scrubber unit, and burned to carbon dioxide and water vapor in the flare stack.

The combustion of CO at the furnace exhaust hole will be suppressed by lowering a movable shirt (an extension of the evacuation duct) toward the furnace exhaust opening, thereby adjusting the gap and controlling ambient combustion air indraft into the evacuation duct. The controlled combustion system results in significantly lower waste gas volume than a full combustion system, with consequent savings in scrubber and fan costs.

The smelter waste gases will be cooled to about 1850° F in the water cooled evacuation duct before entry into the quencher/scrubber unit, as shown on drawing 75-1000. The quencher venturi will further cool the waste gases to approximately 167° F, while simultaneously removing 75-80% of the dust. Further cleaning of the waste gas will take place in the scrubber venturi, so that the dust concentration in the gases discharged from the flare stack will be 0.05 gr/dscf or less. A flare burner atop the stack will burn the combustible CO gas to carbon dioxide and water vapor.

2. System Performance

The particulate emission rate from the smelter waste gas cleaning system will yield a particulate concentration in the ambient air at the plant property line which is within the limitations of the Ontario Provincial Ministry of the Environment, Air Management Branch.

A. (continued)

3. System Design - Smelting Furnace Fume Collection System

Volume	SCFM	ACFM at 3000° F
CO	7140	47,250
CO_2	0	0
H_2	0	0
H_2O	0	0
N_2	0	0
O_2	0	0
	7140 SCFM	47,250 ACFM @ 3000° F

(a) Temperature Profile in Hood

To determine hood diameter.

Volume = 47,250 ACFM

Velocity desired = 4000 feet/min.

$$\pi D^2/4 = \frac{47,250}{4,000}$$

Take D as 3.5 feet

Number of tubes = 59

Tube OD = 1.5"

Tube wall thickness = .188"

Bar thickness = .375"

Water Flow = 1500 GPM

Inlet gas temperature = 3000° F

Gas Emissivity = .4

Water inlet temperature = 85° F outlet temperature = 115° F

(b) To Determine Fan Size

Inlet temperature = 3000° F

Fan inlet volume = 15,559 ACFM

Processed gas volume = 7140 dry

Water vapor volume = 3197 SCFM

Gas density = 0.0465 lbs./cu.ft.

Temperature at fan inlet = 150° F

A. (continued)

(b) (continued)

I.D. Horsepower = 245

Water flow to scrubber = 154 GPM

Water pumped to quencher = 160 GPM

Make-up spray water = 21 GPM

B. Refining Furnace Gas Cleaning System

1. The waste gas cleaning system will control particulate and carbon monoxide emissions from the refining furnace. A full combustion system will be used because the refining furnace cannot be tightly sealed against ambient air infiltration. The gases will be evacuated through a fourth hole in the furnace roof, with full combustion of the CO taking place in the water cooled evacuation duct.

   The refining furnace off-gases will be cooled to about 1600° F in the evacuation duct before entry into the quencher/scrubber unit, as shown on the flow sheet, drawing 75-1000. The quencher venturi will further cool the gas to approximately 174° F, while simultaneously removing 75 - 80% of the dust. Further cleaning of the waste gas occurs in the scrubber venturi, so that the dust concentration in the gases discharged to the atmosphere will be 0.05 gr/dscf or less.

2. System Performance

   The particulate emission rate from the refining waste gas cleaning system will yield a particulate concentration in the ambient air at the plant property line which is within the limitations of the Ontario Provincial Ministry of the Environment, Air Management Branch.

3. System Design - Refining Furnace Fume Collection System

   Oxygen Lancing Rate = 1,000 SCFM

C. Material Handling Gas Cleaning System

1. System Description

The gas cleaning system will collect the dust generated during coal and ore handling. Dusty gases will be ventilated from the various transfer points by close-fitting hoods and conveyed to a fabric filter dust collector (refer to drawing 75-1001). The dust captured by the filter bags will be removed automatically by a shaker mechanism, and removed for disposal or recycle by a screw conveyor.

2. System Performance

The performance of the system shall be such that the emissions from the material handling operations will result in a particulate concentration in the ambient air at the plant property line which is within the limitations of the Ontario Provincial Ministry of the Environment, Air Management Branch.

D. Water System Description and Performance

The water used to scrub the smelting and refining furnace gases will be recycled to prevent any environmental pollution. The slurry formed in the two scrubbers will flow to a common thickener. The sludge formed in the thickener will then be pumped to vacuum filters for dewatering, while clear water from the thickener and vacuum filters will be recirculated as scrub water in the closed system.

12.4 EQUIPMENT REQUIREMENTS

SECTION IV - EQUIPMENT REQUIREMENTS

Major Equipment Specifications

A. Material Handling Equipment consisting of:

1. Ore Unloading Hopper - one (1)
   A. 12'-0" x 12'-0" reinforced steel track hopper 6'-0" deep.
   B. Welded construction, 1/2" thick, T-1 steel plate.
   C. 60° sloping sides.

2. Electro-Mechanical Vibrating Pan Conveyor - one (1)
   A. Capacity 210 TPH @ 150 PCF ore concentrate.
   B. Size - 24" wide flat pan.
   C. Length - 96" long trough.
   D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.
   E. Included - removable 1/4" thick A.R. liner plates.

3. Belt Conveyor - one (1)
   A. Capacity 210 TPH @ 150 PCF ore concentrate.
   B. Size - 24" wide belt @ 200 FPM
   C. Length - 222'-0" center to center pulleys, 58'-0" lift 15° slope.
   D. Motor - 30 HP, 575 volt, 3 phase, 60 hertz.
   E. Included - 20° troughing idlers, lagged head pulley with holdback, skirtboards, belt scraper and gravity take-up.

4. Coal Unloading Hopper - one (1)
   A. 12'-0" x 12'-0" reinforced steel track hopper, 6'-0" deep.
   B. Welded construction, 1/2" thick, T-1 steel plate.
   C. 60° sloping sides.

5. Electro-Mechanical Vibrating Pan Conveyor - one (1)
   A. Capacity 210 TPH @ 55 PCF coal.
   B. Size - 36" wide flat pan.
   C. Length - 96" long trough.

Major Equipment Specifications (continued)

5. Electro-Mechanical Vibrating Pan Conveyor - continued
   D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.
   E. Included - removable 1/4" thick A.R. liner plates.

6. Belt Conveyor - one (1)
   A. Capacity 210 TPH @ 55 PCF coal.
   B. Size - 30" wide belt @ 300 FPM.
   C. Length - 262'-0" center to center pulleys, 58'-0" lift, 15° slope.
   D. Motor - 30 HP, 575 volt, 3 phase, 60 hertz.
   E. Included - 20° troughing idlers, lagged head pulley with hold back, skirtboards, belt scraper and gravity take-up.

7. Ore Belt Tripper Conveyor - one (1)
   A. Capacity 210 TPH @ 150 PCF ore concentrate.
   B. Size - 24" wide belt @ 200 FPM.
   C. Length - 145'-0" center to center pulleys.
   D. Motors - 7-1/2 HP, conveyor drive, 7-1/2 HP tripper, 575 volt, 3 phase, 60 hertz.
   E. Included - 20° troughing idlers, lagged head pulley, belt tripper w/flop gate, 130'-0" lg, rails, belt scraper and gravity take-up.

8. Coal Belt Tripper Conveyor - one (1)
   A. Capacity 210 TPH @ 55 PCF coal.
   B. Size - 30" wide belt @ 300 FPM.
   C. Length - 145'-0" center to center pulleys.
   D. Motors - 7-1/2 HP conveyor drive, 7-1/2 HP tripper, 575 volt, 3 phase, 60 hertz.
   E. Included - 20° troughing idlers, lagged head pulley, belt tripper w/flop gate, 130'-0" lg. rails, belt scraper and gravity take-up.

Major Equipment Specifications (continued)

9. Tripper Conveyor Transfer Chutes - two (2)
   A. Welded construction, 3/8" thick, T-1 steel plate.

10. Yard Reclaim Hopper - one (1)
    A. 12'-0" x 12'-0" reinforced steel hopper, 6'-0" deep.
    B. Welded construction, 1/2" thick, T-1 steel plate.
    C. 60° sloping sides.

11. Electro-Mechanical Vibrating Pan Conveyor - one (1)
    A. Capacity 210 TPH @ 55 PCF coal and 150 PCF ore concentrate.
    B. Size - 36" wide flat pan.
    C. Length - 96" long trough.
    D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.
    E. Included - removable 1/4" thick A.R. liner plates.

12. Reclaim Belt Conveyor - one (1)
    A. Capacity 210 TPH @ 55 PCF coal and 150 PCF ore concentrate.
    B. Size - 30" wide belt @ 300 FPM.
    C. Length - 255'-0" center to center pulleys, 67'-0" lift, 15° slope.
    D. Motor - 30 HP, 575 volt, 3 phase, 60 hertz.
    E. Included - 20° troughing idlers, lagged head pulley with hold-back, skirtboards, belt scraper and gravity take-up.

13. Discharge Chute and Flop Gate Assembly - one (1)
    A. Welded construction, 3/8" thick, T-1 steel plate.
    B. Pneumatic cylinder operated flop gate.
    C. Electrical remote position indicator.

14. Ore Belt Conveyor w/Plows - one (1)
    A. Capacity 210 TPH @ 150 PCF ore concentrate.
    B. Size - 24" wide belt @ 300 FPM.
    C. Length - 67'-0" center to center pulleys.

Major Equipment Specifications (continued)

14. Ore Belt Conveyor w/Plows (continued)
    - D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.
    - E. Included - full length skirtboards with covers and three (3) pneumatic operated V-type belt plows with discharge chute, troughed 20° idlers with slider plate under plow section.

15. Coal Belt Conveyor w/Plows - one (1)
    - A. Capacity 210 TPH @ 55 PCF coal.
    - B. Size - 30" wide belt @ 300 FPM.
    - C. Length - 67'-0" center to center pulleys
    - D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.
    - E. Included - full length skirtboards with covers and discharge chute, troughed 20° idlers with slider plate under plow section.

16. Ore Storage Bins - four (4)
    - A. 20'-0" x 20'-0" reinforced steel bin, 23'-0" deep, straight sides, with 13'-0" deep sloping bottom.
    - B. Welded construction, 3/8" thick mild steel side plates and 3/8" thick T-1 steel bottom plates.
    - C. 60° sloping bottom sides.

17. Coal Storage Bins - four (4)
    - A. 20'-0" x 13'-0" reinforced steel bin, 23'-0" deep, straight sides with 13'-0" deep sloping bottom.
    - B. Welded construction, 3/8" thick mild steel side plates and 3/8" thick T-1 steel bottom plates.
    - C. 60° sloping bottom sides.

Major Equipment Specifications (continued)

18. Electro-Mechanical Vibrating Pan Conveyors - four (4)
    A. Capacity 225 TPH @ 150 PCF ore concentrate.
    B. Size - 24" wide flat pan.
    C. Length - 84" long trough.
    D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.
    E. Included - removable 1/4" thick A.R. liner plates.

19. Electro-Mechanical Vibrating Pan Conveyors - four (4)
    A. Capacity 60 TPH @ 55 PCF coal.
    B. Size - 24" wide flat pan.
    C. Length - 84" long trough.
    D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.
    E. Included - removable 1/4" thick A.R. liner plates.

20. Weigh Hopper System - two (2)
    A. Capacity 125 cu. ft. hoppers.
    B. Size - 5'-0" x 5'-0" welded steel hopper, 4'-0" deep, straight sides with sloping bottom.
    C. Weigh system - electronic load cell arrangement.
    D. Accuracy - ± 1/2 of 1%.
    E. Scale indication - 12,000 # maximum.
    F. Included - full automatic controls with local readout and totalization system controls. Pneumatic cylinder operated rolling blade gate valve discharge.

21. Collecting Belt Conveyor - one (1)
    A. Capacity 280 TPH @ 110 PCF coal-ore concentrate mix.
    B. Size - 30" wide belt @ 200 FPM.
    C. Length - 67'-0" center to center pulleys.
    D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.
    E. Included - 20° troughing idlers, lagged head pulley, full length skirtboards, belt scraper and screw take-up.

Major Equipment Specifications (continued)

22. Skip Hoist Tub and Rail Assembly - one (1)
    A. Capacity 125 cu.ft. skip tub, 12,000 # maximum.
    B. Lift - 80'-0" overall.
    C. Speed - 80 FPM.
    D. Motor - 25 HP, 575 volt, 3 phase, 60 hertz.
    E. Included - hoist drive, wire rope, sheaves, loading chute, rail assembly.

23. Surge Bin and Flop Gate Assembly - one (1)
    A. 6'-0" x 6'-0" reinforced steel bin, 6'-0" deep straight sides, with sloping bottom.
    B. Welded construction, 3/8" thick T-1 steel plate.
    C. Pneumatic cylinder operated flop gate.
    D. Electrical remote position indicator.

24. Belt Conveyor with Plows - one (1)
    A. Capacity 30 TPH @ 110 PCF coal-ore concentrate.
    B. Size - 24" wide belt @ 100 FPM.
    C. Length - 78'-0" center to center pulleys.
    D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.
    E. Included - full length skirtboards with covers and five (5) pneumatic operated V-type belt plows with discharge chute. Troughed 20° idlers with slider plate under plow section.

25. Belt Conveyor with Plows - one (1)
    A. Capacity 30 TPH @ 110 PCF coal-ore concentrate.
    B. Size - 24" wide belt @ 100 FPM.
    C. Length - 84'-0" center to center pulleys.
    D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.
    E. Included - full length skirtboards with covers and five (5) pneumatic operated V-type belt plows with discharge chute. Troughed 20° idlers with slider plate under plow section.

Major Equipment Specifications (continued)

26. Holding Bins - twelve (12)
    A. 4'-0" x 4'-0" reinforced steel bin, 4'-0" deep straight sides with sloping bottom.
    B. Welded construction 3/8" thick T-1 steel plate.
    C. Pneumatic cylinder operated slide gate valve discharge.

27. Additive and Flux Storage Bins - five (5)
    A. 7'-0" x 10'-0" reinforced steel bins, 5'-0" deep, straight sides with sloping bottom.
    B. Welded construction, 3/8" thick, T-1 steel plate.

28. Electro-Mechanical Vibrating Pan Conveyors - five (5)
    A. Capacity - 35 TPH, FeMn @ 260 PCF - 1 required.
       18 TPH, FeSi @ 160 PCF - 1 required.
       15 TPH, SiMn - 1 required.
       15 TPH, Calcium Carbide @ 75 PCF - 1 required.
       15 TPH, Quartzite @ 110 PCF - 1 required.
    B. Size - 12" wide flat pan.
    C. Length - 72" long trough.
    D. Motor - 1-1/2 HP, 575 volt, 3 phase, 60 hertz.
    E. Included - removable 1/4" thick A.R. liner plates.

29. Portable Drop Bottom Hoppers - ten (10)
    A. Capacity - 40 $Ft.^3$
    B. Included - crane sling pick-up points and fork truck lift guides.

30. Portable Dump Hoppers - five (5)
    A. Capacity - 20 $Ft.^3$
    B. Included - dump mechanism and fork truck lift guides.

31. Additive and Flux Floor Dump Hoppers - two (2)
    A. 4'-0" x 4'-0" steel bins.
    B. Welded construction, 3/8" thick, T-1 steel plate.
    C. Included - bar grizzly cover, cylinder operated swing gate with replaceable end, shut-off gate.

Major Equipment Specifications (continued)

32. Flux Pneumatic Truck Unloading System - two (2)
    A. Capacity - 35 TPH, lime @ 65 PCF.
    B. Description - positive pressure pneumatic system complete with blowers, rotary feeders, piping and bin receiver. Approximately 100'-0" horizontal run, 95'-0" vertical run.
    C. Motors - 150 HP blower, 2 HP rotary feeder.

33. Flux Storage Silo - one (1), concrete stave silo.
    A. Capacity - 4550 cu. ft., 140 ton burnt lime @ 65 PCF.
    B. Size - 30'-0" diameter x 87'-0" high overall, elevated floor 25'-0" above base.
    C. Included - ladders, handrails, two discharge openings, one top mounted feed opening, one manhole opening.

34. Flux Storage Silo - one (1), concrete stave silo.
    A. Capacity - 4550 cu. ft., 140 ton burnt lime @ 65 PCF.
    B. Size - 30'-0" diameter x 77'-0" high overall, elevated floor 15'-0" above base.
    C. Included - ladders, handrails, two discharge openings, one top mounted feed opening, one manhole opening.

35. Screw Conveyors - two (2)
    A. Capacity - 15 TPH, lime @ 65 PCF.
    B. Size - 12" diameter, 30% loading.
    C. Length - 30'-0" center inlet to center discharge.
    D. Motor - 3 HP, 575 volt, 3 phase, 60 hertz.

36. Screw Conveyors - two (2)
    A. Capacity - 15 TPH, lime @ 65 PCF.
    B. Size - 12" diameter, 30% loading.
    C. Length - 40'-0" center inlet to center discharge.
    D. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.

Major Equipment Specifications (continued)

B. Smelting Furnace - one (1)

A. Capacity 60 MVA with six 55" diameter electrodes, three 20 MVA transformers.

B. Size - furnace shell length - 66'-0" width, 22'-0".

C. Maximum electrode current - 173 KA secondary voltage: lowest reduced current 31 volts, lowest full capacity 182 volts, top voltage 200 volts.

D. Included - furnace body, furnace shell and grillage, furnace shell cooling, doors and tapping spouts, roof and refractory lining gas off-take.

Electro columns including contact plates, power tubes, pressure ring, fume seals, electrode mantles, electrode suspension frames, electrode holding and slipping bands, hydraulic electrode positioning cylinders, electrode position indicators, guide roller assemblies, combination mantle blower and heater assemblies, hydraulic power unit for electrode positioning and slipping.

Power supply, including disconnect switches, oil circuit breaker, single phase FOW furnace transformers, secondary circuit with aluminum bus and bus enclosures flexible conductors and miscellaneous electrical.

Instrumentation and controls including potential transformers, control and instrument panels, solid state electrode position controller, transformer tap adjustment electrode slipping controls.

E. Motors - 575 volts, 3 phase, 60 hertz.

Electrode positioning hydraulic pumps six (6) - 15 HP
Spare electrode positioning hydraulic pumps three (3) - 15 HP
Electrode slipping hydraulic pumps three (3) - 15 HP
Spare electrode slipping hydraulic pumps three (3) - 7-1/2 HP
Fume seal fans six (6) - 1 HP
Mantle heater blowers six (6) - 3 HP
Furnace bottom cooling blowers four (4) - 15 HP

Major Equipment Specifications (continued)

C. Refining Furnace - one (1)

A. Capacity 55 ton heat, 8 MVA transformer, three 14" diameter electrodes.

B. Size - 15'-0" diameter shell.

C. Included - furnace shell cooling, furnace tilting mechanism, doors and tapping spouts, roof and refractory lining, roof lift and swing mechanism.

Electro columns including contact plates, power tubes, pressure ring, fume seals, electrode mantles, electrode suspension frames, electrode holding and slipping bands, hydraulic electrode positioning cylinders and hydraulic power unit.

Power supply including disconnect switches, oil circuit breaker, single phase FOW furnace transformer, secondary circuit with aluminum bus and bus enclosures, flexible conductors and miscellaneous electrical.

Instrumentation and controls including potential-transformers, control and instrument panels, solid state electrode position controller, transformer tap adjustment, electrode slipping controls.

D. Motors - 575 volt, 3 phase, 60 hertz.
Hydraulic pump one (1) - 40 HP.
Electrode winch motors three (3) - 20 HP.
Slag door one (1) - 3 HP.
Transformer pump one (1) - 5 HP.
Side door one (1) - 3 HP.

Major Equipment Specifications (continued)

D. Continuous Casting Machine - one (1)

A. Initial cast billet - 4" x 4" (nominal).

B. Cast billet size range 3-1/2" x 3-1/2" thru 6" x 6" cold (nominal).

C. Casting radius - 18'-0".

D. Billet length - 10'-0" min. - 20'-0" max.

E. Machine speed - 240"/minutes max.

F. Number of strands - three (3).

G. Heat size - 50 tons.

H. Cutting device - torch cut-off.

I. Included -
(a) 1-casting machine support structure casting ladle support structure.
(b) 1-tundish car w/rails.
(c) 6-tundishes w/covers and refractories.
(d) 1-slag box w/3 launders, 1-overflow chute and refractories.
(e) 1-tundish heating station.
(f) 25-mold tubes to cast 4" x 4" billets.
(g) 6-mold jacket assemblies w/foot rolls.
(h) 1-mold template.
(i) 1-mold lubrication system.
(j) 3-mold tables and oscillation mechanism.
(k) 3-spray apron guides.
(l) 3-guide chutes.
(m) 1-spray chamber and chamber exhaust system.
(n) 3-combination straighteners and withdrawal units.
(o) 3-torch approach tables.
(p) 3-torch cut-off units and supports.
(q) 3-dummy bars.
(r) 3-dummy bar heads for 4" x 4" billets.
(s) 3-dummy bar storage racks.
(t) 3-runout tables.
(u) 3-end stops.
(v) 3-billet pusher systems.

Major Equipment Specifications (continued)

D. Continuous Casting Machine - continued

I. Included - continued

(w) 1-cooling bed storage system, 20'-0" long billets maximum.

(x) 1-machine lubrication system.

(y) 1-lot instrumentation and control equipment.

(z) 1-lot electrical equipment.

(aa) 1-tundish repair station w/4 support stands.

(bb) 1-hydraulic system.

(cc) 3-mold level control systems.

(dd) 1-lot utility piping.

J. A.C. Motors - 575 volt, 3 phase, 60 hertz.
tundish car, two 3 HP,
oscillator, three 7-1/2 HP,
mold lub, three 1/4 HP,
spray chamber exhaust, one 15 HP,
runout table, fifty 1 HP,
hydraulic power unit, two 15 HP,
two 40 HP.

K. D.C. Motors - straightener and withdrawal units, six 5 HP S.C.R. variable speed.

Auxiliary Equipment Specifications (continued)

A. Equipment consisting of:

1. Track Type Bucket Loader - one (1)
   - A. Capacity 2-1/4 cu.yd. SAE rated bucket, 4000#/cu.yd. material maximum.
   - B. Motor - diesel engine with electric start, glow plug starting kit and engine block heater.
   - C. Drive - torque converter.
   - D. Included - enclosed steel cab with winterization kit, (heater, defroster).

2. Clay Guns - two (2)
   - A. Capacity - 3 cu.ft.
   - B. Power requirements - gun 15 HP, trolley 3 HP.
   - C. Included - monorail w/trolley drive, pendant controlled.

3. Service Crane - one (1)
   Heavy duty, pendant controlled, electric overhead traveling, steel mill crane, indoor operation, intermittent basis. Service Class D.
   - A. Capacity - 10 ton.
   - B. Bridge span - 60'-0".
   - C. Bridge travel speed - 350 FPM.
   - D. Lift - 80'-0".
   - E. Hoisting speed - 50 FPM.
   - F. Trolley speed - 150 FPM.
   - G. Motors, 40 HP main, 5 HP trolley, 20 HP bridge, 575 volts, 3 phase, 60 hertz.

4. Hot Metal Crane - one (1)
   Heavy duty, cab controlled, electric overhead traveling steel mill crane, indoor operation, service class E, continuous basis.
   - A. Capacity - 100 ton main hoist, 25 ton auxiliary hoist.
   - B. Bridge span - 70'-0".
   - C. Bridge travel speed - 250 FPM.

Auxiliary Equipment Specifications (continued)

4. Hot Metal Crane - continued
   D. Lift - main hoist - 55'-0", auxiliary hoist - 55'-0".
   E. Hoisting speed - main 15 FPM, auxiliary 50 FPM.
   F. Trolley speed - 110 FPM.
   G. Motors - 125 HP main, 100 HP auxiliary, 30 HP trolley, 100 HP bridge, 575 volt, 3 phase, 60 hertz.

5. Hot Metal Transfer Car - one (1)
   A. Capacity - 100 ton.
   B. Travel - 135 ft. initial.
   C. Speed - 20 FPM.
   D. Motor - 200 HP, 575 volt, 3 phase, 60 hertz.
   E. Included - power rail pick-up and controls.

6. Hot Metal Charging Ladles - three (3) pouring type.
   A. Capacity - 55 ton.
   B. Trunnion centers - 9'- 8-1/4"

7. Hot Metal Teeming Ladles - three (3)
   A. Capacity - 50 ton.
   B. Trunnion centers - 9' - 8-1/4"
   C. Included - hydraulic operated slide gate valve discharge.

8. Ladle Slide Gate Valve Operator and Hydraulic System - one (1)
   A. Motor - 10 HP.

9. Hot Metal Charging Ladle Bail - one (1)
   A. Trunnion centers - 9'- 8-1/4"

10. Hot Metal Teeming Ladle Bails - two (2)
    A. Trunnion centers - 9'- 8-1/4"

Auxiliary Equipment Specifications (continued)

11. Platform Scales - three (3)
    A. Capacity - 0 to 3000# dial.
    B. Size - 3'-0" x 4'-0" platform.
    C. Accuracy - ± 1%.
    D. Included - local dial indication and totalization.

12. Service Crane - one (1)
    Heavy duty, cab controlled, electric overhead traveling steel mill crane, indoor operation, continuous basis. Class D.
    A. Capacity - 10 tons main hoist, 5 tons auxiliary hoist.
    B. Bridge span - 70'-6".
    C. Bridge traveling speed - 100 FPM.
    D. Lift - 20'-0" main and auxiliary hoist.
    E. Hoisting speed - 35 FPM main and auxiliary hoist.
    F. Trolley speed - 150 FPM.
    G. Motor - 30 HP main, 15 HP auxiliary, 5 HP trolley, 20 HP bridge, 575 volt, 3 phase, 60 hertz.

13. Smelting Furnace Gas Cleaning System - one (1) - suppressed combustion wet scrubber system.
    A. Capacity - 32,000 ACFM @ quencher inlet
       14,500 ACFM @ scrubber,
       16,000 ACFM @ fan
    B. Motor - 300 HP, 575 volt, 3 phase, 60 hertz.
    C. Included - One (1) - 80' long x 42" dia. tube-bat-tube water cooled duct assembly.
       One (1) - quencher unit, 32,000 inlet CFM @ 1850°F, 7' diameter, 10" W.C. AP.
       One (1) - venturi unit, 14,500 inlet CFM @ 167°F, 7' diameter, 50" W.C. AP.
       One (1) - I.D. fan, 16,000 ACFM @ 150°F, W.C., radial tip wheel, anti-friction bearings, with inlet louver dampers and damper actuator.
       One (1) - 300 HP motors TEFC w/coupling (1200 RPM).

Auxiliary Equipment Specifications (continued)

13. Smelting Furnace Gas Cleaning System - continued

C. Included (continued)

One (1) - stack 130' high x 3' dia. with igniter and flare assembly.

One (1) - lot of ductwork, 60 lineal ft., 3' dia. plate duct, 3/16" thick.

Three (3) - explosion doors and discs.

14. Refining Furnace Gas Cleaning System - one (1) full combustion evacuation system with wet scrubber.

A. Capacity - 49,300 ACFM @ quencher inlet
27,500 ACFM @ scrubber
29,400 ACFM @ fan

B. Motor - 500 HP, 575 volt, 3 phase, 60 hertz.

C. Included - one (1) - 35' long x 4" dia. tube-bar-tube water cooled duct assembly.

one (1) - quencher unit, 49,300 inlet CFM @ 1600"F, 7' diameter, 10" W.C. AP.

one (1) - venturi unit, 27,500 inlet CFM @ 174°F, 7' diameter, 50 W.C. AP.

one (1)-500 HP motor with coupling, 1200 RPM, TEFC.

one (1) - I.D. fan 29,400 ACFM @ 150°F, 70" W.C., radial tip wheel, anti-friction bearings, with inlet louver dampers and damper actuator.

one (1) - stack 130' high x 3.5 dia. (without any igniter, etc.)

one (1) - lot of ductwork, 60 lineal ft., 3.5 dia. plate duct, 3/16" thick.

Auxiliary Equipment Specifications (continued)

15. Smelting Furnace and Refining Furnace Cooling Tower and Pump - one (1)
    A. Capacity - 1852 GPM, 156,000 CFM, 20°F temp. drop.
    B. Size - 36'-0" lg. x 7'-7" wide x 11'-0" high, pump 12" x 10".
    C. Motors - blowers (6) 20 HP, pump 200 HP, 575 volts, 3 phase, 60 hertz.

16. Continuous Caster Mold Heat Exchanger - one (1)
    A. Capacity - 1230 GPM
    B. Size - 43'-0" lg. x 9'-6" wide x 17'-0" high.
    C. Motors - blowers (4) 20 HP, 575 volt, 3 phase, 60 hertz.

17. Continuous Caster Scale Pit - one (1), pumps (3)
    A. Capacity - 705 GPM, pump 100 TDH.
    B. Size - pump 8" x 6".
    C. Motor - 30 HP, 575 volt, 3 phase, 60 hertz.

18. Continuous Caster Spray Pump - two (2)
    A. Capacity - 1236 GPM, 50 TDH.
    B. Size - 10" x 8".
    C. Motor - 25 HP, 575 volt, 3 phase, 60 hertz.

19. Mold Water Recirculation Pump - one (1)
    A. Capacity - 1230 GPM, 30 TDH.
    B. Size - 10" x 8".
    C. Motor - 20 HP, 575 volt, 3 phase, 60 hertz.

20. Clarifier - one (1)
    A. Capacity - 1235 GPM.
    B. Size - 50'-0" diameter, 1960 $ft.^2$ settling area.
    C. Motor - 3 HP, 575 volt, 3 phase, 60 hertz.
    D. Included - powered rake.

Auxiliary Equipment Specifications (continued)

21. Clarifier Underflow Pump - one (1)
    A. Capacity - 40 GPM.
    B. Size - 3" x 2" diaphram, 75 TDH.
    C. Motor - 2 HP, 575 volt, 3 phase, 60 hertz.

22. Clarifier Vacuum Filter, Pump and Receiver - one (1)
    A. Capacity - 40 GPM.
    B. Motor - 5 HP, 575 volt, 3 phase, 60 hertz.

23. Roof Repair Form - one (1)

24. Ladle Dryers - two (2)
    A. Heat source - natural gas burner.

25. Fork Lift Truck - two (2)
    A. Capacity - 3000#.

26. Transformer Drain Tanks - four (4)

27. Ladle Preheaters - three (3)
    A. Heat source - natural gas burner.

28. Slide Gate Oven - one (1)
    A. Heat source - natural gas burner.

29. Ladle Reline Jib Crane - two (2)
    A. Capacity - 3 ton.
    B. Jib length - 10'-0" overall.
    C. Motors - hoists 3 HP, trolley 1 HP, 575 volt, 3 phase, 60 hertz.

30. Tundish Repair Jib Crane - one (1)
    A. Capacity - 6 ton.
    B. Jib length - 10'-0" overall.
    C. Motors - hoist 5 HP, trolley 1 HP, 575 volt, 3 phase, 60 hertz.

Auxiliary Equipment Specifications (continued)

31. Billet Handling Magnets - two (2)
    A. Capacity - 5 ton.
    B. Electrical - 5 KW.

32. Scrap Handling Magnet - one (1)
    A. Capacity - 5 ton.
    B. Electrical - 15 KW.

33. Billet Handling Spreader Beam - one (1)
    A. Length - 15'-0".

34. Plant Air Compressor System - one (1)
    A. Capacity - 250 SCFM @ 125 PSIG.
    B. Motor - 75 HP, 575 volt, 3 phase, 60 hertz.
    C. Included - air receiver, pre-filter, air dryer.

35. Nuisance Dust Baghouse Collector - one (1)
    A. Capacity - 35,000 CFM @ 12° W.C. 100°F.
    B. Size - 6 module, 30,000 sq.ft. cloth area.
    C. Included - dacron cloth bags.
    D. Motors - shakers two (2) - 3 HP, rotary valves, two (2)- 3/4 HP, screw conveyor 3 HP, 575 volt, 3 phase, 60 hertz.

36. Nuisance Dust Fan - one (1)
    A. Capacity - 35,000 CFM @ 12" W.C. 100°F.
    B. Motor - 200 HP, 575 volt, 3 phase, 60 hertz.

37. BRI Refractory Guns - two (2)

38. Cold Well - one (1)

39. Mold Cooler Pump - one (1)

40. Sump Pumps - four (4)

41. Fuel Oil Storage Tanks - two (2)

42. Fuel Oil Transfer and Circulating Pumps - two (2)

43. Transformer Vault Vent System - four (4)

44. Hood Cooling Storage Expansion Tank - one (1)

Electrical Equipment Specifications (continued)

A. Electrical equipment list consists of:

1. 115 KV Outdoor Substation
   - A. Galvanized steel structures, complete with ACSR cable, static cable, tubing, insulators, terminals, clamps and associated miscellaneous hardware.
   - B. One (1) 115 KV, 600 ampere disconnect switch.
   - C. Two (2) 115 KV, 1200 ampere motor operated circuit switches.
   - D. One (1) 45/60 MVA 115/34.5 KV oil filled transformer complete with lightning arrestors, forced air cooling fans, bushing type multiratio current transformers and relays for overcurrent protection, differential protection, neutral ground protection and sudden pressure.
   - E. One (1) 10/13 MVA 115/13.8 KV oil filled transformer complete with lightning arrestors, forced air cooling fans, bushing type multiratio current transformers and relays for overcurrent protection, differential protection, neutral ground protection and sudden pressure.
   - F. One (1) 34.5 KV 1200 ampere 1500 MVA oil circuit breaker, complete with multiratio current transformers, relays for overcurrent protection and kilowatt meters and ammeter.
   - G. Two (2) 34.5 KV/120 volt potential transformers.
   - H. One (1) group of power factor capacitors for smelting furnace, 30 MVAR, complete with disconnect switches, lightning arrestors, current limiting reactors, and current limiting fuses.

Electrical Equipment Specifications (continued)

2. 13.8 KV Indoor Metal-Clad Switchgear

   A. Four (4) 13.8 KV 1200 ampere, 500 MVA, three-pole, single throw, air-magnetic break, spring stored energy operated, drain-out circuit breakers complete with appropriate relays and meters. The switchgear shall form a free-standing line-up of all-welded steel frame and steel compartmentation construction. The switchgear will also include necessary potential transformers.

3. Control Power Battery and Charger

   A. One (1) control power battery for separate indoor mounting suitably rated for operating the 34.5 KV oil circuit breaker and the 13.8 KV switchgear and consisting of the following:

      1. One (1) storage battery, lead acid type, in sealed glass jars, 125 volt. Unit will be complete with battery rack and accessories.

      2. One (1) automatic battery charger, silicon rectifier type, 115/230 volt, 60 hertz input complete with circuit breaker panelboard.

4. 600 Volt 1000 KVA Unit Substations - four (4)

   A. Each 1000 KVA unit substation will consist of the following:

      1. One (1) incoming line unit rated 15 KV consisting of load interrupter switch, two position, rated 600 ampere, with current limiting fuses.

      2. One (1) 1000/1150 KVA OA/FA 13.8 KV/575 volt transformer of the non-flameable liquid-immersed type, delta-grounded wye connected.

Electrical Equipment Specifications (continued)

4. 600 Volt 1000 KVA Unit Substations (continued)

A. Continued

3. One (1) low voltage, 600 volt, switchgear consisting of one (1) transformer secondary breaker rated at 1600 amperes continuous, 50.000 amperes interrupting capacity and five (5) feeder breakers rated at 600 amperes continuous and 25.000 amperes interrupting capacity. Each breaker will be three-pole, single throw, drawout type air circuit breakers and manually operated with stored energy type operating mechanism to provide quick-make operation.

5. 575 Volt Motor Control Centers - three (3)

A. Each motor control center shall be rated 575 volt, 3 phase, 60 hertz, and will be indoor, dead-front NEMA 1A with gaskets. They will be wired to NEMA class I, type B construction. Each control center will include an incoming line fused disconnect switch rated at 600 ampere. Horizontal and vertical buses will be braced for a minimum of 25.000 amperes interrupting capacity. All starters will be minimum size 1 and be of the fusible disconnect switch type combination starters.

Electrical Standards

The electrical equipment described will conform to the standard for industrial equipment and work developed by the following organizations:

CSA - Canadian Standards Association
CEMA - Canadian Electrical Manufacturer's Association
CIEE - Canadian Institute of Electrical Engineers
IES - Illuminating Engineering Society
IPCEA- Insulated Power Cable Engineer's Association
CEC - Canadian Electrical Code
AISE - Association of Iron and Steel Engineers

12.5 SITE REQUIREMENTS

SECTION V Site Requirements

A. Land Acreage - The site was selected by Mertec and is shown on drawing 73-0504. No official survey of the area has been performed, however, the land acreage has been calculated at approximately 68 acres.

Ingress and egress to the facility will be through a main gate located near the existing road to Coniston. A new guard house will be provided as well as approximately 3100 ft. of 7'-0" high chain link fencing topped with three (3) strands of barbed wire. Only the plant perimeter will be fenced with access gates at the main entrance and road to the plant dump area.

B. Rail Support - It is proposed that the necessary railway be tied into the Canacian Pacific Railroad main line located behind the main plant. As informed by Mertec, all rail handling of the ore concentrate from the mine site will be by C.P.R.R. and eliminates all switching normally encountered when different railroads are used to bring material in across different railroad system.

The in-plant trackage was designed to permit a complete ore or coal carrying train to enter the plant to prevent tie-up of the main C.P.R.R. line. To minimize in-plant trackage, it will be necessary to break the train up and store the railroad cars on the rail spurs provided. No provisions have been made in the estimate for a railroad switch engine. It is assumed the engine delivering the cars to the plant will stay within the plant for shuttling; however, if this is not possible, it is recommended that Mertec investigate the possibility of leasing or buying a new or used switching engine for this purpose.

It is estimated that approximately 10,660 lineal feet of standard gauge railroad track will be required. Railroad curves are shown at 390'-0" radius, the minimum recommended in-plant curve by the railroad companies.

C. Roadways - It is proposed that the main entrance from the plant will be by the existing roadway from "Coniston". It is recommended that they be 30'-0" wide, rolled and compacted aggregate or other material. Mertec can provide hard surfacing at a later date should they desire. Approximately 2,940 lineal feet will be required.

D. Grading Plan - It is assumed that the site area choosen upon by Mertec will require only minimum site preparation prior to plant construction.

E. Soil Conditions - It is assumed that the soil conditions are the best available and no building or equipment foundations will require piling or caissons. Foundation design does include consideration of the seismic zone and seasonal elements encountered.

F. Electrical Supply - Because of the nature of the proposed site, the plant is conveniently located near Ontario Hydro 115 KV transmission lines and requires only minimum routing to the main plant substation.

12.6 BUILDING DESCRIPTIONS

SECTION VI Building Descriptions

All building structures, siding and foundation will be based on its location in a seismic zone 1 with recorded wind velocities of over 84 mph. All building dimensions are centerline to centerline of column. Foundation designs were based on 6000#/Ft.^{2} bearing at a 6'-0" depth.

A. Yard Storage Building

This building will be a single bay shop measuring 300'-0" long by 100'-0" wide by 48'-0" to bottom chord of truss as shown on drawing 72-1804.

The building will be of steel framed construction with galvanized roofing. Building support columns will be spaced on 50'-0" centers with intermediate bents at 25'-0" centers. One access opening is provided near the center of the building for entry of the bucket loader.

Within the main building support columns, a retaining wall will be included around the parameter to prevent material spillage. At one end of the building, the retaining wall will be compartmented to hold the various alloys required.

Should Mertec decide to completely close this building, they may do so at a later date.

B. Storage Bin Building

This building will be a 80'-0" long by 35'-0" wide by 50'-0" to top of bins with varying roof truss 10'-0" to 17'-0" above bins. This design is to enclose the material handling equipment and conveyors bringing material into the bins as shown on drawings 73-0502 and 72-1802.

Building design is to support the main storage bins and will be of steel framed construction.

B. (continued)

The building will be covered with galvanized corrugated siding and roofing. Two (2) mandoors at varying elevations will be provided for operating and maintenance purposes.

C. Smelting Furnace Building

This building will be a single bay shop measuring 125'-0" long by 64'-6" wide by 90'-0" to bottom chord of truss as shown on drawings 72-1802 and 72-1803.

The building will be of steel framed construction with galvanized corrugated siding and roofing. Building support columns will be spaced on 50'-0" centers with intermediate bents at 25'-0" centers. Electrode access will be through an opening measuring 12'-0" wide by 14'-0" high. This opening will be equipped with a motor drive guillotine type door. Two (2) mandoors at various elevations have been included.

D. Melt Shop Building

This building will be a single bay shop measuring 300'-0" long by 74'-6" wide by 73'-0" to bottom chord of truss as shown on drawing 72-1800. The building will be of steel framed construction with galvanized corrugated siding and roofing. Building support columns will be spaced on 50'-0" centers with intermediate bents at 25'-0" centers. Four (4) openings measuring 12'-0" wide by 14'-0" high equipped with motor driven guillotine type doors are included as are six (6) mandoors.

E. Caster Building

This building will be a single bay shop measuring 200'-0" long by 75'-0" wide by 35'-0" to bottom chord of truss as shown on drawing 72-1801. The building will be of steel framed construction with galvanized corrugated siding and roofing. Building support columns will be spaced on 50'-0" centers with intermediate bents at 25'-0" centers. Two (2) openings measuring 12'-0" wide by 14'-0" high equipped with motor driven guillotine type doors are included as are two (2) mandoors.

F. Administrative Offices and Locker Rooms

This building will be a concrete block structure measuring 25'-0" wide by 90'-0" long. Its design will incorporate administrative facilities, wash rooms, lunch rooms and locker rooms under one roof. The building will be located adjacent to the melt shop building but will be connected only by walkways to minimize shop vibration and noise.

G. Miscellaneous Buildings

These buildings and rooms will include all structures called out below or shown on the general arrangement drawings 73-0502 and 73-0503. They will be concrete block and/or steel construction with corrugated siding and roofing. They will be suitable in design to meet the required service for their use.

1. Track unloading sheds-two (2)
2. Belt conveyor gallerys with walkways-three (3)
3. Guard houses-one (1)
4. Smelting furnace transformer rooms-three (3)
5. Refining furnace transformer rooms-one (1)
6. Electrical equipment rooms-three (3)
7. Melters Office-one (1)
8. Lab. - one (1)

12.7 UTILITIES

SECTION VII Utilities

A. Electrical requirements within the plant will be as follows:

1. Primary Voltage - Incoming voltage will be 115 KV. Normal load will be 55 MVA with peak load of 65 MVA.

2. Substation Capacities - Substation capacity will be based on the loads shown on PEC drawing 79-2500 and 79-2501. Power will be brought in from existing 115 KV Ontario Hydro Transmission lines.

3. Lighting - PEC recommends the listed minimum illumination levels in the following areas of the new plant:

(a) Lighting for the high bay area of the Yard Building, Smelter Building, Melt Shop and Caster Building will be by 480 volt A.C. mercury vapor fixtures to average level of 30 foot candles.

(b) Lighting for the electrical and mechanical equipment rooms will be by 120 volt A.C. industrial fluorescent fixtures to an average level of 30 foot candles.

(c) Lighting of control rooms and offices will be by 120 volt A.C. industrial fluorescent fixtures to an average level of 50 foot candles. Lighting for the laboratory to an average level of 70 foot candles.

(d) Lighting of roadways will be by single, pole mounted, 480 volt A.C., weatherproof mercury vapor fixtures to an average level of 1 foot candles.

