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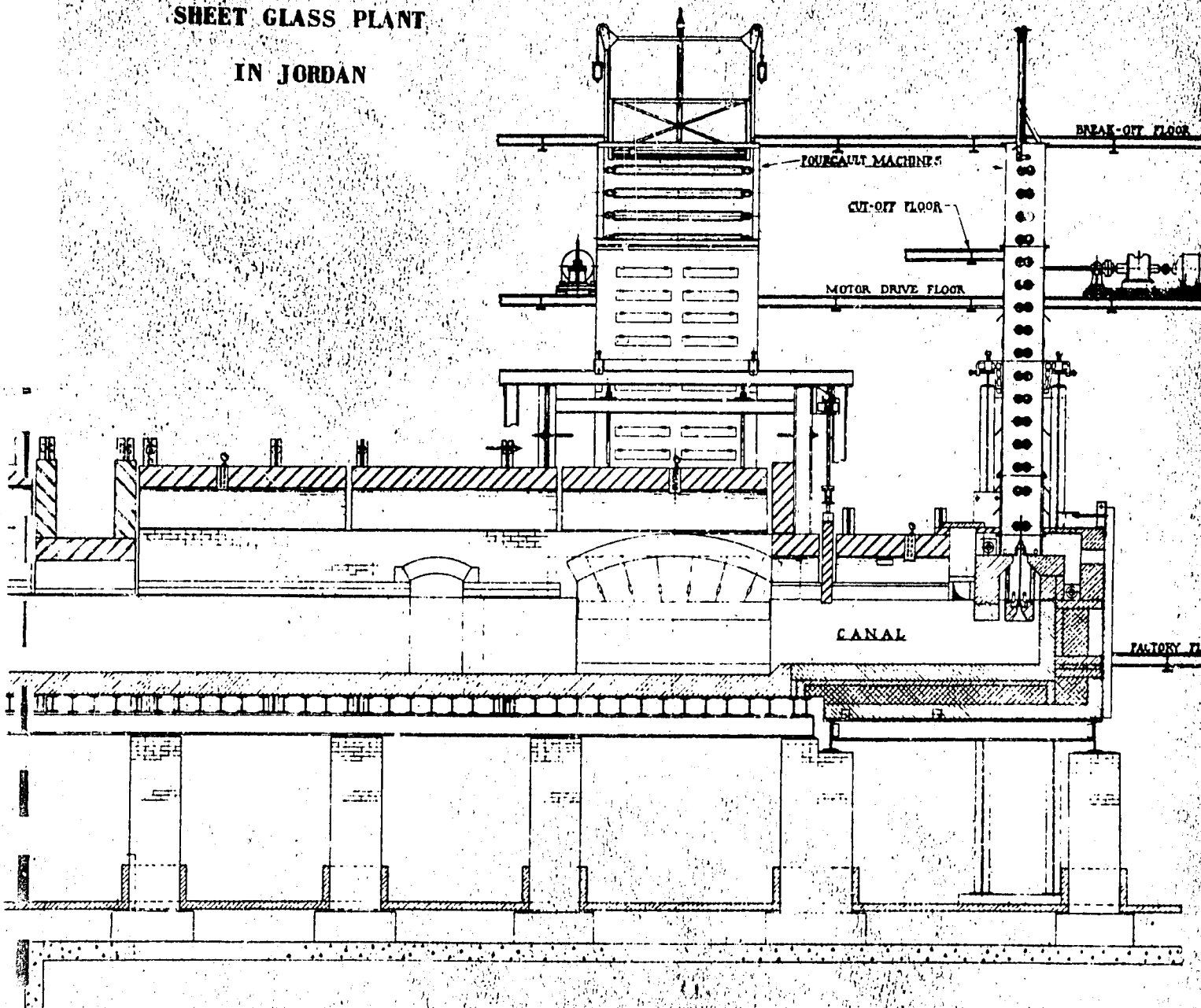

FOURCAULT SHEET GLASS FURNACE

Swindell-Dressler Company
A Division of Pullman Incorporated
441 Smithfield Street
Pittsburgh, Pa. 15222
U.S.A.

MAY 1973

DRAFT

REPORT OF

FINAL FEASIBILITY STUDY

for a

S H E E T G L A S S P L A N T

IN JORDAN

Submitted to

THE HASHEMITE KINGDOM OF JORDAN

Represented by

THE NATIONAL PLANNING COUNCIL

May 1973

Swindell-Dressler Company
A Division of Pullman Incorporated
441 Smithfield Street
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U. S. A.

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The Contractor's personnel who have been involved in this study deeply appreciate the cooperation received throughout the progress of the work. Their gratitude goes specifically to the officials and other personnel of The Ministry of National Economy; The National Planning Council; The Jordan Centre for Industrial Development; The Natural Resources Authority; The Jordan Housing Corporation; The Department of Statistics; The Jordan Office for Geological and Engineering Services; and US - AID in Amman, Jordan, and Washington, D.C.

Recognition is also due the many industrial and business enterprises whose personnel were so helpful in surveys involving marketing research and supplying of operating data for existing facilities. Individual mention should go to a wide range of people in all of the groups but space will not permit the listing of such a large number of names. The Contractor does, however, wish to thank the Committee of The National Planning Council as a body and as individuals for their devoted service in supplying information, guidance, and criticism at all stages of the work.

The members of the Contractor's field staff are pleased to add that they found most Jordanians very receptive to the possibility of producing sheet glass and also found all who were contacted to have a sense of urgency to accelerate the general development of the Kingdom.

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ABBREVIATIONS

MNE	The Ministry of National Economy
NRA	The Natural Resources Authority
MRD	The Mineral Resources Division (of NRA)
NPC	The National Planning Council (formerly The Jordan Development Board)
JCID	The Jordan Centre for Industrial Development
JHC	The Jordan Housing Corporation
JSA	The Jordanian Standards Association
SDC	The Swindell-Dressler Company
UNIDO	United Nation Industrial Development Organization
JD	Jordanian Dinar
USA	United States of America
ASTM	American Society For Testing and Materials
GOJ	Government of Jordan
IDB	Industrial Development Bank
mt	metric ton

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I. SUMMARY

Reviews of previous investigations augumented by the Contractor's Prefeasibility Study, pages E-5 to E-12 in the Phase I Report dated August 1972, substantiate that there is a requirement for a sheet glass manufacturing facility in Jordan.