(e) Lighting of ourdoor alloy storage areas will be by pole mounted, 480 volt A.C., weatherproof, mercury vapor fixtures (maximum of four (4) fixtures to a pole) to an average level of 10 foot candles.

(f) Lighting of plant areas other than those covered above will be by 120 volt A.C. incandescent fixtures to illumination levels appropriate to that particular area.

3. Lighting (continued)

(g) Emergency lighting of building exits, stairways, key operating and key equipment areas will be of self-contained, battery powered, flood lamp units to levels appropriate with personnel safety.

B. Water

Source - Plant water supply lines will be from existing lines servicing the town of Coniston. The initial fill of all cooling water systems and make-up water for the smelting and refining, furnace cooling, mold cooling, duct cooling and caster spray water systems will be from the city water system. Emergency water for all water systems will be city water.

Should plant demands require more water that the city water system can provide, it is recommended that Mertec install its own water system at a later date. After the initial fill of the cooling water systems, only minimal make-up water will be required and the quantity required should have little effect on the town usage.

Treatment-Quality - Electric furnace water quality requirements are a specific conductivity of 250 micro mhos, turbidity of 50 ppm, and a 7 to 8 pH value. Continuous caster spray system water quality requirements are a chemical purity of 60- ppm $CaCO_3$ and mechanical purity of 0.010 inches. The mold cooling water is to have a chemical purity of 0 to 10.0 ppm $CaCO_3$ and a mechanical purity of 0.015 inches, all water in this system is to be chemically softened.

Estimated Usage - Refer to PEC drawing 69-2000

C. Natural Gas and Fuel Oil

Natural gas will be used throughout the plant under normal operations. Incoming line pressure is 15 psig.

Curtailment in winter months - The tundish preheats, smelting furnace flare stack and torch cut-offs must be on a firm supply. Other points of gas usage can be curtailed during the winter months.

C. (continued)

No. 2 diesel fuel oil will be used for building heat. Supply tanks and pumps have been included.

D. Oxygen

Due to the high daily consumption, PEC recommends that Mertec install their own oxygen producing facility. Safety features and flow measuring devices will be provided by the oxygen producing facility manufacturer. Peak consumption will be approximately 1200 scfm. Daily consumption is estimated at 36 tons.

E. Compressed Air

The air compressor will be a rotary screw type compressor and the air dryer will be a refrigerant type. For the capacity refer to PEC drawing 69-2002. Dewpoint is 0° F at line pressure. The compressed air equipment will be housed in its own room to insulate the noise it generates.

F. Disposal Services

A plant clarifying system is provided to process all plant used water prior to recycle. Clarifier water sludge will be pumped to a vacuum filter and collected on a cake conveyor for removal. Removal will be by truck to a dump area.

Slag from the refining furnace is of no value and should considered as waste material. It is recommended that Mertec use it as an inert land fill within the plant or surrounding area.

Slag from the smelting furnace does contain TiO_2 (titania) which is suitable for resale. This is dependent on the present mining of TiO_2. It may not be profitable to reclaim the slag until a later date. It is recommended that if Mertec cannot develope a sales potential, the slag be stockpiled until a market is developed.

G. Sewage

It is recommended that the plant sewer system be tied into the existing system servicing the town of Coniston. Tie-in sewer installation has been included.

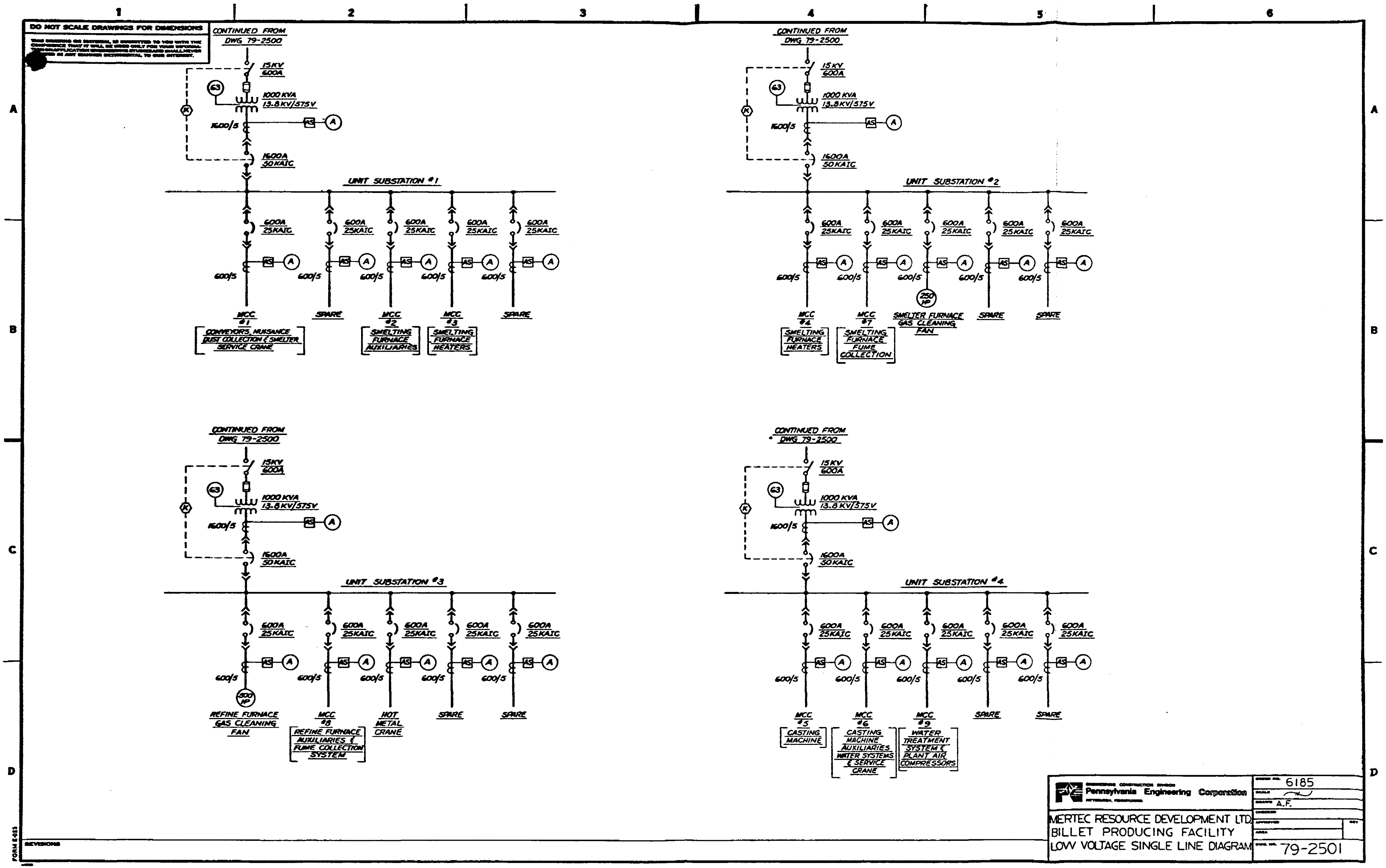
12.8 DRAWINGS

SECTION VIII Drawings

BILLET PRODUCING FACILITIES

Drawing Index

73-0501	Process Flow Diagram
73-0502	General Arrangement - Plan
73-0503	General Arrangement - Sections
73-0504	Plot Plan
75-1000	Smelting and Refining Furnace Gas Cleaning Flow Diagram
75-1001	Nuisance Dust Flow Diagram
72-1800	Furnace and Casting Building Elevations Line A & D
72-1801	Building Elevations
72-1802	Smelter Building Elevations, Line 3, 3A and 5A
72-1803	Column Placing and Crane Runway Plan
72-1804	Yard Storage Building - Plan and Sections
69-2000	Water System Diagram
69-2001	Process Gas and Oil Diagram
69-2002	Compressed Air System Diagram
79-2500	High Voltage Distribution - Single Line Diagram
79-2501	Low Voltage Distribution - Single Line Diagram


DO NOT SCALE DRAWINGS FOR DIMENSIONS
CONTINUED FROM DWG 79-2500
15KV 600A
1000 KVA 13.8KV/575V
1600/5
1600A 50KAIC
UNIT SUBSTATION #1
600A 25KAIC
600/5
MCC #1
CONVEYORS, NUISANCE DUST COLLECTION & SMELTER SERVICE CRANE
SPARE
MCC #2
SMELTING FURNACE AUXILIARIES
MCC #3
SMELTING FURNACE HEATERS
SPARE
UNIT SUBSTATION #2
MCC #4
SMELTING FURNACE HEATERS
MCC #7
SMELTING FURNACE FUME COLLECTION
250 HP
SMELTER FURNACE GAS CLEANING FAN
SPARE
SPARE
UNIT SUBSTATION #3
500 HP
REFINE FURNACE GAS CLEANING FAN
MCC #8
REFINE FURNACE AUXILIARIES & FUME COLLECTION SYSTEM
HOT METAL CRANE
SPARE
SPARE
UNIT SUBSTATION #4
MCC #5
CASTING MACHINE
MCC #6
CASTING MACHINE AUXILIARIES WATER SYSTEMS & SERVICE CRANE
MCC #9
WATER TREATMENT SYSTEM & PLANT AIR COMPRESSORS
SPARE
SPARE
Pennsylvania Engineering Corporation
6185
A.F.
MERTEC RESOURCE DEVELOPMENT LTD.
BILLET PRODUCING FACILITY
LOW VOLTAGE SINGLE LINE DIAGRAM
79-2501
REVISIONS

12.9 COST ESTIMATE

SECTION IX Facility Estimate

The Facility Estimate has been developed to reflect pricing of equipment, as determined by the Process Engineering Design and the Scope of Equipment required for the facility, and was developed to minimize the production cost of the finished billets. Building structure estimates materials cost for buildings and structures as outlined for building and miscellaneous structures, fabricated and delivered to the construction site. Estimated quantities are based on pounds per cubic foot for various type structures.

Installation Cost Estimate No. 4 (Items A, B, C, D, E and F), estimated cost is based on Proposal Drawings 73-0502 and 73-0503, estimated material quantities and equipment weights, as representative of the proposed facility, qualified as our best efforts without the benefit of performing the installation engineering and is subject to change based on detail engineering. Estimated cost for excavation is based on normal excavation, with no allowance for hard excavation, dewatering, or other unforeseen condition included. The estimate cost for sitework does not include the cost for land, utilities, roadways or railroad tracks and right-of-ways to the site.

This estimate is based on preliminary information and the best estimate cost to date, exclusive of escalation.

Exclusions to the estimate are:

1. Agglomeration plant and all auxiliary equipment, utilities or sitework required for the agglomeration plant.

2. Property

3. All other than normal excavation.

4. All utilities, roads, railroads and right-of-ways for utilities to the plant property lines.

5. Bearing or sheet piling.

6. Temporary power and utilities to construction site.
7. Computer systems.
8. All federal, state and local taxes and permits.
9. Insurance and fees.
10. Material and equipment escalation.
11. All costs are based on U. S. Dollars.

A.	Major Equipment		$6,442,000
	1. Material Handling Equipment	$1,410,500	
	2. Smelting Furnace	3,086,000	
	3. Refining Furnace	750,000	
	4. Continuous Casting Machine	1,195,500	
B.	Auxiliary Equipment including Electrical Equipment		$5,310,000
C.	Building Costs		$2,428,000
	1. Yard Storage Building	$ 371,200	
	2. Storage Bin Building	95,200	
	3. Smelting Furnace Building	158,400	
	4. Melt Shop Building	1,106,000	
	5. Caster Building	154,600	
	6. Miscellaneous Buildings	542,600	
D.	Installation Materials and Installation		$7,475,000
	1. Sitework	$ 815,000	
	2. Mechanical Installation	1,832,200	
	3. Structural Installation	1,163,600	
	4. Foundation Installation	914,200	
	5. Piping and Instrumentation Install.	1,500,000	
	6. Electrical Matl. & Installation	1,250,000	
		Sub Total	$21,655,000

<u>NOTE:</u> Cost Items A through D are exclusive of Engineering, Project Management, Procurement, Expediting, Start-up or Field Services

	SUB TOTAL FROM PAGE 2	$21,655,000
E.	Engineering	1,200,000
F.	Management Fee	1,350,000
	TOTAL COST	$24,205,000

NOTE: Items E and F includes Escalation and Contingency which are reflected as cost based on our experience.

12.10 CONSTRUCTION SCHEDULE

SECTION X Construction Schedule

The basis for the schedule is assumed on the following:

1. Purchase order for the smelting furnace, refining furnace and 100/25 ton EOT crane issued two (2) months after the awarding of a contract.

2. Refining furnace delivered seventeen (17) months after the purchase order.

3. Mill order for building steel issued four (4) months after the awarding of a contract.

4. Piping, wiring and instrumentation must be completed twenty-four (24) months after awarding of a contract.

5. Final test and checkout beginning twenty-two (22) months after awarding of a contract with steel production, operation checkout and operator training beginning two (2) months later.

LEGEND:
ENGINEERING
P.O.
DEL ON SITE
CONSTRUCTION

AWARD OF CONTRACT

Pennsylvania Engineering Corporation

SHEET 1 OF 1

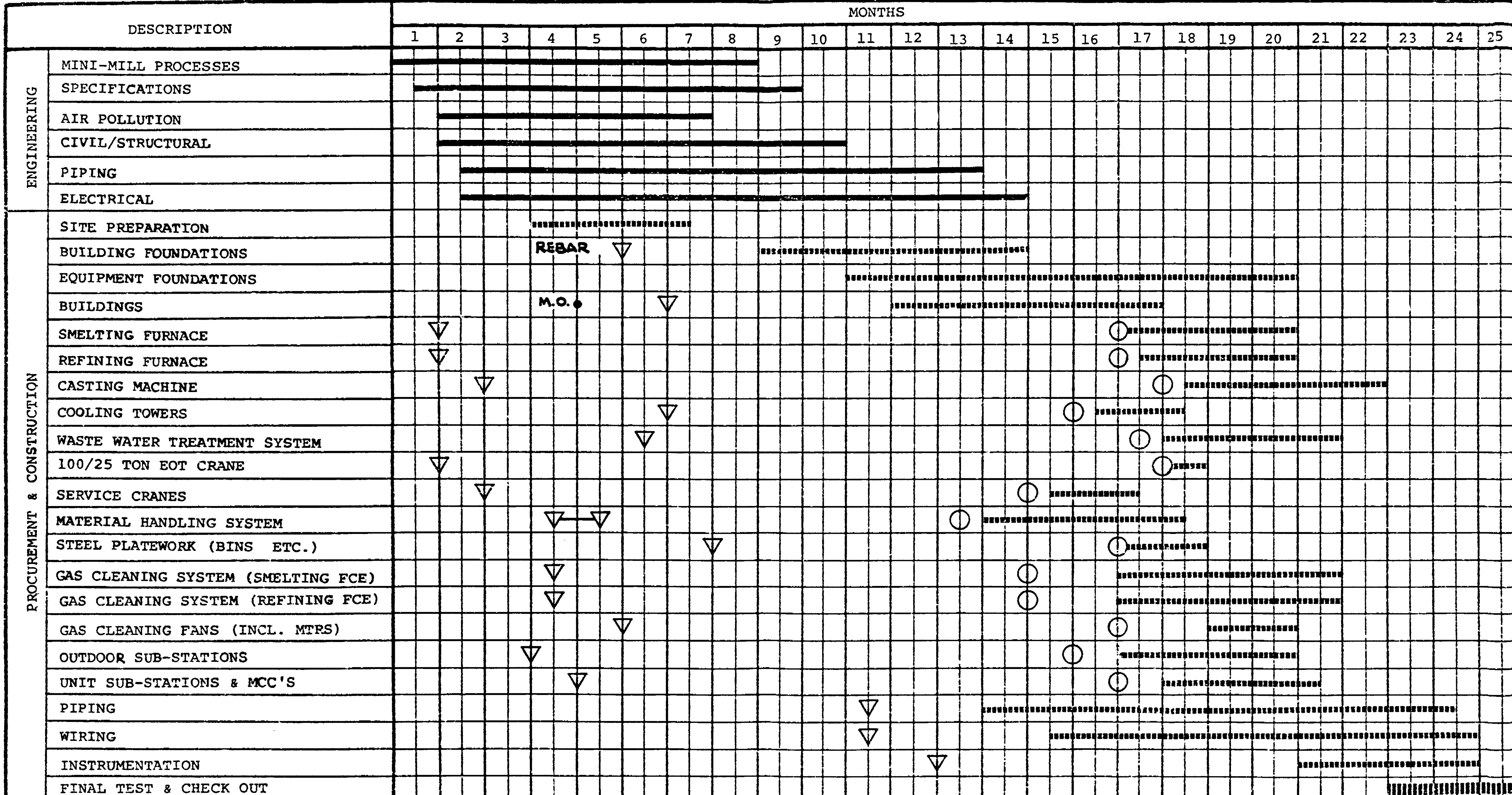
ENGINEERING/CONSTRUCTION SCHEDULE

MERTEC RESOURCE DEVELOPMENT LTD., CANADA
BILLET PRODUCING FACILITY

CONTRACT NO. 6185

DATE: 9/13/74

DWG: PEC-70-39



PEC 101 7/73

25-P

12. SMELTER

12.11 OPERATING COST

SECTION XI Operating Cost

The following were assumed in establishing the plant operating cost per ton of steel produced:

A. Metallurgical Coal - shipped from West Virginia coal fields estimated at $60.00/ton by Consolidated Coal Company.

B. Coal shipment estimated @ $10.00/ton.

C. Material additive costs per telephone conversation with Scrivener Engineering, Ltd., bulk net ton:

1.	High carbon - standard FeMn	- $323.00/ton
2.	FeSi 50%	- 463.00/ton
3.	SiMn	- 378.00/ton
4.	Medium carbon FeMn	- 530.00/ton
5.	Calcium carbide	- 200.00/ton
6.	Burnt lime	- 32.50/ton
7.	Oxygen (24,000 ft^3/ton)	- 24.00/ton
8.	Quartzite	- 3.70/ton

D. Electrical cost of $11.50 MwH

E. 55" ø Carbon Paste Electrodes @ $.15/lb.

F. 14" ø Graphite Electrodes @ $.30/lb.

G. Refining Furnace Refractory @ $.30/lb.

H. Smelting Furnace Refractory - 5 year replacement consideration, $20,000.00/year or $.11/ton of steel produced.

I. Continuous Caster Operation - present cost on similar casters running $5.00 to $10.00/ton of product, used $7.50/ton.

J. Labor Cost were based on similar U.S.W. job classes with fringe benefits as listed in Section XI. Wages are US rates.

K. Burden Labor is assuming 30% additional labor over normal labor requirements shown in Section XII at an average hourly rate of $5.25/hr.

SECTION XI

Operating Cost/Ton Steel Produced

Smelting Furnace

Ore	75.75 T/Heat	
Coal	15.4 T/Heat	$1,078.00
Calcium Carbide	0.24 T/Heat	48.00
Electrical	89.7 MwH/Heat	1,031.00
	48.5 Tons Hot Metal Output	$2,157.55
	Cost/Ton	$ 44.48
Furnace Refractory Replacement Cost/Ton		0.11
Gunning Material	1 lb/Ton @ 15¢/lb.	0.15
Electrodes	21 lb/ton @ 15¢/lb.	3.27
	Cost/Ton of Hot Metal from Smelting Furnace	$ 48.01

Refining Furnace

Burnt Lime	1.15 T/Heat	$ 37.37
Quartzite	0.35 T/Heat	1.29
Standard FeMn	1.15 T/Heat	371.45
FeSi 50%	0.58 T/Heat	268.54
Electrical	5.09 MwH/Heat	58.56
Oxygen	48,000 scfm @ $0.10/100 ft^3	48.00
	46 Tons Hot Metal Output	$ 785.21
	Cost/Ton	$ 17.06
Refractory 9 lb/ton @ 30¢/lb		2.70
Gunning Material	1 lb/ton @ 15¢/lb.	0.15
Electrodes	5 lb/ton @ 30¢/lb.	1.50
		$ 21.41
Projected yield from refining furnace @ 95% Adjusted cost/ton of Hot Metal from smelting furnace $48.01/ton ÷ 0.95		$ 50.53
	Cost/Ton of hot metal from Refining furnace	$ 71.94

Continuous Casting Machine

Estimated cost/ton includes starter bars, spray nozzles, etc.	$	7.50
Refractory 5 lb/ton @ 30¢/lb		1.50
	$	9.00
Projected yield from continuous casting machine @ 95.2%		
Adjusted cost/ton of hot metal from refining furnace $71.94/ton ÷ 0.952	$	75.56
Cost/ton of steel from continuous casting machine	$	84.56

Auxiliary Electric 3 Mw/Hr $ 1.50/ton

Labor

		Cost/Ton
Management and Yard Handling	$	2.25
Smelting Furnace		2.34
Refining Furnace		1.38
Continuous Casting Machine		2.33
Support Maintenance		3.66
Miscellaneous		0.59
	$	12.55
Burden Labor 30% additional labor		2.18
Labor Cost/Ton	$	14.73
Vacation Pay 4% hourly labor Cost/Ton		0.58
	$	15.31

Utilities 1% estimate of billet selling price/ton 1.90

Total Cost/Ton of Finished Steel Billets Produced

Smelting*, Refining and Casting	$	84.56
Auxiliary Electric		1.50
Labor		15.31
Utilities		1.90
	$	103.27

* Does not include pelletizing, shipping from the mine site of mining process cost of ore.

Revision #3 is per customers revised ore analysis and Pennsylvania Engineering Corporations review and coordination of Sections II and XII of this study.

Operating Cost - Pig Iron Facility

The following were assumed in establishing the plant operating cost per ton of pig iron produced.

A. Metallurgical coal - shipped from West Virginia coal fields estimated at $60.00/ton by Consolidated Coal Company.

B. Coal shipment - estimated @ $10.00/ton

C. Material additive cost per telephone conversation with Scrivener Engineering Ltd., bulk net ton:

   1. Calcium Carbide - $200.00/ton

D. Electrical cost of $11.50/MwH

E. 55" ø Carbon Paste Electrodes @ $0.15/lb.

F. Smelting Furnace Refractory - 5 year replacement consideration $20,000/year or $0.11/ton of steel produced.

G. Labor Cost were based on similar U.S.W. job classes with 30% fringe benefits as listed in Section XII. Wages are U.S. rates.

H. Burden Labor is assuming 30% additional labor over normal labor requirements shown in Section XII @ an average hourly rate of $5.25/hour.

I. Pig iron Labor 9 men @ average hourly rate of $6.25/hr.

Operating Cost/Ton Pig Iron Produced

Smelting

Ore	75.75 T/Heat	
Coal	15.4 T/Heat	$1,078.00
Calcium Carbide	0.24 T/Heat	48.00
Electrical	89.7 MwH/Heat	1,031.55
	48.5 Ton Output	$2,157.55
	Cost/Ton	$ 44.48
Refractory Repair		0.11
Gunning Material	1 lb/Ton @ 15¢	0.15
Electrodes	21 lb/Ton @ 15¢/lb.	3.27
		$ 48.01

Pig Machine 193,806 Tons Pig Iron Produced/Year

Burnt Lime (Mold Wash)	48.5 Ton Output 0.5 Ton/Heat	$ 16.25
	Cost/Ton	.33
Projected yield from pig machine @ 95% Adjusted cost/ton of hot metal from smelting furnace	$48.01 ÷ .95	$ 50.53
	Cost/ton finished pig iron from pigmachine	$ 50.86

Auxiliary Electric 2 Mw/H @ $11.50/MwH

Labor

		Cost/Ton
Management and Yard Handling		$ 2.25
Smelting Furnace		2.34
Pig Machine		0.25
Support maintenance		2.43
Miscellaneous		0.59
Burden Labor	30% additional labor	1.31
	Labor Cost/Ton	$ 9.17
Vacation Pay	4% hourly labor Cost/Ton	0.36
		$ 9.53

Utilities	1% estimate of pig iron selling price	$	1.55/Ton

Total Cost/Ton Steel Produced

Smelting*	$	50.86
Pig Machine		0.33
Auxiliary Electric		0.83
Labor		9.53
Utilities		1.55
	$	63.10

* Does not include pelletizing, shipping from mine or mining process cost of ore.

Revision #1 is per customers revised ore analysis and Pennsylvania Engineering Corporations review and coordination of Sections II and XII of the refining facility study.

12.12 LABOR REQUIREMENTS

SECTION XII Labor Requirements

The following personnel are considered the minimum required to operate the facility efficiently.

The following is based on an 8 hours/day - 5 days/week - 2080 work hours/year/per man.

Position	U.S.W. Job Class	Number Required
General Manager		1
Secretary		1
Clerk-Typist		1
Chief Accountant		1
Accounts-Payroll		1
Buyer		1
Clerk		1
Warehouseman		1
Warehouse Labor	JC-5	1
Fork Truck Operator	JC-6	1
Nurse		3
Metallurgist		1
Metallurgist Technician		2
Plant Engineer		1
Draftsman		2
Yard Foreman		1
Ore and Coal Laborers	JC-6	2
Mechanic	JC-16	1
Truck Drivers	JC-6	2
Alloy Laborers	JC-5	2

Required 8000 work hours/year, 20 shifts/week, 50 weeks/year.

Smelting Furnace		
General Foreman		3
Melter		3
First Helper	JC-19	3
Second Helper	JC-16	3
Ladleman	JC-10	3
Pit Laborer	JC-6	6

SECTION XII (continued)

Position	U.S.W. Job Class	Number Required
Refining Furnace		
Melter		3
First Helper	JC-19	3
Second Helper	JC-16	3
Crane Operator	JC-16	3
Continuous Casting Machine		
Foreman		3
Sub-Foreman		3
Casters	JC-16	9
Discharge Laborer	JC-10	6
Maintenance		
Electrical Foreman		3
Electrician	JC-16	6
Mechanical Foreman		3
Millwright	JC-16	6
Welder	JC-16	3
Pipe Fitter	JC-16	3
Machinist	JC-16	2
Mason Foreman		3
Brick Mason	JC-16	4
Miscellaneous		
Bucket Loader Operator	JC-13	3
Plant Guard	JC-9	3

Total Personnel Required - 119

SECTION XII (continued)

U.S.W. Job Class labor rates as of July 1, 1974 including a 65 cent per hour cost of living allowance and 30% fringe benefits:

Job Class	Hourly Rate
1 and 2	$5.65
3	5.76
4	5.91
5	6.03
6	6.14
7	6.26
8	6.38
9	6.50
10	6.61
11	6.73
12	6.85
13	6.96
14	7.08
15	7.20
16	7.31
17	7.43
18	7.55
19	7.67

Foreman rates were considered 15% higher than top job class rate of men under that particular foreman.

Rates are U.S. Funds.

13. ORGANIZATION (summary)

Payroll	Concentrator	Briquetter	Pig Iron	Steel
Hourly	21	6	65	115
Salary	10	1	15	19
Totals			118	172

Concentrator	-	Three shifts 325 days per year
Pelletizer	-	Three shifts 325 days per year
Smelter	-	Three shifts 325 days per year

14. ESTIMATE OF CAPITAL COST (summary)

14.1 Pig Iron

('000 dollars)	Cost	Taxes	Contingency and Escalation	Total
Land	500			500
Buildings				
Mill and Agglomeration				
Crushing plant	487			
Transfer Tower	129			
Fine Ore Bin	500			
Concentrator	924			
Briquetter and Dryer	371			
Sub Station	40			
Fuel Oil Supply	14			
Guest House	25			
Site Preparation	170			
Water Supply	17			
Recycle Water	22			
Engineering and Management	135		598	3,431
Sub Total	2,833			
Smelter				
Site Preparation	815			815
Yard Storage	372		78	450
Storage Bin	95		19	114
Smelting Furnace	158		33	191
Pig Machine	206		44	250
Miscellaneous	349		64	413
Foundations	573		119	692
Structural	520		109	629
Sub Total	3,088		466	3,554
Total Buildings	5,921		1,064	6,985

14. ESTIMATE OF CAPITAL COST (summary)

14.1 Pig Iron (cont.)

('000 dollars)	Cost	Taxes	Contingency and Escalation	Total
Equipment				
Mill and Agglomeration				
Crushing plant	578			
Transfer Tower	94			
Fine Ore Bin	181			
Concentrator	2,364			
Agglomeration	2,878			
Sub Station	287			
Sewage Disposal	42			
Fuel Oil System	75			
Parking Lot	25			
Site Piping and Fire Protection	53			
Water Supply	225			
Recycle Water System	87			
Potable Water System	15			
Telephone Line	45			
Engineering and Management	571			
	7,520			
Trackmobile	43			
Sub Total	7,563		1,578	9,141

14. ESTIMATE OF CAPITAL COST (summary)

14.1 Pig Iron (cont.)

('000 dollars)	Cost	Taxes	Contingency and Escalation	Total
Smelter				
Locomotive	91	6	12	109
Material Handling Equipment	1,411	279	355	2,045
Smelting Furnace	3,086	216	593	3,895
Pig Iron Machine	401	28	90	519
Auxiliary Equipment including Cranes and Gas Cleaning	3,170	221	711	4,102
Mechanical	1,373	48	297	1,718
Piping and Instrumentation	850	30	185	1,065
Electrical	600	46	136	782
Engineering and Management	1,723		172	1,895
Sub Total	12,705	874	2,551	16,130
Total Equipment	20,268	874	4,129	25,271
Other Fixed Assets				
Tailings Disposal System	565			
Engineering and Management	40			
	605		127	732
Road	25			25
Rail	955		95	1,050
Hydro	733		163	936
Total Other Fixed Assets	2,358		385	2,743

14. ESTIMATE OF CAPITAL COST (summary)

14.1 Pig Iron (cont.)

('000 dollars)	Cost	Taxes	Contingency and Escalation	Total
Development Expenses				
Feasibility Studies, including amounts to September 30, 1974	300			300
Multi-Minerals Lease	100			100
Diamond Drilling	50			50
Total Development Expenses	450			450
Administration	1,125			1,125
Working capital	1,000			1,000
Total Capital Costs	31,622	874	5,578	38,074
Less amounts paid to September 30, 1974 or Financed by Mortgage				427
Loan required for capital construction purposes				37,647

14. ESTIMATE OF CAPITAL COST (summary)

14.2 Steel*

('000 dollars)	Cost	Taxes	Contingency and Escalation	Total
Land	500			500
Buildings				
Mill and Agglomeration	2,833		598	3,431
Smelter				
Oxygen Plant	50		5	55
Site Preparation	815			815
Yard Storage	372		78	450
Storage Bin	95		19	114
Smelting Furnace	158		33	191
Melt Shop	1,106		232	1,338
Caster	155		33	188
Miscellaneous	543		114	657
Foundations	914		193	1,107
Structural	1,164		244	1,408
Total Buildings	8,205		1,549	9,754
Equipment				
Mill and Agglomeration	7,563		1,578	9,141
Locomotive	91	6	12	109
Oxygen	750	52	168	970
Material Handling	1,411	279	355	2,045
Smelter Furnace	3,086	216	593	3,895
Refining Furnace	750	53	98	901
Casting Machine	1,196	84	269	1,549
Cranes	650	46	147	843
Gas Cleaning Equipment	2,000	140	449	2,589

* Some figures are summarized from 14.1

14. ESTIMATE OF CAPITAL COST (summary)

14.2 Steel (cont.)

('000 dollars)	Cost	Taxes	Contingency and Escalation	Total
Other Auxiliary equipment	2,660	186	598	3,444
Mechanical	1,832	64	399	2,295
Piping and Instrumentation	1,500	52	325	1,877
Electrical	1,250	108	285	1,643
Engineering and Management	2,550		255	2,805
Total Equipment	27,289	1,286	5,531	34,106
Other Fixed Assets	2,358		385	2,743
Development Expenses	450			450
Administration	1,125			1,125
Working capital	1,000			1,000
Total Capital Costs	40,927	1,286	7,465	49,678
Less amounts paid to September 30, 1974 or financed by Mortgage				427
Loan required for capital construction purposes				49,251

15. ESTIMATE OF OPERATING COSTS (summary)

15.1 Anomaly No. 6

	Ore (1)	Concentrates (2)	Pig Iron (3)	Steel Billets (4)
Mining	$5.74			
Milling	3.05			
Property Lease	10			
	8.89	14.32		
Agglomeration		5.30		
Transportation		4.25		
		23.87	37.25	40.15
Smelting			63.32	103.27
Administrative			1.55	1.67
			102.12	145.09
Apatite Revenues Net of Drying Cost			(15.09)	(16.27)
			87.03	128.82
Selling Price			150.00	200.00
Contribution			$ 62.97	$ 71.18

* Bracketted numerals refer to notes at 15.3

15. ESTIMATE OF OPERATING COSTS (summary)

15.2 Anomalies Nos. 3 and 4

	Ore (5)	Concentrates (6)	Pig Iron (7)	Steel Billets (8
Mining	$5.74			
Milling	3.03			
Property Lease	05			
	8.82	67.33		
Agglomeration		5.30		
Transportation		4.35		
		72.21	112.83	121.60
Smelting			63.32	103.27
Administration			3.58	3.86
			179.73	228.73
Apatite Revenues Net of Drying Cost			(73.72)	(79.44)
			106.01	149.29
Selling Price			150.00	200.00
Contribution			$ 43.99	$ 50.71

* Bracketted numerals refer to notes at 15.3

15.3 Notes to Estimate of Operating Cost (summary)

(1) Based on 487,500 tons per year of ore.

(2) Based on 302,737 tons per year of magnetite concentrates.

(3) Based on 194,000 tons per year of pig iron production.

(4) Based on 180,000 tons per year of steel production.

(5) Based on 1,000,000 tons per year of ore.

(6) Based on 131,000 tons per year of magnetite concentrates.

(7) Based on 83,840 tons per year of pig iron.

(8) Based on 77,804 tons per year of steel.

Mining costs as estimated by MacIsaac Mining and Tunnelling Company Limited.

Milling costs as estimated by A.H. Ross and Associates, plus an amount for operating of a trackmobile.

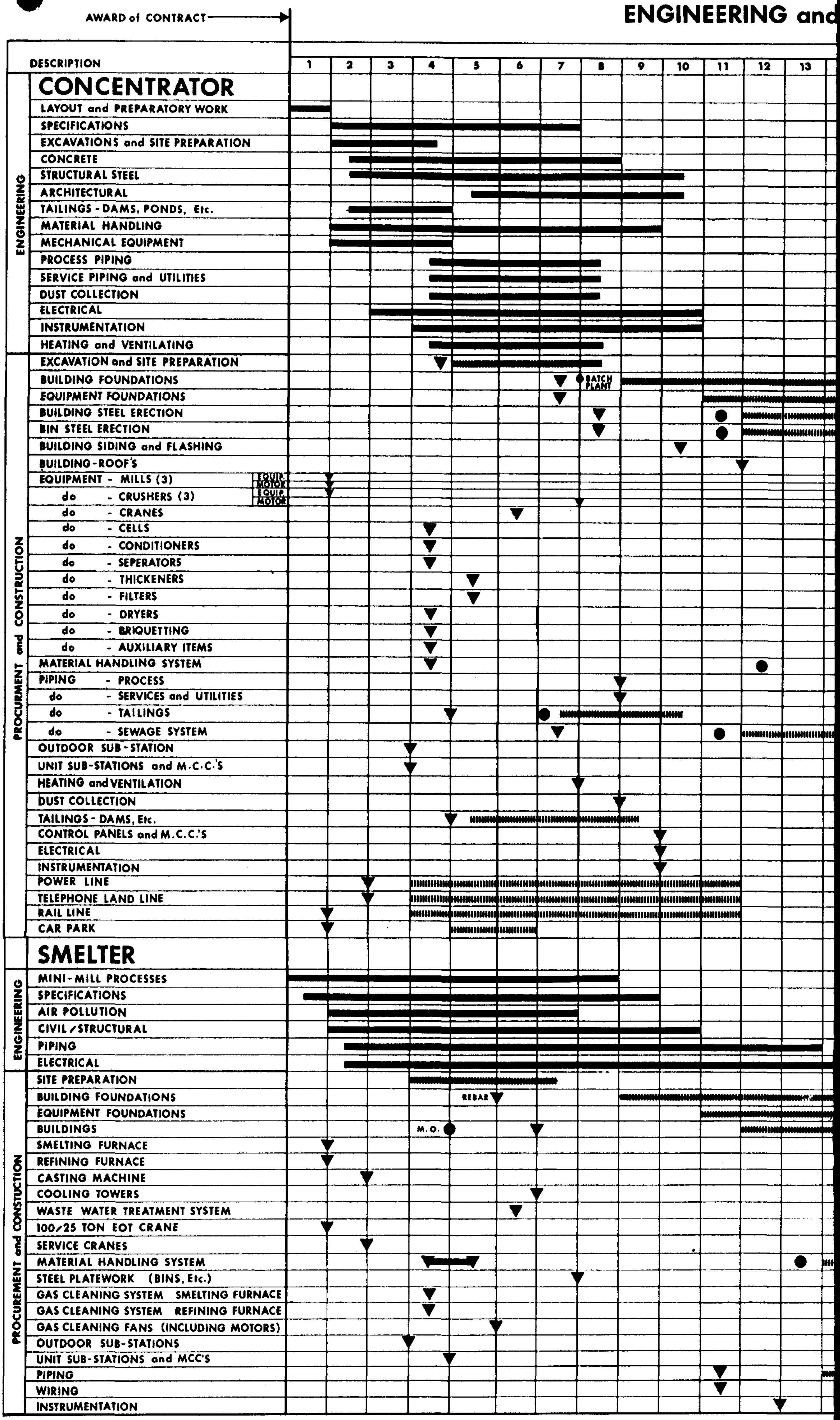
Agglomeration costs as estimated by Ferro Tech.

Transportation costs as estimated by C.P. Rail.

Smelting costs as estimated by Pennsylvania Engineering.

16. CONSTRUCTION SCHEDULES (summary)

ENGINEERING and

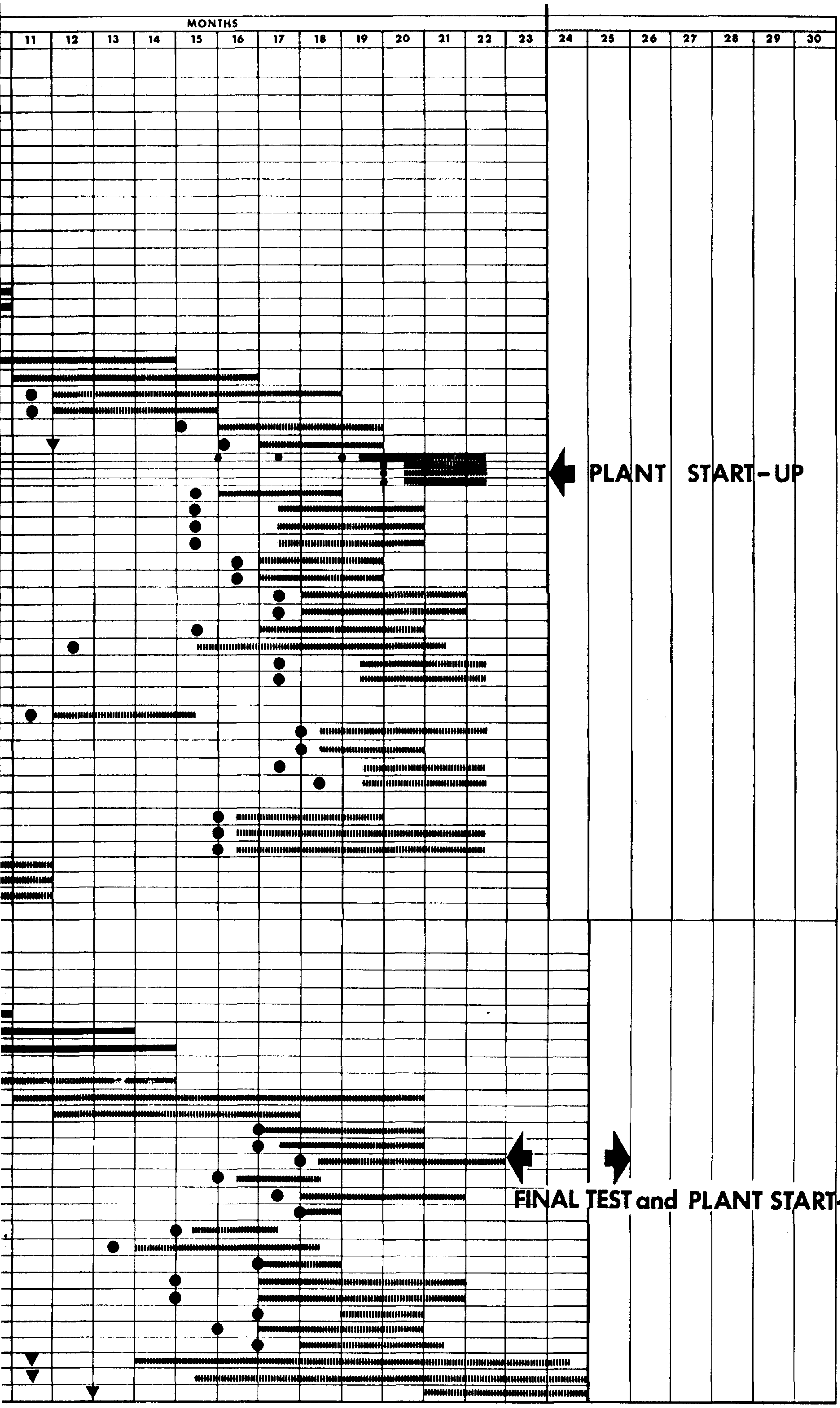


LEGEND:

ENGINEERING ▼ PURCHASE ORDER ● DELI

DWG NO	DESCRIPTION	DWG NO	DESCRIPTION	NO	BY	DATE	DESCRIPTION	NO	BY	DATE	DESCRIPTION	NO	BY	DATE

NEERING and CONSTRUCTION SCHEDULE



ASE ORDER ● DELIVERED ON SITE ▬ CONSTRUCTION

REVISIONS	NO	BY	DATE	DESCRIPTION

scrivener ENGINEERING

DRAWN W.L. SPENCER
SCALE None
DATE NOV 74
CHECKED
APPROVED
APPROVED

CLIENT
MERTEC RESOURCE DEVELOPMENT LIMITED
Sudbury Ontario

PROJECT
RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

DRAWING
ENGINEERING & CONSTRUCTION SCHEDULE - SUMMARY

DRAWING NUMBER 5699·107
REV. P

17. FINANCIAL EVALUATION

17.1 General

To test the financial viability, pro-forma financial statements were developed for a period of 20 years. For the first three years during the capital construction and start-up operations, the financial statements were prepared on a quarterly basis so as to provide an assessment of the cash requirements in a reasonably detailed form. Commencing in 1978, which is when the project is operating at full capacity, the financial projections were developed on an annual basis.

Two alternative projects were considered in the financial evaluation. Originally it was decided to produce steel billets, however, because of the substantial capital costs and high interest rates, the rate of return on the investment was not as great as originally anticipated. As an alternative, the project was analyzed on the basis of producing pig iron wherein the capital costs and payback period were substantially less.

Concurrent with the development of the financial information, further cost analyses were being undertaken with the result that some of the figures used in the development of the financial information require up-dating. A brief summary of those items are set out below:

1. An altemative site for the location of the smelter is being reviewed and, if it is decided to proceed on this basis, there is a potential saving of $350,000.00 in land costs and an additional $400,000.00 for site preparation.

2. The capital costs provide for driers for the magnetite concentrate, but the Ross report indicates that the moisture content of the magnetite concentrate is such that drying may not be required.