Two of the major components of glass, silica sand and limestone, are available in practically unlimited quantities in Jordan. The sand has very good properties, and the limestone is of sufficient quality to make a good sheet glass. Jordanian feldspathic ores are being investigated, and preliminary work indicates that this material, after beneficiation, will also be satisfactory for sheet glass.

The establishment of a sheet glass plant to manufacture 6000 mt per year with the capacity to increase production in the future as the market demands is economically feasible, and will return an estimated 14.5% to 15.9% on an investment of approximately JD 905,844. The financial study was based upon estimated sales and manufacturing costs over the first six years of operation.

The size of the manufacturing unit is based on a current market survey with Jordan consuming 54% of the total output and 46% being exported to Arab countries that do not produce sheet glass at present. These projected percentages apply to the year 1976.

II. INTRODUCTION

The National Planning Council was established by provisional law No. 68 of November 25th, 1971, to replace the Jordan Development Board. According to this law, NPC is responsible for the preparation and formation of long and short-term comprehensive well integrated plans and cooperates with Budget Department in setting up priorities among the selected development projects for implementation in the GOJ budget. The NPC is responsible for manpower planning, follow-up and implementation of development projects, obtaining loans for financing the execution of projects, and the creation of planning cells in the various ministries.

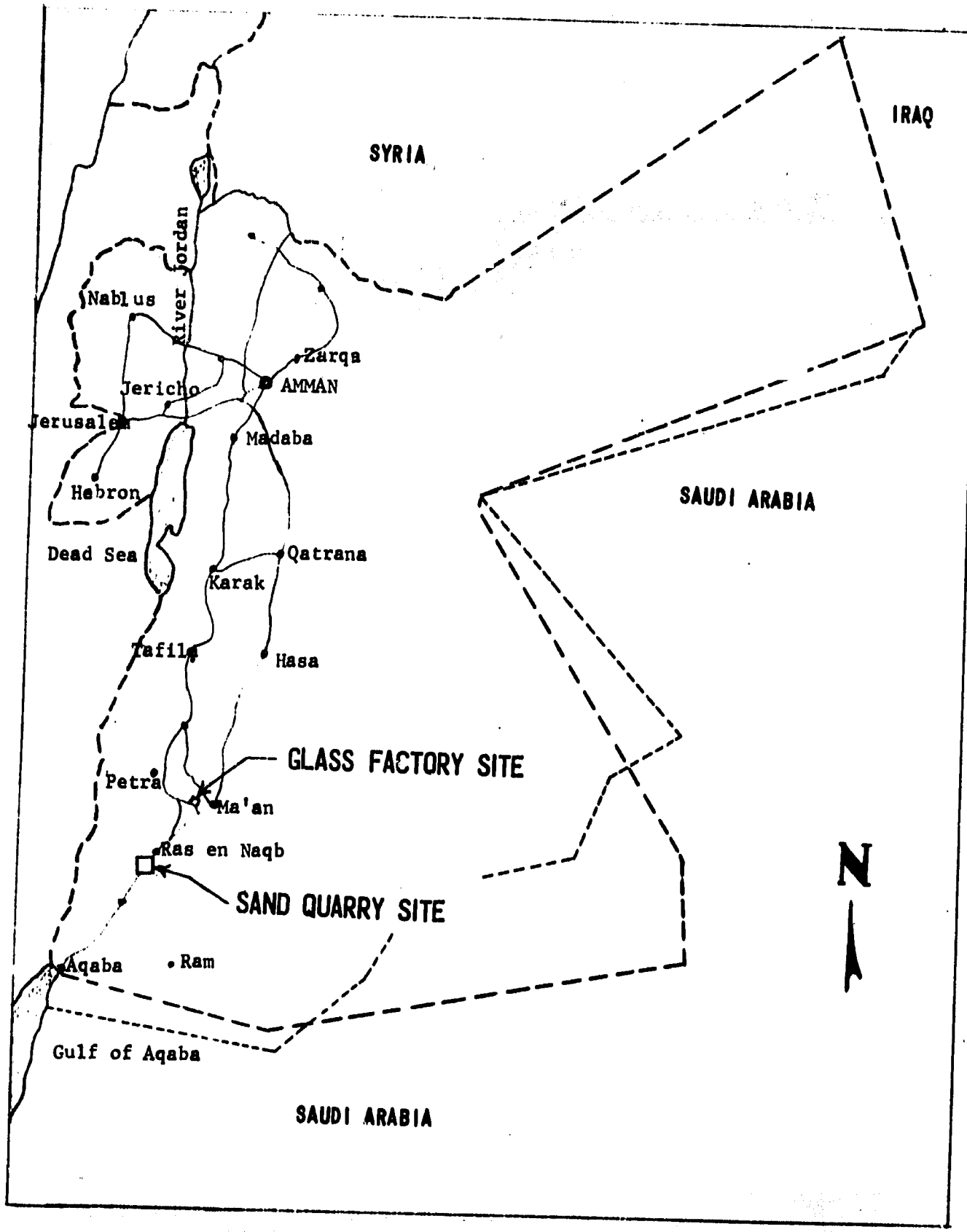
Pursuant to this responsibility, the National Planning Council contracted with the Swindell-Dressler Company of Pittsburgh, Pennsylvania, U.S.A., a Division of Pullman Incorporated, hereinafter termed the "Contractor," to conduct a study of the feasibility of producing specified glass products in Jordan, for both national consumption and for export. Swindell-Dressler subcontracted with the Agri Division of Dunlap and Associates, Inc., Manhattan, Kansas, U.S.A., for assistance on the marketing and pricing aspects of this project.

After the submission of the Phase I report, the Contractor was requested to conduct a final feasibility study for the manufacture of sheet glass to be based on the Contractor's Phase I study and subsequent research and engineering.

The appendix contains a review of the report "Glass Sand of Ras En Naqb" by Y. F. Nimry and M. S. Haddadin, and other information which was used either directly or indirectly in the preparation of this report.

The water well location and capacity information was furnished to the Contractor by the Water Resources Division of N.R.A.

FIGURE II-1



THE HASHEMITE KINGDOM OF JORDAN

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III. MARKET STUDY

The Contractor's Marketing Research Report, Phase I, along with the selected tables which follow, presents the source data upon which the production tonnages for sheet glass were established.

The combination of national plus export markets results in a projected demand adequate to support the development of a sheet glass manufacturing enterprise in Jordan. The market study covered a period of ten years.