17.1 General (cont.)

3. Through the purchase of used equipment, which it is understood is currently available, and due to late adjustments in original capital cost estimates in the mill equipment, the capital costs could be reduced by a further $1,500,000.00.

4. Late revisions in the smelting cost estimates by Pennsylvania Engineering, show costs per ton of $63.10 and $103.27 for pig iron and steel respectively. In the financial evaluation costs of $59.78 and $101.92 were used. No adjustments were made to reflect these changes as the variances were less than 7% and certain contingency factors were already provided for in the original estimates.

   It should be noted that there is no provision for interest income on amounts of excess cash in that dividend and investment policies have not been established.

17.2 Financing

The method by which the project is to be financed has not been finally determined and accordingly, the entire financing is assumed to be done by loan, bearing interest at the rate of 15%. The one exception to this is the acquisition of the land which it is expected to be financed by way of mortgage.

Discussions have taken place with the Northern Ontario Development Commission and the Department of Regional Economic Expansion and it is expected that substantial assistance will be available from these sources by way of cash grants, loan guarantees and low interest rate loans. Further, government grants are also available in the form of contribution towards salary costs during training periods. Nothing has been included in the financial studies to reflect this possible assistance.

17.3 Capital Costs

The capital costs, which have been summarized in a separate section of this report, include provisions for contingencies and escalation. The basic assumption was to provide 10% each for contingency and escalation factors. Each item was reviewed separately however, to determine whether such a factor was required. Overall, approximately 15% of the total capital costs accrue from the addition of the contingency and escalation amounts.

Depreciation has been provided at a rate of 30% on a declining balance basis. This coincides with the rates allowed for income tax purposes. Projected profits and losses approximate the amounts against which income taxes are provided.

17.4 Operating Costs

The operating costs and revenues are based on current figures and no provision has been made for inflationary increases as it is expected that any increased costs will be recovered through additional revenues.

Income taxes have been provided on the basis of 35% of the net profit before taxes. This rate would seem to be liberal in light of the current budget proposals and considering the fact that no provision has been made for tax reductions for depletion allowances.

The mining taxes are based on estimated profits on the concentrates f.o.b. the mine site. Because of the lower grade of ore found in Nos. 3 and 4 Anomalies, it is unlikely mining taxes will apply when they are mined.

Financial projections for Nos. 3 and 4 Anomalies reflect the lower magnetite content of this ore which results in the smelter operating at less than capacity. Substantial additional profits can be anticipated if richer deposits of magnetite are located on the property or if other sources of this material are secured. Since the mining of these ore bodies will be delayed for about 10 years, these alternatives do not require immediate consideration.

17.5 Summary

The financial projections for the steel billet facility were not extended beyond 1986 as it was apparent that the cash flow generated from mining the Nos. 3 and 4 Anomalies were insufficient to carry the interest costs of the outstanding loan balance.

The cash flow analysis of the pig iron project allows for a repayment of the debt over a period of approximately $8\frac{1}{4}$ years. When considering the effect of possible grants and potential cost reductions noted earlier, it is anticipated the repayment period could be reduced by approximately $2\frac{1}{2}$ years. On this basis, the pig iron project becomes a very attractive economic undertaking.

EXHIBIT A-1

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Balance Sheets

PIG IRON PROJECT

(Thousands of Dollars)

ASSETS

	1974 Oct 1	1975 Jan 1	1975 Apr 1	1975 July 1	1975 Oct 1	1976 Jan 1	1976 Apr 1	1976 July 1	1976 Oct 1	1977 Jan 1	1977 Apr 1	1977 July 1	1977 Oct 1	1978 Jan 1
CURRENT ASSETS	$ (28)	(35)	62	110	159	207	256	306	531	810	1,052	1,103	1,156	1,204
LAND		500	500	500	500	500	500	500	500	500	500	500	500	500
Capitalized Interest			9	18	27	36	45	54	62	62	62	62	62	62
TOTAL LAND		500	509	518	527	536	545	554	562	562	562	562	562	562
BUILDINGS			8	462	1,149	2,127	3,326	4,677	6,379	6,985	6,985	6,985	6,985	6,985
Capitalized Interest					17	61	143	273	459	459	459	459	459	459
TOTAL BUILDINGS					1,166	2,188	3,469	4,950	6,838	7,444	7,444	7,444	7,444	7,444
Less: Accumulated Depreciation										513	1,033	1,513	1,958	2,369
NET BUILDINGS			8	462	1,166	2,188	3,469	4,950	6,838	6,931	6,411	5,931	5,486	5,075
EQUIPMENT			762	1,650	3,563	6,870	11,191	15,414	20,008	24,440	25,271	25,271	25,271	25,271
Capitalized Interest				29	92	229	495	933	1,546	1,546	1,546	1,546	1,546	1,546
TOTAL EQUIPMENT			762	1,679	3,655	7,099	11,686	16,347	21,554	25,986	26,817	26,817	26,817	26,817
Less: Accumulated Depreciation										1,617	3,445	5,198	6,819	8,319
NET EQUIPMENT			762	1,679	3,655	7,099	11,686	16,347	21,554	24,369	23,372	21,619	19,998	18,498
OTHER FIXED ASSETS		25	35	50	25	25	25	736	2,729	2,743	2,743	2,743	2,743	2,743
Capitalized Interest			1	2	4	5	6	7	10	10	10	10	10	10
TOTAL OTHER FIXED ASSETS		25	36	52	29	30	31	743	2,739	2,753	2,753	2,753	2,753	2,753
Less: Accumulated Depreciation										206	382	560	724	898
NET OTHER FIXED ASSETS		25	36	52	29	30	31	743	2,739	2,547	2,371	2,193	2,029	1,855
DEVELOPMENT EXPENSES	184	234	450	450	450	450	450	450	450	450	450	450	450	450
Capitalized Interest		7	16	33	51	70	90	110	131	131	131	131	131	131
TOTAL DEVELOPMENT EXPENSES	184	241	466	483	501	520	540	560	581	581	581	581	581	581
Amortization										44	84	121	156	188
NET DEVELOPMENT EXPENSES	184	241	466	483	501	520	540	560	581	537	497	460	425	393
	$ 156	731	1,843	3,304	6,037	10,580	16,527	23,460	32,805	35,756	34,265	31,868	29,656	27,587

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Balance Sheets

PIG IRON PROJECT

(Thousands of Dollars)

LIABILITIES	1974 Oct	1975 Jan 1	1975 Apr 1	1975 July 1	1975 Oct 1	1976 Jan 1	1976 Apr 1	1976 July 1	1976 Oct 1	1977 Jan 1	1977 Apr 1	1977 July 1	1977 Oct 1	1978 Jan 1
MORTGAGE $		375	373	371	369	367	365	363	361	358	356	354	351	348
CONSTRUCTION LOAN		220	1,387	2,865	5,561	9,967	15,608	22,034	30,634	36,072	37,239	37,375	37,511	37,647
Accrued Interest			8	60	170	385	773	1,387	2,265	3,499	4,983	6,566	8,214	9,929
TOTAL CONSTRUCTION LOAN		220	1,395	2,925	5,731	10,352	16,381	23,421	32,899	39,571	42,222	43,941	45,725	47,576
OPERATING LOAN									275	2,011	5,171	7,804	9,087	10,505
Accrued Interest										10	86	283	586	949
TOTAL OPERATING LOAN									275	2,021	5,257	8,087	9,673	11,454
ADVANCES	156	156	156	156	156	156	156	156	156	156	156	156	156	156
SHAREHOLDERS' EQUITY SHARE CAPITAL	6	6	6	6	6	6	6	6	6	6	6	6	6	6
RETAINED EARNINGS (DEFICIT)	(6)	(26)	(87)	(154)	(225)	(301)	(381)	(486)	(892)	(6,356)	(13,732)	(20,676)	(26,255)	(31,953)
NET EQUITY	-	(20)	(81)	(148)	(219)	(295)	(375)	(480)	(886)	(6,350)	(13,726)	(20,670)	(26,249)	(31,947)
$	156	731	1,843	3,304	6,037	10,580	16,527	23,460	32,805	35,756	34,265	31,868	29,656	27,587

MERTEC RESOURCE DEVELOPMENT LIMITED

EXHIBIT A-3

Pro Forma Statements of Profit and Losses and Deficit

PIG IRON PROJECT

(Thousands of Dollars)

	1974	1975				1976				1977			
	Oct Dec	Jan Mar	Apr June	July Sept	Oct Dec	Jan Mar	Apr June	July Sept	Oct Dec	Jan Mar	Apr June	July Sept	Oct Dec
Revenues:													
Apatite	$								373	373	373	373	373
Pig Iron									90	270	810	2,160	2,940
TOTAL REVENUES									463	643	1,183	2,533	3,313
Operating Expenses:													
Mining								200	700	699	700	699	700
Milling								75	372	372	372	372	372
Agglomeration									300	300	300	300	401
Transportation									100	242	242	242	242
Property Lease											12	13	12
Drying									7	7	7	7	14
Smelting									720	2,183	2,183	2,183	2,910
Administrative	20	60	60	60	60	60	80	100	125	125	125	125	125
TOTAL OPERATING EXPENSES	20	60	60	60	60	60	80	375	2,324	3,928	3,941	3,941	4,856
Depreciation and Amortization:													
Buildings									513	520	480	445	411
Equipment									1,617	1,828	1,753	1,621	1,500
Other Fixed Assets									206	176	178	164	174
Development									44	40	37	35	32
TOTAL DEPRECIATION EXPENSE									2,380	2,564	2,448	2,265	2,117
Mortgage Interest									8	8	8	8	8
Loan Interest - Construction		1	7	11	16	20	25	31	1,205	1,443	1,535	1,595	1,667
- Operation									10	76	197	303	363
TOTAL INTEREST EXPENSE		1	7	11	16	20	25	31	1,223	1,527	1,738	1,906	2,038
NET LOSS	20	61	67	71	76	80	105	406	5,464	7,376	6,944	5,579	5,698
DEFICIT (Opening)	6	26	87	154	225	301	381	486	892	6,356	13,732	20,676	26,255
DEFICIT (Closing)	$ 26	87	154	225	301	381	486	892	6,356	13,732	20,676	26,255	31,953

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Statement of Cash Flow for Capital Construction

PIG IRON PROJECT

(Thousands of Dollars)

Total Cost		1974 Oct Dec	1975 Jan Mar	1975 Apr June	1975 July Sept	1975 Oct Dec	1976 Jan Mar	1976 Apr June	1976 July Sept	1976 Oct Dec	1977 Jan Mar	1977 Apr June	1977 July Sept	1977 Oct Dec
	EQUIPMENT													
9,141	Mill and Briquetter		119	257	454	917	1,752	1,951	1,662	2,029				
109	Locomotive					10	7	27	40	14	11			
2,045	Material Handling			137	188	411	752	319	238					
3,895	Smelting Furnace		390	246	966	1,399	504			390				
519	Pig Iron Machine						78	130	233	78				
452	Cranes		226	18	70	101	37							
1,295	Gas Cleaning Equipment			130	40	165	390	340	100	130				
2,355	Other Auxiliary Equipment						300	400	600	1,055				
1,718	Mechanical							224	802	435	257			
1,065	Piping and Instrumentation						72	280	406	146	161			
782	Electrical						52	206	299	108	117			
1,895	Engineering and Management		27	100	195	304	377	346	214	47	285			
25,271	SUB TOTAL EQUIPMENT		762	888	1,913	3,307	4,321	4,223	4,594	4,432	831			
1,125	ADMINISTRATION	20	60	60	60	60	60	80	100	125	125	125	125	125
1,000	WORKING CAPITAL		100	50	50	50	50	50	200	250	200			
		20	160	110	110	110	110	130	300	375	325	125	125	125
$37,647	TOTAL CASH REQUIRED FOR CONSTRUCTION	$ 220	1,167	1,478	2,696	4,406	5,641	6,426	8,600	5,438	1,167	136	136	136

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Statement of Cash Flow for Capital Construction

PIG IRON PROJECT

(Thousands of Dollars)

Total Cost		1974 Oct Dec	1975 Jan Mar	1975 Apr June	1975 July Sept	1975 Oct Dec	1976 Jan Mar	1976 Apr June	1976 July Sept	1976 Oct Dec	1977 Jan Mar	1977 Apr June	1977 July Sept	1977 Oct Dec
	DEVELOPMENT EXPENSES													
$ 116	Feasibility Study	$ 50	66											
100	Multi Mineral Lease		100											
50	Diamond Drilling		50											
266	SUB TOTAL DEVELOPMENT COSTS	50	216											
	OTHER FIXED ASSETS													
732	Tailings Disposal System								732					
25	Road	25	10	15	(25)									
1,050	Railway							250	800					
936	Hydro Line							461	461	14				
2,743	SUB TOTAL OTHER FIXED ASSETS	25	10	15	(25)			711	1,993	14				
	BUILDINGS													
3,431	Mill, Briquetter and Dryer		8	54	200	853	791	515	748	262				
815	Site Preparation			400	415									
450	Yard Storage							100	282	68				
114	Storage Bin							20	77	17				
191	Smelting Furnace				50	87	25	29						
250	Pig Machine							212	38					
413	Miscellaneous							62	201	150				
692	Foundations						372	227	93					
629	Structural				22	38	11	186	263	109				
6,985	SUB TOTAL BUILDINGS		8	454	687	978	1,199	1,351	1,702	606				
257	LAND	125	11	11	11	11	11	11	11	11	11	11	11	11

EXHIBIT A-5

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Statement of Cash Flow for Operations

PIG IRON PROJECT

(Thousands of Dollars)

	1976 July Sept	1976 Oct Dec	1977 Jan Mar	1977 Apr June	1977 July Sept	1977 Oct Dec
Revenues:						
Apatite	$	373	373	373	373	373
Pig Iron		90	270	810	2,160	2,940
TOTAL REVENUES		463	643	1,183	2,533	3,313
Operating Expenses:						
Mining	200	700	699	700	699	700
Milling	75	372	372	372	372	372
Agglomeration		300	300	300	300	401
Apatite Drying		7	7	7	7	14
Transportation		100	242	242	242	322
Lease				12	13	12
Smelting		720	2,183	2,183	2,183	2,910
TOTAL EXPENDITURES	275	2,199	3,803	3,816	3,816	4,731
NET CASH REQUIREMENT FOR OPERATIONS	$ 275	1,736	3,160	2,633	1,283	1,418

MERTEC RESOURCE DEVELOPMENT LIMITED

EXHIBIT A-6

Pro Forma Balance Sheets

as at December 31

PIG IRON PROJECT

(Thousands of Dollars)

ASSETS	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
CURRENT ASSETS	$ 1,129	1,143	1,297	1,136	1,025	1,114	1,091	1,180	198	2,481	4,708	6,895	9,055	11,196	13,323	15,441	17,589	19,736
LAND	562	562	562	562	562	562	562	562	562	562	562	562	562	562	562	562	562	562
BUILDINGS	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444	7,444
Less: Accumulated Depreciation	3,891	4,957	5,703	6,225	6,591	6,847	7,026	7,151	7,239	7,301	7,344	7,374	7,395	7,410	7,420	7,427	7,432	7,436
NET BUILDINGS	3,553	2,487	1,741	1,219	853	597	418	293	205	143	100	70	49	34	24	17	12	8
EQUIPMENT	26,817	26,817	26,817	26,817	26,817	26,817	26,817	26,817	27,817	27,817	27,817	27,817	27,817	27,817	27,817	27,817	27,817	27,817
Less: Accumulated Depreciation	13,868	17,753	20,472	22,376	23,708	24,641	25,294	25,751	26,371	26,805	27,108	27,321	27,470	27,574	27,647	27,698	27,734	27,759
NET EQUIPMENT	12,949	9,064	6,345	4,441	3,109	2,176	1,523	1,066	1,446	1,012	709	496	347	243	170	119	83	58
OTHER FIXED ASSETS	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753
Less: Accumulated Depreciation	1,454	1,844	2,117	2,308	2,441	2,535	2,600	2,646	2,678	2,701	2,716	2,727	2,735	2,740	2,744	2,747	2,749	2,750
NET OTHER FIXED ASSETS	1,299	909	636	445	312	218	153	107	75	52	37	26	18	13	9	6	4	3
DEVELOPMENT EXPENSES	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581	581
Less: Amortization	306	388	446	487	515	535	549	558	565	570	574	576	577	578	579	580	581	581
NET DEVELOPMENT EXPENSES	275	193	135	94	66	46	32	23	16	11	7	5	4	3	2	1	-	-
	$ 19,767	14,358	10,716	7,897	5,927	4,713	3,779	3,231	2,502	4,261	6,123	8,054	10,035	12,051	14,090	16,146	18,250	20,367
LIABILITIES																		
MORTGAGE	$ 337	325	312	298	283	266	248	229	208	185	160	131	102	71	78	3	-	-
CONSTRUCTION AND OPERATING LOAN	56,000	51,300	46,000	39,500	32,000	23,500	13,500	2,000										
ADVANCES	156	156	156	156	156	156	156	156										
SHARE CAPITAL	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
RETAINED EARNINGS	(36,732)	(37,429)	(35,758)	(32,063)	(26,518)	(19,215)	(10,131)	840	2,288	4,070	5,957	7,917	9,927	11,974	14,046	16,137	18,244	20,361
TOTAL EQUITY	(36,726)	(37,423)	(35,752)	(32,057)	(26,512)	(19,209)	(10,125)	846	2,294	4,076	5,963	7,923	9,933	11,980	14,052	16,143	18,250	20,367
	$ 19,767	14,358	10,716	7,897	5,927	4,713	3,779	3,231	2,502	4,261	6,123	8,054	10,035	12,051	14,090	16,146	18,250	20,367

MERTEC RESOURCE DEVELOPMENT LIMITED

EXHIBIT A-7

Pro Forma Statement of Profit and Loss and Retained Earnings

for the Years ending December 31

PIG IRON PROJECT

(Thousands of Dollars)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Revenues:																		
Apatite	$ 2,984	2,984	2,984	2,984	2,984	2,984	2,984	2,984	6,300	6,300	6,300	6,300	6,300	6,300	6,300	6,300	6,300	6,300
Pig Iron	27,930	29,100	29,100	29,100	29,100	29,100	29,100	29,100	12,576	12,576	12,576	12,576	12,576	12,576	12,576	12,576	12,576	12,576
TOTAL REVENUES	30,914	32,084	32,084	32,084	32,084	32,084	32,084	32,084	18,876	18,876	18,876	18,876	18,876	18,876	18,876	18,876	18,876	18,876
Operating Expense:																		
Mining	2,798	2,798	2,798	2,798	2,798	2,798	2,798	2,798	5,740	5,740	5,740	5,740	5,740	5,740	5,740	5,740	5,740	5,740
Milling	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050
Agglomeration	1,605	1,605	1,605	1,605	1,605	1,605	1,605	1,605	694	694	694	694	694	694	694	694	694	694
Transportation	1,286	1,286	1,286	1,286	1,286	1,286	1,286	1,286	570	570	570	570	570	570	570	570	570	570
Property Lease	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Drying	56	56	56	56	56	56	56	56	119	119	119	119	119	119	119	119	119	119
Smelting	11,640	11,640	11,640	11,640	11,640	11,640	11,640	11,640	5,055	5,055	5,055	5,055	5,055	5,055	5,055	5,055	5,055	5,055
Administrative	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
TOTAL OPERATING EXPENSES	19,222	19,222	19,222	19,222	19,222	19,222	19,222	19,222	15,578	15,578	15,578	15,578	15,578	15,578	15,578	15,578	15,578	15,578
Depreciation and Amortization:																		
Buildings	1,522	1,066	746	522	366	256	179	125	88	62	43	30	21	15	10	7	5	4
Equipment	5,549	3,885	2,719	1,904	1,332	933	653	457	620	434	303	213	149	104	73	51	36	25
Other Fixed Assets	556	390	273	191	133	94	65	46	32	23	15	11	8	5	4	3	2	1
Development	118	82	58	41	28	20	14	9	7	5	4	2	1	1	1	1	1	
TOTAL DEPRECIATION EXPENSE	7,745	5,423	3,796	2,658	1,859	1,303	911	637	747	524	365	256	179	125	88	62	44	30
Mortgage Interest	33	32	31	30	29	27	26	25	23	21	19	17	15	13	11	9	2	
Loan Interest	8,627	8,038	7,298	6,413	5,363	4,163	2,775	1,163	300									
TOTAL INTEREST	8,660	8,070	7,329	6,443	5,392	4,190	2,801	1,188	323	21	19	17	15	13	11	9	2	
Royalty										11	11	11	11	11	11	11	11	11
NET PROFIT BEFORE TAXES	(4,713)	(631)	1,737	3,761	5,611	7,369	9,150	11,037	2,228	2,742	2,903	3,014	3,093	3,149	3,188	3,216	3,241	3,257
Income Taxes									780	960	1,016	1,054	1,083	1,102	1,116	1,125	1,134	1,140
Mining Taxes	66	66	66	66	66	66	66	66										
TOTAL TAXES	66	66	66	66	66	66	66	66	780	960	1,016	1,054	1,083	1,102	1,116	1,125	1,134	1,140
NET PROFIT	(4,779)	(697)	1,671	3,695	5,545	7,303	9,084	10,971	1,448	1,782	1,887	1,960	2,010	2,047	2,072	2,091	2,107	2,117
RETAINED EARNINGS(Opening)	(31,953)	(36,732)	(37,429)	(35,758)	(32,063)	(26,518)	(19,215)	(10,131)	840	2,288	4,070	5,957	7,917	9,927	11,974	14,046	16,137	18,244
RETAINED EARNINGS(Closing)	(36,732)	(37,429)	(35,758)	(32,063)	(26,518)	(19,215)	(10,131)	840	2,288	4,070	5,957	7,917	9,927	11,974	14,046	16,137	18,244	20,361

EXHIBIT A-8

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Statement of Cash Flow

for the Years ending December 31

PIG IRON PROJECT

(Thousands of Dollars)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
TOTAL REVENUES	$ 30,914	32,084	32,084	32,084	32,084	32,084	32,084	32,084	18,876	18,876	18,876	18,876	18,876	18,876	18,876	18,876	18,876	18,876
Total Operating Expenses	19,222	19,222	19,222	19,222	19,222	19,222	19,222	19,222	15,578	15,578	15,578	15,578	15,578	15,578	15,578	15,578	15,578	15,578
Mortgage Repayments	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	5	
Royalty										11	11	11	11	11	11	11	11	11
Mining Tax	66	66	66	66	66	66	66	66										
Income Tax									780	960	1,016	1,054	1,083	1,102	1,116	1,125	1,134	1,140
TOTAL EXPENDITURES	19,332	19,332	19,332	19,332	19,332	19,332	19,332	19,332	16,402	16,593	16,649	16,687	16,716	16,735	16,749	16,758	16,728	16,729
Net Cash Available	11,582	12,752	12,752	12,752	12,752	12,752	12,752	12,752	2,474	2,283	2,227	2,189	2,160	2,141	2,127	2,118	2,148	2,147
Loan Repayments:																		
Principal	3,030	4,700	5,300	6,500	7,500	8,500	10,000	11,500	2,000									
Interest	8,627	8,038	7,298	6,413	5,363	4,163	2,775	1,163	300									
Total	11,657	12,738	12,598	12,913	12,863	12,663	12,775	12,663	2,300									
Repayment of Advances									156									
Capital Expansion									1,000									
EXCESS (DEFICIENCY)	$ (75)	14	154	(161)	(111)	89	(23)	89	(982)	2,283	2,227	2,189	2,160	2,141	2,127	2,118	2,148	2,147

MERTEC RESOURCE DEVELOPMENT LIMITED

EXHIBIT B-1

Pro Forma Balance Sheets

STEEL BILLET PROJECT

(Thousands of Dollars)

ASSETS	1974 Oct 1	1975 Jan 1	1975 Apr 1	1975 July 1	1975 Oct 1	1976 Jan 1	1976 Apr 1	1976 July 1	1976 Oct 1	1977 Jan 1	1977 Apr 1	1977 July 1	1977 Oct 1	1978 Jan 1
CURRENT ASSETS	$(28)	(35)	62	111	159	207	254	304	530	781	983	1,370	1,387	1,405
LAND		500	509	518	527	536	545	554	562	562	562	562	562	562
BUILDINGS			8	715	1,621	2,886	4,227	6,465	8,684	9,754	9,754	9,754	9,754	9,754
Capitalized Interest					27	89	201	367	623	623	623	623	623	623
TOTAL BUILDINGS			8	715	1,648	2,975	4,428	6,832	9,307	10,377	10,377	10,377	10,377	10,377
Less: Accumulated Depreciation										698	1,424	2,095	2,716	3,291
NET BUILDINGS			8	715	1,648	2,975	4,428	6,832	9,307	9,679	8,953	8,282	7,661	7,086
EQUIPMENT			1,526	2,691	5,125	9,348	14,905	20,592	27,013	32,802	34,106	34,106	34,106	34,106
Capitalized Interest				57	160	358	722	1,308	2,129	2,129	2,129	2,129	2,129	2,129
TOTAL EQUIPMENT			1,526	2,748	5,285	9,706	15,627	21,900	29,142	34,931	36,235	36,235	36,235	36,235
Less: Accumulated Depreciation										2,186	4,740	7,102	9,287	11,308
NET EQUIPMENT			1,526	2,748	5,285	9,706	15,627	21,900	29,142	32,745	31,495	29,133	26,948	24,927
OTHER FIXED ASSETS		25	36	52	29	30	31	743	2,739	2,753	2,753	2,753	2,753	2,753
Less: Accumulated Depreciation										206	382	560	724	898
NET OTHER FIXED ASSETS		25	36	52	29	30	31	743	2,739	2,547	2,371	2,193	2,029	1,855
DEVELOPMENT EXPENSES	184	241	466	483	501	520	540	560	581	581	581	581	581	581
Amortization										44	84	121	156	188
NET DEVELOPMENT EXPENSES	184	241	466	483	501	520	540	560	581	537	497	460	425	393
	$ 156	731	2,607	4,627	8,149	13,974	21,425	30,893	42,861	46,851	44,861	42,000	39,012	36,228

EXHIBIT B-2

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Balance Sheets

STEEL BILLET PROJECT

(Thousands of Dollars)

LIABILITIES

	1974 Oct 1	1975 Jan 1	1975 Apr 1	1975 July 1	1975 Oct 1	1976 Jan 1	1976 Apr 1	1976 July 1	1976 Oct 1	1977 Jan 1	1977 Apr 1	1977 July 1	1977 Oct 1	1978 Jan 1
MORTGAGE	$	375	373	371	369	367	365	363	361	358	356	354	351	348
CONSTRUCTION LOAN		220	2,151	4,159	7,595	13,204	20,222	28,999	39,943	47,202	48,842	48,978	49,114	49,250
Accrued Interest			8	89	248	542	1,057	1,855	3,012	4,623	6,566	9,028	11,203	13,465
TOTAL CONSTRUCTION LOAN		220	2,159	4,248	7,843	13,746	21,279	30,854	42,955	51,825	55,408	58,006	60,317	62,715
OPERATING LOAN									275	2,514	7,160	11,211	13,912	16,628
Accrued Interest										10	105	377	812	1,364
TOTAL OPERATING LOAN									275	2,524	7,265	11,588	14,724	17,992
ADVANCES	156	156	156	156	156	156	156	156	156	156	156	156	156	156
SHAREHOLDERS' EQUITY SHARE CAPITAL	6	6	6	6	6	6	6	6	6	6	6	6	6	6
RETAINED EARNINGS (DEFICIT)	(6)	(26)	(87)	(154)	(225)	(301)	(381)	(486)	(892)	(8,018)	(18,330)	(28,110)	(36,542)	(44,989)
NET EQUITY	-	(20)	(81)	(148)	(219)	(295)	(375)	(480)	(886)	(8,012)	(18,324)	(28,104)	(36,536)	(44,983)
	$ 156	731	2,607	4,627	8,149	13,974	21,425	30,893	42,861	46,851	44,861	42,000	39,012	36,228

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Statements of Profit and Loss and Deficit

STEEL BILLET PROJECT (Thousands of Dollars)

	1974	1975				1976				1977			
	Oct Dec	Jan Mar	Apr June	July Sept	Oct Dec	Jan Mar	Apr June	July Sept	Oct Dec	Jan Mar	Apr June	July Sept	Oct Dec
Revenues:													
Apatite	$								373	373	373	373	746
Pig Iron									90	270	540	540	1,103
Steel											338	1,688	2,250
TOTAL REVENUES									463	643	1,251	2,601	4,099
Operating Expenses:													
Mining								200	700	699	700	699	700
Milling								75	372	372	372	372	372
Agglomeration									300	300	300	300	401
Transportation									100	242	242	242	322
Property Lease											12	13	12
Drying									7	7	7	7	14
Smelting									1,223	3,669	3,669	3,669	4,994
Administrative	20	60	60	60	60	60	80	100	125	125	125	125	125
TOTAL OPERATING EXPENSES	20	60	60	60	60	60	80	375	2,827	5,414	5,427	5,427	6,940
Depreciation and Amortization													
Buildings									698	726	671	621	575
Equipment									2,186	2,554	2,362	2,185	2,021
Other Fixed Assets									206	176	178	164	174
Development									44	40	37	35	32
TOTAL DEPRECIATION EXPENSE									3,134	3,496	3,248	3,005	2,802
Mortgage Interest									8	8	8	8	8
Loan Interest - Construction		1	7	11	16	20	25	31	1,610	1,942	2,076	2,158	2,244
- Operation									10	95	272	435	552
TOTAL INTEREST EXPENSE		1	7	11	16	20	25	31	1,628	2,045	2,356	2,601	2,804
NET LOSS	20	61	67	71	76	80	105	406	7,126	10,312	9,780	8,432	8,447
DEFICIT (Opening)	6	26	87	154	225	301	381	486	892	8,018	18,330	28,110	36,542
DEFICIT (Closing)	$ 26	87	154	225	301	381	486	892	8,018	18,330	28,110	36,542	44,989

MERTEC RESOURCE DEVELOPMENT

EXHIBIT B-4

Pro Forma Statement of Cash Flow for Capital Construction

STEEL BILLET PROJECT

(Thousands of Dollars)

Total Cost		1974 Oct Dec	1975 Jan Mar	1975 Apr June	1975 July Sept	1975 Oct Dec	1976 Jan Mar	1976 Apr June	1976 July Sept	1976 Oct Dec	1977 Jan Mar	1977 Apr June	1977 July Sept	1977 Oct Dec
$ 266	DEVELOPMENT EXPENSES	50	216											
2,743	OTHER FIXED ASSETS	25	10	15	(25)			711	1,993	14				
257	LAND	125	11	11	11	11	11	11	11	11	11	11	11	11
1,125	ADMINISTRATION	20	60	60	60	60	60	80	100	125	125	125	125	125
1,000	WORKING CAPITAL		100	50	50	50	50	50	200	250	200			
	BUILDINGS													
3,431	Mill, Briquetter and Dryer		8	54	200	853	791	515	748	262				
815	Site Preparation			400	415									
55	Oxygen								55					
450	Yard Storage							100	282	68				
114	Storage Bin							20	77	17				
191	Smelting Furnace				50	87	25	29						
1,338	Melt Shop				50	250	50	350	388	250				
188	Caster							160	28					
657	Miscellaneous							151	333	173				
1,107	Foundations			253	91		450	313						
1,408	Structural				100	75	25	600	308	300				
9,754	SUB TOTAL BUILDINGS		8	707	906	1,265	1,341	2,238	2,219	1,070				
	EQUIPMENT													
9,141	Mill, Briquetter and Dryer		119	257	454	917	1,752	1,951	1,662	2,029				
109	Locomotive					10	7	27	40	14	11			
970	Oxygen						97	277	499	97				
2,045	Material Handling			137	188	411	752	319	238					
3,895	Smelting Furnace		390	246	966	1,399	504			390				
901	Refining Furnace		90	57	224	324	116			90				
1,549	Casting Machine		465	28	102	201	267	203	51	232				
843	Cranes		421	33	131	190	68							
2,589	Gas Cleaning Equipment			259	80	320	800	670	200	260				
3,444	Other Auxiliary Equipment						400	500	1,000	1,544				
2,295	Mechanical							299	1,071	581	344			
1,877	Piping and Instrumentation						126	495	716	258	282			
1,643	Electrical						110	433	627	226	247			
2,805	Engineering and Management		41	148	289	451	558	513	317	68	420			
34,106	SUB TOTAL EQUIPMENT		1,526	1,165	2,434	4,223	5,557	5,687	6,421	5,789	1,304			
$49,251	TOTAL CASH REQUIRED FOR CONSTRUCTION	$ 220	1,931	2,008	3,436	5,609	7,019	8,777	10,944	7,259	1,640	136	136	136

EXHIBIT B-5

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Statement of Cash Flow for Operations

STEEL BILLET PROJECT

(Thousands of Dollars)

		1976 July Sept	1976 Oct Dec	1977 Jan Mar	1977 Apr June	1977 July Sept	1977 Oct Dec
Revenues:							
Apatite	$		373	373	373	373	746
Pig Iron			90	270	540	540	1,103
Steel					338	1,688	2,250
TOTAL REVENUES			463	643	1,251	2,601	4,099
Operating Expenses:							
Mining		200	700	699	700	699	700
Milling		75	372	372	372	372	372
Agglomeration			300	300	300	300	401
Apatite Drying			7	7	7	7	14
Transportation			100	242	242	242	322
Lease					12	13	12
Smelting			1,223	3,669	3,669	3,669	4,994
TOTAL EXPENDITURES		275	2,702	5,289	5,302	5,302	6,815
NET CASH REQUIREMENT FOR OPERATIONS	$	275	2,239	4,646	4,051	2,701	2,716

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Balance Sheets

as at December 31

STEEL BILLET PROJECT

(Thousands of Dollars)

ASSETS	1978	1979	1980	1981	1982	1983	1984	1985	1986
CURRENT ASSETS	$ 769	(14)	113	315	742	857	734	911	(6,301)
LAND	562	562	562	562	562	562	562	562	562
BUILDINGS	10,377	10,377	10,377	10,377	10,377	10,377	10,377	10,377	10,377
Less: Accumulated Depreciation	5,417	6,905	7,947	8,676	9,186	9,543	9,793	9,969	10,091
NET BUILDINGS	4,960	3,472	2,430	1,701	1,191	834	584	408	286
EQUIPMENT	36,235	36,235	36,235	36,235	36,235	36,235	36,235	36,235	36,235
Less: Accumulated Depreciation	18,786	24,021	27,686	30,251	32,045	33,303	34,183	34,799	35,229
NET EQUIPMENT	17,449	12,214	8,549	5,984	4,190	2,932	2,052	1,436	1,006
OTHER FIXED ASSETS	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753	2,753
Less: Accumulated Depreciation	1,454	1,844	2,117	2,308	2,441	2,535	2,600	2,646	2,678
NET OTHER FIXED ASSETS	1,299	909	636	445	312	218	153	107	75
DEVELOPMENT EXPENSES	581	581	581	581	581	581	581	581	581
Less: Amortization	306	388	446	487	515	535	549	558	565
NET DEVELOPMENT EXPENSES	275	193	135	94	66	46	32	23	16
	$ 25,314	17,336	12,425	9,101	7,063	5,449	4,117	3,447	(4,356)
LIABILITIES									
MORTGAGE	$ 337	325	312	298	283	266	248	229	208
CONSTRUCTION AND OPERATING LOAN	80,707	79,000	78,000	77,000	76,000	74,500	72,500	70,500	70,500
ADVANCES	156	156	156	156	156	156	156	156	156
SHAREHOLDERS' EQUITY SHARE CAPITAL	6	6	6	6	6	6	6	6	6
RETAINED EARNINGS (DEFICIT)	(55,892)	(62,151)	(66,049)	(68,359)	(69,382)	(69,479)	(68,793)	(67,444)	(75,226)
NET EQUITY	(55,886)	(62,145)	(66,043)	(68,353)	(69,376)	(69,473)	(68,787)	(67,438)	(75,220)
	$ 25,314	17,336	12,425	9,101	7,063	5,449	4,117	3,447	(4,356)

EXHIBIT B-7

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Statement of Profit and Loss and Retained Earnings

for the Years ending December 31

STEEL BILLET PROJECT

(Thousands of Dollars)

	1978	1979	1980	1981	1982	1983	1984	1985	1986
Revenues:									
Apatite	$ 2,984	2,984	2,984	2,984	2,984	2,984	2,984	2,984	6,300
Steel	34,567	36,000	36,000	36,000	36,000	36,000	36,000	36,000	15,560
TOTAL REVENUES	37,551	38,984	38,984	38,984	38,984	38,984	38,984	38,984	21,860
Operating Expenses:									
Mining	2,798	2,798	2,798	2,798	2,798	2,798	2,798	2,798	5,740
Milling	1,487	1,487	1,487	1,487	1,487	1,487	1,487	1,487	3,050
Agglomeration	1,605	1,605	1,605	1,605	1,605	1,605	1,605	1,605	694
Drying	56	56	56	56	56	56	56	56	119
Transportation	1,286	1,286	1,286	1,286	1,286	1,286	1,286	1,286	570
Property Lease	50	50	50	50	50	50	50	50	50
Smelting	18,390	18,390	18,390	18,390	18,390	18,390	18,390	18,390	7,930
Administrative	300	300	300	300	300	300	300	300	300
TOTAL OPERATING EXPENSES	25,972	25,972	25,972	25,972	25,972	25,972	25,972	25,972	18,453
Depreciation and Amortization:									
Buildings	2,125	1,488	1,042	729	510	357	250	176	122
Equipment	7,478	5,235	3,665	2,565	1,794	1,258	880	616	430
Other Fixed Assets	556	390	273	191	133	94	65	46	32
Development	118	82	58	41	28	20	14	9	7
TOTAL DEPRECIATION AND AMORTIZATION	10,277	7,195	5,038	3,526	2,465	1,729	1,209	847	591
Interest:									
Mortgage	33	32	31	30	29	27	26	25	23
Loan	12,106	11,978	11,775	11,700	11,475	11,287	11,025	10,725	10,575
TOTAL INTEREST	12,139	12,010	11,806	11,730	11,504	11,314	11,051	10,750	10,598
NET PROFIT BEFORE TAXES	(10,837)	(6,193)	(3,832)	(2,244)	(957)	(31)	752	1,415	(7,782)
Mining Taxes	66	66	66	66	66	66	66	66	
TOTAL TAXES	66	66	66	66	66	66	66	66	
NET PROFIT	(10,903)	(6,259)	(3,898)	(2,310)	(1,023)	(97)	686	1,349	(7,782)
RETAINED EARNINGS (Opening)	(44,989)	(55,892)	(62,151)	(66,049)	(68,359)	(69,382)	(69,479)	(68,793)	(67,444)
RETAINED EARNINGS (Closing)	$(55,892)	(62,151)	(66,049)	(68,359)	(69,382)	(69,479)	(68,793)	(67,444)	(75,226)

EXHIBIT B-8

MERTEC RESOURCE DEVELOPMENT LIMITED

Pro Forma Statement of Cash Flow

for the Years ending December 31

STEEL BILLET PROJECT

(Thousands of Dollars)

	1978	1979	1980	1981	1982	1983	1984	1985	1986
TOTAL REVENUES	$ 37,551	38,984	38,984	38,984	38,984	38,984	38,984	38,984	21,860
Total Operating Expenses	25,972	25,972	25,972	25,972	25,972	25,972	25,972	25,972	18,453
Mortgage Repayments	44	44	44	44	44	44	44	44	44
Mining Tax	66	66	66	66	66	66	66	66	
TOTAL EXPENDITURES	26,082	26,082	26,082	26,082	26,082	26,082	26,082	26,082	18,497
Net Cash Available	11,469	12,902	12,902	12,902	12,902	12,902	12,902	12,902	3,363
Loan Repayments:									
Principal		1,707	1,000	1,000	1,000	1,500	2,000	2,000	
Interest	12,106	11,978	11,775	11,700	11,475	11,287	11,025	10,725	10,575
TOTAL REPAYMENTS	12,106	13,685	12,775	12,700	12,475	12,787	13,025	12,725	10,575
EXCESS (DEFICIENCY)	$(637)	(783)	127	202	427	115	(123)	177	(7,212)

APPENDIX

A. Bibliography

B. Report of A.H. Ross and Associates

C. Market Survey Correspondence

   (1) Steel and Pig Iron
   (2) Fertilizer

D. Property Lease Agreements

E. Drawings List

F. Mining Contract Agreement

G. Canadian Pacific Railway Spur Quote

H. Ontario Hydro Power Commission Line Quote

I. Construction Schedule

APPENDIX A

Bibliography

The Multi-Minerals Limited property has been the subject of numerous reports during the past 22 years. The data developed in this Feasibility Study has relied to an important degree on this prior work. Reports and other data on which this study has been based are under the following headings.

Geology

No new geological studies were made for this report, either by surface examination or diamond drilling.

1) Geological Report on the Property of Nemegos Uranium Corp.
by M.W. Bartley, P.Eng. and W.L.C. Greer, P.Eng.
dated August 30, 1952

2) Geological Report on Property of Multi-Minerals Limited
by E. Neczkar
dated September 15, 1954

3) Airborne Scintillometer Survey
by Central Geophysics Limited
dated June 18, 1955

4) Columbium Deposits of Canada
by R.B. Rowe, 1958
Economic Geology Series No.18, Geological Survey of Canada

5) Alkaline Rocks and Niobium Deposits Near Nemegos, Ontario
by R.W. Hodder, 1958
Geological Survey of Canada

6) Drill Logs
by H.L. Garvie, P.Eng.
dated 1953 to 1959

7) Niobium-Bearing Complexes East of Lake Superior
by G.E. Parsons, 1961
Geological Report No.3, Ontario Department of Mines

Geology (continued)

8) Preliminary Map No. P.452 (Revised)
by J. Satterly, 1970
Ontario Department of Mines and Northern Affairs

9) Map 2116 - Chapleau - Foleyet Sheet
Geological Compilation Series
Ontario Department of Mines

General

10) Report on the Nemegos Property of Multi-Minerals Limited
by H.L. Garvie, P.Eng.
dated December 30, 1959

11) Report on Iron Phosphate-Niobium Property for Multi-Minerals Ltd
by Ross Kidd, P.Eng.
dated June 19, 1972

Ore Dressing

12) Results of Mill Test at Department of Mines & Technical Surveys
Ottawa
by B.D. Weaver, P.Eng.
dated November 15, 1956

13) Summary of Mineral Dressing Tests - Multi-Minerals Limited
by B.D. Weaver, P.Eng.
dated January 25, 1960

Mining

The feasibility and design for the open pit mining operation was investigated by International Nickel Company of Canada Limited in conjunction with Pioneer Construction Incorporated. This work was reported as:-

14) Feasibility Study for Open Pit Operation Nemegos Property
by Inco
dated April 10, 1974

APPENDIX A

Mill Design

Concentrator product flow and process design was developed by A.H. Ross and Associates in co-operation with International Nickel Company of Canada Limited and Scrivener Engineering Limited. Bench scale and pilot plant testing, carried out by Inco, was co-ordinated by Ross. Scrivener provided plant layout, site selection and the engineering design function.

The Ross report, included in Appendix B, is titled:

15) A Metallurgical Evaluation of an Apatite-Magnetite Deposit, Nemegos, Ontario
by A.H. Ross and Associates
dated November, 1974

Smelting

Plant design, process flow and technology for the smelting of the titaniferous magnetite concentrate are described in the report of Pennsylvania Engineering Corporation which is included in this study as section 12. The methods described for the recovery of iron and titanium slag are not novel. Similar methods are used in Canada and elsewhere. The report is titled:

16) Engineering Study for New Billet Producing Facility
by Pennsylvania Engineering Corporation
dated September, 1974

APPENDIX B

Report of A.H. Ross and Associates

A Metallurgical Evaluation of an Apatite-Magnetite Deposit, Nemegos, Ontario

J.M. Hemstock, P. Eng.