Sheet glass is used primarily for windows in both residential and commercial buildings. The demand for sheet glass is, therefore, primarily related to the volume of building construction, but is also influenced by revisions in construction specifications with relation to changes in the amount of glass used per unit of building.

The requirements for sheet glass to be produced by a plant in Jordan will arise from demand generated by the Jordanian construction industry, plus the possibility of exporting sheet glass from Jordan to other Arab countries.

In 1972 sheet glass manufacturing plants supplying glass to Jordan were located in Lebanon, Syria, Iraq, Egypt, and other nations in Europe and the Orient.

Table III-1 entitled "Forecasted Consumption and Market Share for Jordanian Production of Sheet Glass in Selected Arab Countries" appears on Page III-2. This table was used to size the proposed production at the start of operations and for the future glass manufacturing potential. It is to be noted that Arab countries now producing sheet glass are not considered as potential customers for Jordan.

Market research by the Contractor disclosed that imports of sheet glass into Jordan have increased steadily over the past ten years from 1,633 mt in 1961 to 3,095 mt in 1970, a gain of 90 percent. Reference to Table III-2 on Page III-3 shows that Jordanian consumption is projected to exceed 3,500 mt by 1980.

Table III-1 Forecasted consumption and market share for Jordanian production of sheet glass in selected Arab countries

	Year						
	1974	1975	1976	1977	1978	1979	1980
Jordan							
Total consumption mt	3,220	3,340	3,460	3,580	3,700	3,830	3,960
Market share Pct.	90	90	90	90	90	90	90
Market share mt	2,900	3,010	3,110	3,220	3,330	3,450	3,560
Kuwait							
Total consumption mt	6,000	6,300	6,600	6,900	7,200	7,500	7,810
Market share Pct.	6	12	20	20	20	20	20
Market share mt	360	760	1,320	1,380	1,440	1,500	1,560
Saudi Arabia							
Total consumption mt	4,310	4,680	5,070	5,470	5,890	6,320	6,780
Market share Pct.	10	25	30	30	30	30	30
Market share mt	430	1,170	1,520	1,640	1,760	1,900	2,030
Gulf States							
Total consumption mt	2,630	2,970	3,330	3,710	4,110	4,540	5,010
Market share Pct.	6	12	15	15	15	15	15
Market share mt	160	360	500	560	620	680	750
Sudan							
Total consumption mt	1,600	1,650	1,700	1,740	1,790	1,830	1,880
Market share Pct.	6	12	20	20	20	20	20
Market share mt	100	200	340	350	360	370	380
Total							
Total consumption mt	17,760	18,940	20,160	21,400	22,690	24,020	25,440
Market share Pct.	22.2	29.0	33.7	33.4	33.1	32.9	32.5
Market share mt	3,950	5,500	6,790	7,150	7,510	7,900	8,280

Note: Iraq, Lebanon, Syria and Egypt are not considered as potential markets for Jordanian Sheet Glass production.

Table III-1 is based on the assumption that the Jordanian sheet glass plant will supply 90 percent of Jordan's total demand for sheet glass. Jordan's share of the export market in 1974 is projected to vary from 6 percent in Kuwait, Gulf States, and Sudan to 10 percent in Saudi Arabia, increasing by 1980 to 15 percent of consumption in the Gulf States, 20 percent in Kuwait and Sudan and 30 percent in Saudi Arabia. Jordan's overall market share of the sheet glass imports into Kuwait, Gulf States, Saudi Arabia, and Sudan is expected to increase from 7.2 percent in 1974 to 22.0 percent in 1980.

Reference to Table III-2 below shows the projected demand in tons per year together with the percentage distribution between the domestic and export markets.

TABLE III-2

PROJECTED DEMAND FOR JORDANIAN SHEET GLASS

Year	Jordan		Export		Total - Mt.
	Mt.	% of Total	Mt.	% of Total	
1974	2900	73.4	1050	26.6	3950
1975	3010	54.7	2490	45.3	5500
1976	3110	45.8	3680	54.2	6790
1977	3220	45.0	3930	55.0	7150
1978	3330	44.3	4180	55.7	7510
1979	3450	43.7	4450	56.3	7900
1980	3560	43.0	4720	57.0	8280

In the marketing research study conducted in 1971 and described in a report dated February 1972 (Page V-26) the price set per metric ton for the sale of glass in Jordan was JD 52.000.

The price in early 1973 of Lebanese glass delivered to Amman was JD 68.000 per ton. To equalize the selling price in Amman the cost of freight from the proposed factory site near Maan in the amount of JD 2.400 must be deducted. Therefore it is estimated that the fair selling price for Jordanian sheet glass in Amman would be JD 65.600 per mt.

It will also be noted on page V-26 of the 1972 report that the selling price varies from country to country. Listed below are the prices from the 1971 market study and the estimated 1973 prices for the various countries:

	1971 JD/Ton	1973 JD/Ton
Jordan	52.00	65.60
Kuwait	57.00	71.82
Saudi Arabia	37.00	46.62
Gulf States	52.00	65.60
Sudan	40.00	50.40

IV. RAW MATERIALS

Glass can be produced from a wide variety of compositions, but the commercial glasses of today are confined to a relatively small group. The sheet glass manufacturer in determining his batch formula must consider the basic cost of his raw material, the ease of melting and refining the material, the resultant viscosity required for drawing the sheet and avoidance of divitrification.

The raw materials generally used in the manufacture of sheet glass are listed in Chapter VIII - Glass Batch.

A. GENERAL DESCRIPTION

The following materials are the ones most commonly used in sheet glass batches.

1. Sand

Silica, silicon dioxide (SiO_2) is the principal glass-forming oxide and is readily available in the area of Ras En Naqb.

2. Soda Ash

Sodium carbonate (Na_2CO_3) is the most common source of soda in a glass batch. Soda ash is a powerful flux as is demonstrated in the manufacture of silicate of soda (water glass) that is a combination of silica and soda fused together into a soluble glass. Soda ash lowers the melting point of silica.

3. Dolomite

Raw dolomitic limestone ($CaO.MgO.2CO_3$) is one of the stabilizing oxides in the batch formula. It decreases the melting rate, lengthens the working range and decreases the possibility of divitrification in the furnace. Dolomite is available in the Tafila area.