REGISTERED PROFESSIONAL ENGINEER
J. M. HEMSTOCK
PROVINCE OF ONTARIO

K.R. Coyne, P. Eng.

Toronto, Ontario, Canada
November 7, 1974

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Preface

Mertec Resource Development Limited has retained the services of Scrivener Engineering Limited to conduct a feasibility study relative to the production of steel and apatite concentrate from the Multi-Minerals ore bodies at Nemegos, Ontario.

On June 18, 1974, A. H. Ross & Associates were retained by Mertec to evaluate the bench-scale and pilot plant investigations conducted by the International Nickel Company of Canada Limited (Inco). The terms of reference included working with Inco personnel to establish the response of the new ore sample to the proposed flowsheet by bench-scale testwork, to provide sufficient data to select a pilot plant circuit, operating conditions and metallurgical objectives for pilot plant testing in the Inco Test Centre.

In addition, the equipment and flowscheme were to be inspected to insure adequacy for the proposed study, the pilot plant operation was to be observed, and the data generated during the investigation was to be evaluated.

On August 23, 1974, A. H. Ross & Associates' duties were expanded to include the following:

- Prepare a recommended flowsheet and material balance in schematic form.

- Submit a list of the major processing equipment including a brief description and size for each item.

- Provide an estimate of recovery and grade of products that may be expected during operation of the commercial plant.

- Supply operating cost factors such as manpower, reagent consumption, maintenance, analytical, operating supplies, etc.

Assist with and review the conceptual general arrangement drawings which would be prepared by Scrivener Engineering.

On June 4, 1974, bench-scale testwork was begun in the Inco Test Centre facilities on a 400 pound sample of ore supplied by Mertec Resource Development Limited.

During the period July 16-26, 1974, a total of 160 tons of Nemegos apatite-magnetite ore, from the number 6 zone of the deposit, was processed through the Inco pilot plant.

On September 3, 1974 samples of magnetite and apatite concentrates were forwarded by Inco to the Eimco Division of Envirotech Canada Limited (Eimco), Mississauga Ontario, for thickening and filtration testwork.

On October 18, 1974, one drum of lump ore was forwarded by Mertec to the Ontario Research Foundation (ORF) for grindability testwork.

Throughout the bench-scale and pilot plant phases of the project, J. M. Hemstock of A. H. Ross & Associates observed the testwork and held meetings and discussions regularly with Inco personnel at the Copper Cliff Test Centre.

This report presents a technical study of the data as developed during the investigations, an estimate of the magnetite and apatite production to be expected when milling ore as represented by the ore reserve calculations, a recommended flowsheet and equipment sizing for a commercial plant. In addition, at the request of Scrivener Engineering, the cost of major equipment and an estimate of operating costs have been included.

The activities of A. H. Ross & Associates have related only to the processing of ore from crushing through to production of separate magnetite and apatite concentrates in the form of wet filter cake.

1.2 Evaluation Basis

All production estimates are premised on the treatment of an average of 1500 tons per day of ore having an average grade of 42.73% iron and 8.40% P_2O_5. As an allowance for downtime, it has been assumed that the mill will operate 325 days per year.

The operating schedule will be as follows:

Crushing - 2 shifts per day, 5 days per week

Milling - 3 shifts per day, 7 days per week

Production will consist of separate concentrates in the form of filter-cake; magnetite as magnetic concentrate and apatite as flotation concentrate.

2. SUMMARY

2.1 Qualifications

The information presented in this summary is subject to the limitations stated in prior and subsequent sections of this report. The data contained herein can be used for project evaluation and feasibility purposes.

2.2 Metallurgy

The metallurgical investigations were directed toward recovery of two products, a magnetite concentrate by magnetic separation and an apatite concentrate by flotation from the non-magnetic tailings.

The specifications for the two concentrates were defined by Mertec Resource Development Limited as follows:

Magnetite: Less than 0.1% sulphur
Less than 0.275% P_2O_5

Apatite: Less than 0.1% sulphur
3 to 4% combined
Fe_2O_3 and Al_2O_3
Minimum 68% BPL = 31% P_2O_5

To the extent that the metallurgical test samples are typical of the ore to be processed, the mineral deposit is amenable to production of magnetite concentrate within the above specifications and with recovery of 93.5 percent of the contained Fe.

The P_2O_5 content of the apatite concentrate was higher than required, however, the sulphur content was 0.21 percent which exceeded the specification. Recovery is projected to be only 56.0 percent of the contained P_2O_5. It is expected that the recovery of apatite will be improved significantly after the commercial plant has been brought on-stream.

2.3 Production Data

Projection of pilot plant results to the average ore grade, as represented by the proposed mill feed grade, indicates the following annual production can be expected from treatment of 1500 tons per day of ore in the commercial milling facility.

	Dry Tons/Year	Grade % P_2O_5	Grade % Fe	Grade % S
Ore	487,500	8.40	42.73	0.80
Magnetite Concentrate	302,737	0.30	64.30	0.05
Contained Iron	194,660			
Apatite Concentrate	66,300	34.59	1.86	0.21
Contained P_2O_5	22,933			

2.4 Commercial Plant

Equipment sizes pertaining to the pilot plant investigations are specified in the International Nickel Company of Canada Limited report entitled, "Nemegos Apatite-Magnetite Ore; Magnetite and Apatite Recovery", dated September 19, 1974.

Equipment sizing for the commercial plant has been based upon the Inco report data, thickening and filtration testwork conducted by the Eimco Division of Envirotech Canada Limited, and information contained in the files of A. H. Ross & Associates.

Sufficient laboratory and pilot plant testwork has been completed to permit detailed engineering design of a commercial scale milling plant.

All items of recommended equipment are of proven design and commonly used in the mineral processing industry.

2.5 Operating Costs

Based on present day unit costs generally applicable in the area, a direct operating cost of $3.01 per ton of ore has been estimated for the milling plant.

3. METALLURGICAL STUDIES

3.1 Bench-Scale Testwork

Approximately 54 bench scale tests were conducted in the Inco Test Centre facilities on 400 pounds of sample supplied by Mertec Resource Development Limited.

The initial objective of the testwork was to produce magnetite and apatite products in accordance with the following specifications:

Magnetite Concentrate:	Less than 0.1% P (0.2% P_2O_5)
	Less than 0.1% S
Apatite Concentrate:	1.5% maximum Fe (normal Florida)
	35% minimum P_2O_5

The data in this section of the report have been derived from the Inco laboratory worksheets, copies of which were obtained during visits to the Inco Test Centre. No formal report of the bench-scale testwork has been issued by Inco.

3.1.1 Regrinding and Magnetic Cleaning of Reground Magnetic Rougher Concentrate

Test No. 6330 was undertaken to study the possibility of producing a rougher magnetic concentrate at a relatively coarse grind, followed by regrinding of the rougher concentrate and upgrading by magnetic cleaning. Results of this test are tabulated as follows:

Grinding Time - 5 minutes, primary grind.

Regrinding Time (shown) - Rougher concentrate split into 300 gram lots and reground for cleaning.

ORE (HEADS)

Magnetic Roughing

	%	Assay %			% Distribution		
	Wt.	P_2O_5	Fe	S	P_2O_5	Fe	S
Heads (Calculated)	100.00	12.40	42.78	0.77	100.0	100.0	100.0
Rougher Concentrate	71.45	3.30	59.00	0.71	19.0	98.5	65.8
Tails	28.55	35.17	2.20	0.92	81.0	1.5	34.2

Magnetic Cleaning (No Regrind)

	%	Assay %			% Distribution		
	Wt.	P_2O_5	Fe	S	P_2O_5	Fe	S
Feed (Calculated)	100.00	3.55	59.8	0.69	100.00	100.00	100.00
Concentrate	95.24	2.08	62.6	0.64	55.7	99.7	88.9
Tails	4.76	33.17	4.34	1.60	44.3	0.3	11.1
Cleaner Concentrate Recovery from Ore	68.0				10.6	98.2	58.5

Magnetic Cleaning (2 1/2 minute Regrind)

Feed (Calculated)	100.00	3.54	59.2	0.66	100.0	100.0	100.0
Concentrate	92.44	1.34	63.60	0.58	35.0	99.3	80.7
Tails	7.56	30.38	5.76	1.69	65.0	0.7	19.3
Cleaner Concentrate Recovery from Ore	66.0				6.6	97.8	53.1

Magnetic Cleaning (5 minute Regrind)

Feed (Calculated)	100.00	3.91	59.7	0.76	100.0	100.0	100.0
Concentrate	90.66	1.27	65.2	0.64	29.4	99.0	76.8
Tails	9.34	29.56	6.16	1.88	70.6	1.0	23.2
Cleaner Concentrate Recovery from Ore	64.8				5.6	97.5	50.5

Magnetic Cleaning (7 1/2 minute Regrind)

Feed (Calculated)	100.00	3.54	60.0	0.71	100.0	100.0	100.0
Concentrate	89.51	0.60	66.1	0.54	15.2	98.7	67.9
Tails	10.49	28.65	7.60	2.18	84.8	1.3	32.1
Cleaner Concentrate Recovery from Ore	63.9				2.9	97.2	44.7

Magnetic Cleaning (10 minute Regrind)

Feed (Calculated)	100.00	3.31	60.9	0.70	100.0	100.0	100.0
Concentrate	89.29	0.34	67.3	0.52	9.2	98.7	66.6
Tails	10.71	28.10	7.48	2.17	90.8	1.3	33.4
Cleaner Concentrate Recovery from Ore	63.8				1.7	97.2	43.8

From the above test results it became obvious that the sulphur specification (less than 0.1%) could not be achieved by magnetic separation, due to the pyrrhotite in the ore being sufficiently magnetic to carry excess sulphur into the magnetic concentrate.

Based upon these results, it was concluded that removal of sulphides by flotation preceding magnetic separation was required.

3.1.2 Review of Selected Tests including Desliming and Sulphide Flotation Preceding Magnetic Separation

The test results shown in the following tabulation were selected as representative of the various studies to optomize magnetite and apatite recovery.

	%	Grade %			% Distribution		
	Wt.	P_2O_5	Fe	S	P_2O_5	Fe	S
Test 6343							
Rougher Magnetic Concentrate	70.48	1.92	61.4	-	11.63	97.52	-
Rougher Apatite Concentrate	21.27	36.07	2.93	-	65.60	1.40	-
(Calculated) Head		11.69	44.47	-			
Test 6344							
Rougher Magnetic Concentrate	72.97	3.22	60.71	0.67	22.58	98.22	63.55
Cleaner Magnetic Concentrate	64.07	0.79	66.20	0.42	4.87	94.04	34.97
Rougher Apatite Concentrate	21.73	30.30	2.51	0.85	63.36	1.21	24.02
Cleaner Apatite Concentrate	21.42	30.41	2.49	0.85	62.68	1.18	23.67
(Calculated) Head		10.39	45.10	0.77			

(No suphide float; deslimed both rougher magnetic concentrate and tail on 325M)

	% Wt.	Grade % P_2O_5	Grade % Fe	Grade % S	% Distribution P_2O_5	% Distribution Fe	% Distribution S
Test 6346							
Rougher Magnetic Concentrate	74.77	1.47	57.8	0.074	11.98	93.91	6.85
Apatite Rougher Concentrate	1.76	31.16	8.85	0.55	6.04	0.34	1.21
Apatite Rougher Tails	20.76	35.69	6.09	0.03	80.73	2.75	0.78
(Calculated) Head		9.18	46.02	0.81			

(Sulphide prefloat, no desliming. Rougher magnetic tails contain 86.77% of the P_2O_5 @ 35.55% grade; however, Fe is 6.31%)

	% Wt.	Grade % P_2O_5	Grade % Fe	Grade % S	% Distribution P_2O_5	% Distribution Fe	% Distribution S
Test 6347							
Magnetic Concentrate (Sulphide Flotation Tail)	73.09	3.78	55.8	0.06	22.62	94.63	5.54
Apatite Concentrate (Sulphide Flotation Tail)	11.86	41.70	1.20	0.014	40.49	0.33	0.21
(Calculated) Head		12.21	43.1	0.79			

(No desliming; floated sulphides from rougher magnetic concentrate and from apatite rougher concentrate)

	% Wt.	Grade % P_2O_5	Grade % Fe	Grade % S	% Distribution P_2O_5	% Distribution Fe	% Distribution S
Test 6351							
Rougher Magnetic Concentrate	65.53	1.95	58.8	0.06	10.05	93.64	5.03
Apatite Rougher Concentrate	21.19	37.20	2.38	0.02	62.00	1.22	0.42
(Calculated) Head		12.71	41.15	0.78			

(Sulphide prefloat and deslimed rougher magnetic tails; this test was ground through 65 mesh screen)

	% Wt.	Grade % P_2O_5	Grade % Fe	Grade % S	% Distribution P_2O_5	% Distribution Fe	% Distribution S
Test 6353							
Rougher Magnetic Concentrate	67.96	2.93	62.4	0.10	16.05	94.08	8.28
Apatite Rougher Concentrate	22.81	36.19	3.57	0.10	66.53	1.81	2.90
(Calculated) Head		12.41	45.07	0.82			

(Ground through 65 mesh screen; sulphide prefloat, apatite float feed deslimed)

	%	Grade %			% Distribution		
	Wt.	P_2O_5	Fe	S	P_2O_5	Fe	S
Test 6354							
Magnetic 3rd Cleaner Concentrate	61.11	0.275	65.20	0.06	1.33	93.02	4.57
Apatite Rougher Concentrate	28.88	36.36	2.72	0.08	83.10	1.83	2.72
(Calculated) Head		12.63	42.83	0.80			

(Ground through 65 mesh screen; sulphide prefloat, apatite float feed deslimed)

As a result of marketing studies conducted by Mertec Resource Development Limited, the product specifications, shown in Item 3.1 above, were altered. The new specifications for the two concentrates were defined as follows:

Magnetite: Less than 0.1% S
Less than 0.275% P_2O_5

Apatite: Less than 0.1% S
3 to 4% combined
Fe_2O_3 and Al_2O_3
Minimum 68% PBL = 31% P_2O_5

In view of the redefined limits on impurities, it was apparent that specifications were achieved in Test No. 6354 above.

Based upon these results, the decision was taken to proceed to pilot plant testing. The initial circuit was to include primary grinding through 65 mesh, followed by sulphide flotation preceding magnetic separation and desliming of non magnetics ahead of apatite flotation.

3.2 Pilot Plant Investigations

The pilot plant feed consisted of 160 tons of Nemegos apatite-magnetite ore from the Number 6 ore zone of the deposit, which had been crushed to -1/2 inch immediately prior to shipment to Inco.

Pilot plant investigations are reported in the International Nickel Company of Canada Limited report entitled, "Nemegos Apatite-Magnetite Ore; Magnetite and Apatite Recovery", dated September 19, 1974. In this report the data for 21 shifts operated in the pilot plant, between July 16th and July 26th, are presented and evaluated.

3.2.1 Preliminary Evaluation of Pilot Plant Data

Based upon unofficial test data obtained from Inco personnel, test periods were selected which represented the best metallurgical results achieved. Data for these test periods are presented on Page 3 - 7.

From this tabulation the period of July 22, (4-12) shift was selected as representing the best overall metallurgy, indicating 67.9% Fe in the magnetite concentrate and 35.05% P_2O_5 in the apatite concentrate at recoveries of 91.4% and 69.8% respectively.

When the formal Inco report was issued the above test period was also featured, typifying the best results on apatite. However, uncertainty arose in regard to this test period when it was observed that in the Inco material balance, Figure 2.3, the apatite tailing was computed to contain 19.0% P_2O_5 whereas the actual apatite tailing assay, reported in Table 3.5.3, was 25.43% P_2O_5. Discussion with Inco personnel did not resolve this apparent discrepancy and resulted in their eliminating this test period from consideration and substituting in its place the period July 23, (4-12) shift.

PRELIMINARY METALLURGICAL BALANCES

JULY, 1974

Day	Shift	Products	% Weight	Grade % P_2O_5	Grade % Fe	Grade % S	Grade % BPL	% Distribution P_2O_5	% Distribution Fe	% Distribution S
19	(8-4)	Plant Feed (Ore)	100.00	10.50	45.50	0.91	-	100.0	100.0	100.0
		Magnetite Concentrate	68.36	0.27	62.10	0.07	-	1.8	93.3	5.3
		Apatite Concentrate	19.91	32.07	2.12	0.12	69.9	60.8	0.9	2.6
		Tailings	11.73	33.52	22.39	7.15	-	37.4	5.8	92.1
22	(4-12)	Plant Feed (Ore)	100.00	10.06	45.80	0.88	-	100.0	100.0	100.0
		Magnetite Concentrate	61.65	0.27	67.90	0.07	-	1.7	91.4	4.9
		Apatite Concentrate	20.03	35.05	1.53	0.08	76.4	69.8	0.7	1.8
		Tailings	18.32	15.67	19.83	4.48	-	28.5	7.9	93.3
23	(8-4)	Plant Feed (Ore)	100.00	9.93	46.50	0.86	-	100.0	100.0	100.0
		Magnetite Concentrate	68.83	0.24	63.50	0.05	-	1.7	94.0	4.0
		Apatite Concentrate	18.28	33.90	1.88	0.10	73.9	62.4	0.7	2.1
		Tailings	12.89	27.68	18.98	6.26	-	35.9	5.3	93.9
25	(4-12)	Plant Feed (Ore)	100.00	10.07	44.38	0.95	-	100.0	100.0	100.0
		Magnetite Concentrate	64.44	0.26	65.70	0.08	-	1.7	95.4	5.4
		Apatite Concentrate	19.90	32.53	2.59	0.20	70.9	64.3	1.2	4.2
		Tailings	15.66	21.89	9.75	5.48	-	34.0	3.4	90.4

Further discussions were held with Inco personnel in regard to the three material balances, Figures 2.2, 2.3 and 2.4, shown on Pages 25-27 of the Inco formal report. It was agreed that the pilot plant run of July 23, 1974 (4-12) shift was the best overall test period reported. The following metallurgical balance was calculated from data contained in the tables presented in the Inco report:

	%	% Grade			% Distribution		
	Wt.	P_2O_5	Fe	S	P_2O_5	Fe	S
Ore	100.0	10.14	45.74	0.88	100.00	100.00	100.00
Magnetite Concentrate	67.0	0.30	64.30	0.05	1.98	94.19	3.80
Apatite Concentrate	18.0	34.59	1.86	0.21	61.43	0.73	4.29
Overall Tailing	15.0	24.72	15.47	5.40	36.59	5.08	91.91

It will be observed that some differences appear between the figures in the above balance and those in Inco Figure 2.3, in particular a difference of 5.57% in P_2O_5 recovery, which results from different methods of computation.

3.3 Ontario Research Foundation, Grindability Testwork

One drum of lump ore was forwarded by Mertec Resource Development Limited to Ontario Research Foundation, Sheridon Park Ontario, for Bond grindability determination.

By letter of October 22, 1973 to Scrivener Engineering, Ontario Research Foundation reported the Bond work index to be 13.5.

This work was undertaken on the recommendation of A. H. Ross & Associates, due to concern that the power requirement as specified in the Inco report might be excessive.

3.4 Eimco, Thickening and Filtration Testwork

On September 3, 1974 samples of magnetite and apatite concentrates were forwarded by Inco to the Eimco Division of Envirotech Canada Limited, Mississauga, Ontario, for thickening and filtration testwork. These samples are identified as follows:

Magnetite Concentrate: From barrel 57, assays
66.7% Fe, 0.08% S, 0.215% P_2O_5

Apatite Concentrate: From Barrel 10, assays
1.45% Fe, 0.13% S, 35.0% P_2O_5, 0.85% Al_2O_3

Both samples were shipped in slurry form and represent the period when the pilot plant was operated on primary grinding followed by regrinding of magnetite prior to cleaner magnetic separation.

It was believed necessary to have these tests undertaken as the magnetite concentrate was not filtered at the Inco Test Centre. Also due to the necessary circulation of products in the thickeners at the test centre, it could not be determined with confidence that the pilot plant thickeners and filter were operated at optimum capacity.

Eimco test results, as received by A. H. Ross & Associates by telephone call from Mr. J. Crane of Eimco, on October 17, 1974, were as noted below.

Thickening Test Results

Magnetite Concentrate: Area required = 0.224 sq. ft./TPD
Underflow Density = 84.48% solids
Pumping Density = 75-78% solids

Apatite Concentrate: Area required = 2.40 sq. ft./TPD
Underflow Density = 78.1% solids
Pumping Density = 68-70% solids

Filtration Test Results

Magnetite Concentrate:	Filtration Rate	= 250 lb/sq.ft./hour
	Filter Cake Moisture	= 6 1/2 to 7%
Apatite Concentrate:	Filtration Rate	= 115 lb/sq.ft./hour
	Filter Cake Moisture	= 11 1/2 to 12 1/2%

4. COMMERCIAL PLANT

4.1 Calculation of Mill Head Assays from Available Ore Reserve Data

A letter from Mr. G. O. Loach, Scrivener Engineering to Mr. P. A. Crossgrove, Mertec Resource Development Limited advised that the mill heads for delivery to the concentrator would be:

Titaniferous magnetite	69.6%
Apatite	21.8%

The above grade was to be adjusted for a mining dilution factor of 10%.

Mr. S. C. Varshney, Scrivenber Engineering, advised during a telephone conversation on October 9, 1974, that the TiO_2 content of the magnetite was 4.68%. The average mill feed grade has been calculated as follows:

Magnetite in mill feed = 69.6 - 4.68 = 64.92%
Iron in mill feed = 64.92 x 72.4% = 47.00%
With 10% dilution allowance = 42.73% Fe

Apatite in mill feed = 21.8%
Apatite assumed to be fluorapatite, i.e. 42.26% P_2O_5
mill feed = 21.8 x 42.26 = 9.2% P_2O_5
With 10% dilution allowance = 8.4% P_2O_5

Sulphur in ore reserves, not specified, has been assumed to be 0.80% after dilution.

4.2 Projected Plant Metallurgy

The ore sample, upon which the expected plant metallurgy is based, graded 45.74, 10.14 and 0.88 percent Fe, P_2O_5 and S respectively whereas the average mill feed grade has been calculated to contain 42.73, 8.4 and 0.80 percent Fe, P_2O_5 and S respectively.

The results to be expected when milling feed of the average grade have been calculated.

Since the ore samples investigated have responded well to conventional ore treatment techniques, it is reasonable to expect that these results can be achieved in commercial scale equipment, within one year from the commencement of operations.

On this premise, the processing of the reserve grade ore would result in the following weight and product distributions:

	%	Grade %			% Distribution		
	Wt.	P_2O_5	Fe	S	P_2O_5	Fe	S
Ore (Reserves)	100.0	8.40	42.73	0.80	100.0	100.0	100.0
Magnetite Concentrate	62.1	0.30	64.30	0.05	2.2	93.5	4.3
Apatite Concentrate	13.6	34.59	1.86	0.21	56.0	0.6	4.1
Overall Tailings	24.3	14.44	10.39	3.02	41.8	5.9	91.6

For purposes of mill design, the above material balance has been expanded to include the intermediate product tonnages and analyses for a commercial plant treating 1500 tons per day of ore, and is presented on the following page.

The recommended flowsheet and associated solids-solution balance is presented on Page 4 - 9.

4.3 Commercial Production Data

Following the initial start-up period, when the concentrator is treating average ore at rated tonnage, production data has been estimated as follows:

CONCENTRATOR METALLURGICAL BALANCE FOR AVERAGE FEED GRADE

	Products	% Weight	Design Weights TPD	Design Weights TPH	% Grade P_2O_5	% Grade Fe	% Grade S	% Distribution P_2O_5	% Distribution Fe	% Distribution S
1.	Mill Feed	100.0	1500	63	8.40	42.73	0.80	100.0	100.0	100.0
2.	Sulphide Concentrate	3.6	54	3	6.20	46.60	19.27	2.7	3.9	86.7
3.	Sulphide Tailing	96.4	1446	60	8.48	42.59	0.11	97.3	96.1	13.3
4.	Rougher Magnetics	69.6	1044	43	3.06	58.51	0.10	25.3	95.3	8.3
5.	Rougher Non-Magnetics	26.8	402	17	22.57	1.23	0.15	72.0	0.8	5.0
6.	Magnetite Concentrate	62.1	932	39	0.30	64.30	0.05	2.2	93.5	4.3
7.	Cleaner Non-Magnetics	7.5	112	4	25.9	10.29	0.43	23.1	1.8	4.0
8.	Slimes	5.6	84	3	27.11	8.87	0.43	18.1	1.2	3.0
9.	Apatite Concentrate	13.6	204	9	34.59 (1)	1.86	0.21	56.0	0.6	4.1
10.	Apatite Tailing	15.1	226	9	11.71	2.32	0.10	21.0	0.8	1.9
11.	Overall Tailing	24.3	364	15	14.44	10.39	3.02	41.8	5.9	91.6

(1) 75.52% BPL

FLOWSHEET

1 =	2+3	5 =	3-4	9 =	(5+7)-(8+10)
2 =	1-3	6 =	4-7	10 =	(5+7)-(8+9)
3 =	1-2	7 =	4-6	11 =	2+8+10
4 =	3-5	8 =	(5+7)-(9+10)		

	Dry Tons/Year	Grade %		
		P_2O_5	Fe	S
Ore	487,500	8.40	42.73	0.80
Magnetite Concentrate	302,737	0.30	64.30	0.05
Contained Iron	194,660			
Apatite Concentrate	66,300	34.59	1.86	0.21
Contained P_2O_5	22,933			

4.4 Equipment Sizing

Equipment sizing has been based upon the information contained in the Inco report, thickening and filtering testwork conducted by Eimco, and data in the files of A. H. Ross & Associates.

The grinding power for 1500 tons per day of ore based on a Bond work index of 13.5, as noted in Section 3 of this report, calculated to 1,209 horsepower, whereas the grinding power requirement based upon the Inco pilot plant data calculated to 2,171 horsepower. This difference in estimated power requirement would have a significant effect on the size and capital cost of the grinding mills, and operating cost. This subject was reviewed during a meeting in Sudbury, Ontario on October 25, 1974, between representatives of Mertec, Inco and A. H. Ross & Associates. Those present agreed that time did not permit further testwork, and since the concentrator capital and operating costs represent a small fraction of the overall costs of the project, it would be prudent to base the grinding circuits on the higher power requirement. In addition, the ability of the concentrator to supply sufficient feed to the steel plant is of critical importance.

4.5 Equipment List

4.5.1 Crushing Circuit

	Units	Size	Installed H.P.	Equipment Cost
Jaw Crusher	1	36" x 42"	125	$125,000 (1)
Cone Crushers				
Standard	1	4 1/4'	150	72,000
Shorthead	1	4 1/4'	150	73,500
Vibrating Screen	1	5' x 10' Rod Deck	15	14,600
Conveyors	1	30" x 180'	15	27,200
	2	30" x 60'	30	17,200
	1	24" x 200'	10	27,200
Weightometer	1	-	-	6,900
Metal Detector	1	-	-	7,200
Crane	1	20 - Ton	20	14,800
Dust Collector	1	-	40	25,300
Total			555	$410,900

(1) Estimated by J.M.H., Mr. Varshney will obtain cost of used Buchanan Crusher from Paul Greco.

4.5.2 Grinding Circuit

	Units	Size	Installed H.P.	Equipment Cost
Fine Ore Bins	2	35' x 41'	-	$132,000
Slot Feeders	2	36" x 50'	20	21,400
Mill Feed Conveyor	1	24" x 100'	5	11,600
Weightometer	1	24"	-	5,800
Rod Mill	1	9 1/2' x 12'	500	180,000
Ball Mill	1	11 1/2' x 15'	1,000	331,000
Primary Cyclones	3	D15B	-	8,200
Regrind Ball Mill	1	10 1/2' x 13'	700	246,000
Regrind Cyclones	-	-	-	2,500
Grinding Circuit Pumps	4	8" x 6"	120	13,800
Crane	1	20 - Ton	20	14,800
Total			2,365	$967,100

4.5.3 Sulphide Flotation Circuit

	Units	Size	Installed H.P.	Equipment Cost
Conditioners	1	8' x 8'	5	$ 3,100
	1	6' x 6'	3	2,200
Flotation Cells	12	100 cu. ft.	180	71,100
Pumps	2	8" x 6"	60	6,900
Total			248	$ 83,300

4.5.4 Magnetic Separation Circuit

	Units	Size	Installed H.P.	Equipment Cost
Magnetic Separators				
Roughers	1	36" x 72" double drum	15	$ 30,800
Cleaners	1	36" x 72" triple drum	15	52,800
Pumps	2	5" x 4"	30	4,200
Total			60	$ 87,800

4.5.5 Apatite Flotation Circuit

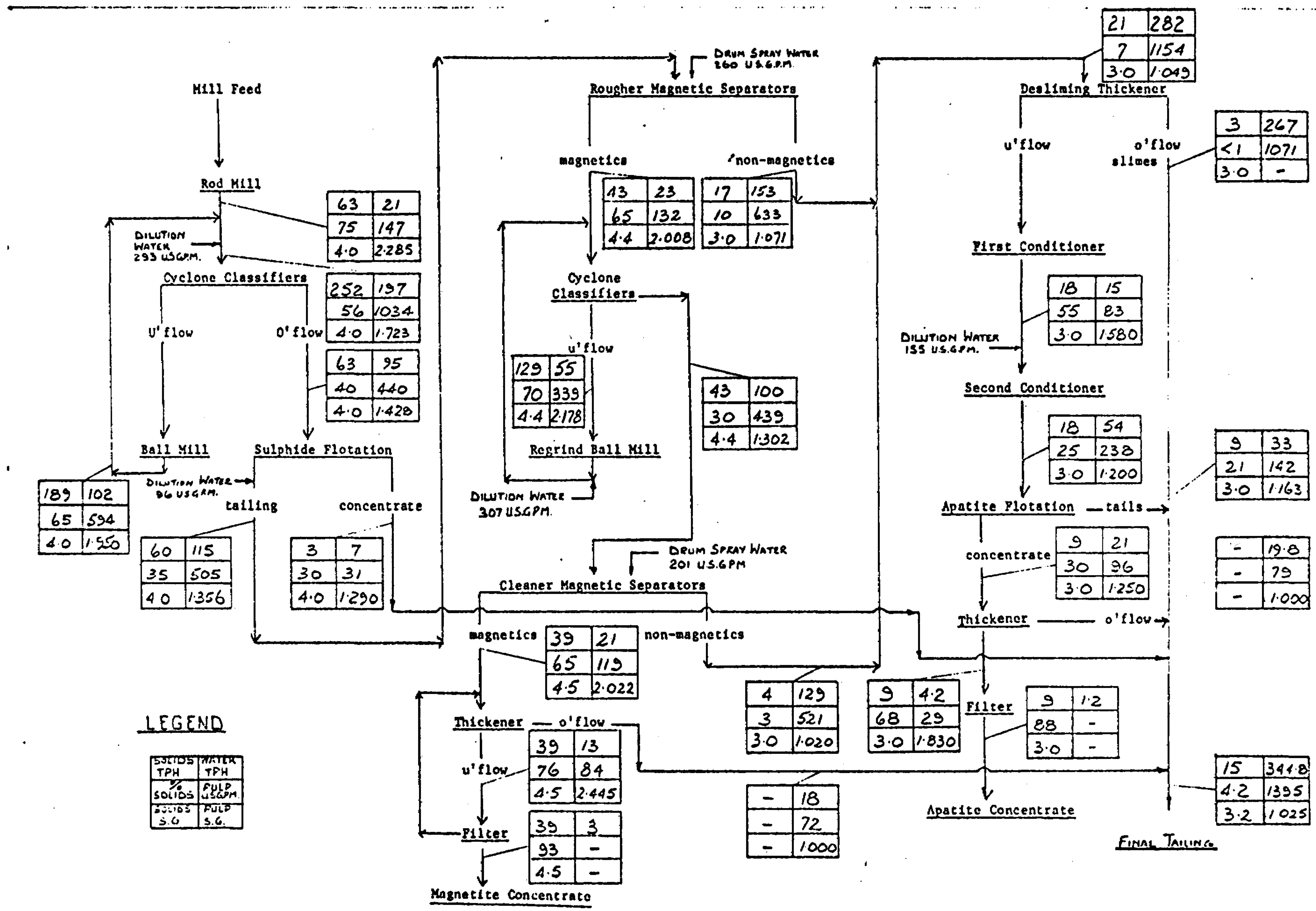
	Units	Size	Installed H.P.	Equipment Cost
Desliming Thickener	1	45' diam.	3	$ 39,700
Thickener Underflow Pump	1	4" duplex	2	3,500
Conditioners	2	4' x 4'	4	2,700
Flotation Cells	10	50 cu. ft.	75	28,900
Total			84	$ 74,800

4.5.6 Dewatering Circuits

	Units	Size	Installed H.P.	Equipment Cost
Magnetite Concentrate				
Thickener	1	20'	3	$ 20,500
Disc Filter & Auxiliaries	1	6' - 9", 7 disc	60	35,000
Diaphragm Pump	1	4" duplex	2	3,500
Apatite Concentrate				
Thickener	1	25'	3	25,000
Filter & Auxiliaries	1	Extractor 4635	60	40,000
Diaphragm Pump	1	2" duplex	2	2,800
Total			130	$126,800

4.5.7 Miscellaneous Equipment

	Units	Size	Installed H.P.	Equipment Cost
Flotation Air Blower	1	Model 1560-H	60	$ 4,400
Automatic Samplers	10	-	5	13,100
Reagent Feeders	8	Clarkson Model E	-	2,900
Tailings Pumps	2	5" x 4"	50	4,400
Tailings Pipe	1	6" x 1 mile	-	22,200
Total			115	$ 47,000



A. H. ROSS & ASSOCIATES

5. OPERATING COSTS

5.1 Basis of Preparation

The estimates have been based upon the International Nickel Company of Canada, Limited, Process Technology Report, Program Title, "Nemegos Apatite-Magnetite Ore", dated September 19, 1974. They are predicted on stable operating conditions at rated tonnage and will not apply to the initial start-up period.

The estimates include all direct costs from receipt of ore at the primary crusher to production of Magnetite and Apatite concentrates in the form of filter cake for conveying to further processing.

The estimates are premised on costs for October, 1974 and do not include any allowance for escalation.

Staff salaries and labour rates are based upon those presently in effect in similar operations and a payroll overhead of 30 percent has been allowed to cover labour burden and fringe benefits. The unit costs of chemicals and supplies are based on current quotations.

The expenses for analytical services include the costs associated with all assaying for both mine and mill.

The estimates represent direct costs only and do not include any allowance for the following:

Local management, accounting and purchasing
Administration and head office
Insurance
Taxes
Legal and Audit expense
Warehousing
Personnel, safety and security
Amortization and depreciation

Since this project has had the benefit of pilot plant operation, a contingency allowance of 10 percent is considered suitable for the study.

5.2 Summary of Direct Operating Costs

The estimate of direct operating cost is summarized below:

	$/Ton of Ore
Supervision and Clerical	0.20
Operating Labour	0.26
Payroll Overhead	0.14
Grinding Media and Reagents	1.25
Operating Supplies	0.10
Maintenance	0.31
Power	0.34
Analytical	0.14
	2.74
Contingency (10%)	0.27
TOTAL ESTIMATE	$3.01

5.3 Details of Direct Operating Costs

Details of the operating cost estimate are presented below:

5.3.1 Supervision and Clerical

Position	Number	Monthly Salary	Total Cost Per Month
Superintendent	1	$1,600	$ 1,600
Metallurgist	1	1,200	1,200
Mill Foreman	1	1,100	1,100
Shift Foreman	4	900	3,600
Mill Clerk	1	700	700
TOTAL COST PER MONTH			$ 8,200

Cost per ton of ore:

$$\frac{\$8{,}200 \times 12}{1500 \text{ TPD} \times 325 \text{ days}} = \$0.20$$

5.3.2 Operating Labour

	Men/Shift	Shifts/Week	Manshifts/ Week
Crushing	2	5	10
Grinding and Magnetic Separation	1	21	21
Flotation and Dewatering	1	21	21
Reagent, Labour Tailings Disposal	3	5	15
			67

Cost per ton of ore:

$$\frac{\$5.00/\text{hour} \times 8 \text{ hours/shift} \times 67 \text{ Manshifts/Week}}{1500 \text{ TPD} \times 7 \text{ Days}} = \$0.26$$

5.3.3 Payroll Overhead

30% of Direct Payroll Costs = $(0.20 + 0.26) X 0.30 = $0.14

5.3.4 Grinding Media and Reagents

	Consumption Pounds/Ton	Unit Cost $/Pound	$/Ton of Ore
Grinding Media:			
Rods	1.2	0.11	0.132
Balls	2.8	0.13	0.364
Copper Sulphate	0.8	0.38	0.304
Sulphuric Acid	4.0	0.0075	0.030
Sodium Isobutyl Xanthate	0.8	0.39	0.312
Frother (SA 1263)	0.06	0.45	0.027
Fatty Acid-Oil Mixture	0.6	0.12	0.072
Sodium Hydroxide	0.11	0.08	0.009
TOTAL COST PER TON OF ORE			$1.250

5.3.5 Operating Supplies

In addition to the items listed above, an allowance is included for other operating supplies such as filter cloths, and flocculants. Based upon similar milling facilities an allowance of $0.10 per ton is included in this estimate.

5.3.6 Maintenance

For purposes of this estimate an allowance of $0.31 per ton has been included to cover maintenance labour and supplies.

5.3.7 Power

Power requirements are estimated below, based upon the installed horsepower of the major equipment and suitable usage factors.

	KWH/Ton OF ORE
Crushing:	
Installed H.P. = 555; 80% usage, 70 hours/week	
Power = $\frac{555 \text{ X } 70 \text{ X } 0.746 \text{ X } 0.80}{1500 \text{ TPD X } 7 \text{ Days}}$ =	2.2
Grinding:	
Installed H.P. = 2365; 90% usage, 24 hours/Day	
Power = $\frac{2365 \text{ X } 24 \text{ X } 0.746 \text{ X } 0.90}{1500 \text{ TPD}}$ =	25.4

	KWH/TON OF ORE
Remainder of Plant:	
Installed H.P. = 637; 80% usage, 24 hours/Day	
Power = $\frac{637 \times 24 \times 0.746 \times 0.80}{1500 \text{ TPD}}$ =	6.1
TOTAL POWER CONSUMPTION	33.7

Cost per ton of ore:

33.7 X \$0.01 per KWH = \$0.34

5.3.8 Analytical Laboratory

	Cost per Day
Chief Chemist at \$1,200 per month	\$ 40.00
2 Technicians at \$900 per month	60.00
1 labourer at \$5.00 per hour	28.60
	\$ 128.60
Payroll overhead at 30%	38.58
Supplies	41.80
TOTAL	\$ 208.98

Cost per ton of ore:

$$\frac{\$208.98}{1500 \text{ TPD}} = \$0.14$$

A.H. ROSS & ASSOCIATES
CONSULTING CHEMICAL & METALLURGICAL ENGINEERS
1706-80 RICHMOND STREET WEST
TORONTO, ONTARIO M5H 2A4
CANADA

A. H. ROSS - PRINCIPAL
K. R. COYNE - PRINCIPAL ASSOCIATE (SENIOR)
J. M. HEMSTOCK - PRINCIPAL ASSOCIATE
D. F. LILLIE - SENIOR ASSOCIATE

D. H. EBERTS
M. J. LAKE
R. H. RICHARDS
W. C. SPENCE

CODE 416-366-1653
CABLE "ROSSONTO"

November 11, 1974

Mr. G.O. Loach
Scrivener Engineering Limited
Engineers and Constructors
1235 Bay Street
Toronto, Ontario, M5R 1A5

Dear Mr. Loach:

Mertec Magnetite-Apatite Project
<u>Return Water From Tailings Pond</u>

In accordance with our discussions in your office on November 7, 1974, we wish to confirm the conditions under which we believe water can be returned from the tailings area for reuse in the mill.

We suggest that the magnetite thickener overflow and the desliming thickener overflow be directed to the first, or upstream pond, and the apatite flotation tailings to the second or downstream pond. With this arrangement, return water from the first pond can be returned for use in the grinding, sulphide flotation and magnetic separation circuits.

Fresh water consumption will be reduced to that required for dilution in the agitator preceding apatite flotation, and makeup water to compensate for losses, such as the water remaining in the settled solids in the tailings area. Some additional fresh water may be required for pump glands, vacuum pumps etc., however gallonage to the final settling area for eventual return to the watershed will be minimal.

Yours very truly,

J.M. Hemstock

J.M. Hemstock, P. Eng.

JMH:ea
cc: Mr. P.A. Crossgrove

APPENDIX C

Market Survey Correspondence

(1) Steel and Pig Iron

TELEPHONE
YUKON 6-3000
CABLE ADDRESS
ZINCUM

ASSOCIATED METALS & MINERALS CORPORATION
733 THIRD AVENUE
NEW YORK, N. Y. 10017

TWX
RCA TELEX
ACR TELEX
WESTERN UNION

August 30, 1974

Mr. George R. Eaton,
Vice President & Director
Mertec Resources Development Limited
44 Charles Street West
Apartment 4911
Toronto, Ontario

Dear Mr. Eaton:

We have studied with interest your recent letter regarding the potential production of continuous cast steel billets, and understand that you are planning to begin this production in 1976 at the rate of 150,000 to 180,000 short tons per year.

For your general information, material of this general quality is currently priced in Canada at $160 to $200 per short ton FOB works. This market is somewhat volatile, as you know, and we have not been able to develop a practical formula which would serve as the basis for a long term contract between us. We think of ourselves as dealers in physical materials rather than speculators on market levels, and if we conclude any arrangement with you we certainly want it to be one which will satisfy both parties in the long run. We feel it is a little early to establish a workable contract.

We think it may be possible to place these billets for conversion or to sell them outright after more details on quality are known. For this reason, we would be most interested in hearing the results of the work to be performed at Albany, Oregon.

If you would care to keep us informed as the project proceeds we feel there is a good chance of our coming to satisfactory business together.

Yours truly,

ASSOCIATED METALS & MINERALS CORPORATION

A. B. Cramer

ABC:lgg

cc: Mr. E. F. Carr
Mr. P. A. Uhl

INTERNATIONAL GROUP OF COMPANIES
73
IMI

INTERNATIONAL IRON & METAL COMPANY

DIVISION OF INTERMETCO LIMITED

HEAD OFFICE: 73 ROBERT STREET • MAILING ADDRESS: P.O. BOX 70, HAMILTON, ONTARIO, CANADA • CABLE ADDRESS: COMINT • PHONE (416) 528-1191

October 29th. 1974.

Scrivener Engineering Limited,
1235 Bay Street,
TORONTO, Ontario
M5R 1A5

Attention: Mr. G.O. Loach, P. Eng.
Executive Vice President

Dear Gerry:

This will refer to our meeting in Toronto on October 8th., during which we discussed the Mertec plan for producing Pig Iron in the Sudbury area during 1977.

Intermetco is prepared to undertake a five year exclusive contract for the sale of the total output of Pig Iron from this facility. However, since it is not possible for you to unconditionally guarantee specifications and delivery, we are not able to make a take or pay commitment at a firm price at the present time.

For your guidance, it might be useful for you to know that in today's market, material meeting normal commercial specifications, could be sold at $150.00 per short ton f.o.b. plant. It is also our opinion that Pig Iron will be in short supply over the next few years and price will be under upward pressure.

Yours very truly,

INTERNATIONAL IRON & METAL COMPANY

Abby Goldblatt

Abby M. Goldblatt
Executive Vice President

AMG:pr

NEWMAN STEEL WAREHOUSE LTD.
2485 SPEERS ROAD • OAKVILLE, ONTARIO L6L 2X9

October 9, 1974.

Mr. G.O. Loach
Executive Vice President
Scrivener Engineering Ltd
1235 Bay Street
Toronto, Ontario.

Dear Mr. Loach:

We have discussed the potential production of approximately 180,000 net tons 4 inch square and we also might ask you to explore the potentail of 5 x 5 or 6 x 6 billets and possibly pig iron.

We would wish to commit for the entire output on a take or pay basis for a minimum period of five years and a five year option. In to-day's market the indicated price for billets would be $150.00 to $200.00 per net ton, F.O.B. plant.

When your project is closer to operation, we would be prepared to establish a mutually acceptable floor price for product and to provide for escalation based on certain material costs, labour, taxes, etc.

We would also like an indication when the product would be ready to come to Market.

Yours very truly,

B.P.R. Newman

B.P.R. Newman
President
NEWMAN STEEL WAREHOUSE LIMITED.

/bgm.

Hamilton 525-0010 | Toronto 364-5463 | St. Catharines 688-5381 | Oakville 827-4194
Preston 653-1181 Zenith 7-5400

TELEPHONE: (212) 725-1010
CABLES: NORORECO NEW YORK

TELEX: RCA 224448 NORORE
WUI 620853 MINEIRA

NORORE CORPORATION

230 PARK AVENUE
NEW YORK, N. Y. 10017

September 16, 1974

Mr. Gerry O. Loach
Executive Vice President
Scrivener Engineering Limited
1235 Bay Street
Toronto M 5R 1A 5, Canada

Dear Mr. Loach:

We refer to telephone conversation had with you a few days ago during which you consulted us as to markets for pig iron. We understand that you expect to have a production of about 180,000 tons of pig iron per year starting sometime during 1975 or 1976 and that the quality of the same will be similar to Sorel iron. We confirm to you that we would be greatly interested in contracting for this production either on short term or long term basis, preferably the latter.

Under present market conditions the price for this quality of pig iron will be about $185 per metric ton FOB loaded aboard ocean vessel, the port to have good deep water facilities. We hope to hear from you further about this matter in the near future.

Very truly yours,

NORORE CORPORATION

N. Blechner

NB:mmp

stelco

The Steel Company
of Canada, Limited

General Office
Stelco Tower
Hamilton, Ontario
L8N 3T1
(416) 528-2511

October 30, 1974

Mr. Jerry Loach,
Executive Vice President
Scrivener Engineering Limited
1235 Bay Street
Toronto, Ontario

Dear Mr. Loach:

MERTEC RESOURCE DEVELOPMENT LTD.

This letter is written to express Stelco's potential interest in purchasing all or part of the annual future output of steel billets from the proposed Mertec Resource Development Limited mini-mill planned to be built in the Sudbury area in 1975-76.

This interest is predicated on many conditions, some of which are as follows:

1. The billets produced must meet all of Stelco's metallurgical, quality, size and production and commercial specifications and requirements. A favourable report from the studies currently being conducted by Stelco Research personnel is vital to this condition.

2. Economic conditions and Stelco's steel supply requirements must be conducive to entertaining a proposal at the time Mertec is ready to sell billets.

3. Price and delivery and other commercial and technical requirements must be negotiated at the time Mertec is prepared to offer billets for sale to Stelco.

You also asked about Stelco's interest in pig iron output from Mertec prior to the start-up of the billet caster. It is possible, particularly in the year 1975, that Stelco may have a need for some pig iron but again our interest is related to conditions similar to those outlined with respect to the billets.

I believe you will agree that the response and encouragement Mertec has received to date from Stelco is indicative of our genuine interest.

cont'd.....

You must not however construe our actions or this letter as a firm committment on the part of Stelco to buy any or all of the output of the Mertec mill unless conditions are favourable for us to do so.

We would ask to be given the opportunity of first refusal on the output of the Mertec mill when it becomes available.

Yours very truly,
THE STEEL COMPANY OF CANADA, LIMITED

Leonard Hansell / Per: J.

Leonard Hansell
Purchasing Manager
Production Materials -
Central Region

LH:ji

APPENDIX C

Market Survey Correspondence

(2) **Fertilizer**

Bovis Corporation Limited

PROPERTY, HOUSING & CONSTRUCTION:
Including the McNamara, Federal, General Supply,
Bohna & 20th Century Companies

EXECUTIVE OFFICES

October 9, 1974

Mr. Gerald O. Loach, P. Eng.
Executive Vice-President
Scrivener Engineering Limited
1235 Bay Street
Toronto, Ontario M5R 1A5

Dear Gerald:

As a result of your telephone call to me today wherein you asked us to provide you with further detail pertaining to the excellent quality of the Nemegos apatite as it relates to use in our BESA-2 process, I would like to submit the following:

a) The Nemegos Apatite

Not only is the Nemegos apatite high in P_2O_5, it also has correspondingly low impurity levels, especially those that are considered deleterious in the manufacture of phosphoric acid. The "bad actors" in conventional phosphate rocks are Magnesium, Flourine, Aluminum, Iron, and in some cases, Silica. The Nemegos apatite has considerable lower concentrations of these ions as compared to Florida or Western U.S. rock. It also has apparently no organic content, which is especially desirable in the manufacture of high quality phosphoric acids.

A copy of an analysis of the sample of apatite furnished us is enclosed. This analysis was completed by Mr. Albert E. Henderson Jr., of Southern Analytical Laboratory, which is a division of Technical Services Inc., in Jacksonville, Florida. Mr. Archie Slack of the Tennesse Valley Authority who is a world renown expert in the field of phosphoric acid, recommended to us the Technical Services Inc. group in Jacksonville and particularly Mr. Henderson as being one of the most competent people in the analysis of phosphate rock in the world. Please note that the rare earth analysis is semi-quantitative; the actual content could vary considerably. In that regard, and for your perusal, I attach a copy of the American Spectographic Laboratories Inc., analysis of the oxides of elements as indicated in "Mertec Sample No. 1". This is a very gross, and in our opinion, analysis of little value of the rare earth content

(Cont'd) . . .

255 Consumers Rd., Willowdale, Ontario M2J 1R3
Telephone: (416) 493-2770 Telex: 06-966856

but gives some indication of their presence. I enclose it, I repeat again, for your perusal only.

b) The BESA-2 Process

The BESA-2 process is especially effective in eliminating the "bad actors" noted above which accounts for its high purity as compared to that of other phosphoric acids. It is also axiomatic; that the more pure the phosphate rock (or apatite) feed, the lower will be the level of these impurities in the final product.

At one point in the BESA-2 process we have a stream which contains about 15% P_2O_5 in methanol. This is a clear stream, without suspended solid matter (gypsum), which is an ideal situation for recovery of any dissolved impurities by ion exchange. This ion exchange system will be included in any BESA-2 plant for the production of very high quality phosphoric acid,and we would plan to include this system in the proposed plant at Sudbury using the Nemegos apatite.

This same ion exchange unit is believed to be completely satisfactory for the recovery of rare earths. It is possible that there are specific ion exchange resins designed to absorb only certain elements. For instance; there may be a resin that could remove only cerium, or other of the valuable rare earths. With these resins, the methanol/phosphoric acid could be run through an ion exchange tower to produce a very concentrated, one element sludge. (We know that resins for the selective absorption of gold, uranium, etc., exist). Again, BESA-2 has a distinctive chance to recover valuable, individual elements, as does the wet process.

In contrast, one of the chief problems of the conventional wet process is to obtain satisfactory filtration of gypsum from the dilute phosphoric acid/water solution. While a clear stream might be obtained for use in an ion exchange system, the filtration step would be extremely expensive. Further, it would be found that the ion exchange step would be very expensive to operate because of the very high concentration of the above named "bad actors".

Finally, in order to process Nemegos rock, it would probably require the development of a new wet process plant, designed especially to process the Nemegos apatite. Because of this special filtration equipment required to produce a clear stream for ion exchange, and because of the need for extra ion exchange capacity, the plant would likely be more capital intensive to build and operate than that of the BESA-2 process. This can be demonstrated by the Bechtel report left with you on September 27, 1974. And it seems doubtful that a plant based upon the relatively small Nemegos supply could compete in the market place against the giant plants now existing, unless the rare earth recovery was extremely profitable.

(Cont'd) . . . .

We trust the above will be of assistance to you in the preparation of your feasibility study. We look forward to working together with you on the exploitation of the Nemegos apatite, and will be forwarding our proposal for participation very shortly. The days are long and our efforts the strongest I can assure you Gerry, and I am confident of our mutual success.

Sincerely yours,

Dolliver H. Frederick

Dolliver H. Frederick
Corporate Development Manager

:dd

Encl.

SOUTHERN ANALYTICAL LABORATORY
A DIVISION OF TECHNICAL SERVICES, INC.
103 STOCKTON STREET — P. O. BOX 628
JACKSONVILLE, FLORIDA 32201
AREA 904 / 353-5761

Industrial Chemists
ANALYSTS OF INDUSTRIAL MATERIALS
RESEARCH · TECHNICAL REPORTS

September 26, 1974

Laboratory No. 10,116

Sample of Phosphate Rock

Date Received September 10, 1974

For B & A Engineering, Inc., 240 Second Street, Marine Firemen's Building, San Francisco, Calif. 94105

Marks:

CERTIFICATE OF ANALYSIS OR TESTS

Total Phosphric Acid:	37.84%
Insoluble Phosphoric Acid:	28.24%
Available Phosphoric Acid:	9.60%
Total Iron, as Fe_2O_3	0.85%
Magnesium, as MgO	0.15%
Calcium, CaO	49.31%
Fluorine, as F	2.96%
Silica, as SiO_2	0.80%
Sulfate, as SO_4	0.10%
Aluminum, as Al_2O_3	0.40%
Carbonate, as CO_2	0.66%
Loss on Ignition (including loss @ 105°C)	7.62%
Moisture (loss @ 105°C)	6.92%
	99.99%

cc: Mr. Dolliver Frederick

Respectfully submitted,

SOUTHERN ANALYTICAL LABORATORY

BY Albert E. Anderson Jr.

American Spectrographic Laboratories, Inc.
Analysis • Research • Consultation
557 MINNA STREET • SAN FRANCISCO, CALIF. 94103
TELEPHONE: (415) 863-0190

October 1, 1974

ASL #2210

B & A Engineers, Inc.
240 Second St.
San Francisco, CA

Attn.: Denes B. Turcsanyi

RE: Semi-quantitative spectrographic analysis, as requested on your P. O. #22-11-1, on your "phosphate rock" sample.

The following are reported as oxides of the elements indicated.

Ca	50. %
P	30.
Si	5.
Fe	1.5
Sr	0.6
Al	.35
Mg	.25
Mn	.15
Na	.12
Ti	.06
Zr	.05
Ba	.008
Cu	.004
Ni	.003
Cr	.001
Pb	< .003
Ce	.85
La	.4
Y	.08
Pr	.08
Sm	.05
Eu	.04
Dy	.02
Sc	.005
Yb	.001
Nd	.25
Th	.1(?)

Identification:
"Mertec sample No. 1"

AMERICAN SPECTROGRAPHIC LABORATORIES
Frank W. Barley
Frank W. Barley

NOTE: MATERIALS SUBMITTED FOR ANALYSIS ARE HELD FOR THIRTY DAYS AND THEN DISCARDED.

C·I·L

Canadian Industries Limited

CIL House
Box 10, Montreal, Quebec, Canada
H3C 2R3
(514) 874-3000

cc: Mr. G. Eaton - Toronto

July 26th, 1974

Mr. P.A. Crossgrove, President
Mertex Resource Development Ltd.,
P.O. Box 2248 Station A
Sudbury, Ontario

Dear Peter:

This letter will confirm our discussion of 24th July, 1974 at the office of Canadian Industries Limited, 630 Dorchester Blvd.W., Montreal, Quebec.

Canadian Industries Limited indicated an interest in purchasing up to 90,000 tons of phosphate rock per annum produced by Mertec Resource Development Limited, at Nemagos, Ontario commencing during the period January - March 1976.

A sales agreement would be contingent on the following:-

1) Satisfactory laboratory analysis of the product
2) Satisfactory physical and operating characteristics of the product
3) Satisfactory price arrangements.
4) Satisfactory supply schedules.

The sample you left with me has been passed to our laboratory for analysis.

W.E. Plummer, a Superintendent at Lambton Works with many years of experience in the manufacture of fertilizer, is planning to visit your pilot plant today or Friday and will finalize arrangements for his visit with Gord Annis and/or yourself..

We will keep in touch with you and would appreciate any informatio you can give us regarding your progress with this project and planned start-up schedules.

Yours very truly

J.U. Stephens
Assistant Manager- Raw Material Purchases

JUS/fhh

Canadian Industries Limited
Lambton Works
P.O. Box 1900
Courtright, Ontario NON 1HO
October 11, 1974

Mr. G.O. Loach
Scrivener Engineering Limited
1235 Bay Street
Toronto, Ontario

Dear Mr. Loach:

This is to enlarge on our recent telephone conversation concerning Nemego's rock. Our analysis of the rock was as follows:

	CIL Analysis 1974	Dept. of Mines Analysis 1952
P_2O_5	33.3%	39.25
Al_2O_3	1.87	0.05
Fe_2O_3	3.63	0.2
Fluoride	2.68	3.05
Sulfide	0.23	-
Silicon Dioxide	9.0	3.6
Calcium Oxide	44.06	55.8

I have included an analysis of rock from the same source which was carried out by the Department of Mines in 1952. You will note that the rock was of higher grade in the earlier analysis.

From a process point of view it is difficult to assess suitability of rock by mere analysis but added experiments indicate that the rock would not be suitable for normal or triple superphosphate. It could, however, be suitable for phosphoric acid manufacture. We intend to utilize a consultants services for further work in this area together with Noranda and hopefully the Mertec group themselves.

Possible obstacles in utilizing the rock would be the high silica and the sulfide content. The latter could involve changing some of our materials of construction. Another item of concern is the low annual tonnage 90,000, which you quoted. The CIL plant consumes in excess of 1000 tons of rock/day and if we were obliged to modify our plant for a 50% share of the available rock, costs could be prohibitive.

Yours very truly

T. B. Lynch

T.B. Lynch
Technical Superintendent

ERCO Industries Limited
2 Gibbs Road, Islington, Ontario M9B 1R1
Telephone: 416 · 239 · 7111
Cable: ELREDCHEM

10 October 1974

Mr. G.O. Loach,
Executive Vice President,
Services Engineering Ltd.,
1235 Bay St.,
Toronto, Ontario

Dear Mr. Loach:

Enclosed please find a copy of a report on our analysis of a sample of phosphate rock concentrate from the Nemegos Ontario deposit submitted to us in August 1974. In the report are comments relating to its possible use in P_4 furnace operations. On the assumption that the rock will pelletize satisfactorily, the probability is high that this phosphate rock would be technically suitable for P_4 manufacture.

If such a phosphate rock were to become available commercially ERCO would be interested in further discussions on such economic matters as logistics, price and availability as a prelude to possible purchases.

Yours sincerely,

J. D. McGilvery

J.D. McGilvery - Manager
Industrial Chemicals R & D

:eh

Enc.

ERCO Industries Limited

Evaluation of Mertec/Multi-Minerals Phosphate Rock Concentrate

Source of Sample

The sample received was reportedly obtained by beneficiation of the apatite/magnetite deposit at Nemegos Ontario on the property of Multi-Minerals Ltd. It had been subjected to a flotation process to separate gangue, a wet magnetic separation to remove magnetite and an apatite flotation to improve the grade of the phosphate.

Analysis

The chemical analysis of the sample determined by ERCO's laboratory is as follows:

P_2O_5	33.53%
BPL	73.26%
CaO	47.3 %
Excess CaO	3.2 %
Ac.Insol. + SiO_2	9.6 %
SiO_2	5.7 %
F	4.7 %
Fe_2O_3	2.2 %
Al_2O_3	1.1 %
CO_2	1.3 %
SO_3	0.3 %
MgO	0.15%
Na_2O	0.4 %
K_2O	0.12%
MnO_2	0.08%
L.O.I.	0.3 %
H_2O	10.5 %

Screen Size	% Cum.
+ 40 m	0.0
+ 50 m	0.4
+ 60 m	0.9
+ 80 m	5.3
+100 m	15.8
+140 m	51.1
+200 m	57.1
+250 m	67.2
+325 m	76.8
-325 m	23.2

Comments

The material is in the form of a fine sand and for P_4 furnace feed some form of pelletizing or nodulizing would be required. Tests would be required to identify any potential problems in this regard although the chemical analysis does not indicate any difficulties would be expected.

The Fe_2O_3 present results in undesirable ferrophosphorus formation and the contained 2.2% Fe_2O_3 would result in a P loss as ferrophosphorus of about 3.5% of the P present in the rock. Florida rocks normally are in the range 0.5 to 1.5% Fe_2O_3 so the Nemegos rock is somewhat inferior from this viewpoint. It is however quite acceptable for furnace operation. For wet acid production it would be less desirable because of the relatively high R_2O_3 (Fe_2O_7 + Al_2O_3).

Excess CaO can result in premature sintering in the furnace. The 3.2% Excess CaO in the Nemegos rock is less than many Florida rocks and should be quite satisfactory.

Fluorine at 4.7% is somewhat higher than Florida rocks which range from about 3.5 to 4.5%. This could result in a somewhat higher lime requirement for scrubbing the pelletizing kiln off-gases and/or the possibility of more P_4 mud formation (due to increased SiF_4 in the furnace).

In general there is reason to believe, from the evidence available to date, that the Nemegos phosphate rock concentrate would be suitable for P_4 furnace operation.

Although the present sample was not examined for reactivity for wet acid manufacture, a previous sample received in April 1972 was so analyzed. The reactivity value obtained was 6.7% which compares with about 20% for most Florida rocks. It seems probable that this rock will be relatively difficult to attack in the wet acid process.

Toronto, Ont.
10 October 1974

JDM:eh

ERCO Industries Limited
2 Gibbs Road, Islington, Ontario M9B 1R1
Telephone: 416 · 239 · 7111
Cable: ELREDCHEM

November 19, 1974

Scrivener Engineering Limited,
1235 Bay Street,
Toronto, Ontario M5R 1A5

Attention: Mr. Gerald O. Loach, P. Eng.

Gentlemen:

Further to our discussion of November 15/74, we are pleased to confirm that we are interested in the phosphate rock from Nemegos, and would be interested in a five year contract along the lines suggested below.

1. Contract term - Five years - commencing 1977/1978.

2. Quantity - 65,000-75,000 tons per year.

3. Price - The current Phosphate Rock Export Association for 72 BPL is $41.65 per short ton F.O.B. mines, Florida. A contract would contain escalation/de-escalation based on the Phos-Rock market price.

4. Quality - Would have to be comparable to material currently being used, or acceptable to our plant. A trial shipment of 10-15,000 tons would be required for evaluation.

5. Normally, phosphate rock contracts contain a penalty/bonus based on the BPL content, and on the iron content as determined at the time of shipment.

6. The material would contain a maximum of 3% moisture, and be invoiced on a dry basis.

cont'd...

We discussed the possibility of pelletizing the phosphate at Nemegos, and shipping to our plant at Varennes, Quebec in a form suitable for direct furnace feed. We understand that you will examine the feasibility of pelletizing, and will advise what extra cost would be involved. Currently we pay a premium of $3/ton to have phosphate rock screened to 90% plus 6 mesh for our Varennes furnaces.

Should it not be possible for you to pelletize the material, we could probably use it at our plant in Newfoundland. We estimate that it would cost about $25. per short ton to move it from Nemegos to Newfoundland, which is considerably more than the freight cost from Florida. We would therefore anticipate a freight allowance on the Nemegos material.

Our willingness to pay the full market price would depend on the flexibility of tonnage we would be required to take. Should we agree to take your total annual output we would expect a price concession accordingly.

Trusting you will keep us informed of your progress,

Yours very truly,

F. J. Pope,
Manager - Purchasing.

FJP/bi

Noranda Mines Limited
P.O. Box 45
Commerce Court West
Toronto, Ont., Canada M5L 1B6

noranda

September 30, 1974

Mr. Peter Crossgrove
President
Mertec Resource Development Limited
Box 2248, Station "A"
Sudbury, Ontario
P3A 4S1

Dear Peter:

Just to let you know that we are continuing our investigations, I have attached herewith a copy of the preliminary test report on the Nemegos Apatite concentrate. You will note from Guy Pelletier's letter to me that Mr. Lynch from CIL will be getting together with the Valleyfield people this week.

Yours very truly,

M. S. Scott
Manager - Chemical Products

MSS/lcf

Att.

noranda group

LES ENGRAIS DU SAINT-LAURENT LTÉE / ST. LAWRENCE FERTILIZERS LTD.

P.O. BOX 310,
VALLEYFIELD, P.Q.
TEL. 371-0251 (AREA 514)

September 24, 1974

Mr. Malcolm S. Scott
Manager - Chemical Products
Noranda Mines Limited
P.O. Box 45
Commerce Court West
Toronto, Ontario

Dear Malcolm:

Please find attached the report on the preliminary evaluation of the Nemegos Apatite, conducted in the S.L.F. lab in Valleyfield, P.Q.

A meeting has been scheduled with T.B. Lynch, the C.I.L. technical reprensentative from their Courtwright plant, for Thursday, September 26th.

Yours very truly,

G. H. Pelletier
Plant Manager

GHP:lrl
encl.

ST. LAWRENCE FERTILIZERS LTD.

MEMORANDUM

TO: G. H. Pelletier

FROM: S. Benzimra

Date: September 19, 1974

File:

Copies: René Léger
Germain Bossé

Subject: Nemegos Apatite Test Report

By mid-August, we received a 1,200 lbs sample of Nemegos Apatite from "INCO COPPER CLIFF" smelter warehouse.

Some preliminary laboratory tests were performed on this material, in order to get more information about its suitability for phosphoric acid and super phosphate manufacture.

It should be noted, however, that our lab is not fully equipped to carry out this kind of investigation, and the present report is only intended as a preliminary evaluation of some features of this rock, such as its reactivity.

The analytical work was mainly performed by Mr. R. Léger, lab supervisor, assisted by Mr. L. Hébert, technician; all the operating conditions, experimental results and calculations are reported on the attached "DATA SHEETS". Some particular comments are listed below :

A) PHOSPHORIC ACID TEST (see "DATA SHEETS" Nos. 1, 2, 3)

1. The Nemegos Apatite grade was not as high as expected (80-84% BPL, according to the Department of Mines' Report, March 1956). A week ago, we received another sample of Nemegos Apatite from the same origin; although all the tests were carried out on the first sample, we analysed the second one, obtaining the following results :

P_2O_5	:	34.50%	(75.3 BPL)	on a
CaO	:	48.68%		dry
SiO_2	:	7.15%		basis
Moisture	:	10.33%		
Size	:	32% - 200 mesh		

The moisture is still too high, making cars unloading almost impossible.

2. The fluorine content has not been indicated, due to the erratic figures obtained.

3. Nemegos Apatite - when groud - appeared to be highly hydrophobe, thus making sieve analysis uneasy; even in contact with 75% sulphuric acid, the mixing was not immediate. We supposed that this phenomenon was partly due to the presence of fatty reagents used during the flotation steps. In fact, large amounts of organic matters were removed by washing the sample with acetone and ether, so giving a dark yellow filtrate*, but nochange was observed with respect to water mixing.

   It seems however, that the presence of these oils may explain why no foaming occurred during the digestion step.

4. Following Mr. R. L. Sommerville's recommendations, a digestion test was performed on a coarser Apatite sample (without grinding the received material). Water mixing, as well as P_2O_5 extraction, were slightly improved, but the filtration rate decreased drastically (down to 20 minutes in comparison with the 1 - 2 min. rate when using the ground material).

   An optimum grain size should probably be determined for best results.

5. In addition to the water mixing difficulties, large clods appeared while the feeding was going on, thus considerably increasing the viscosity of the slurry to such an extent that the agitator stopped. A special attention should be given to this question, in the course of further trials.

6. The soluble P_2O_5 losses in gypsum are particularly high. These figures should not be taken into account, since our filtration device does not allow a proper washing. This is the reason why the P_2O_5 "extraction" is much more meaningful than the P_2O_5 "recovery".

   On the other hand, insoluble P_2O_5 losses are amazingly high in Nemegos gypsum. This figure (3.26%) should be split up into "co-crystallized" and "unreacted" P_2O_5, in order to determine the right amount of excess sulphuric acid to supply to the slurry. For this preliminary test the same acid to rock ratio was used for both Florida and Nemegos rocks.

7. Gypsum crystals were quite different in the two cases. Florida gypsum formed large aggregated crystals while Nemegos gypsum crystallized in long sharp needles having a length to width ratio greater than 6**. This is probably due to the high silica content in Nemegos Apatite.
   In spite of those needle shaped crystals, the retained water in the gypsum cake and its washability showed no difference with Florida gypsum.

Note : * The same trial, performed on Florida rock, gave a colourless filtrate.

** The average needle length has been roughly estimated at 10-30 micron

B) SUPERPHOSPHATE TEST : (see "DATA SHEET" No. 4)

1. Since the phosphoric acid concentration obtained in the precedent step was about 10% P_2O_5, with a relatively high SO_4 %, it has not been possible to react each rock with its corresponding acid after evaporation. Both rocks, thus, were attacked by the same phosphoric acid from Florida rock (44.6% P_2O_5).

2. The low reactivity of Nemegos Apatite with phosphoric acid, is obvious as indicated by :

   - a slight temperature rise during the reaction : 10°C compared with 34°C for Florida rock
   - a high amount of insoluble P_2O_5 in the obtained "Super" (2.30% P_2O_5 for Nemegos as compared to 0.48% for Florida)
   - a very long fluid and plastic stage before caking (42 minutes), thus probably precluding its use in a belt conveyor process. By comparison, when Florida is used, caking is observed within a few seconds.

3. All the "super" analysis were carried out before curing. The remaining moisture of the product (16.54% and 18.04%) is pretty close to the figure we are supposed to get before drying (17% H_2O according to Kuhlman design).

4. The "super" analysis figures were calculated on a basis of 6.54% H_2O product (average moisture before storage).
It is noteworthy that the characteristics of the "super" made from Florida rock during the test, are much better than those of the T.S.P. made in the plant, especially in terms of "acid consumption" (72% vs 74-75%) and "conversion rate" (96% vs 86%). This is probably due to a better mixing.

C) CONCLUSIONS

1. Nemegos Apatite does not seem suitable for T.S.P. manufacture, with the "Kuhlman" process because of the short residence time.

2. For phosphoric acid production, an acceptable P_2O_5 recovery may be attained, but several points are still to be clarified, among which:

   - unloading of a wet rock
   - mixing ability of the rock with water and acid
   - clod formation in the reactor
   - optimum fineness of ground rock (re existing grinding capacity)
   - optimum acid to rock ratio
   - filtration rate (in terms of tons of P_2O_5 per sq. ft. per day)
   - etc. etc...

Several specialized engineering consultants have been contacted to date :

- Robert L. Sommerville & Ass. (N.J. U.S.A.)
- Dorr-Oliver Inc. (Conn. U.S.A.)
- Tennessee Valley Authority (Alta. U.S.A.)
- Jacobs Engineering Comp. (Conn. U.S.A.)
- Fisons Ltd. (Suffolk, U.K.)
- De Prayon Engineering (Engis, Belgium)
- Cerphos (Paris, France)

So far T.V.A. and Dorr-Oliver declined, and R.L. Sommerville and De Prayon wrote us proposals turning around $20,000.

A desicion should be taken as soon as possible.

Salomon Benzimra
Technical Superintendent

SB:lrl

encl. 4 data sheets
2 diagrams

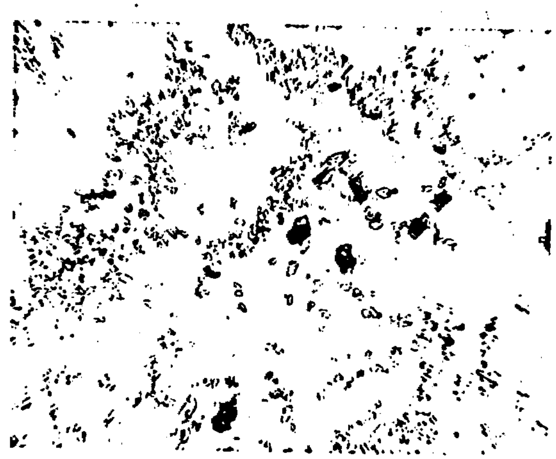
- Phosph. Acid Test -

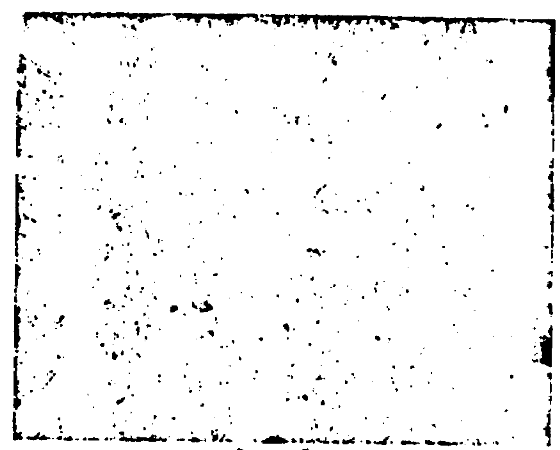
DATA SHEET

		FLORIDA ROCK	NEMEGOS APATITE	REMARKS
Raw Material Analysis (as received)	P_2O_5	Not determined	29.49% (64.4 BPL)	A complete analysis
	CaO		42.63%	
	SiO_2		8.77	is under way at
	F		Not determined	
	Moisture	0.9%	12%	Noranda Mines'Lab.
	Size	See attached	Diagram	
Raw Material Analysis (after drying and grinding) For use in the phosphoric acid Test	P_2O_5	32.93% (72 BPL)	33.47% (73 BPL)	Sieve analysis on Nemegos apatite were uneasy to carry through, because of its low ability to get mixed with water.
	CaO	49.84%	48.38%	
	SiO_2	4.95%	9.95%	
	F	Not determined	Not determined	
	Moisture	0.79%	0.12%	
	Size	56% - 200 mesh	Approx 36% - 200 mesh	
Operating Conditions used for the phosphoric Acid T st (I-Digestion)	-Existing amount of water in the beaker before reaction	375 ml.	375 ml.	Nemegos apatite was not easily mixed with sulphuric acid and large clods were observed at the beginning of the reaction. The slurry became so thick that the agitator stopped and the lumps had to be broken manually before the mechanical stirrer started again
	-Quantity of rock fed	250 g.	250 g.	
	-Quantity of 75% H_2SO_4 fed	275 g. (206 g. H_2SO_4)	275 g. (206 g. H_2SO_4)	
	-Temperature of reactants	Room temp.	Room temp.	
	-Feeding time	4 min.	4 min. 15 sec.	
	-Temperature after feeding	74°C	70°C	
	-Digestion time	3 hours at 79-81°C	3 hours at 79-81°C	
	-Water added during			
	-Digestion	150 ml	150 ml	
	-Foaming	Yes	Not at all.	
	-Agitation	Around 800 RPM (2in. dia. central agit.)	Around 800 RPM (2in. dia. central agit.)	

		FLORIDA ROCK	NEMEGOS APATITE	REMARKS
Operating Conditions used for the phosphoric acid Test (II-Filtration)	-Büchner	5 in. dia (with a Prayon filter cloth)	5 in. dia (with a Prayon filter cloth)	No noticeable difference was observed in the filtration rat of the two slurries.
	-Vacuum	400 mm. Hg	400 mm. Hg	
	-First wash	with the mother liquor	with the mother liquor	
	-Second and third wash	with 2x150 ml. hot water (50°C)	with 2x150 ml. hot water (50°C)	
	-Cake thickness	around 2 in.	around 2 in.	
Characteristics of the obtained Acid	-Acid weight	605.0 g.	596.5 g.	As far as colour is concerned, the Nemegos'Acid was much lighter than Florida's one
	-Acid strength	9.57% P_2O_5	10.29% P_2O_5	
	-H_2SO_4 %	2.9%	1.9%	
	-CaO	0.50%	0.98%	
	-Solids content	0.73%	0.34%	
Characteristics of the obtained gypsum	-Gypsum weight	543.9 g. (wet)	638.0 g. (wet)	
	-Moisture (½ hr at 65°C)	39.0%	38.76%	
	-Soluble P_2O_5 on a dry basis	5.54%	1.93%	
	-Insoluble P_2O_5 on a dry basis	0.66%	3.26%	
	-Total P_2O_5 on a dry basis	6.20%	5.19%	
	-CaO on a dry basis	36.83%	29.96%	
	-Crystals	Good crystal formation	Long sharp needles	See attached photographs.

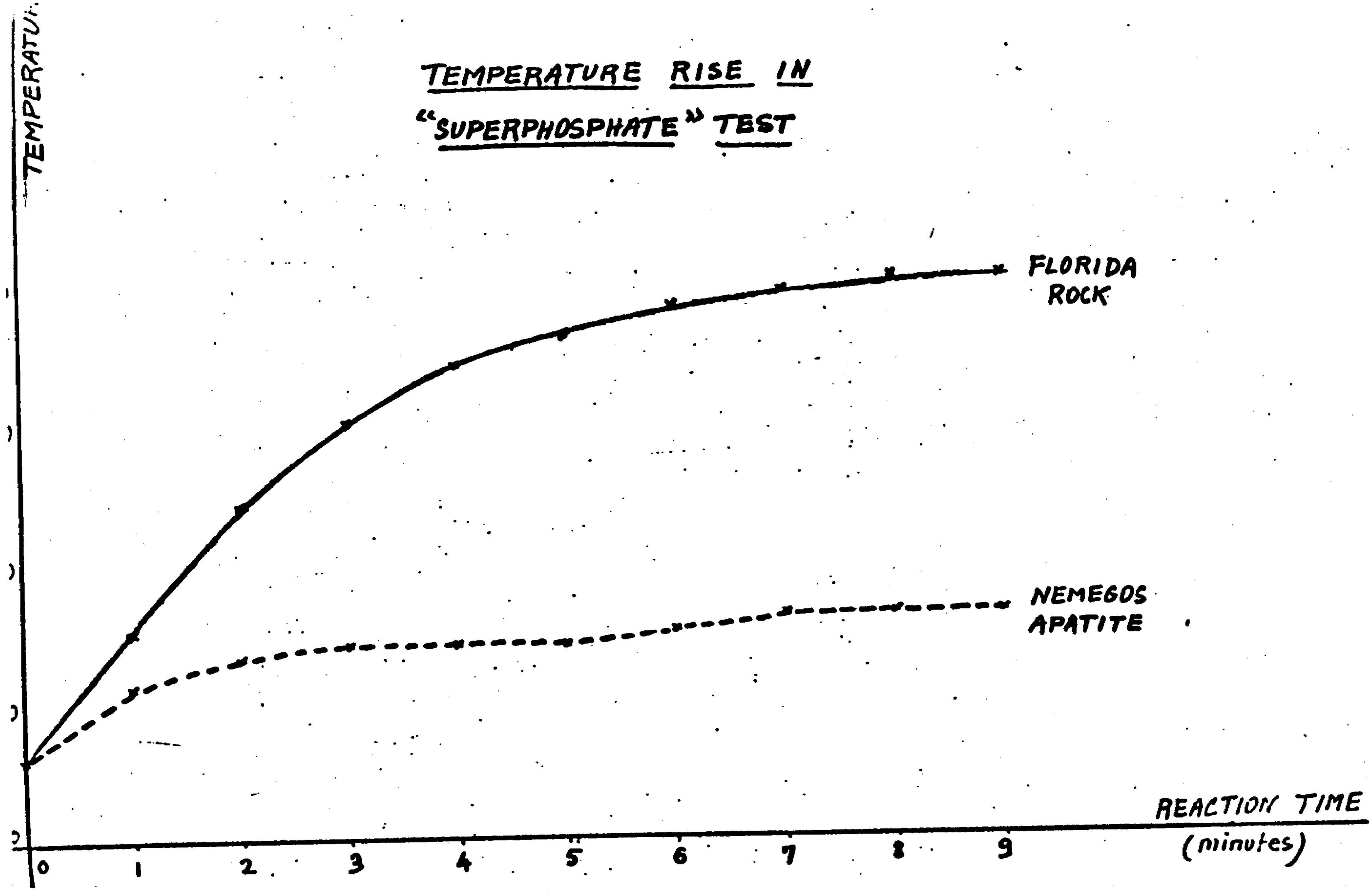
		FLORIDA ROCK	NEMEGOS APATITE	REMARDS
Final Calculations	-"K" ratio $\left(\frac{\text{Tons of gypsum}}{\text{Tons of } P_2O_5 \text{ fed}}\right)$	3.93 (experiment. figure: 4.03)	4.43 (experiment. figure: 4.67)	$K = \frac{(CaO)_R (P_2O_5)_A - (CaO)_A (P_2O_5)_R}{(P_2O_5)_g (CaO)_A (P_2O_5)_R + (P_2O_5)_A (CaO)_g (P_2O_5)_R}$ (where R= rock, A= acid, G= gypsum)
	-Material balance	Output/Input =	Output/Input =	
	• P_2O_5	95.3%	97.6%	
	• CaO	100.5%	101.6%	
	$-P_2O_5$ overall efficiency	(70.3%)	(73.4%)	Due to our poor filtration equipment, the "P_2O_5 efficiency" does not make sense. The conversion rate (P_2O_5 extration from the rock) is much more meaningful.
	-Completion of reaction (P_2O_5 extration from the rock)	97.35%	84.78%	



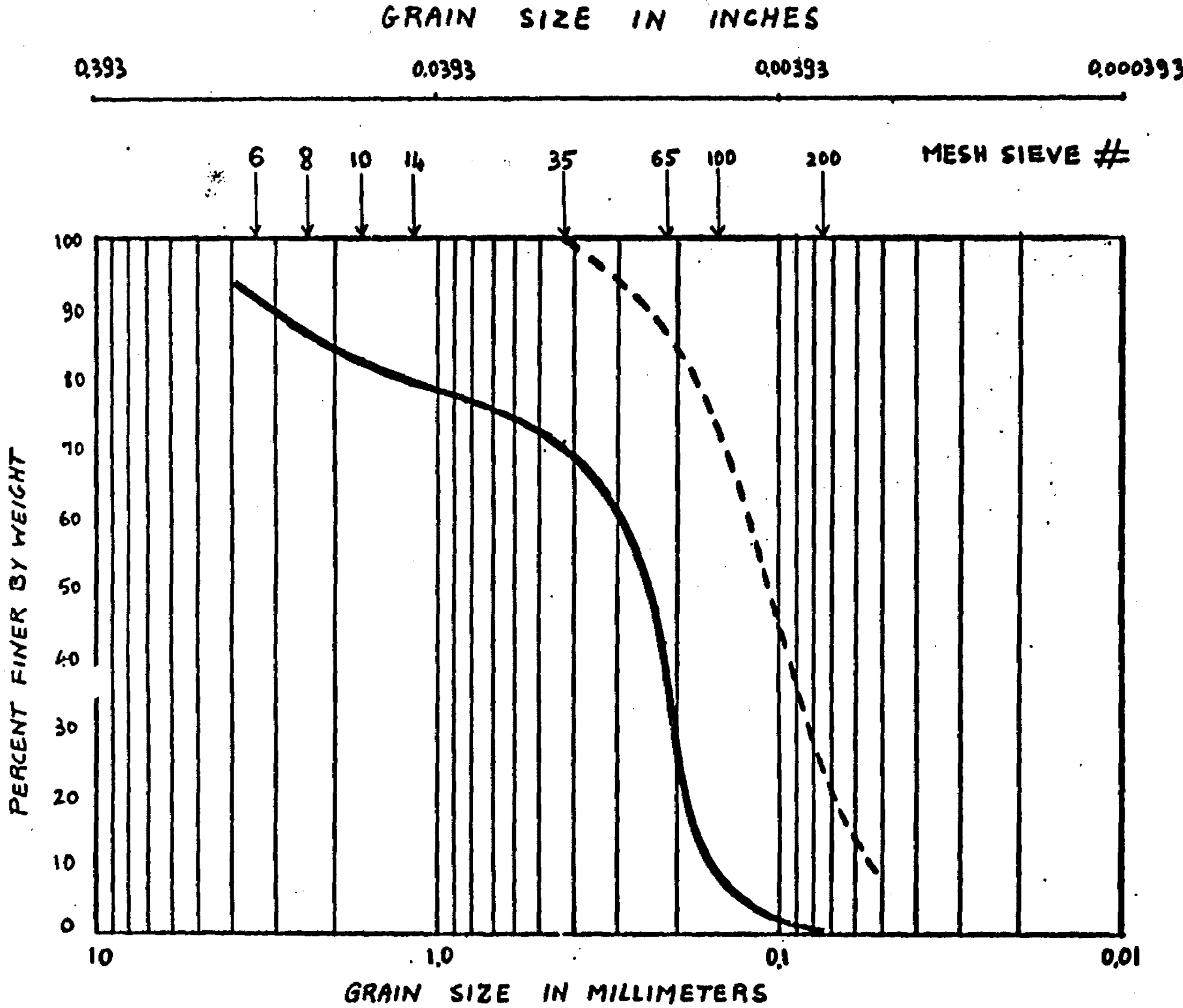


DATA SHEET

		FLORIDA ROCK	NEMEGOS APATITE	REMARKS
Raw Materials Analysis (after drying & grindin) for the "Super" Test	-Phosphoric Acid . P_2O_5	44.6%	44.6%	Both "Super" were made from Concentrated Phosphoric Acid from the plant.-
	-Rock . P_2O_5	32.53%	33.47%	
	. size	92.7% - 200 mesh	Roughly 75% - 200 mesh	
Operating Conditions used for the "Super" Test	-Acid fed	200 g.	200 g.	The use of Florida rock l'd to a very quick cake formation, whereas the Fluid stage - when using Nemegos Apatite - lasted some 12 min, followed by a half an hour plastic stage.
	-Rock fed	108 g.	105 g.	
	-Corresponding acidulation rate (Acid P_2O_5) Rock P_2O_5	2.54	2.54	
	-Temperature rise during reaction	see attached chart	see attached chart	
Characteristics of the obtained "Super"	-Moisture (before drying)	16.54% would * 6.54	18.04% would * 6.54	* Assuming an eventual 6.54% moisture after drying
	-Free Acid (on a wet basis)	4.52% give 5.06	9.57% give 10.91	
	-A.P.A. (on a wet basis)	43.12% ~~give~~ 48.29	40.77% ~~give~~ 46.49	
	-Insoluble P_2O_5 (on a wet basis)	0.48% after 0.54	2.30% after 2.62	
	-Total P_2O_5 (on a wet basis)	43.60% drying 48.83	43.07% drying 49.11	
	-CaO (on a wet basis)	19.83% ----> 22.21	17.86% ----> 20.36	
Final Calculations	-Rock usage per unit "Super" (dried to 6.54%)	0.438	0.415	Rock/Super= $\frac{(CaO)super}{(CaO)rock}$ (approximately)
	-Acid usage per unit "Super" (dried to 6.54%)	0.346	0.350	Acid/Super=(Total P_2O_5)super - Rock (P_2O_5) rock
	-Acid consumption (for a 6.54% H_2O "Super")	72%	75%	A.C.=(P_2O_5 from acid)/(A.P.A. in "Super")
	-Conversion rate (for a 6.54% H_2O "Super")	96%	83%	C.R.=% of solubilized P_2O_5 from rock



TEMPERATURE RISE IN
"SUPERPHOSPHATE" TEST
TEMPERATU
FLORIDA
ROCK
NEMEGOS
APATITE
REACTION TIME
(minutes)
0
1
2
3
4
5
6
7
8
9



GRAIN SIZE DISTRIBUTION CURVE

FLORIDA ROCK } as received
NEMEGOS APATITE } as received

MESH SIEVE #	PERCENT FINER BY WEIGHT	
	FLORIDA ROCK	NEMEGOS APATITE
6	91.7	-
8	85.8	-
10	82.9	-
14	78.5	-
35	70.5	99.9
65	42.1	86.5
100	9.3	72.9
200	0.2	24

SLF
noranda group

LES ENGRAIS DU SAINT-LAURENT LTÉE / ST. LAWRENCE FERTILIZERS LTD.