4. Limestone

Calcium carbonate ($CaCO_3$) is also a glass stabilizing oxide, but

4. Limestone (Continued)

increases the melting rate with silica at lower temperatures. The advantages of using limestone are low cost of the raw material and uniformity of composition. It is available in the area of Ras En Naqb.

5. Feldspar

Feldspar ($R_2O.Al_2O_3.6SiO_2$) is one of the more important sources of alumina and its reaction is that of a glass stabilizer and usually melts between 1000° & 1200° C. It lengthens the viscosity range for annealing while it decreases the possibility of divitrification and increases glass durability. Feldspathic ore is available in the vicinity of Aqaba and preliminary tests indicate that after beneficiation, this material will be satisfactory for the manufacture of glass.

6. Salt Cake

Sodium Sulfate (Na_2SO_4) -- The principal use of the sulfate in the batch is for its effect in preventing silica scum that sometimes floats on the glass bath. It is also a source of soda as it yields about 43% Na_2O.

7. Charcoal

Charcoal is used in sheet glass batches to reduce the sulfate of salt cake to sulfite, which more readily reacts with silica.

8. Arsenic

Arsenous oxide (As_2O_3) is added to a glass batch as a gasifier to remove small blisters from the melt by forming larger bubbles which rise to the glass surface carrying the smaller bubbles or seeds to the surface. It also acts as a decolorizer.

V. DESCRIPTION OF PHYSICAL PLANT

It is proposed that the sheet glass manufacturing plant be located on the road from the Desert Highway to Petra, approximately 18 km southwest of Ma'an. The total land area to be fenced will be 120 meters by 240 meters in size. This area of 28,800 square meters will include all of the buildings, roadways, and raw material provisions for the sheet glass plant.

The total building area will be 5,748 square meters. The main manufacturing building will cover 1,527 square meters and the warehouse 2,852 square meters.

The plant flow pattern is projected so that it will be possible to increase production by a minimum of 50% when the market is available.

The main plant building will be reinforced concrete in its skeletal structure.

The furnace and Fourcault machine areas will have roof ventilators designed to remove the excess heat in these areas. Makeup air will be brought into the building by wall louvers at the operating floor level.

Sufficient space shall be provided for transport of materials in and out of the plant site along with parking facilities for employees and visitors.

The general appearance of the buildings and surrounding landscape shall be pleasing to the eye and act as an invitation for tourists on their way to Petra to stop and enjoy a guided tour through a modern glass manufacturing facility.

VI. PLANT SITE

A. GENERAL REQUIREMENTS

The plant site location can greatly influence the success of a glass manufacturing facility. There are many factors to be considered in plant site selection and the Contractor with the able assistance received from various agencies of the Government of Jordan, as well as from private individuals, investigated a number of sites for the following qualifications:

1. Proximity to Sources of Raw Materials

Since sand constitutes the largest volume of raw material used in the manufacture of glass, it is naturally desirable to locate the plant site as close as practical to the sand quarry without unduly raising the shipping cost of other raw materials.

2. Proximity to Labor Supply

Sheet glass manufacture is a twenty-four hour operation requiring three eight-hour shifts per day; therefore, access to and from the selected site should not present any undue travel difficulties for the employees. The area should also have an adequate supply of dependable labor.

3. Proximity to Market

In selecting the plant site, the location of the potential market areas must also be considered.

4. Access to Site by Good Highway

Access to a main highway is essential because all of the raw materials will be delivered to the plant by motor truck, and shipping of the finished product will also be by motor trucks. Sheet glass by its nature is a fragile

A. GENERAL REQUIREMENTS - Continued

4. Access to Site by Good Highway

material and must be securely packed and braced in motor truck transport. As the bracing in the customer's motor truck will be their responsibility, a smooth highway is of considerable importance to the customers.

5. Electric Power Supply

A commercial power supply is not a positive requirement because a power generating station should be supplied as a part of the complete project. One of the main reasons is to assure continuous supply under the factory's direct control. Power interruption is very detrimental to sheet glass production.

6. Water Supply

A sufficient supply of water is a definite requirement for use in the shoet glass manufacturing process because an uninterrupted supply is needed to help assure proper cooling of the glass during drawing.

7. Available Land

The use of Government-owned lands may in some cases reduce the capital cost of the plant and promote good land usage; however, in some cases, the location and topography may cause the purchase of privately-owned land to be more economical in the long run. Available lands should provide space for a possible future town site and for additional glass manufacturing facilities.

8. Topography

The plant site should be generally level to reduce building construction costs, simplify material flow through plant, and make for easier transportation

A. GENERAL REQUIREMENTS - Continued

8. Topography- Continued

of raw materials and finished product.

9. Proper Drainage

The terrain should have natural drainage to assure that storm water from a flash flood would not enter any underground flues to the regenerator or the stack.

10. Soil with Good Load-Bearing Capacity

The general factory area should have a load-bearing capacity of 20,000 kg/m^2 especially in the furnace area because of the heavy weight of a furnace full of molten glass and the necessity of preventing differential settlement.

11. Favorable Prevailing Winds

A generally level area normally has light winds from various directions. These conditions are favorable for the maintenance of uniform furnace temperatures and cooler working conditions.

12. Pollution Tolerance

The site under consideration should be viewed with all of the plant operations in mind in order to appraise their effect upon the ecology of the area.

13. Esthetic Effect on Surroundings

The site under consideration should be evaluated from the standpoint of the effect that the proposed plant will have upon the residents, and upon the beauty of the general surroundings.

B. QUALIFICATIONS OF THE SELECTED SITE

Six (6) different sites in various parts of Jordan were visited and inspected by personnel from N.P.C., N.R.A., and the Contractor. A review of the site investigation will be found in the Appendix on Page A-1.

The site selected is in the Jafr Basin, approximately 18 km southwest of the city of Ma'an, at map coordinates E204.620-N950.970. It generally meets the site requirements outlined above because of:

1. Proximity to Sources of Raw Materials

The sand deposit at Ras en Naqb where the sand will be quarried is estimated to be only 24 km south of the site, and the proposed plant location is reasonably convenient to the sources of other raw materials.

2. Proximity to Labor Supply

A good supply of labor is available in the area of Ma'an, and it is believed that the city of Ma'an will provide bus transportation for the employees.

3. Proximity to Market

The principal domestic consumption of sheet glass will be in Amman and Aqaba with minor consumption between these two cities. The selected plant site is approximately 240 km south of Amman and 100 km north of Aqaba. The port of Aqaba is expected to continue its present growth rate thereby increasing its consumption of glass. Export shipments to Saudia Arabia and the Gulf states will also be expedited by locating the plant at the proposed site.