P.O. BOX 310.
VALLEYFIELD, P.Q.
TEL. 371-0251 (AREA 514)

October 3, 1974

Mr. G. O. Loach
Executive Vice-President
Scrivener Engineering Ltd.
1235 Bay Street
Toronto, Ontario

Dear Mr. Loach:

As discussed in our phone conversation of yesterday, St. Lawrence Fertilizers has made a preliminary evaluation of the Nemegos Apatite on samples obtained from Mr. P.A. Crossgrove. However, our testing facilities at the Valleyfield plant are rather limited, permitting only a cursory examination of this material; it is too soon to conclude with any degree of confidence on the suitability of the phosphate concentrate to be produced by Mertec as a possible source of P_2O_5 input for our process.

Further evaluation is considered and,

a) we are planning in a near future a plant visit to a fertilizer operation, using an apatite concentrate as raw material

b) we are contemplating a full evaluation of the Nemegos Apatite in the production of phosphoric acid and of triple superphosphate; several consultants have been contacted to define the terms of such a study.

Obviously Mertec will benefit from the knowledge gained from this work, and we intend to discuss the possibility of sharing the cost involved.

If we can be of further assistance, please do not hesitate to contact us.

Yours very truly,

G. H. Pelletier

G. H. Pelletier
Plant Manager

cc: Mr. M. S. Scott, Manager - Chemical Products - Noranda Mines Limited

PHOSROCK

Phosphate Rock Export Association

September 23, 1974

Mr. G. O. Loach, P. Eng.
Executive Vice President
Scrivener Engineering Limited
1235 Bay Street
Toronto, Canada M5R 1A5

Dear Mr. Loach:

As requested, attached is a copy of the October 1, 1974 Price Schedule. The prices are for Metric Tons, loaded vessel, basis zero moisture.

We would appreciate your keeping us posted on your apatite development. We are most interested in seeing that Canada obtains the phosphate rock it needs. We trust that your project will prove to be viable. Please include us on your mailing list for announcements, etc.

If we can be of further assistance, please contact us at your convenience.

Yours very truly,

R. Q. Phillips
Director of Marketing

RQP/as

Encl.

PHOSROCK

Phosphate Rock Export Association 1311 N. West Shore Blvd. — Suite 301, Tampa, Florida 33607, U.S.A.

PHOSPHATE ROCK — EXPORT PRICE SCHEDULE

BASIS METRIC TON, UNGROUND, FREE ON BOARD VESSEL

TAMPA RANGE OR JACKSONVILLE, FLORIDA, SUBJECT TO CHANGE WITHOUT NOTICE

RUN OF MINE

EFFECTIVE OCTOBER 1, 1974

	Price	BPL Rise	BPL Fall
77/76%	$62.00 basis 77%	$2.00 per unit	$2.00 per unit to 76%
75/74%	55.00 basis 75%	2.00 per unit	2.00 per unit to 74%
72/70%	48.00 basis 72%	2.00 per unit	2.00 per unit to 70%
70/68%	43.00 basis 70%	2.00 per unit	2.00 per unit to 68%
68/66%	39.00 basis 68%	2.00 per unit	2.00 per unit to 66%
66/64%	36.00 basis 66%	1.50 per unit	1.50 per unit to 64%

DISTINGUISHING FEATURES OF PHOSROCK PRICING

1. Buyer pays for exact BPL shipped.
2. Prices are billed on a bone dry basis; moisture remaining after drying is deducted from the Bill of Lading weight. This applies on CIF contracts, as well as F.O.B.

I&A

3% combined iron and alumina for 75/74% and 77/76%; any excess up to 4% guaranteed maximum will be adjusted by deducting from the actual analysis 2 units of BPL for one unit I&A. 4% maximum combined I&A for all other grades except 66/64%. 5% maximum combined I&A for 66/64%.

H_2O

Although prices are applied on a bone dry basis, actual moisture is guaranteed to be a maximum of 3½% on all grades but 66/64%, which is guaranteed at a maximum of 5%.

CONDITIONS OF SALE

1. TERMS—Net cash in U.S. Dollars against shipping documents consisting of invoice, bills of lading and certificates of weight and analysis and to this end the Buyer hereby undertakes to open, not less than fifteen days in advance of the expected date of the vessel's reporting at loading port, in the case of each shipment, an irrevocable confirmed bank credit in a U.S. Bank in favor of the Seller (the bank to be subject to the Seller's approval) for the full amount of the purchase price of the shipment to be loaded on such vessel, and Buyer agrees to maintain such letter of credit by renewals, extensions or increase if necessary until payment has been made or the shipment cancelled in accordance with the contract.

2. DELIVERY—Delivered free on board vessel at Tampa range or Jacksonville, Florida, in Seller's option to be declared promptly upon nomination of steamer. Price includes loading into vessel and seaworthy trimming, but does not include leveling. Buyer's vessel shall pay the prevailing charge for leveling if the latter is required.

3. WEIGHING, SAMPLING AND ANALYSIS—Railroad or Terminal Company's weights at port of shipment to be accepted as basis of settlement. Samples taken by Seller's representatives to be used as basis of settlement. The sampling may be under the supervision of Seller's and/or Buyer's representatives, if desired. Seller's analysis shall be basis for settlement.

4. The above prices are exclusive of any imposed severance or other government tax, and are based upon rail rates to and loading charges at the point of shipment prevailing on this date.

5. Sales hereunder will be subject to the terms and conditions of Seller's Sales Contract.

Sept. 5, 1974

APPENDIX D

Property Lease Agreements

THIS LEASE made this 13th day of March,1974.

In Pursuance of The Short Forms of Leases Act R S O, 1970, Chapter 436.

B E T W E E N:

MULTI-MINERALS LIMITED, a company incorporated under the laws of the Province of Ontario having its head office at the City of Toronto, in the said Province (hereinafter called the "Lessor")

OF THE FIRST PART,

- and -

MERTEC RESOURCE DEVELOPMENT LIMITED, a company incorporated under the laws of the Province of Ontario having its head office at the City of Sudbury, in the said Province (hereinafter called the "Lessee")

OF THE SECOND PART.

WHEREAS THE Lessor has represented and by these presents does represent and warrant that the Lessor is the registered and beneficial owner of certain patented mining claims situate in the Townships of McNaught and Lackner in the Province of Ontario and entered in the Land Titles Office at Sudbury, Ontario all as set forth in Part 1 of Schedule "A" hereto (hereinafter called the "Mining Property") free and clear of all encumbrances save and except for the mechanics lien described in Part II of Schedule "A" hereto;

AND WHEREAS the Lessee desires to lease the Mining Property in order to conduct studies (hereinafter called the "Studies") for the purpose of determining the feasibility of mining, processing and selling ores, minerals, and metals from the Mining Property, including, without limitation, apatite and titaniferous magnetite concentrates and if such feasibility is confirmed for the purpose of mining and processing such ores, minerals and metals from the Mining Property;

NOW THEREFORE in consideration of the premises and the sum of Ten Dollars ($10.00) in lawful money of Canada now paid by the Lessee to the Lessor (receipt of which is hereby acknowledged) and the mutual covenants and agreements herein contained the parties hereto agree as follows:

1. GRANTING CLAUSE

The Lessor hereby leases, demises and grants the Mining Property to the Lessee, its successors and permitted assigns, for the purpose of giving and granting unto the Lessee, its successors and permitted assigns, the exclusive right and privilege to enter upon the Mining Property and to explore for, mine, remove, beneficiate, concentrate or otherwise treat, ship and sell any ores, minerals and metals which it may desire to take and as are or may be found therein or thereon or produced therefrom, together with the full right privilege and authority of constructing and maintaining and/or removing any and all buildings, structures, machinery, excavations, openings, ditches, drains, water pipes, railroads, roads, tramways and such other improvements, property and/or fixtures as may be reasonably necessary, convenient or suitable for mining, removing, beneficiating, concentrating or otherwise treating and/or shipping any of such ores, minerals, metals or products thereof or for any activity incidental thereto or to any of the rights or privileges of the Lessee hereunder, including full right and authority (to the extent that the Lessor's interest in the Mining Property permits it to grant such right and authority) to sink wells, divert streams, pools or lakes, onto or from the Mining Property, to construct new channels or beds therefor, and to use the waters thereof, and to remove lateral and/or subjacent support and to cave, subside or destroy the surface of any part thereof, and to dump earth, rocks, waste and/or ores or materials on any part of such surface, and to commit waste to the extent necessary, usual or customary in the carrying out of any and/or all of such purposes, rights, privileges or authorities.

The Lessor also hereby grants the Lessee, its successors and permitted assigns, a free and uninterrupted right of way, in, over, upon and across any roadways on the Mining Property or on other lands owned or controlled by the Lessor for the purpose of giving the Lessee access to the Mining Property and to enable the Lessee to carry on the activities contemplated hereby and for such utility, power, water and other facilities, necessary for the effective conduct of such activities over the Mining Property and such other lands.

Provided that, notwithstanding the foregoing, during the Initial Term (as hereinafter defined) of this Lease the Lessee shall not be entitled to remove ores, minerals, metals or products thereof from the Mining Property except for the purpose of making assays or tests related to the Studies.

2. TERM OF LEASE

(a) Initial Term The initial term of this Lease (herein called the "Initial Term") shall be for the period from the date hereof to and including the earlier of one year from the date upon which this Lease has been ratified by the shareholders of the Lessor or the date which is 90 days after the results of the Studies have been delivered to the Lessee.

(b) Second Term The Lessee shall have the right in its sole discretion by giving notice to such effect to the Lessor at any time on or before the date the Initial Term expires to cause the term of this Lease to be extended for the period (herein called the "Second Term") from the date such notice is given to and including December 31, 1984.

(c) Subsequent Terms The Lessee shall have the right in its sole discretion, and provided that it shall not be in default hereunder, to extend the term of this Lease beyond the Second Term for further periods (each of which is herein called a "Subsequent Term") of five (5) years for each period for such number of consecutive Subsequent Terms as are necessary until, in the sole opinion of the Lessee, the Mining Property is completely exploited. The Lessee may exercise the right to extend this Lease for any such Subsequent Term by giving notice to such effect to the Lessor at least 90 days prior to the date such Subsequent Term is to commence.

3. RENT

(a) The Lessee covenants to pay to the Lessor as rental for the Initial Term the sum of $10 in lawful money of Canada, which sum is payable on the execution of this Lease and receipt of which is hereby by the Lessor acknowledged.

(b) The Lessee covenants to pay to the Lessor as rental for the Second Term the aggregate of:

(i) the sum of $100,000 in lawful money of Canada which sum shall be payable on the date of commencement of the Second Term or on such later date as the Lessor may determine; and

(ii) from and after the day which is 180 days after the Date of First Commercial Shipment (as hereinafter defined) the sum of $137.00 per day in lawful money of Canada for each day of the remainder of the Second Term with respect to which the Lessee has not made an election to cease mining operations as permitted by paragraph 4(c) hereof which sums shall be payable on the last day of each March, June, September and December after such day; provided that if the Second Term is terminated under this Lease otherwise than by effluxion of time the said sums accrued from the last such day immediately preceding such termination shall be payable on the date of termination; and

(iii) a sum equal to 20% of the Profits of the Mining Property (as hereinafter defined) during the Second Term which sum shall be computed for each year ended December 31 and shall be payable 120 days after such December 31; and

(iv) from and after the day which is 180 days after the Date of First Commercial Shipment the sum of $68.50 per day in lawful money of Canada for each day of the Second Term during which the Lessee has elected not to conduct mining operations as permitted by paragraph 4(c) hereof which sums shall be payable on the earliest of the last day of each March, June, September and December immediately following any such day or the 30th day after the Lessee shall resume the conduct of such mining operations or the date the Second Term is terminated hereunder or expires.

(c) The Lessee covenants to pay to the Lessor as rental for each Subsequent Term the aggregate of:

(i) the sum of $137.00 per day in lawful money of Canada for each day of such Subsequent Term with respect to which the Lessee has not made an election to cease mining operations as permitted by paragraph 4(c) hereof which sums shall be payable on the last day of each March, June, September and December after the commencement of such Subsequent Term provided that if such Subsequent Term is terminated under this Lease otherwise than by effluxion of time the said sums accrued from the last such day immediately preceding such termination shall be payable on the date of termination; and

(ii) a sum equal to 20% of the Profits of the Mining Property during such Subsequent Term which sum shall be computed for each year ended December 31 and shall be payable 120 days after such December 31; and

(iii) the sum of $68.50 per day in lawful money of Canada for each day of such Subsequent Term during which the Lessee has elected not to conduct mining operations as permitted by paragraph 4(c) hereof which sums shall be payable on the earliest of the last day of each March, June, September and December immediately following any such day or the 30th day after the Lessee shall resume the conduct of such mining operations or the date such Subsequent Term is terminated hereunder or expires.

For the purposes of this paragraph 3 "Profits of the Mining Property" for any period shall mean all revenues derived by the Lessee from the sale of all ores, minerals, and metals and other products derived by the Lessee from the Mining Property less all costs and expenses of every nature incurred by the Lessee (and not reimbursed to the Lessee by way of gift or outright grant, but not by loan from any Federal, Provincial or other government or governmental authority) in connection with mining, processing, transporting and selling such ores, minerals and metals including without limitation, rents payable under paragraphs 3(b)(ii),3(b)(iv), 3(c)(i) and 3(c)(iii) hereof without interest and all taxes (other than taxes on income or profits which are not taxes applicable only to mining operations) and after deducting (to the extent not deducted for any prior period or in the aforesaid calculation) the aggregate of:

(i) all costs and expenses incurred by the Lessee in constructing or acquiring the mill and ancilliary processing facilities referred to in paragraph 4(a) hereof; and

(ii) all costs and expenses incurred by the Lessee in constructing or acquiring improvements and machinery for use in connection with mining operations on the Mining Property and transporting and processing ores, minerals and metals therefrom; and

(iii) all costs and expenses incurred by the Lessee in exploration and development of the Mining Property including, without limitation, the actual cost of the Studies plus $15,000; and

(iv) the sum of $100,000 payable as rent to the Lessor under paragraph 3(b)(i) hereof; and

(v) all amounts provided by the Lessee as working capital for the mining and processing operations contemplated hereby in excess of working capital derived from such mining and processing operations; and

(vi) an allowance for interest equal to the amount obtained by applying the prime lending rate of

The Toronto-Dominion Bank to commercial borrowers in effect from time to time plus 3% on each amount described in subparagraphs (i), (ii), (iii), (iv) and (v) above from the date such amount is expended until the date such amount can be repaid out of net revenues derived by the Lessee from the mining and processing operations contemplated hereby.

all computed in accordance with sound accounting practice and certified by an independent firm of chartered accountants who may be the auditors of the Lessee.

For the purposes of this paragraph 3 the "Date of First Commercial Shipment" shall mean the earlier of (i) the date the Lessee first ships processed ores, minerals or metals derived from the Mining Property to a customer of the Lessee pursuant to a contract of sale with such customer after the Lessee has sold processed ores, minerals or metals derived from the Mining Property for sales prices aggregating at least $50,000 or (ii) the date which is one year and six months from the date of commencement of the Second Term.

4. LESSEE TO CONDUCT MINING OPERATIONS

(a) If the Lessee shall give notice extending this Lease for the Second Term as contemplated by paragraph 2(b) hereof, the Lessee covenants and agrees with the Lessor that, subject as hereinafter provided, the Lessee will forthwith proceed to construct or acquire a mill and such ancilliary production facilities either on the Mining Property or in some other suitable location, as the Lessee may determine, which may, in the opinion of the Lessee, be necessary to process (which word when used throughout this lease shall mean to render ore into concentrate and no more unless the Lessee in its sole discretion determines otherwise) not less than 1,000 tons per day of ore from the Mining Property containing apatite and titaniferous magnetite and the Lessee further covenants and agrees with the Lessor to complete such construction or acquisition on or before the date which is two years from the date of commencement of the Second Term. It is understood and agreed by and between the Lessor and the Lessee that the market price of the ores, minerals and metals from the Mining Property or other economic or market conditions may at any time and from time to time not warrant the continuance of construction and acquisition of such mill and production facilities and that the covenant of the Lessee to continue and complete such construction and acquisition is subject to temporary discontinuance or termination at any time when, in the sole opinion of the Lessee, the same does not appear to be economically feasible. If the Lessee shall elect to temporarily discontinue or terminate such construction and acquisition as aforesaid, the Lessee shall notify the Lessor of such election and shall similarly notify the Lessor of any election by the Lessee to recommence such construction and acquisition if termporarily discontinued.

(b) If the Lessee does not notify the Lessor that the Lessee has elected to recommence the construction and acquisition as contemplated under paragraph 4(a) within three (3) years from the date upon which the Lessee has notified the Lessor of its election to temporarily discontinue or terminate such construction and acquisition as provided in paragraph 4(a), this Lease shall terminate on the giving by the Lessor of notice of termination after the expiry of such three (3) year period.

(c) If the Lessee shall become obligated to construct or acquire the mill and production facilities as described in paragraph 4(a), the Lessee covenants and agrees with the Lessor that, subject as hereinafter provided, the Lessee will, on completion of its said obligation, carry on the mining, processing and selling of ores, minerals and metals from the Mining Property on a commercial scale in accordance with good mining practice and in compliance with the mining laws of the Province of Ontario. The Lessee covenants to use its best efforts to obtain fair market prices for all ores, minerals and metals from the Mining Property sold by it at the time contracts pertaining to such sales are made and in relation to the duration and nature of such contracts. It is understood by and between the Lessor and the Lessee that the quality, quantity and market price of the ores, minerals and metals from the Mining Property or other economic or market conditions may at any time and from time to time not warrant the continuance of mining and processing operations and that the covenant of the Lessee contained in this paragraph 4(c) is limited to such period or periods of time when, in the sole opinion of the Lessee, such mining and processing operations can economically be conducted. At any time when the Lessee shall elect to discontinue mining and processing operations as aforesaid, the Lessee shall notify the Lessor of such election and shall similarly notify the Lessor of any election by the Lessee to recommence such operations.

(d) The Lessee shall at its own expense obtain and maintain insurance with a reputable Canadian insurance company or companies on the mill and ancilliary production facilities described in paragraph 4 (a) against loss or damage by fire or other hazards to the full insurable value thereof but only against such fire or other hazards ordinarily encountered in the conduct of the operations contemplated hereby and only to such extent as is usual in the case of similar operations. The Lessor shall be furnished with a copy of each such policy of insurance. To the extent that any moneys become payable under such insurance to the Lessee and are not applied in reimbursement of the expenses of restoring, replacing or improving such mill and ancilliary production facilities such moneys shall, for the purpose of determining the respective interests of the Lessor and the Lessee thereto, be deemed to be revenues derived by the Lessee from the sale of ores, minerals and metals derived by the Lessee from the Mining Property for the purpose of computation of Profits from the Mining Property under paragraph 3 hereof.

5. <u>TAXES TO BE PAID BY LESSEE</u>

The Lessee hereby covenants and agrees to pay during the Initial Term, the Second Term and each Subsequent Term all taxes, levies and assessments, general and specific, which during the continuance of this Lease shall be assessed upon the Mining Property and all improvements placed thereon, upon all ore therein or thereon and the concentrated product of such ore, upon all personal property placed on the Mining Property by the Lessee and upon any business or occupation carried on upon the Mining Property. The Lessee shall pay that proportion of the taxes assessed for the year in which this Lease commences and that proportion of the taxes assessed against the Mining Property for the year in which this Lease is terminated or surrendered which the number of days in each such year during which this Lease is in effect bear to 365. All such taxes shall be paid before they become delinquent, but the Lessee shall have the right to contest in the courts or otherwise the validity of any such taxes, provided that any taxes and penalties thereon shall be paid before the Mining Property shall be sold for non-payment thereof. The Lessee shall furnish to the Lessor receipts showing payment of all taxes thus paid as and when requested by the Lessor.

6. PEACEABLE SURRENDER OF MINING PROPERTY ON TERMINATION OF LEASE

The Lessee hereby agrees that upon the termination of this Lease for any cause it will peaceably surrender the Mining Property to the Lessor or to its successor in interest.

7. LESSOR'S RIGHT TO ENTER MINING PROPERTY AND INSPECT AND OBTAIN RECORDS

The Lessor shall have the right at all times to have a representative or representatives enter upon the Mining Property and all plants, structures or workings thereon, and to inspect the same and the Lessee's operations hereunder and to examine and inspect the results of all geological and geophysical surveys relating to the Mining Property and to examine and inspect all assay plans and reports, maps, diamond drill records and cores, and all other data, reports and information prepared by or for the Lessee relating to the Mining Property, not, however, unnecessarily hindering or interrupting such operations. The Lessee shall maintain appropriate books and records respecting its operations hereunder, including without limitation exploration and mining work and same shall be made available for inspection at all reasonable times to the Lessor, its agents and servants.

Upon termination of this Lease, the Lessee will deliver to the Lessor one copy of each assay plan, assay report, map, plan, record and any other data in its possession or under its control relating to the work done by the Lessee on the Mining Property and its operations thereon and not previously delivered to the Lessor.

8. <u>LIENS AND CLAIMS</u>

(a) Should any lien or liens be registered against the Mining Property in consequence of any work done or materials brought thereon by or at the direction of the Lessee, the Lessee shall forwith take proceedings at its own expense to have such lien or liens removed; provided always that should the Lessee desire to dispute or contest such claim or lien or liens it shall be entitled to do so but shall remove or have the same removed within fifteen (15) days after the validity of same has been finally determined, and the Lessee shall indemnify and save harmless the Lessor and protect the Mining Property from and against any damages, losses, costs, charges and expenses incurred incidentally thereto or in connection therewith.

(b) The Lessee further agrees to protect and indemnify and hold the Lessor harmless from and against any and all claims made by third parties for injury to or death of persons or damage to property arising from or on account of the Lessee's operations under this Lease while the same is in force and effect excepting that the Lessee shall not be liable for any injuries to any agent or representative of the Lessor sustained while on the Mining Property which are caused by the negligent act or conduct of such agent or representative. The Lessee shall at is own expense obtain and maintain liability insurance with a reputable Canadian insurance company or companies with respect to such claims made by third parties in the amount of $1,000,000 for each person and for each accident and covering property damage in the amount of $500,000 for each accident. The Lessor shall be named as an additional insured in any such policy or policies of insurance and shall be furnished with a copy thereof.

9. <u>ASSIGNMENT AND SUBLETTING BY LESSEE</u>

The Lessee may not assign this Lease or sublet the Mining Property or any part thereof to any third party without obtaining the written consent of the Lessor thereto which consent shall not be unreasonably withheld.

10. <u>FORFEITURE OF LEASE BY LESSEE</u>

The Lessee hereby covenants and agrees unto and with the Lessor that

(a) if the Lessee shall make any default hereunder, and if such default shall continue unremedied by the Lessee or any Mortgagee (as hereinafter defined) for sixty (60) days after the Lessor shall serve notice upon the Lessee and any such Mortgagee specifying such default; or

(b) in the event of the bankruptcy or insolvency of the Lessee, or should the Lessee make an assignment for the benefit of its creditors; or

(c) in the event the Lessee having commenced to carry on the mining, processing and selling of ores, minerals and metals from the Mining Property as provided in paragraph 4(c) had ceased to carry on such mining, processing and selling of ores, minerals and metals for a period of three (3) consecutive years, provided that should the Lessee, having ceased to carry on such mining, processing and selling of ores, minerals and metals, recommence to carry on such mining, processing and selling of ores, minerals and metals the Lessee shall not be deemed to have so recommenced until the Lessee has carried on such mining, processing and selling of ores, minerals and metals for a period of 180 consecutive days;

then upon the happening of any of such events, and subject as hereinafter provided, the Lessor may at any time thereafter without further notice or demand terminate this Lease and with or without any process of law or judgment enter into or upon the Mining Property or any part thereof and take, have and hold possession of the Mining Property as its former estate, and evict, expel, remove and exclude therefrom the Lessee and all parties holding or claiming under it [illegible] waiving any other claim, right, action or remedy which the Lessor would then have in law or equity or otherwise for any breaches hereof or for the recovery of possession of the Mining Property and, thereupon, all rights of the Lessee and all those holding or claiming under it in the Mining Property which would accrue thereafter shall wholly cease and terminate and the right and title thereto shall vest, be and remain in the Lessor; provided, however, that if any claimed default is arbitrated, as hereinafter provided, said sixty day period shall not comence to run until the day of the date of the decision of the arbitrators determining that a default has actually occurred; and further provided that in the event of termination by reason of an event specified in subparagraph (b) above, as a condition precedent to such termination, the Lessee shall serve notice upon any Mortgagee and shall at the written request of any Mortgagee made to the Lessor within 30 days after such notice is served, and provided such Mortgagee has rectified or agreed to rectify all events of default which have occurred and are capable of rectification, enter into a lease of the Mining Property with such Mortgagee and any other Mortgagees so requesting for the term remaining on this Lease substantially on the same terms and conditions as contained in this Lease, including, without limitation, rights of renewal or extension, as would be applicable to such remaining term if the Lessee had remained as Lessee hereunder. For the purposes of this paragraph 10 the term "Mortgagee" means any person, firm, or corporation who has acquired an assignment of this Lease or a mortgage of this Lease by way of sublease as security for any debt or obligation of the Lessee and whose interest in this Lease or in any such sublease is recorded against the title to the Mining Property.

11. SURRENDER OF LEASE BY THE LESSEE

The Lessor hereby agrees that the Lessee may at any time terminate this Lease in its entirety by giving to the Lessor written notice of such termination not less than ninety (90) days prior to the effective date thereof, and by paying to the Lessor prior to such date all sums that shall then have accrued to the Lessor hereunder and, thereupon, all obligations hereunder of the parties hereto shall cease and terminate except the obligations of the Lessee hereunder up to the date of termination respecting the matters herein, including without limitation, the obligation to pay all amounts of rent, taxes and other payments payable by it and accrued to such date but which cannot be paid until after the date of such termination or surrender; provided that the Lessee shall pay all taxes, if any, assessed against the Mining Property on all property removed by the Lessee pursuant to paragraph 12 until the date of such removal.

12. RIGHT OF THE LESSEE TO REMOVE PROPERTY AFTER TERMINATION OF LEASE

(a) Upon the termination of this Lease, by expiration of time or otherwise, the Lessee will peacefully surrender possession of the Mining Property to the Lessor; and thereafter the Lessee shall have six (6) months in which to remove all engines, tools, machinery, railway tracks, shaft houses, buildings, dwellings or structures and all other property of every nature and description erected or placed by it upon the Mining Property; provided that supports placed in shafts, drifts, or openings upon the Mining Property, or any timber or frame work necessary to the use and maintenance of tramways within mines, or necessary to the use or maintenance of shafts or approaches to mine, shall not be removed by the Lessee. Any property which the Lessee shall not remove from the Mining Property within the time fixed for such removal hereby shall be deemed a part of the real estate and shall become the property of the Lessor.

(b) Upon the termination of this Lease by expiration of time or otherwise the fair market value of the property described in paragraph 12 (a) and, without duplication, of the mill and ancilliary production facilities described in paragraph 4 (a) shall be determined by the parties and failing such determination by arbitration. For the purpose of determining the respective interests of the Lessor and the Lessee in such assets, the aggregate of such fair market value shall be deemed to be revenues derived by the Lessee from the sale of ores, metals and minerals from the Mining Property for the purpose of computation of Profits from the Mining Property up to such termination under paragraph 3 hereof. The Lessor shall be entitled to purchase all or any of such property, mill and ancilliary production facilities at such fair market value within 30 days after such determination by notice to the Lessee and, to the extent the Lessor does not exercise such right, such assets shall be disposed of as the Lessee may determine.

13. FORCE MAJEURE

Time shall be of the essence of this Agreement provided, however, that if the Lessee is prevented from or delayed in performing any of its obligations here under by reason of fire, power shortgage, strikes, lock-outs, wars, Acts of God, government regulations or any other cause beyond the reasonable control of the Lessee, its servants or agents, the time limited for the performance of such obligations by the Lessee shall be extended for a period of time equal in length to the time during which the Lessee was so impeded.

The Lessee shall use reasonable diligence to remove such cause of disability as may occur from time to time and shall promptly notify the Lessor of any delays occasioned as aforesaid.

14. CONTROVERSY NOT TO SUSPEND RIGHTS

Unless this Lease shall be terminated in accordance with the provisions hereof, the uninterrupted right of the Lessee to use the Mining Property and to exercise the rights and privileges herein granted to it shall continue unsuspended notwithstanding any controversy or disagreement between the Lessor and the Lessee, provided the Lessee shall duly pay all rents due hereunder, unless such controversy or disagreement relates to the amount thereof, all at the time or times and in the manner and amounts provided for herein.

15. ARBITRATION

In case any disagreement or controversy shall arise between the parties hereto relative to the observance or fulfilment of the terms and obligations hereof by either party, then either party may demand that such controversy or disagreement shall be determined by arbitration. This agreement to submit such matters to arbitration shall be irrevocable, except upon written waiver of consent of both parties. Either party, at any time before issue is joined in any action involving such disagreement or controversy, may demand arbitration thereof. Such demand shall be in writing and shall specify the matter to be submitted to arbitration and in it said party shall nominate some disinterested and competent person to act as arbitrator; thereupon, within fifteen (15) days after receipt of such written notice, the other party by written notice shall choose and nominate a second disinterested and competent arbitrator; the two arbitrators so chosen shall forthwith select a third arbitrator, giving written notice to both parties of the choice so made and fixing a place and time for meeting not later than thirty (30) days thereafter, at which both parties may appear and be heard touching such controversy. The decision of the said arbitrators shall be made in writing within thirty (30) days after the completion of hearings thereon, and when signed by a majority of them shall be final and conclusive upon both parties, In case the two arbitrators shall fail to agree upon a third arbitrator, or in case the party notified of the demand for arbitration shall fail to nominate the second arbitrator within the time herein stipulated, such third arbitrator (or such second and third arbitrators, as the case may be), upon the application of either party, of which the other shall be given notice, shall be named by a person who may then be a Judge of the Supreme Court of Ontario. The arbitrators in their decision shall determine whether the Lessor or the Lessee shall bear the cost and expenses of the arbitration, including the fees of the arbitrators and said arbitrators may in any such decision allocate such costs and expenses between the Lessor and the Lessee in such amounts as they deem fair and equitable by reason of such decision.

16. SALE OF MINING PROPERTY BY LESSOR

The Lessor shall not sell, transfer, assign or otherwise dispose of the Mining Property during the initial

Term, the Second Term or any Subsequent Term of this Lease except as provided in this paragraph 16. If the Lessor is desirous of selling, transfering, assigning or otherwise disposing of all (but not less than all), of the Mining Property during the Initial Term, the Second Term or any Subsequent Term, the Lessor shall first offer to sell all such Mining Property to the Lessee by notice in writing setting out the desired sale price for the Mining Property and the desired terms and conditions of the sale (which notice is hereafter in this paragraph 16 called the "Lessors's Notice of Sale"). If, within sixty (60) days of receipt of the Lessor's Notice of Sale, the Lessee notifies the Lessor, in writing, that the Lessee desires to purchase the Mining Property, then the Lessor shall sell and the Lessee shall purchase all of the Mining Property at the price and on the terms and conditions set out in the Lessor's Notice of Sale. If the Lessee does not notify the Lessor, in writing, within sixty (60) days after receipt by it of the Lessor's Notice of Sale, that the Lessee is desirous of purchasing the Mining Property, the Lessor may sell the Mining Property to any person, firm or corporation at the price and on the terms and conditions set out in the Lessor's Notice of Sale (which sale is hereafter in this paragraph 16 called a "Third Party Sale"). If a Third Party Sale is not completed within one (1) year from the date of the Lessor's Notice of Sale to the Lessee, the provisions of this paragraph 16 requiring an offer to sell the Mining Property to the Lessee shall continue to apply and so on, from time to time.

17. MANNER OF GIVING NOTICE

Any notice hereunder may be given by the Lessee to the Lessor by serving a copy of such notice on one of the corporate officers of the Lessor or by sending a copy of such notice to the Lessor by registered mail, with postage prepaid, addressed to it at:

Suite 4006,
Toronto-Dominion Bank Tower,
Toronto-Dominion Centre,
Toronto, Ontario, Canada.

or at such other place as the Lessor may designate in writing. Any notice hereunder may be given by the Lessor to the Lessee by serving a copy of such notice on one of the corporate officers of the Lessee or by sending a copy of such notice to the Lessee by registered mail, with postage prepaid, addressed to it at:

Shibley, Righton & McCutcheon,
P.O. Box 32, 401 Bay Street,
Toronto, Ontario, Canada

or at such other place as the Lessee may designate in writing.

18. PLACE OF PAYMENT OF RENT

All rentals payable hereunder shall be paid to the Lessor in Canadian dollars at such place as the Lessor shall from time to time designate in writing and, until the Lessee is notified to the contrary, at the address of the Lessor set forth in Section 17 hereof.

19. OBLIGATIONS HEREOF TO RUN WITH LAND

The covenants, conditions and agreements herein contained shall enure to the benefit of and be obligatory upon, as the case may be, the respective successors and permitted assigns of the parties hereto and the same shall run with the land.

20. CLOSING OF MINING PROPERTY

Upon the termination of this Lease, the Lessee shall give up possession of the Mining Property and leave all workings thereon opened up or used by the Lessee in a safe condition such that such workings will in all respects comply with the laws and regulations in force relating thereto, including, without limitation, the capping of shafts and other safety measures.

21. LESSOR'S AUTHORIZATION OF AMENDMENTS

The board of directors of the Lessor may, from time to time, authorize on behalf of the Lessor any amendment of the terms of this Lease without the necessity of obtaining the consent of the shareholders of the Lessor but no amendment to this Lease shall be binding on the Lessee unless consented to in writing by the Lessee.

22. ACCEPTANCE OF LEASE BY REGULATORY AUTHORITY AND SHAREHOLDERS

This Lease shall be subject to acceptance of notice of this Lease by The Toronto Stock Exchange on which the shares of the Lessor are traded and to the approval of a special resolution of the shareholders of the Lessor voting in person or by proxy at a meeting duly called to consider such approval. The Lessor covenants with the Lessee to use its best efforts to obtain such acceptance and approval as soon as reasonably practicable after the execution hereof and in such connection to file all necessary documents and take all necessary corporate proceedings and in any event the Lessor covenants to obtain all such approvals within 60 days of the date hereof, failing which the Lessor or Lessee may terminate this Lease and the parties shall be released from all obligations hereunder.

IN WITNESS WHEREOF the parties hereto have caused this instrument to be executed in their respective corporate names by their respective proper officers and corporate seals to be hereunto affixed, all as of the day and year first hereinabove written.

MULTI-MINERALS LIMITED

President

c/s

Secretary

MERTEC RESOURCE DEVELOPMENT LIMITED

~~President~~ Director

c/s

~~Secretary~~ Director

S C H E D U L E "A"

PART I

MULTI-MINERALS LIMITED, is the owner in fee simple with an absolute title of the whole of the following Parcels of land all of which were granted by the Crown as mining land, and are registered in the Land Titles Division Sudbury (No. 53) in the Register for the District of Sudbury West Section:

Parcel No.	Claim No.
14108	53789
14109	53788
14110	53787
14111	52494
14112	54102
14113	53781
14114	53780
14115	53774
14116	53773
14117	53783
14118	53772
14119	53782
14120	52496
14121	52498
14122	52499
14123	52501
14124	53379
14125	52495
14126	52488
14127	52493
14128	52500
14129	52948
14130	53081
14131	53784
14132	53785
14133	53079
14134	53458
14135	53786
14136	53500
14137	53086
14138	52950
14139	52949
14140	52497
14141	53459
14142	53460
14143	73753
14144	52947
14145	53085
14146	53770
14147	53771
14148	52486
14149	52489
14150	52490
14151	53461
14152	53464
14153	52487
14154	52491
	53463
6096	WD276
6097	WD275

S C H E D U L E "A"

PART I

MULTI-MINERALS LIMITED, is the recorded owner of two Licenses of Occupation filed with the Division of Lands, Ministry of Natural Resources, Toronto, Ontario, as follows:

License of Occupation No. 12,260 covering those parts of mining claims S.52489, S.52490, S.53464, and S.53465 respectively, which consist of land under the waters of Lackner Lake, situate partly in the Township of Lackner and partly in the Township of McNaught in the District of Sudbury.

Licence of Occupation No. 12,261 covering those parts of mining claims S.52491, S.52487, S.53463, and S.53460 which consist of lands under the waters of Lackner Lake and an unnamed lake in the Township of Lackner, in the District of Sudbury.

PART II

Mechanics' Lien registered September 18, 1973 under which Pioneer Construction Co. (1967) Limited claims a mechanic's lien against the above parcels for the sum of $96,286.19 plus costs.

THIS AGREEMENT made this 13th day of March, 1974.

B E T W E E N:

MULTI-MINERALS LIMITED, a company incorporated under the laws of the Province of Ontario and having its head office in the City of Toronto in the said Province (hereinafter called the "Lessor")

OF THE FIRST PART,

- and -

MERTEC RESOURCE DEVELOPMENT LIMITED, a company incorporated under the laws of the Province of Ontario and having its head office in the City of Sudbury in the said Province (hereinafter called the "Lessee")

WHEREAS the parties have entered into a Lease (hereinafter called the "Lease") of even date herewith whereby the Lessor has leased to the Lessee the Mining Property more particularly therein described and being certain patented mining claims situate in the Townships of McNaught and Lackner in the Province of Ontario subject to acceptance of notice of the Lease on behalf of the Lessor by The Toronto Stock Exchange and approval thereof by the shareholders of the Lessor;

AND WHEREAS the Lessee intends to carry out the Studies (as defined in the Lease) in order to enable it to decide whether or not to enter into the Second Term of the Lease;

AND WHEREAS copies of the Studies will be made available by the Lessee to the Lessor whether or not the Lessee elects to enter into the Second Term of the Lease;

NOW THEREFORE in consideration of the premises and the sum of $10.00 in lawful money of Canada now paid by the Lessee to the Lessor (receipt of which is hereby acknowledged) the parties hereto agree as follows:

1. The Lessor agrees that if, in the opinion of the Lessee, the Studies, when completed, do not indicate the economic viability of producing and selling apatite and titaniferous magnetite concentrates and/or metal by-products from the Mining Property as contemplated by the Lease and the Lessee does not exercise its right to enter into the Second Term of the Lease, the Lessor shall deliver to the Lessee, forthwith after demand by the Lessee a first mortgage in form and in substance satisfactory to the Lessee on the Mining Property described in the Lease in the principal amount equal to the aggregate of (i) all out-of-pocket expenses incurred by the Lessee in the conduct of the Studies, including without limitation, the fees and expenses of independent consultants and all taxes paid by the Lessee under the Lease and (ii) the sum of $15,000 as an allowance for overhead incurred by the Lessee in the conduct of the Studies, which mortgage shall bear interest at the rate of 10% per annum compounded semi-annually with a term of three (3) years from the date upon which the mortgage is demanded provided that the

principal amount of such mortgage and any interest or compounded interest may be repaid at any time during the term without notice or bonus.

2. (a) If the Lessor shall fail to pay and satisfy the mortgagee as provided in paragraph 1, the Lessor shall on the demand of the Lessee transfer and convey to the Lessee an undivided ten (10%) per cent interest in the Mining Property. Such transfer and conveyance shall be in form sufficient to permit its registration against the title to the Mining Property. The delivery of such transfer and conveyance pursuant to the demand of the Lessee as aforesaid shall satisfy and discharge all obligation of the Lessor to make any payment to the Lessee pursuant to paragraph 1 above.

(b) In the event that the transaction referred to in paragraph 2(a) takes place, the Lessor shall stand possessed of a ninety per cent (90%) interest in the Mining Claims and the Lessee a ten per cent (10%) interest. The Lessor may at any time and from time to time sell (and for the purposes of this paragraph the word "sell" when used in relation to the Mining Property shall be deemed to mean sell or in any way dispose of or deal with the Mining Property or any interest therein) the Mining

Property or any interest therein on such terms and conditions as in its absolute discretion it deems appropriate and on any such sale the Lessee's ten per cent (10%) interest shall be dealt with along with the Lessor's ninety per cent (90%) interest. In any event, when the Mining Property is sold, the consideration accruing on the sale thereof shall be divisible as to ninety per cent (90%) to the Lessor and as to ten per cent (10%) to the Lessee.

3. If notice of the Lease is not accepted for filing by The Toronto Stock Exchange on behalf of the Lessor or the shareholders of the Lessor do not approve the Lease all within 60 days from the date hereof, the Lessor will notify the Lessee and will pay all costs and expenses incurred by the Lessee, not in excess of $100,000 in the aggregate, unless consent to such excess has been approved in writing by the Lessor, in connection with the Studies up to the date of such notification

4. Time shall be of the essence of this agreement.

5. Any notice, document or other communication required or permitted to be given hereunder shall be in writing and shall be sufficiently given if sent by prepaid registered mail from Toronto addressed in the case of the Lessor as follows:

Multi-Minerals Limited,
Suite 4006,
Toronto-Dominion Bank Tower,
Toronto-Dominion Centre,
Toronto, Ontario.

and in the case of the Lessee as follows:

c/o Shibley, Righton & McCutcheon,
P.O. Box 32, 401 Bay Street,,
Toronto, Ontario.

or if delivered by hand at such address. Each of the foregoing shall be entitled to specify a different address by giving written notice as aforesaid to the other. Any notice given hereunder, if mailed as aforesaid, shall be deemed to have been given on the first business day following such mailing, or if delivered by hand as aforesaid, shall be deemed to have been given on the day of delivery if a business day or if not a business day on the business day next following the day of delivery.

6. This agreement shall enure to the benefit of and be binding on the parties hereto and their respective successors and assigns.

IN WITNESS WHEREOF the parties hereto have duly executed this agreement.

MULTI-MINERALS LIMITED

by ______________________
President

______________________ c/s

MERTEC RESOURCE DEVELOPMENT
LIMITED

by ______________________
~~President~~
Director

______________________ c/s
~~Secretary~~
Director

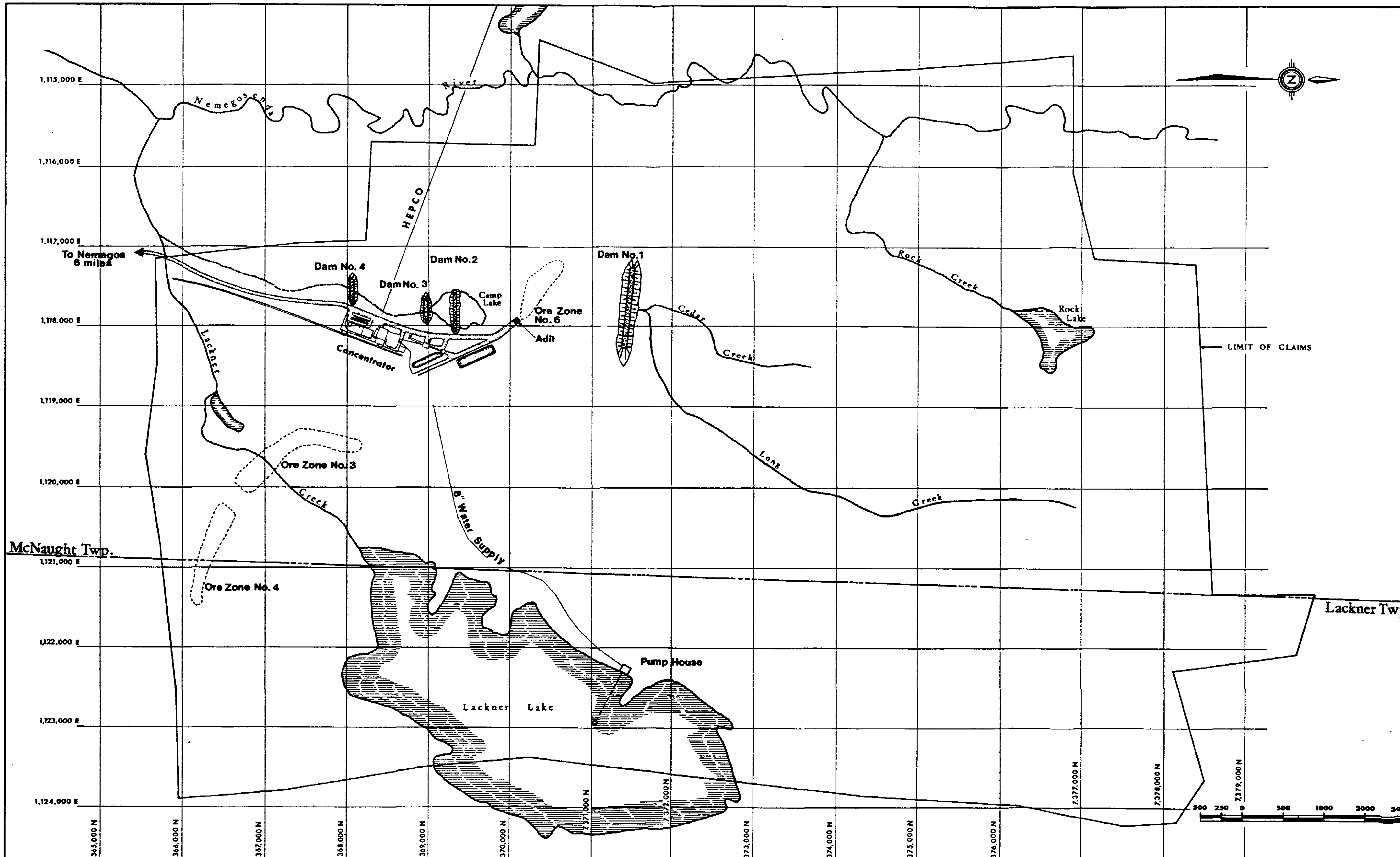
APPENDIX E

DRAWINGS LIST

5699 - 100 Process Flow Sheet (Section 8.7)
101 Area Plan (1" = 500')
102 Site Plan (1" = 100')
103 Mineral Zones and Claim Location Map (Section 4.3)
104 Section No. 6 Ore Body (Section 6.5)
105 Bore Hole Locations (Section 5.8)
106 Engineering and Construction Schedule (Section 8.7)
107 Engineering and Construction Schedule (summary)

5699 - 200 Primary Crusher
201 Secondary Crusher
202 Transfer Station
203 Fine Ore Storage
204 Concentrator Building - Ground Floor Plan
205 Concentrator Building - Operating Floor Plan
206 Concentrator Building - Sections
207 Concentrator Building - Sections
208 Thickener Plans and Sections
209 Drying and Briquetting
210 Loadout

5699 - 700 Single Line Diagram



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Scrivener Engineering

DRAWN W.L. Spencer
SCALE 1" = 500'
DATE OCT 74
CHECKED
APPROVED
APPROVED

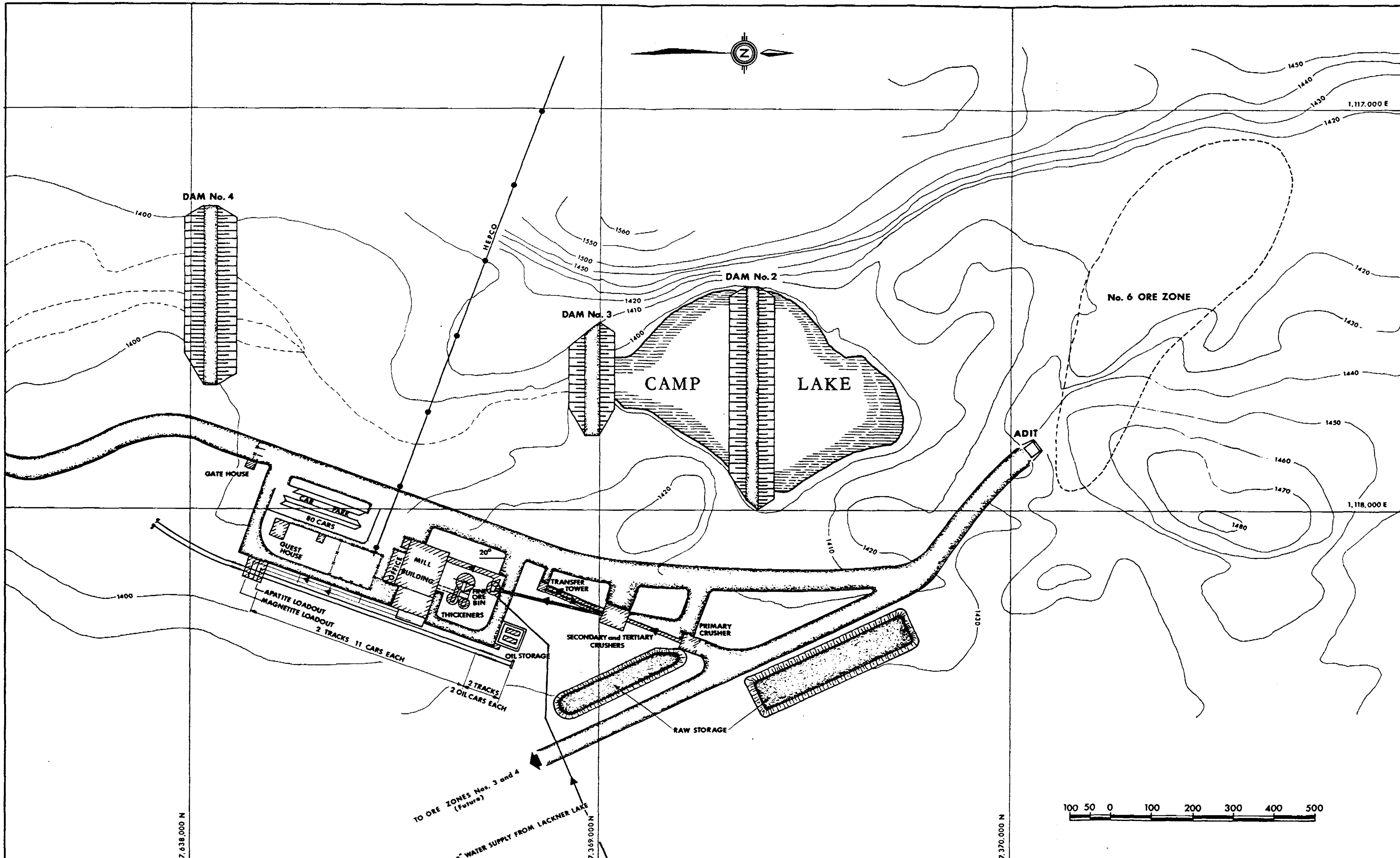
CLIENT: MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury, Ontario

PROJECT: RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

DRAWING: AREA PLAN

DRAWING NUMBER: 5699·101

REV. P



Scrivener ENGINEERING

DRAWN	W.L. Spencer
SCALE	1" = 100'
DATE	NOV 74
CHECKED	
APPROVED	
APPROVED	

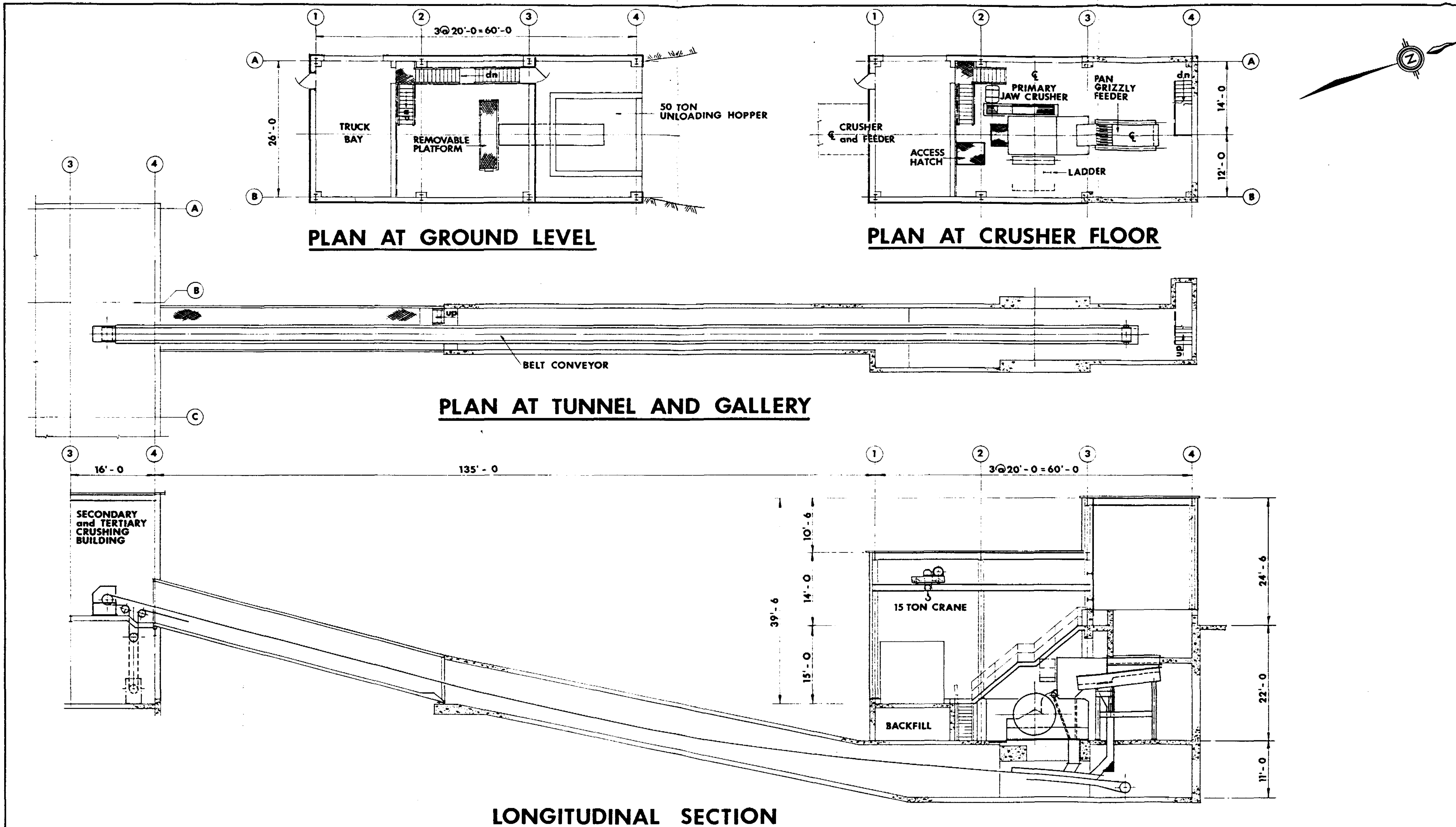
CLIENT: MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury, Ontario

PROJECT: RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

DRAWING: SITE PLAN

DRAWING NUMBER: 5699·102 REV. P

REFERENCE DWG. NO.	DESCRIPTION	REFERENCE DWG. NO.	DESCRIPTION	REVISIONS NO.	BY	DATE	DESCRIPTION	REVISIONS NO.	BY	DATE	DESCRIPTION	REVISIONS NO.	BY	DATE	DESCRIPTION



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Scrivener ENGINEERING

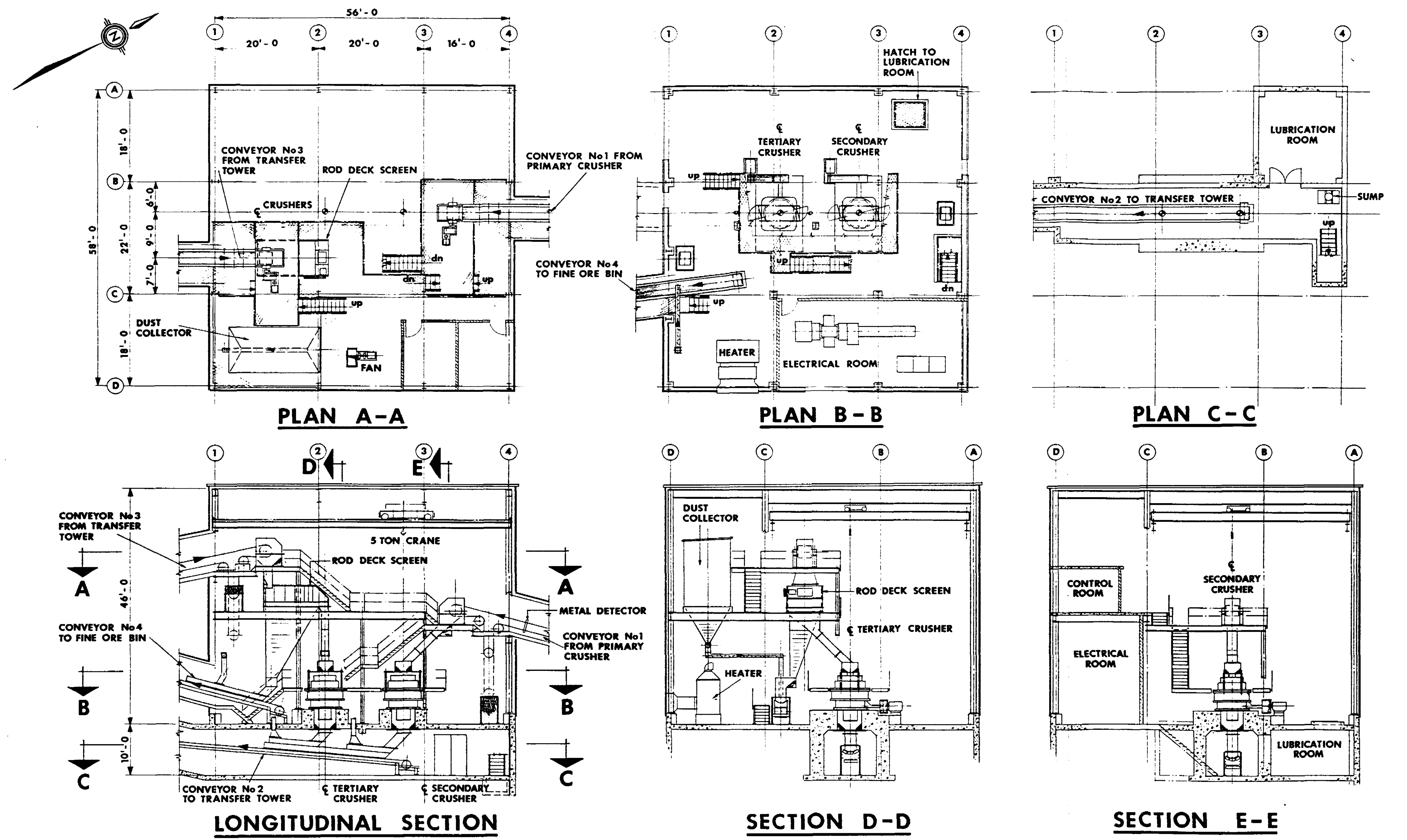
DRAWN D. Bates
SCALE 1/8"=1'-0
DATE NOV 74
CHECKED
APPROVED
APPROVED

CLIENT
MERTEC RESOURCE DEVELOPMENT LIMITED
Sudbury Ontario

PROJECT
RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

DRAWING
CRUSHING PLANT
GENERAL ARRGT. of PRIMARY CRUSHER and BELT CONV. No 1

DRAWING NUMBER 5699·200
REV. P



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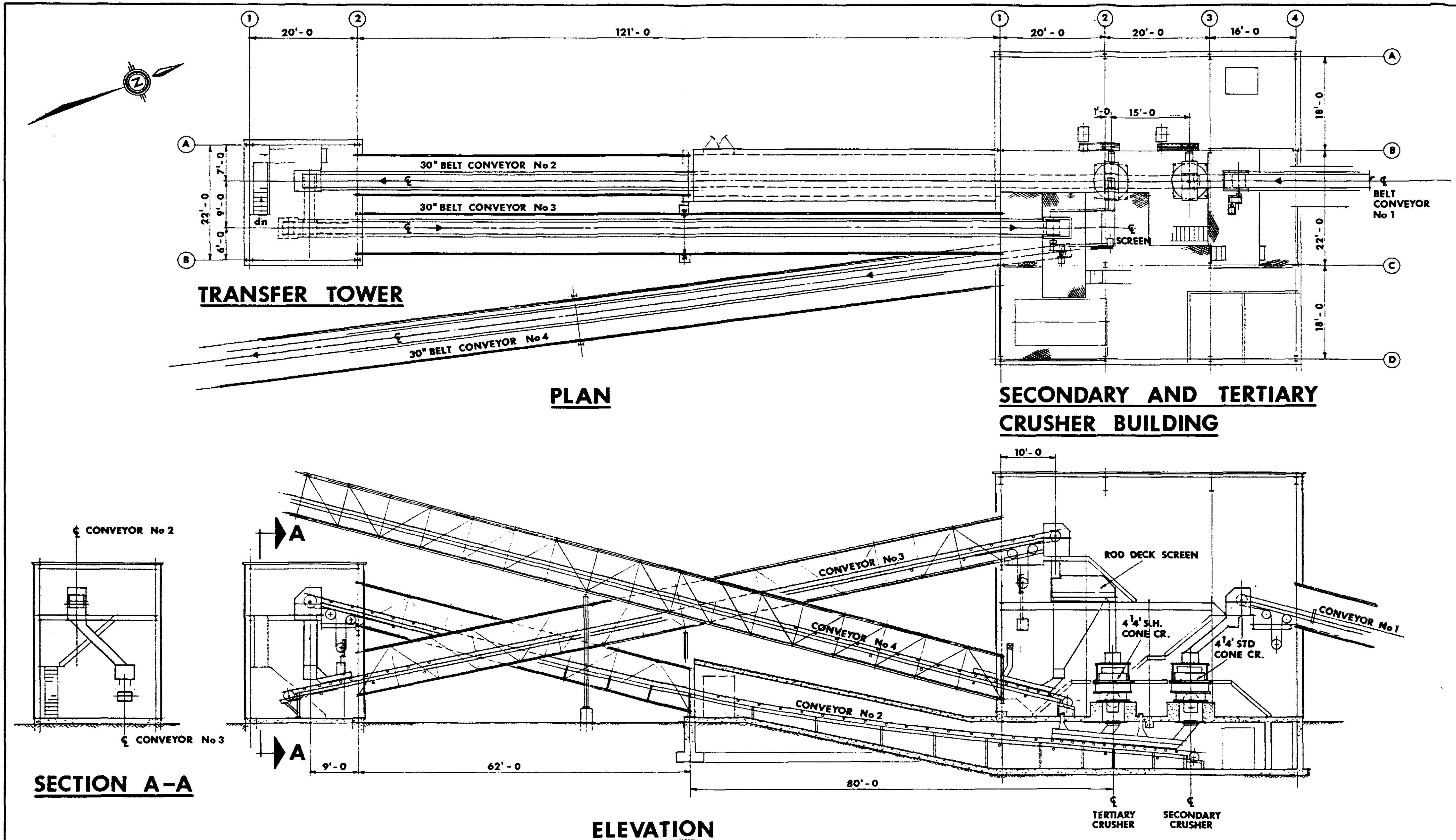
Scrivener ENGINEERING

DRAWN J McCourt SCALE 1/8" = 1'-0 DATE NOV 74 CHECKED APPROVED APPROVED	CLIENT MERTEC RESOURCE DEVELOPMENT LIMITED Sudbury Ontario PROJECT RECOVERY and TREATMENT of MAGNETITE – APATITE CONCENTRATES	DRAWING CRUSHING PLANT GEN. ARRGT. SECONDARY and TERTIARY CRUSHER BUILDING DRAWING NUMBER 5699·201 REV. P



Reference DWG. NO.	Description	Reference DWG. NO.	Description	Revisions NO.	BY	DATE	Description	Revisions NO.	BY	DATE	Description

Scrivener Engineering

Drawn: R. Russell
Scale: 1/8" = 1'-0
Date: NOV 74
Checked:
Approved:
Approved:

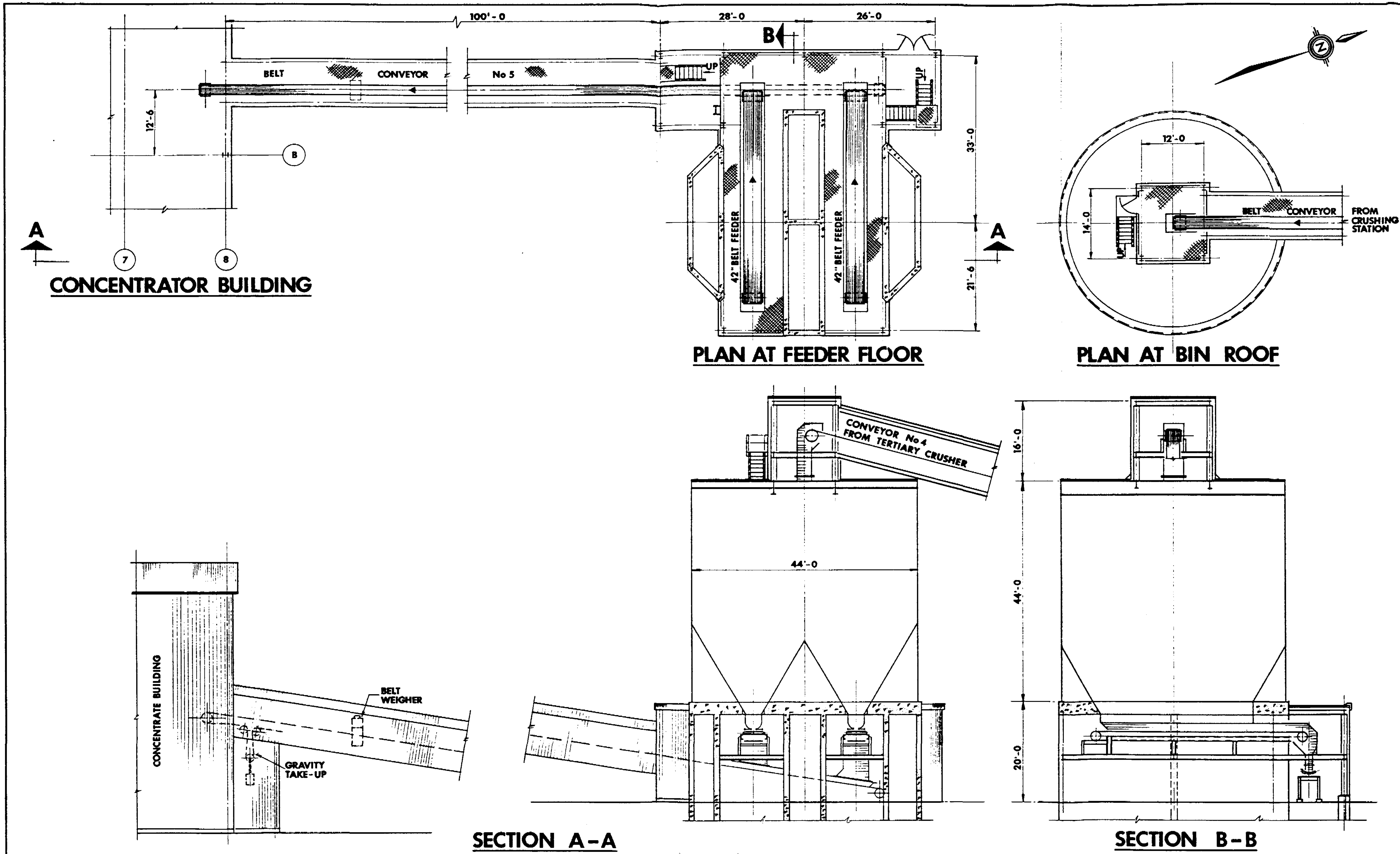
Client: MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury, Ontario

Project: RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

Drawing: TRANSFER STATION

Drawing Number: 5699·202

Rev.: P



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Scrivener ENGINEERING

DRAWN	G. Coulthard
SCALE	1/8" = 1'-0"
DATE	NOV 74
CHECKED	
APPROVED	
APPROVED	

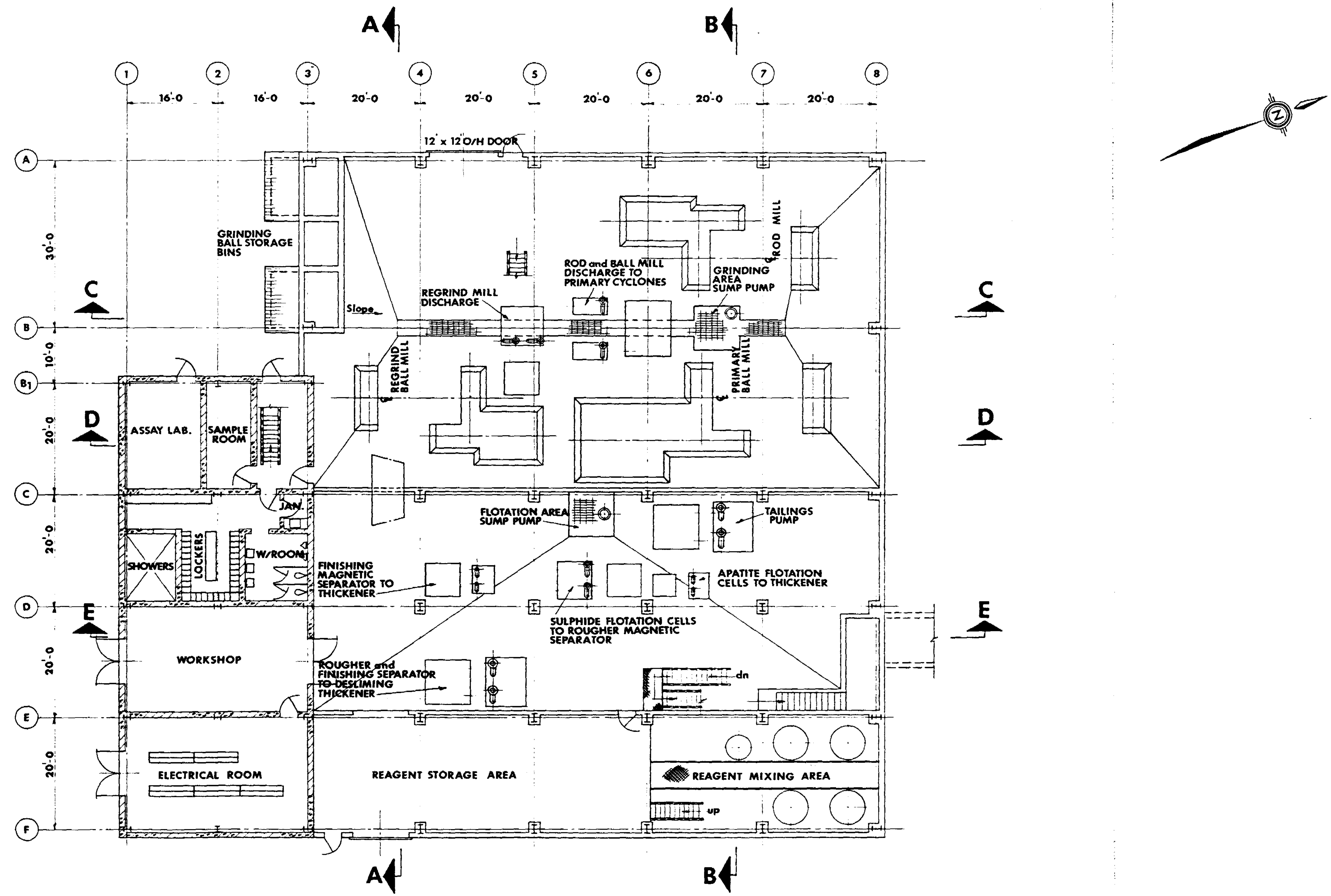
CLIENT: MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury, Ontario

PROJECT: RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

DRAWING: FINE ORE STORAGE GENERAL ARRANGEMENT

DRAWING NUMBER: 5699·203

REV. P

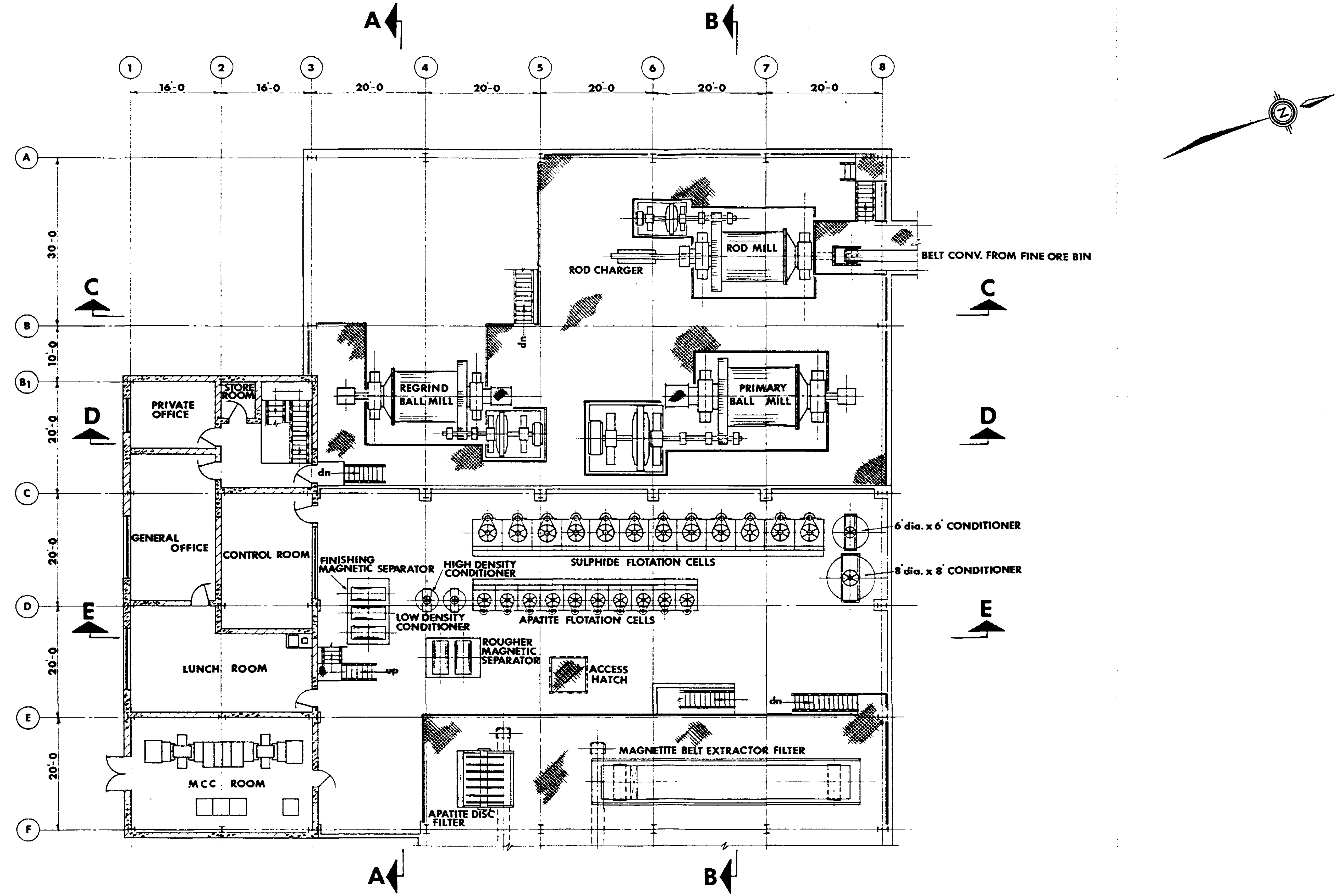


GROUND FLOOR PLAN

REFERENCE DWG. NO	DESCRIPTION	REFERENCE DWG. NO	DESCRIPTION	REVISIONS NO BY DATE	DESCRIPTION	REVISIONS NO BY DATE	DESCRIPTION	REVISIONS NO BY DATE	DESCRIPTION

Scrivener ENGINEERING

DRAWN G COLTHARD SCALE 1/8" = 1'-0" DATE NOV 74 CHECKED APPROVED APPROVED	CLIENT MERTEC RESOURCE DEVELOPMENT LIMITED Sudbury Ontario	DRAWING CONCENTRATOR BUILDING GROUND FLOOR PLAN	
	PROJECT RECOVERY and TREATMENT of MAGNETITE – APATITE CONCENTRATES	DRAWING NUMBER 5699·204	

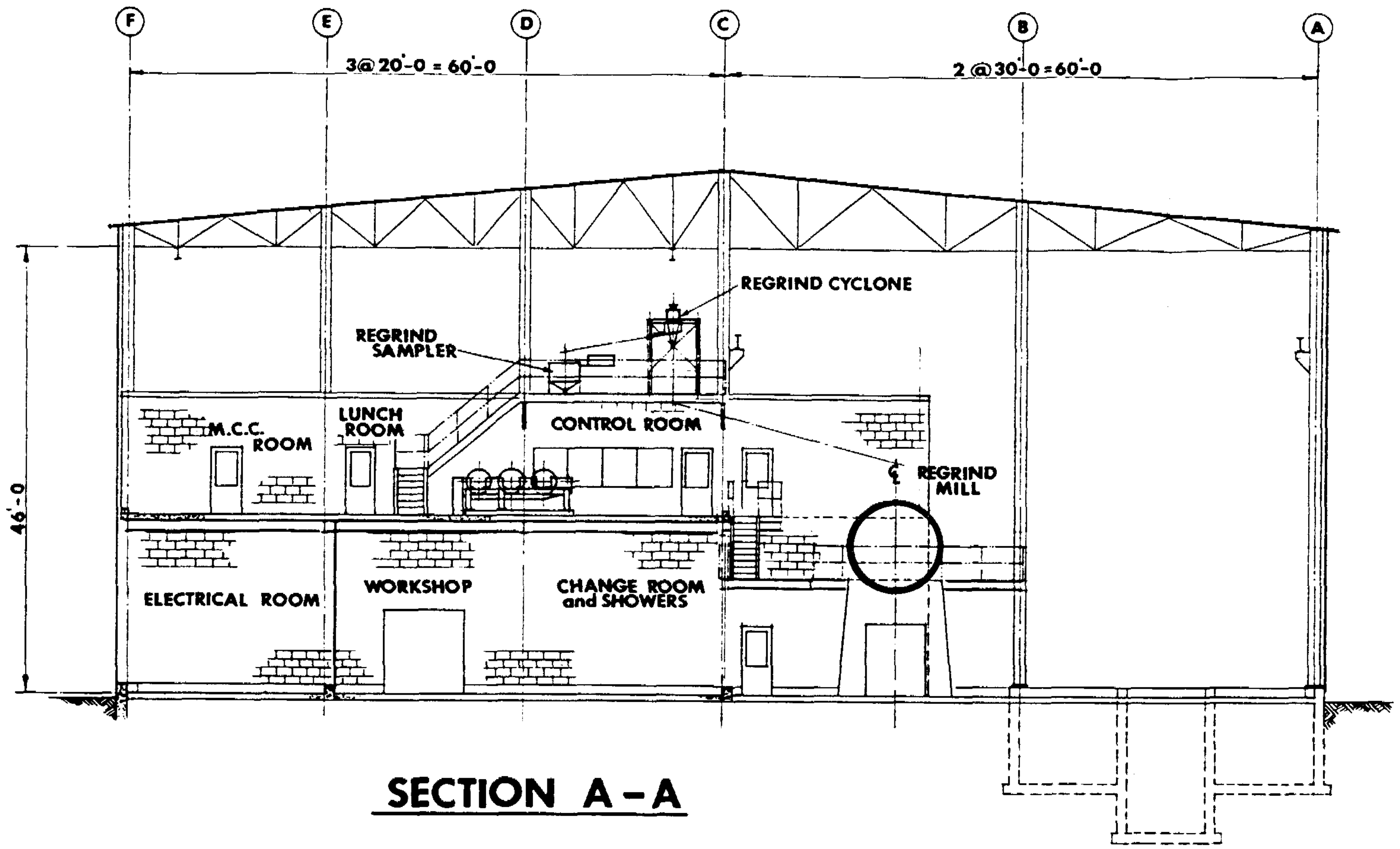


OPERATING FLOOR PLAN

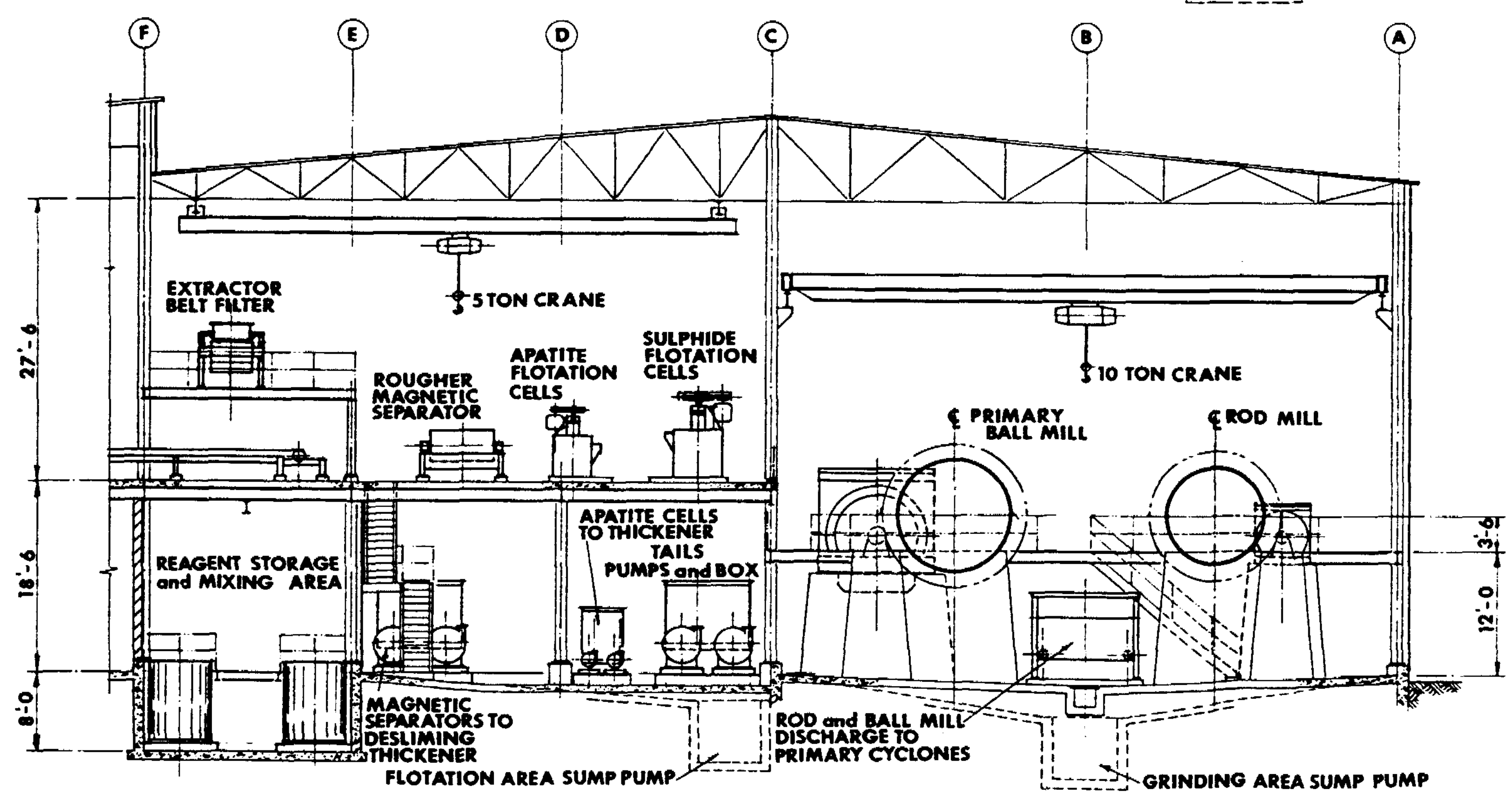
REFERENCE		REFERENCE		REVISIONS		REVISIONS		REVISIONS	
DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION	NO. BY DATE	DESCRIPTION	NO. BY DATE	DESCRIPTION	NO. BY DATE	DESCRIPTION

Scrivener ENGINEERING

DRAWN G COULTHARD	CLIENT MERTEC RESOURCE DEVELOPMENT LIMITED Sudbury Ontario	DRAWING CONCENTRATOR BUILDING OPERATING FLOOR PLAN	
SCALE 1/8"=1'-0"			
DATE NOV 74			
CHECKED	PROJECT RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES	DRAWING NUMBER 5699·205	REV. P
APPROVED			
APPROVED			