4. Access to Site by Good Highway

The site is on the principal highway leading from the desert highway to Petra and is only two km from the desert highway.

5. Electric Power Supply

Electric power will be generated at the plant site.

6. Water Supply

The water requirements are estimated at approximately 5 cu m/hour for personal use and machine cooling. The water used in the machines will be cooled and recirculated.

Well No. S (40) with a capacity of 50 cu M/hour is at the proposed plant site and will be the principal source of water. A second well, which is known as S (61A), is 402 M directly north of the site, has a capacity of 111 cu M/hr., and will serve as a standby source of water.

There are two other wells available within a reasonable distance which have a combined capacity of 280 cu. M/hour.

7. Available Land

The land is Government owned, is not presently being used, and is generally in a favorable location.

8. Topography

The site is practically level with slopes varying from zero to two percent.

9. Proper Drainage

There is a small wadi on the plant site that will provide drainage for storm water.

10. Soil with Good Load-Bearing Capacity

The drilling log of the four nearby wells indicates that the soil has a sufficient load-bearing capacity of approximately 20,000 kg/m^2.

11. Favorable Prevailing Winds

From the topography, it can be assumed that the site is in a generally calm area and is not subject to severe windstorms.

12. Pollution Tolerance

The proposed site is not an industrial or populated area. The principal pollution would be visual, and that would be from small amounts of dust caused by handling of raw materials. This can be minimized by proper supervision and good housekeeping. The fuel oil used for furnace firing will cause a small amount of sulphur to be exhausted from the furnace stack, but this can be held to a minimum by proper control of the firing.

13. Esthetic Effect on Surroundings

The proposed site, which is on the highway to Petra, will be observed by many of the foreign tourists and, thereby, demonstrate the progress that Jordan is making industrially. The factory design will be pleasing to the eye and an invitation can be displayed inviting the tourists to stop and observe the manufacture of sheet glass.

VII. DESIGN CRITERIA

The manufacturing equipment for sheet glass will be designed to process 8515 metric tons of raw material per year to produce 5930 metric tons per year of finished sheet glass assuming 320 days of production in an average year. The 45 remaining days will be nonproductive as this is the average time per year allotted to the down time for legal holidays and major furnace repair over a five-year campaign period.

The furnace and equipment design calculations are based on drawing two-mm-thick glass from two 2,180 mm wide Fourcault machines at an average speed of 1,054 lineal mm per minute.

In order to allow for the training of the furnace and machine operators, an initial rate of 1,054 lineal mm per minute is considered a reasonable speed of draw for two mm glass.

It is proposed that the glass be trimmed on the break-off floor to a width of 1,828 mm. The other dimension (height of the glass sheet as drawn) will be one meter, 1.5 meters or two meters depending upon inventory or sales demand. These sheets of glass will be transferred to the warehouse to await shipment to the glass retailers. The plant design is based on the assumption that the retailers will continue to cut window lights from stock sheets. As progress is made in the standardization of window sizes in Jordan, it will probably become necessary to cut and stock many of the standard sizes at the glass plant. Provision will, therefore, be made in the warehouse area for the future addition of cutting stalls.

PRODUCTION CAPACITY, METRIC TONS

	PER DAY	PER WEEK	PER YEAR
	2-8 Hr. Shifts	14-8 Hr. Shifts	640-8 Hr. Shifts
RAW MATERIAL			
Receiving, Weighing & Delivery to Furnace	26.61	186.3	8515*
Cullet to Furnace	8.87	62.1	2838
	35.48	248.4	11353
	3-8 Hr. Shifts	21-8 Hr. Shifts	960-8 Hr. Shifts
Melting & Drawing	31.06	217.4	9939*
Delivery of Finished Glass to Warehouse	18.52**	129.6	5930

* The 8515 mt of crude raw materials suffer an estimated ignition loss of 16.6% and thereby supply only 7101 mt to the melt. The 2838 mt of cullet does not have any ignition loss; therefore, these two figures total 9939 mt of melting and drawing capacity.

** The daily delivery of finished glass to the warehouse in the amount of 18.52 mt takes into consideration the removal of the bulb edge borders and all other production losses, such as machine breakage and routine cleaning of machine pits. It is to be noted that this is not a raw material loss as the borders and machine breakage (glass broken in manufacture) are returned to the furnace as an admix to the batch formula in the form of cullet.

VIII. GLASS BATCH

In order to formulate a glass batch composition, the chemical analyses of all the materials must be known.

After a formula is established, the glass that is produced will not show the same analysis as that of the batch that was introduced into the furnace, due to the gradual melting away of the various refractories that are used in the construction of the furnace. The type of fuel used and the firing conditions can also affect the finished glass composition. To determine batch costs and batch storage requirements along with the proper raw material handling equipment, a typical Fourcault glass batch is listed below:

Raw Material Requirements

The following is based on 75% raw batch and 25% cullet by weight.

Total glass drawn per day = 31.06 mt.

26.61 mt of raw batch will produce 22.19 mt of glass (16.6% fusion loss)
8.87 mt of cullet
31.06 mt of glass drawn

26.61 mt of raw batch and 8.87 mt of cullet will require 34 batches per day @ 1,056 kg each.

Daily Requirements

Material	Kg. per Batch	Batches Per Day	Kg. Per Day
Sand	453.6	34	15,422
Soda Ash	136.9	"	4,655
Raw Dolomite	68.5	"	2,329
Limestone	62.6	"	2,128
Salt Cake	48.1	"	1,636
Feldspar	18.2	"	619
Charcoal	2.15	"	73
Arsenic Oxide	2.04	"	69
Batch	792.09		
Cullet	264.03	"	8,977
Total	1056.12		35,908

Batch Storage Requirements -- Metric Tons - 5930 Tons/Year of Saleable Glass

Material	1 Day	10 Days	30 Days	90 Days
Sand	15.42	154.2	462.6	1387.8
Soda Ash	4.65	46.5	139.5	418.5
Dolomite	2.33	23.3	69.9	209.7
Limestone	2.13	21.3	63.9	191.7
Salt Cake	1.64	16.4	49.2	147.6
Feldspar	0.62	6.2	18.6	55.8
Charcoal	0.073	0.73	2.19	6.57
Arsenic	0.069	0.69	2.07	6.21
Cullet	8.97	89.70	269.10	807.30
	35.902	359.02	1077.06	3231.18

Reserve Bulk Storage (Rounded 90-Day Supply) - 5930 Tons/Year of Saleable Glass

Material	Mt	Mt/M^3	=	M^3 Storage
Sand	1500	1.36		1103
Soda Ash	500	1.01		495
Raw Dolomite	225	1.39		162
Limestone	200	1.52		132
Salt Cake	150	1.36		111
Feldspar	60	1.28		47
Total Bulk Storage				2050

The equipment for raw material storage will be of two types. One a reserve storage area of about three months supply for sand, soda ash, and feldspar which will be a covered paved area located to the rear of the live storage area.

The live storage of 350 metric tons capacity, equaling approximately 10 days of furnace operation, will consist of a reinforced concrete double silo. The material will flow by gravity from the live storage silo to the batch mixer Ten-day live storage will help assure continued furnace operation in case of transportation difficulties or any mechanical failure up to this point.

The raw material handling, weighing, mixing and delivery to the furnace will operate two eight-hour shifts per day. There will be a mixed-batch storage bin over the furnace batch feeders that will hold sufficient mixed batch for eight hours furnace operation.

The remainder of the glass manufacturing operation, including the delivery of finished glass to the warehouse, will work three shifts per day, seven days per week.

Shipping of finished glass will be on one eight-hour shift per day in a normal six-day week.

IX. DESCRIPTION OF PROCESS FLOW & FLOW CHART

The following description of process flow may be followed by reference to drawing numbers 30372-SG-1 & 30372-SG-2 (see appendix) and Operations Flow Chart, Figure IX-1 Page IX-7.

All material will be received at the gate house and directed to the proper place for unloading.

Raw materials for glass manufacturing will be delivered to the bulk storage building shown on Drawing 30372-SG-1 or to the live storage silo (21) shown on Drawing 30372-SG-2. Bulk material will be dumped on the concrete floor to a height of two meters. Bagged material on pallets will be stacked two pallets high or a minimum of two meters high by the use of the fork lift truck.

In the event that material is required in the live storage silo, it will be dumped into the raw material receiving hopper (21A) and delivered by the raw material belt bucket elevator (21B) to the turn head distributor (21E) which will deliver the material to the selected bin in the silo. The distributor will be manually moved to the proper storage bin by the batch plant supervisor who will then start the bucket elevator (21B) and remain there until the bin has been filled and then stop the elevator (21B). If the material is one of the minor ingredients and is required for the live storage area, a pallet or two will be lifted by fork truck to the silo weigh platform (21H) and stored there until used.

The above procedure will be used when one of the live storage silo bin level signals (21F) indicates that more raw material is required, or the batch plant operator visually observes that the minor ingredient supply is running low. Bulk materials will be transported as required by the front end loader (30) from the bulk storage area to the raw material receiving hopper (21A).

Glass cullet (scrap glass crushed to approximately 15 mm size) is one of the major ingredients of glass manufacture and is used as an admix to the batch formula in the amount of from 20% to 50% of the batch weight. The main source of glass for this use is the bulb edge that is removed from the glass sheet as soon as it is taken out of the Fourcault machine on the break-off floor. These edges will be dropped into a cullet box near the "A" frames (32) that store the trimmed sheets on the break-off floor. When the box has been filled, it will be transported to a chute that delivers the glass to a portable hopper on the ground floor. This hopper will be moved via lift truck to the covered cullet storage (33) and dumped. Other glass will be collected from normal machine breakage and pit cleaning and will also be delivered to the cullet storage area (33) adjacent to the glass cullet crusher (21C). The major batch materials in the live storage silo (21) will flow via gravity down pipes to a quadrant gate shut-off (21G) directly above the weigh hopper (21M). The top of the weigh hopper (21M) and quadrant gates (21G) are enclosed in canvas to eliminate dusting.

The batch plant operator weighs (by operating the quadrant gates (21G)) out each of the major materials separately; watching a dial scale (21K) on the weigh platform (21H) for each accumulated weight.

The minor materials are weighed (21L) before they are required in the batch and stored in separate containers or paper bags. On the side of the main weight hopper, there will be a trap door ready to receive the preweighed minor ingredients. The addition of the paper bag to the batch will not contaminate the formula.

Upon the completion of the weighing cycle the total batch weight is printed on a card or tape. If the total weight is correct, the discharge gate of the weigh hopper (21M) can be opened and the material discharged onto the belt conveyor (21N). In the event that the total weight is not correct, the gate to the belt conveyor (21N) will not open and a discharge gate will open to conduct the incorrect batch to a place of disposal.

The belt conveyor (21N) with a magnetic head pulley will deliver the weighed batch to the batch mixer (21M). The magnetic pulley will remove any tramp iron from the batch prior to the batch entering the mixer.

The batch mixer (21M) will operate for a predetermined length of time before the discharge gate automatically opens to discharge the batch to the mixed batch elevator (21P). While the batch mixer (21M) is operating, a measured volume of water will be automatically sprayed on the batch to give the batch a moisture content of 3 to 4%.

Bucket elevator (21P) will discharge to the belt conveyor (22) that will deliver the batch to the mixed batch storage bin (23), which will have a ten-hour storage capacity of raw mixed batch. Dust collecting hoods (34) will be located over the discharge point of Elevator (21P) and the discharge point of Conveyor (22) and both dust collecting hoods (34) will be connected to an air filter bag dust collecting system located on a balcony built into the building truss. Periodically, the filter bags will be shaken to deposit the dust through a fine water spray into a receiving hopper located at ground elevation for easy removal.

There will be two discharge spouts from bin (23); one to each of the two batch chargers (2). The batch chargers (2) will be controlled by the furnace level control.

The Fourcault glass melting furnace (1) is a cross-fired oil-burning regenerative furnace with reversals of flame direction from one side of the furnace to the other on a predetermined time or temperature cycle. The air for combustion will be furnished by the combustion air fan (8) that blows the air into the top of reversing valve (14). The combustion air will then flow through the underground flue to the base of the regenerator. The regenerator is filled with checker brick in an open pattern to allow the air to flow up past the preheated (from previous reversal) checker brick to supply preheated air for combustion. The flame will travel across the furnace, and the exhaust gases will pass out the ports on the other side of the furnace and down through the checker brick heating them for the next reversal. The gases will then travel through the reversing valve (14) and under the stack damper (15). The stack damper automatically maintains the proper furnace pressure. After leaving the damper, the gases will then pass up the venturi stack (16) and will be exhausted to the atmosphere. There are two ejector fans (17) for the venturi stack operation. One of the fans will be a stand-by to assure furnace operation in case of mechanical failure of the other.