SECTION A-A

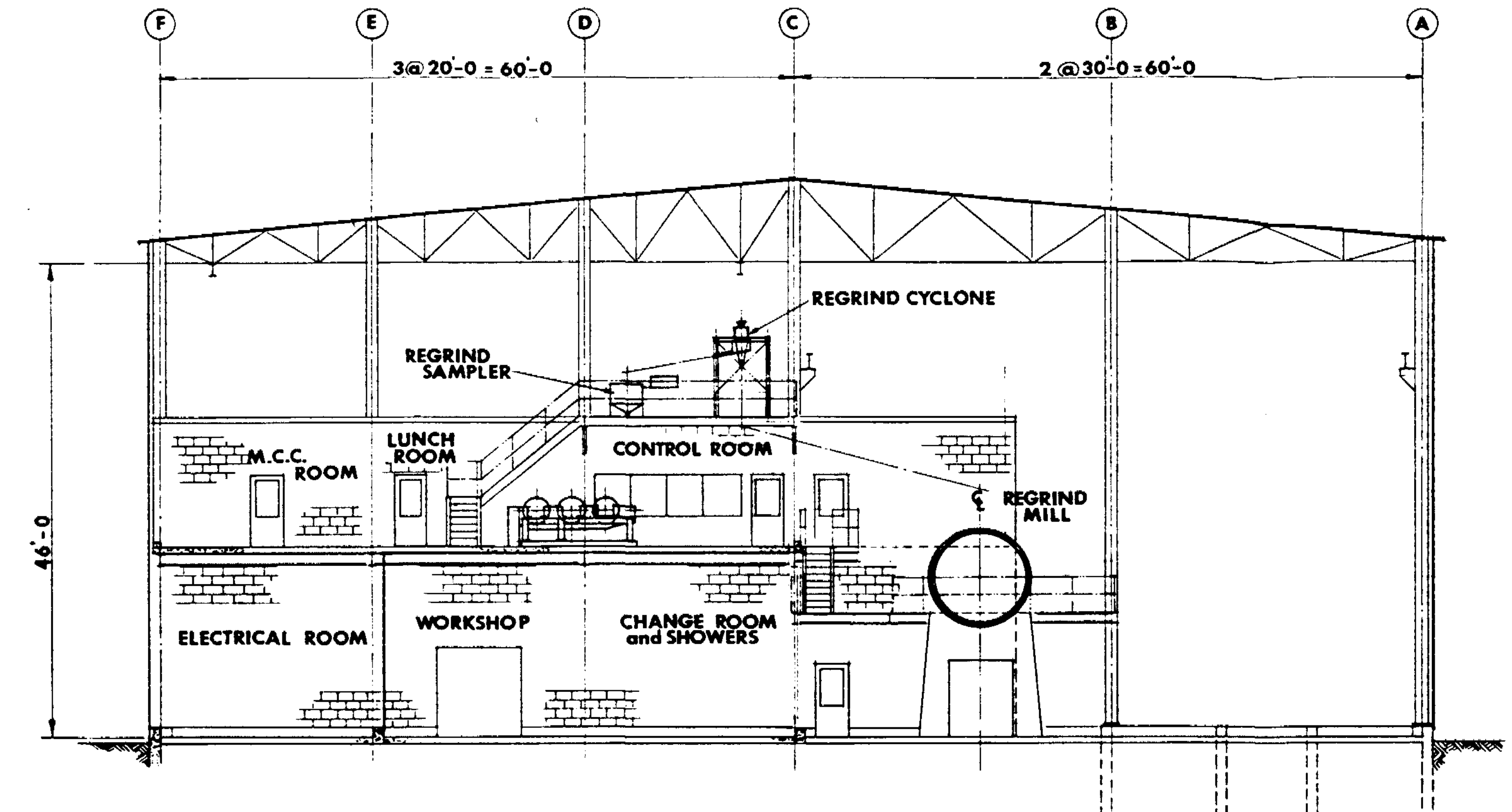


SECTION B-B

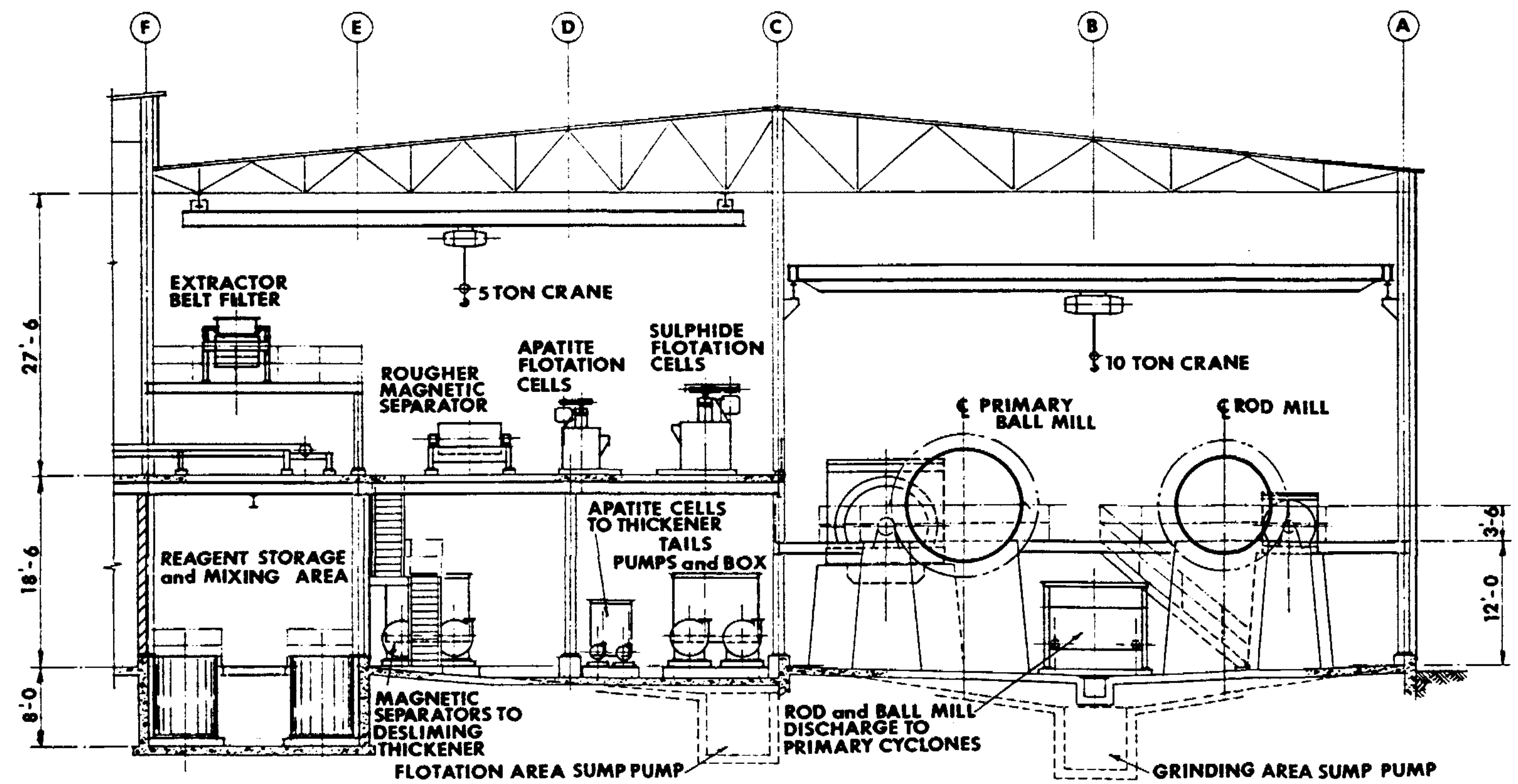
REFERENCE DWG. NO.	DESCRIPTION	REFERENCE DWG. NO.	DESCRIPTION	REVISIONS NO.	BY	DATE	DESCRIPTION

Scrivener ENGINEERING

DRAWN D BATES	CLIENT MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury, Ontario	DRAWING CONCENTRATOR BUILDING SECTIONS A-A and B-B
SCALE 1/8" = 1'-0"		
DATE NOV 74	PROJECT RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES	DRAWING NUMBER 5699·206
CHECKED		REV. P
APPROVED		
APPROVED		



SECTION A-A



SECTION B-B

REFERENCE		REFERENCE		REVISIONS				REVISIONS				REVISIONS			
DWG. NO.	DESCRIPTION	DWG. NO.	DESCRIPTION	NO	BY	DATE	DESCRIPTION	NO	BY	DATE	DESCRIPTION	NO	BY	DATE	DESCRIPTION

Scrivener ENGINEERING

DRAWN: D. BATES
SCALE: 1/8"=1'-0
DATE: NOV 74
CHECKED:
APPROVED:
APPROVED:

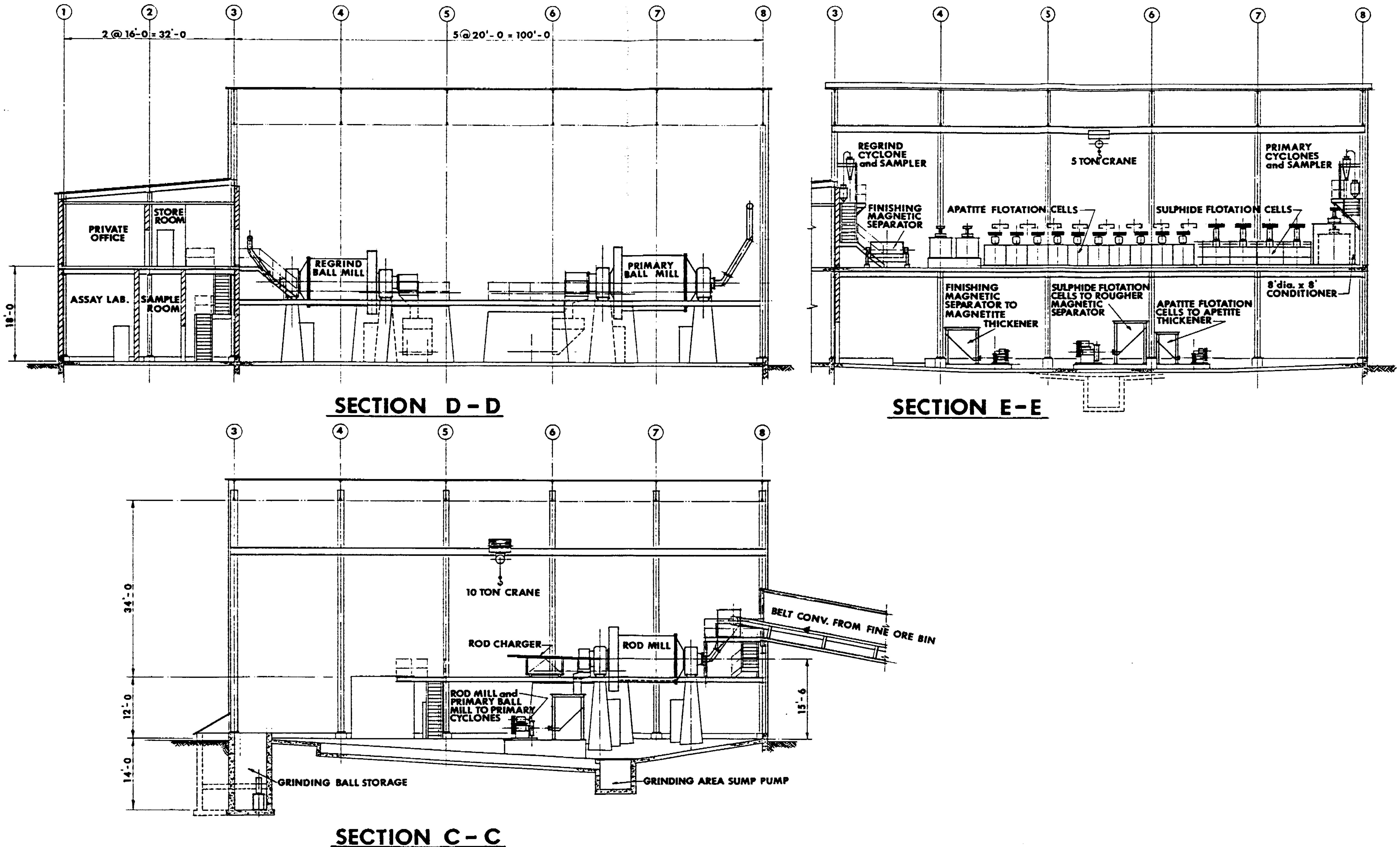
CLIENT: MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury, Ontario

PROJECT: RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

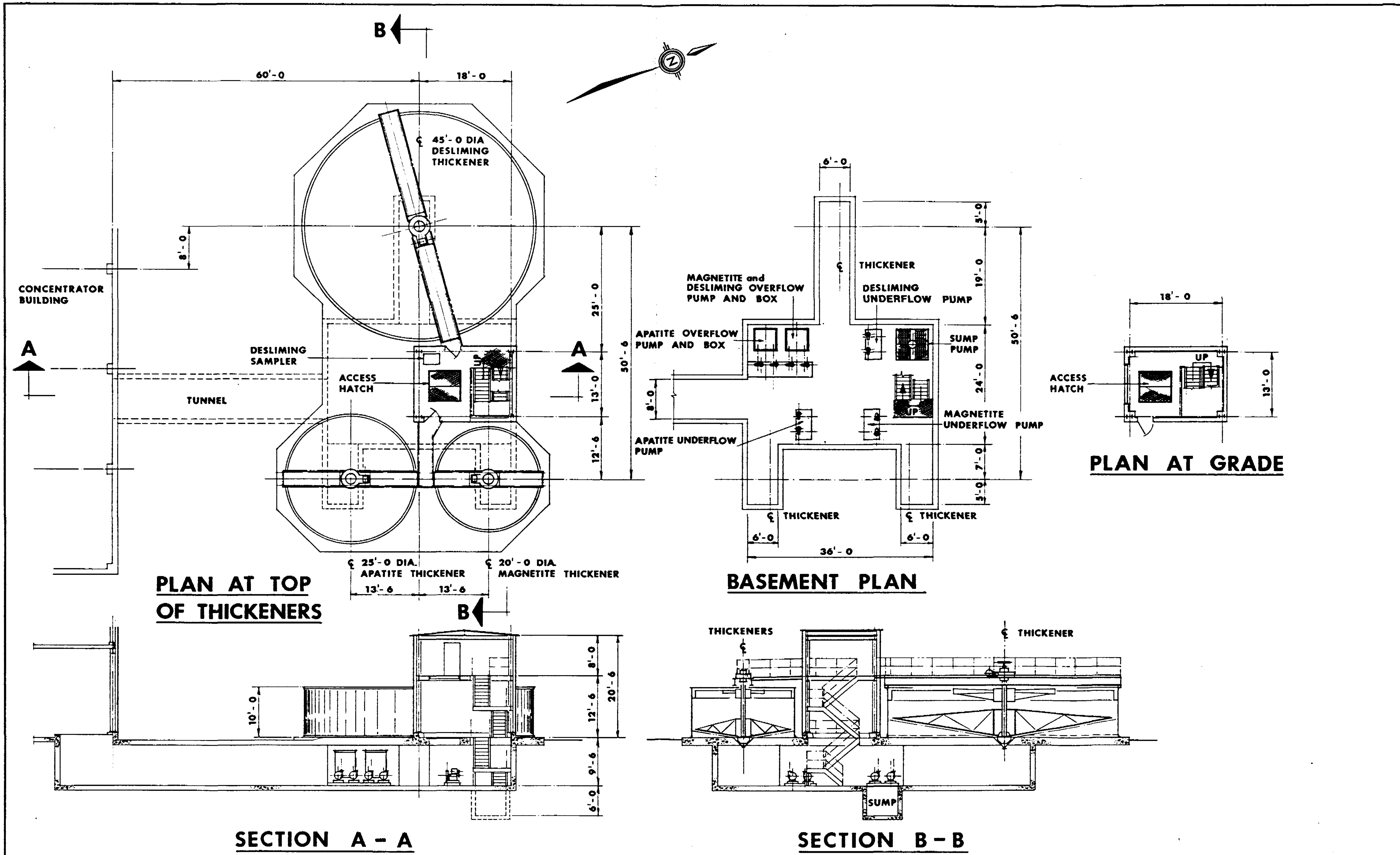
DRAWING: CONCENTRATOR BUILDING SECTIONS A-A and B-B

DRAWING NUMBER: 5699·206

REV. P



Scrivener Engineering	
DRAWN	J. McCourt
SCALE	1/8" = 1'-0"
DATE	NOV 74
CHECKED	D.B.
APPROVED	
APPROVED	
CLIENT	MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury, Ontario
PROJECT	RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES
DRAWING	CONCENTRATOR BUILDING SECTIONS C-C, D-D and E-E
DRAWING NUMBER	5699·207
REV.	P



Scrivener Engineering	
DRAWN	D. BATES
SCALE	1/8" = 1'-0"
DATE	NOV 74
CHECKED	
APPROVED	
APPROVED	

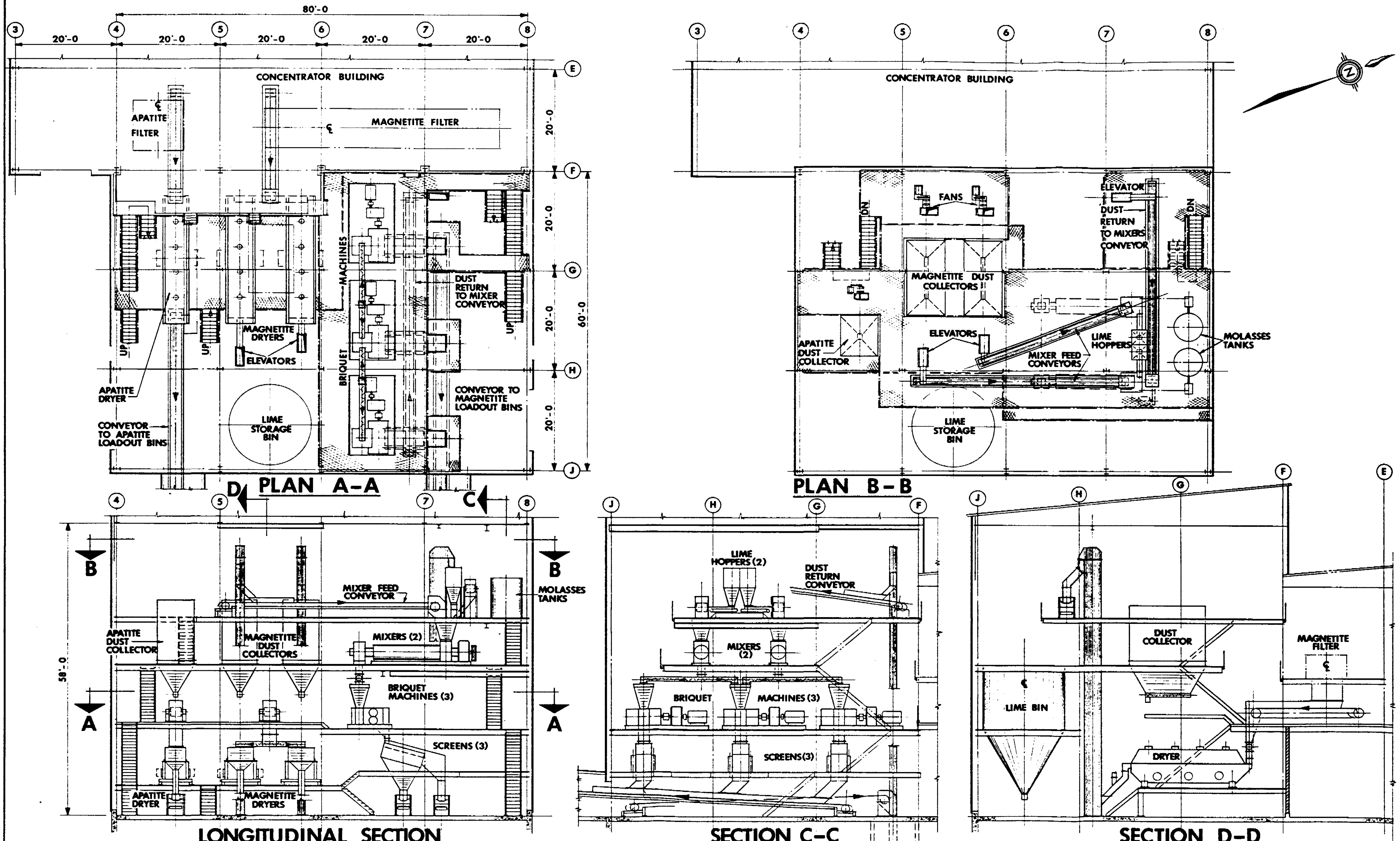
CLIENT: MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury, Ontario

PROJECT: RECOVERY and TREATMENT of MAGNETITE-APATITE CONCENTRATES

DRAWING: THICKENERS PLANS - ELEVATIONS

DRAWING NUMBER: 5699·208

REV.: P



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Scrivener Engineering

DRAWN: McCourt
SCALE: 1/8" = 1'-0"
DATE: NOV 74
CHECKED:
APPROVED:
APPROVED:

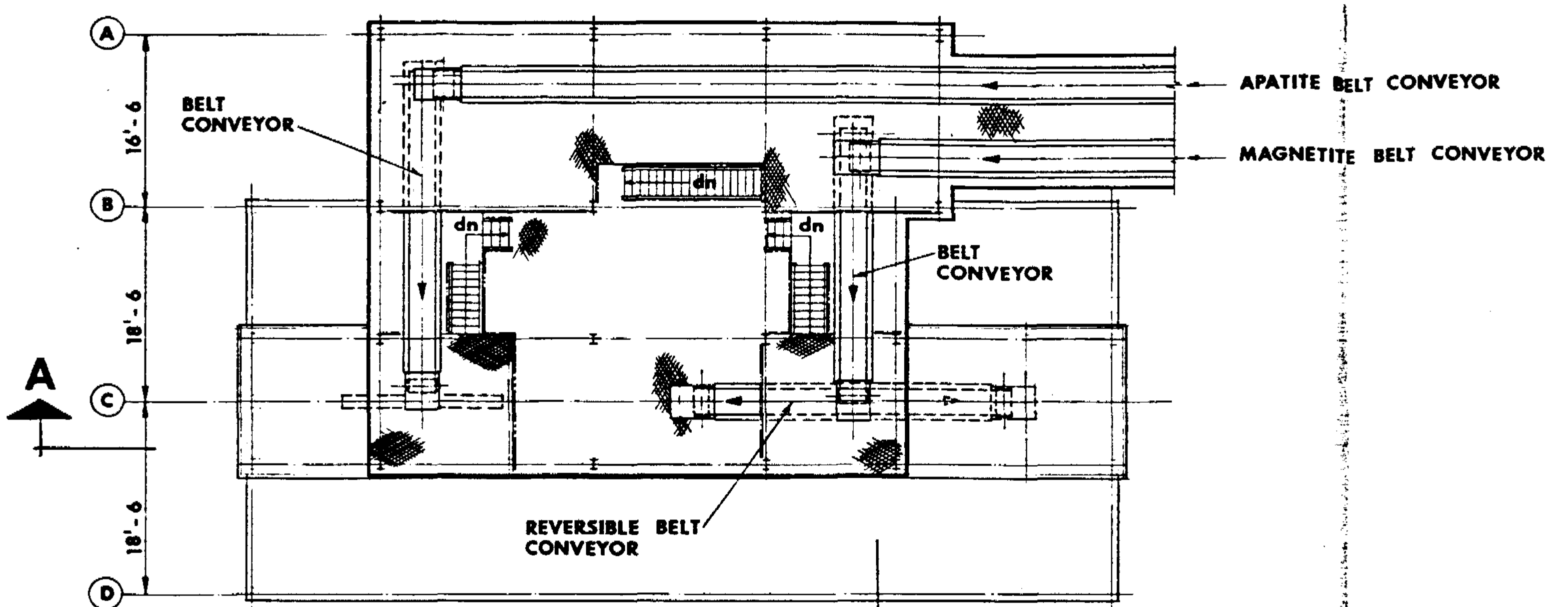
CLIENT: MERTEC RESOURCE DEVELOPMENT LIMITED
Sudbury Ontario

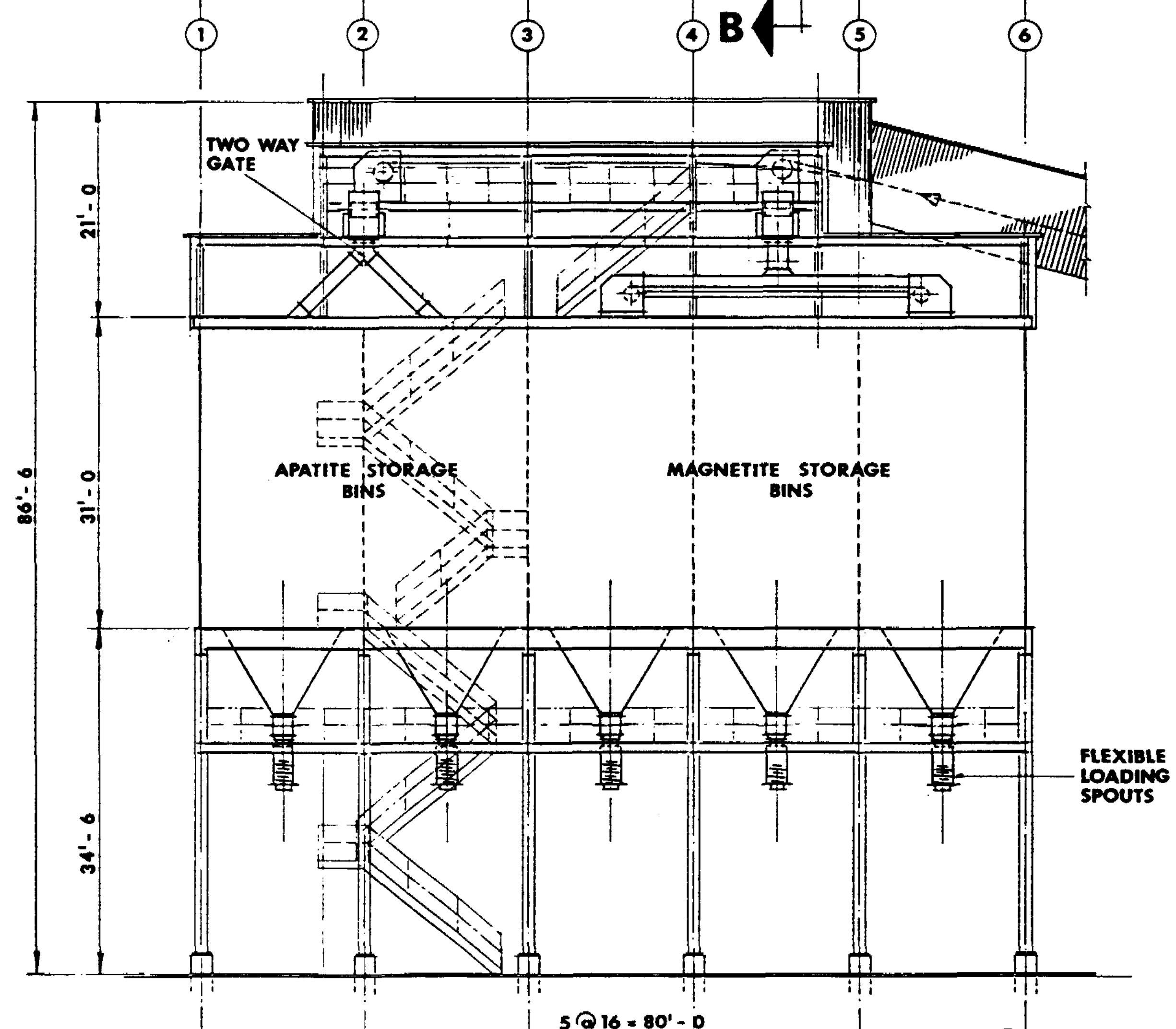
PROJECT: RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

DRAWING: DRYING and BRIQUETTING BLDG. GENERAL ARRANGEMENT

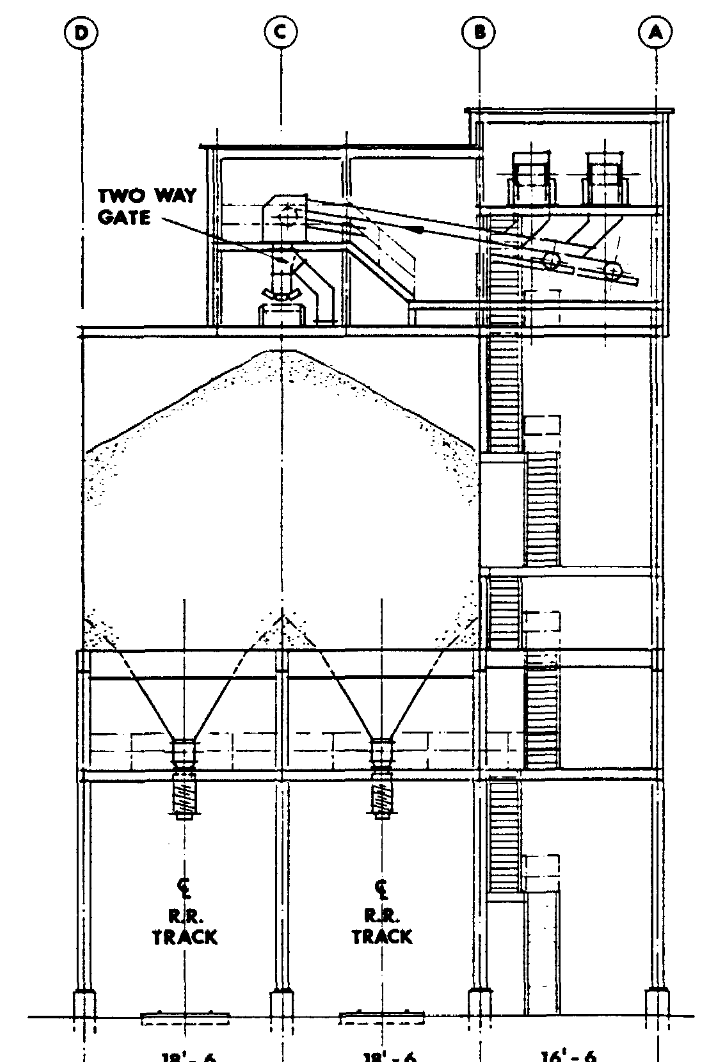
DRAWING NUMBER: 5699-209

REV. P





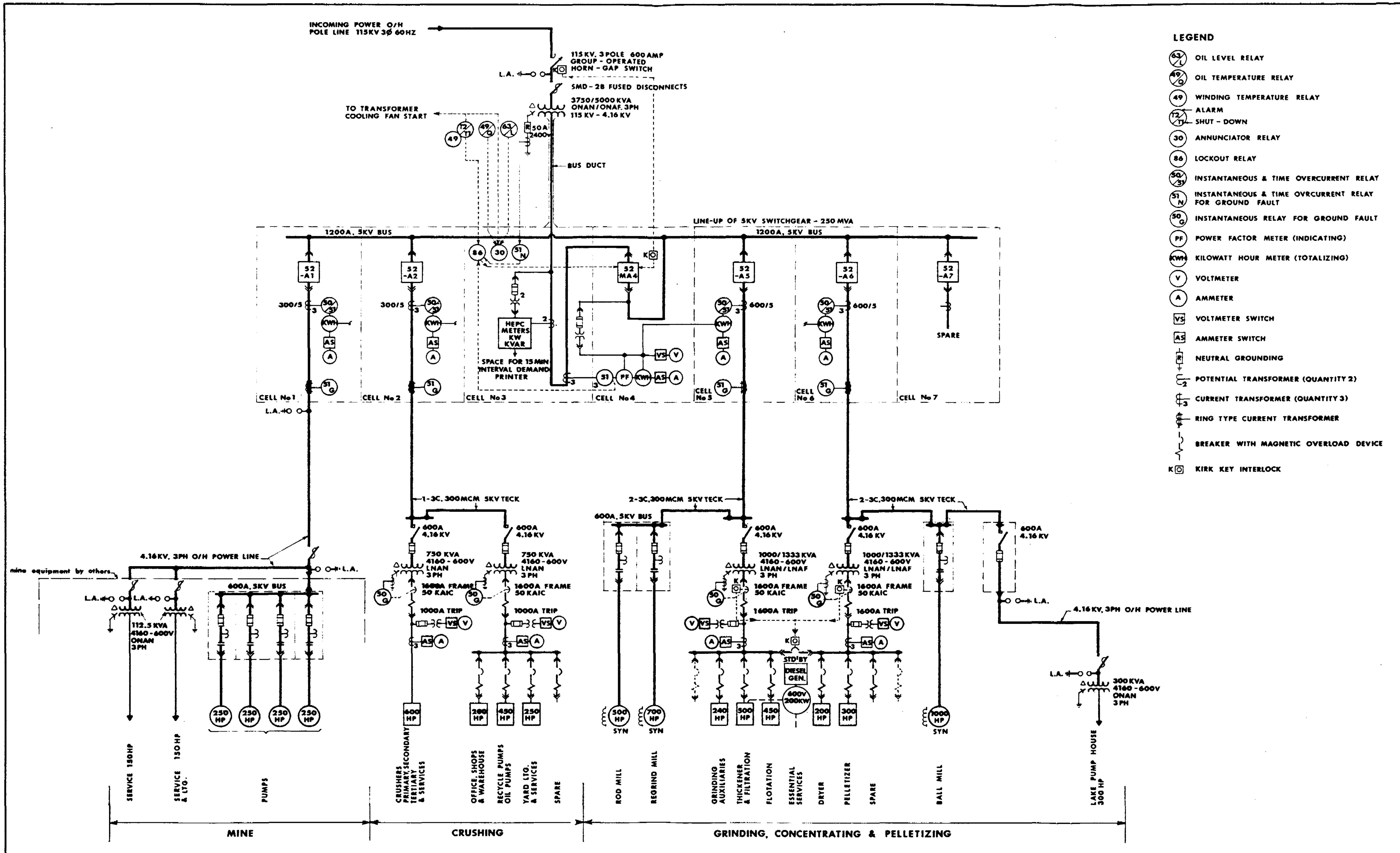
SECTION A-A



SECTION B-B

Scrivener Engineering	
DRAWN	D Bates
SCALE	1/8" = 1'-0
DATE	NOV 74
CHECKED	
APPROVED	
APPROVED	
CLIENT	MERTEC RESOURCE DEVELOPMENT LIMITED, Sudbury Ontario
PROJECT	RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES
DRAWING	LOADOUT BUILDING
DRAWING NUMBER	5699-210
REV.	P

REFERENCE DWG. NO	DESCRIPTION	REFERENCE DWG. NO	DESCRIPTION	REVISIONS NO	BY	DATE	DESCRIPTION	REVISIONS NO	BY	DATE	DESCRIPTION	REVISIONS NO	BY	DATE	DESCRIPTION



REFERENCE	DWG. NO.	DESCRIPTION	REVISIONS	NO	BY	DATE	DESCRIPTION

Scrivener ENGINEERING

DRAWN	M. SURDOL
SCALE	NONE
DATE	NOV 74
CHECKED	
APPROVED	
APPROVED	

CLIENT: MERTEC RESOURCE DEVELOPMENT LIMITED
Sudbury Ontario

PROJECT: RECOVERY and TREATMENT of MAGNETITE - APATITE CONCENTRATES

DRAWING: SINGLE LINE DIAGRAM

DRAWING NUMBER: 5699 · 700

REV. P

APPENDIX F

Mining Contract Agreement

MacIsaac Mining and Tunnelling Company Ltd.

MINING CONTRACTORS

SHAFT SINKING OUR SPECIALTY

SUDBURY ONTARIO

TELEPHONE

November 7, 1974

Scrivener Engineering,
1235 Bay Street,
Toronto, Ontario M5R 1A5

Attn: Mr. Jerry Loach
Executive Vice President

Dear Sir:

This is the cost estimate for the mining property near Nemegos, Ontario as described by Mr. Peter Cosgrove of Pioneer Construction and Mr. George Eaton.

The estimated present day cost to mine the orebody is $5.74 per ton. This would be done by blasthole mining with trackless diesel equipment at a rate of 1500 tons per day. A ramp driven from surface to approximately 350 feet below surface would serve as the haulage drift and access to the orebody. All ore would be delivered to the primary crusher within a reasonable distance from the ramp portal. Mine production of 1500 tons per day would start eighteen months following the start of development.

The limited amount of time available to prepare this estimate and the fact that we were unable to observe the site, forces us to state that the quoted price is not firm and is only an estimate.

Yours very truly,

MacIsaac Mining & Tunnelling Co. Ltd.

J.C. MacIsaac

J.C. MacIsaac,
President.

JCMac/LL

MacIsaac
Mining and Tunnelling Company Ltd.
MINING CONTRACTORS
SHAFT SINKING OUR SPECIALTY

SUDBURY
ONTARIO

TELEPHONE
522-1430

2070 Old Burwash Road

November 15, 1974

Mr. G. O. Loach,
Executive Vice President,
Scrivener Engineering,
1235 Bay Street,
Toronto, Ontario.
M5R 1A5

Dear Sir:

Re: Proposed Mining Method of the No. 6
Anomaly of the Mining Property Near Nemegos

The ore body out crops on surface, is partially overlaid by swamp, is approximatly 700 feet long, 140 feet wide and dips almost vertically on a north-easterly trend. Diamond drilling has delineated the ore body to a depth greater than 350 feet.

Ore reserves, calculated from 50 scale sections, are in the order of 4.3 million tons of magnetite and apatite ore. This compares favorably with the figure obtained from Mr. Ray Bouclin and Mr. Peter Cosgrove of Pioneer Construction Co. Ltd. With a dilution factor of 5% and near total recovery, 4.5 million tons could be realized.

Blast hole mining in two lifts would be employed, with a surface crown pillar to maintain workable conditions. A ramp, suitable for trackless diesel equipment, would be driven to gain access to the ore body and would serve as the haulage drift. The ramp would be driven at minus 16% to 20%, to the first level 200 feet below surface, where level development would begin. The ramp would continue down to the second level 350 feet below surface. These two levels would be the main or extraction levels. Extraction drifts and boxholes driven in the ore on these two levels would be used for ore recovery. Above the boxholes the ore body would be silled out to provide an opening for the long hole rings. Two sub levels driven at appropriate intervals above the main first level would each have two drill drifts from where all the long hole drilling would be done. A slot raise 150 feet long would be the initial opening into which a slot, the full width of the

(Continued)

ore body, would be blasted. Mining would then retreat along the strike of the ore body with blasting being done from the drill drifts in the two sub levels. Scooptrams, mucking the draw points, would load into teletrams hauling up the ramp to surface. The second lift would be mined similar to the first but with only one sub level required, as drilling could be done from the first level. The first level boxhole pillars would be recovered at the same time as the second lift is mined. The crown pillar would be recovered upon completion of the second lift providing there are no plans for continued mining. Surface stipping of the crown pillar area would be required before the crown pillar is blasted down. The second level boxhole pillars would then be recovered.

The usual mining services would be required. A compressor installation would be set up, as would a mine drainage and pumping system. A suitable location for mine water would be required. Hydro electric power and fresh water would be furnished by the company. Fresh air would be forced into the mine via a fresh air raise, through the workings, and exhausted up the ramp. Ventilating air would be heated in winter with electricity furnished by the company.

A complete surface shop would be set up to service the diesel and drilling equipment. In addition, a changehouse, office, and warehouse should be sufficient for the mining contractor's needs.

The No. 3 and 4 anomaly is similar to the No. 6 anomaly in that it is apatite and magnetite ore with a near vertical dip. It is overlaid by 20 to 40 feet of overburden and is situated 3000 feet southeast of the No. 6 anomaly. Preliminary investigation of 200 scale sections reveals in excess of 7 million tons to a depth of 350 feet and an additional 20 million tons in the 650 foot interval down to 1000 feet below surface. This anomaly could be mined in similar fashion to the No. 6 anomaly to a depth of 350 feet. Further study is required to determine an optimum mining method for the deeper 20 million tons.

The proposed mining method could be changed as deemed necessary with the introduction of new information or a change in existing conditions.

Yours very truly,

MacIsaac Mining & Tunnelling Co. Ltd.

J. C. MacIsaac,
President.

JCMac/EA

APPENDIX G

Canadian Pacific Railway Spur Quote

CP Rail

Market Development
Room 1106, Canadian Pacific Building
69 Yonge Street, Toronto, Ontario M5E 1K3
Telex 06-217843

File: C.350

October 2, 1974

Mr. Gerald O. Loach,
Executive Vice-President,
Scrivner Engineering Ltd.,
1235 Bay Street,
Toronto,Ont.
M5R 1A5

Dear Mr. Loach:

This will confirm our meeting of September 30 relative to the development of the Multi Minerals property at Nemegos, Ont.

In relation to trackage installation to connect the No. 6 ore body with our main line at Nemegos, the following is our preliminary estimate of the expense items involved which amount would be paid by the proponent (cost of survey not included):

Clearing 50 acres @ $350/acre	$ 17,500
Grubbing 30 acres @ 450/acre	13,500
Earthwork 6.4 mi. @ 40,000 cu.yd./mile	
@ $2.00 cu.yd.	512,000
Pile Trestle and Span	15,000
Track Laying and Ballasting	285,000
Drainage	25,000
	$868,000
Supervision and Contingencies	87,000
	$955,000

In addition, the proponent would be required to pay an annual rental of $24,220 on the capital material, i.e. rails, fastening, ties, which would remain the property of CP Rail.

The above quotation is on a "unit" basis and assumes that the level of rates applicable on all of the shipments from the mine will justify the necessary capital investment by CP Rail. Should the principal desire to purchase the siding outright, the present market price for the capital material is $591,000.00. In this case, either the railway

... 2

or an appropriate firm operating under railway supervision can be contracted to perform the installation.

All the preceeding amounts are based on 1974 cost factors and are subject to change commencing with 1975, depending on conditions prevailing at the time.

Concerning the rates, I am not yet able to provide you with those applying on the phosphate from Nemegos to Beloeil and Valleyfield, Que. but expect to have these in the near future.

On the iron ore from Nemegos to a CP siding in Sudbury, however, we are prepared to quote a rate of $3.93 per net ton, minimum 100 tons per car and 10 cars per shipment, assuming availability of 100-ton capacity covered hopper cars at commencement of operations. The above rate will remain valid until the end of 1974, but will be subject to change in 1975.

A definite schedule for handling the traffic involved is not available at this time, but, tentatively, we would expect to move 10 carloads daily from Nemegos to Sudbury with turnaround expected to take about five days.

As indicated during our meeting, CP Rail would expect to enter into a formal agreement with the principals which would require minimum annual volumes for a certain number of years and an appropriate short-fall payment in the event the tonnage requirements were not met in any given year. The agreement would also include a system description, all of the obligations of both parties and a force majeure clause temporarily excusing either party from its obligations under acts of God, strikes, etc.

I trust I have provided you with sufficient information to enable you to continue with your study and will contact you again as soon as the rates to Beloeil and Valleyfield are available. Meanwhile, if you require anything further, please feel free to call.

Yours very truly,

Frank DeCarlo

Frank DeCarlo,
Industrial Development Representative
ved

APPENDIX H

Ontario Hydro Electric Power Commission Line Quote

COPY FOR: Scrivener Engineering
Attn: Mr. G.O.Loach

ONTARIO HYDRO ELECTRIC POWER COMMISSION

November 5, 1974

Mertec Resource Development Ltd.
Attn: Mr. P. Crossgrove, President
Box 2248, Station A
SUDBURY, Ontario

Dear Sirs: Re: Electric Power Supply to Nemegos Property

We have been advised by our Planning Department that the Estimated Cost to construct 16.7 miles of 115 KV 1-CCT wood pole transmission line from a junction near Chapleau D.S. to Mertec Resource Development via the most practical direct route, and to install one 138 KV airbreak switch in the new line near the junction at Chapleau D.S. would be $773,000.00.

This estimate is based on the most practical direct line route. If Ontario Hydro were to build the line other routes will have to be considered, with the final route selection dependent on the outcome of the public participation process.

The shortest practical schedule for Ontario Hydro to do the work would provide for an October 1976 in-service date. This schedule would require a decision to proceed by December 1, 1974. If problems with property acquisition or Ministry of the Environment are encountered then a longer period would be required.

It is recommended therefore that if Mertec is interested in an earlier in-service date, you consider obtaining all the necessary approvals and have the line, as specified by Ontario Hydro, built by a contractor.

The total cost of this line will be the responsibility of Mertec Resource Development at the outset. Compensation in the form of a refund of 25% of annual revenue received will be made during the sixth to tenth contract years, up to a maximum of the original capital cost of the line.

When further data is available on the total connected load, the load factor, and the hous use per month, an estimate of the compensation will be provided for you.

I trust this information will be of assistance in your plans and will be pleased to discuss the matter further at any time.

Yours truly,

J. Slatter

J.D. Slatter
Consumer Service Supervisor
Northeastern Region

cc Scrivener Engineering
Attn: Mr. G.O. Loach
1235 Bay St.
Toronto, Ontario
M5R 1A5

APPENDIX I

Construction Schedule