The furnace control room and office (3) will be air conditioned to help assure instrument accuracy.

Heavy fuel oil will be stored in one above-ground 50,000 gallon storage tank (28). The heavy oil will be preheated and pumped to the heavy-oil day tank (18) where it will receive further heating to give it the proper viscosity for firing. The oil will be transported from the day tank to the furnace by means of the equipment in the pump house (20). This house also contains a steam boiler to supply the heat for conditioning the oil in both the large storage tank and the day tank.

The oil will then be pumped around the Fourcault furnace (1) and

Debituse kilns (12) to supply fuel for combustion. The oil will be in continuous movement, and that portion that is not used for combustion will be returned to the heavy oil day tank (18). The light oil storage tank (19) is used to supply oil for the initial furnace (1) heatup, the beginning of the heating cycle for the Debituse kilns (12) and periodic heating of the Fourcault pits.

There will be two block cooling fans (7) to furnish air around the melting end of the furnace (1) to extend the life of the refractory tank blocks that contain the glass. As the Fourcault machines (5) draw the glass out of the furnace, the glass will flow through the refining end past the air curtain to properly condition the temperature of the glass before drawing. Control panel (6) will contain the temperature indicating equipment for the Fourcault machine and drawing pits along with the Fourcault machine (5) drive control. The battery stand-by equipment (9) will be used in case of any electric power failure to keep the Fourcault machines operating until power can be restored.

The glass will be formed into a sheet by being drawn through the slot of the refractory debituse block. This forms a small bulb (known as the onion), which supplies a source of molten glass that imparts the fire-polished surface to the glass as it is drawn upward. Coolers are placed on each side of the sheet as it is drawn away from the onion to set the glass in a sufficiently ridged form so that the asbestos-covered drawing rolls of the Fourcault machine do not mark the glass. As the glass travels up the machine, it gradually cools and is annealed by careful control of the temperature gradient through the machine. The temperature is controlled by the adjustment of the air inlet doors on both sides of the machine. As the glass passes the cut-off floor, the borders are continuously cut and a cross

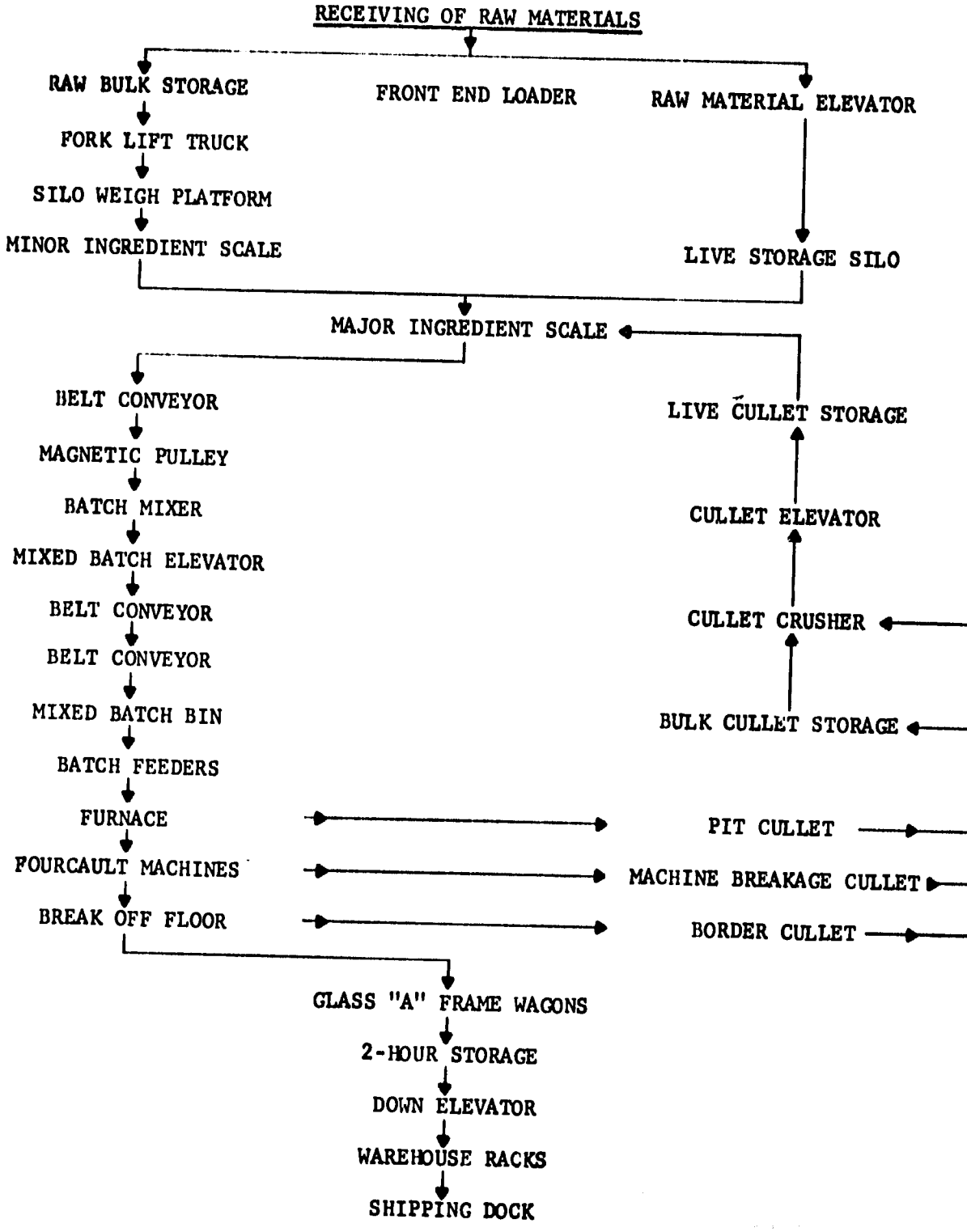
cutter automatically makes a cut at predetermined lengths; usually one, 1.5, or two m. These lengths can be varied to suit customers' demands. When the glass reaches the break-off floor, a vacuum frame is placed against the glass, and the sheet is broken off at the point where the cross cutter scored the sheet.

On the break-off floor behind each machine are two "A" frame wagons (32) to receive the glass as it is broken off the machine. The sheets are placed alternately on the two "A" frame wagons (32) to permit gradual cooling. As each sheet of glass is placed on the "A" frame wagon, (32) the bulb edge is broken off and placed in a cullet box. Drawing two mm glass at a rate of 63 m per hour will require approximately two hours to fill the two wagons. When the wagons are full, they will be marked as to quality by the cut-off checker and manually moved to a location near the elevator (10) and two new "A" frame wagons, (32) will be moved to the break-off operator. The "A" frame wagons will remain near the elevator (10) for approximately two hours cooling time, then taken down in the elevator (10) to the warehouse, and two empty "A" frame wagons (32) will be returned to the break-off floor.

The warehouse operator will unload the "A" frame wagon (32) and place the glass against the stationary "A" frames (31) in the warehouse. The sheets will remain there until instructions are received to deliver glass to the shipping dock for pick-up in customer's motor truck.

FIGURE IX-1

OPERATIONS FLOW CHART



30372

X. MACHINERY & EQUIPMENT

The principal items of equipment for the sheet glass manufacturing plant are as follows:

DEPARTMENT	TYPE OF EQUIPMENT	QUANTITY	GENERAL SPECIFICATIONS
Raw Material	Front End Loader	1	$1.5m^3$ Bucket-Deisel
	Fork Lift Truck	1	2000 kg - Deisel
	Belt-Bucket Raw Material Elevator	1	200 mm x 125 mm Bucket 23 m Ctrs.
	Cullet Crusher	1	Double Roll 600 mm x 600 mm
	Belt-Bucket Cullet Elevator	1	200 mm x 125 mm Bucket - 15 m Ctrs.
	10-day Live Storage Silo	1	Reinforced Concrete
	90-day Bulk Storage	1	Covered Area - $900m^2$
Batch Preparation & Delivery	Major Ingredient Weigh Hopper & Scale	1	300 kg x 1/4 kg to 1300 kg with Printer
	Minor Ingredient Scale	1	Bench Dial Scale 10 kg x 5 gm
	Belt Conveyor	1	450 mm x 5.5 m Ctrs.
	Magnetic Pulley	1	450 mm Diameter x 500 mm Face
	Batch Mixer	1	$0.85\ m^3$ Capacity

DEPARTMENT	TYPE OF EQUIPMENT	QUANTITY	GENERAL SPECIFICATIONS
	Belt-Bucket Mixed Batch Elevator	1	200 mm x 125 mm Bucket 17.5 m Ctrs.
	Mixed-Batch Belt Conveyor		450 mm Belt x 10 m Ctrs.
	Batch Chargers	2	Pusher Type - 600 mm
Melting	Combustion Air Fan	1	250 m^3 per min. at 100 mm S.P.
	Oil Storage Tank	1	200 m^3
	Oil Heating, Pumping, & Burner Equipment	Lot	Various
	Glass Melting Furnace	1	Cross-Fired Regenerative
	Air Reversing Valve	1	Sectional Alloy Steel
	Stack Damper	1	Cast Iron
	Venturi Stack 25 m High	1	560 m^3/min. at 250 mm S.P.
	Block Cooling Blowers	2	1275 m^3/min. at 150 mm S.P.
	Instrumentation	Lot	Various
Forming	Debiteuse Kilns	2	Complete with Tools
	Fourcault Machines	2	15 Rolls High x 1.828 m net width
	Fourcault Machine Drives	2	1½ HP - 125 to 2000 mm/min.
	"A" Frame Wagons	8	550 kg capacity
	"A" Frame Wagon Elevator	1	4500 kg capacity
	Warehouse Glass Storage Frames	300	5000 kg capacity

DEPARTMENT	TYPE OF EQUIPMENT	QUANTITY	GENERAL SPECIFICATIONS
General Operations	Electric Power Generator	1	300 kw Continuous, 375 kw Peak Load
	Water Cooling Tower	1	750 Liters Per Minute
	Pipeline From Well No. S (61A)	1	100 mm Line - 400 m long
	Air Compressors	2	$90m^3$ at 3.4 atmos
	Machine Shop	Lot	Maintenance Tools
	Store Room	Lot	Spare Parts
	Clay Pug Mill	1	400 mm x 1000 mm Feed - Extruding 150 mm x 225 mm
	Clay Room Molds	Lot	Debiteuse & Misc. Shapes
	Transportation	1	Automobile
	"	1	Pick-Up Truck
	Water Wall Pumps	2	Submersible

NOTE: All electric motors are included with their respective machines.

XI. PROPOSED PRODUCTION

The proposed production of sheet glass is based on the Contractor's market survey of Jordan and other Arab countries.

The forecasted sales for 1975 are 5,500 mt/year and for 1976 are 6,790 mt/yr. The forecast was continued to the year 1980 where it reached 8,280 mt/year. To obtain a proper balance in equipment, the basic factory should produce 5930 mt/year as shown on Page VII-2 under the heading of Production Capacity.

This production of 5930 mt is expected to be reached when the furnace and machine operators have had sufficient experience to draw the glass at 1054 lineal mm/minute and the machine breakage and other losses are held to a reasonable minimum.

The drawing of glass being more of an "art" than a "mechanical process," the rate of draw and the quality of product is highly dependent upon the skills developed by the operators. As the learning curve increases, the quality and tonnage of draw will also increase due to the faster drawing rate that can only be achieved as experience is gained.

As the operators improve their skill, the drawing speeds can be increased to as much as 1400 lineal mm/minute, and at this rate, a production of 7870 mt/year could be reached.

A rate of 1400 lineal mm/minute is not to be considered as a top machine drawing speed but rather a good practical speed for a well-trained operating staff. With all conditions at top operating efficiency, speeds of 1525 to 1650 mm/minute can be obtained.

The furnace and all associated equipment have been designed so that as the future demand for glass increases, these facilities can be adapted to higher production without undue additional cost.

At the end of a five-year furnace campaign, a major furnace rebuild can be expected. If the foreseeable future at that time indicates that additional production will be required, a third machine of the same width could be installed, giving a 50% increase in production.

Another possibility should be considered at that time, and that would be to increase the width of the third machine to allow for production of wider sheets of glass for store windows and more economical cutting of smaller sizes.

XII. ENGINEERING AND CONSTRUCTION SCHEDULE

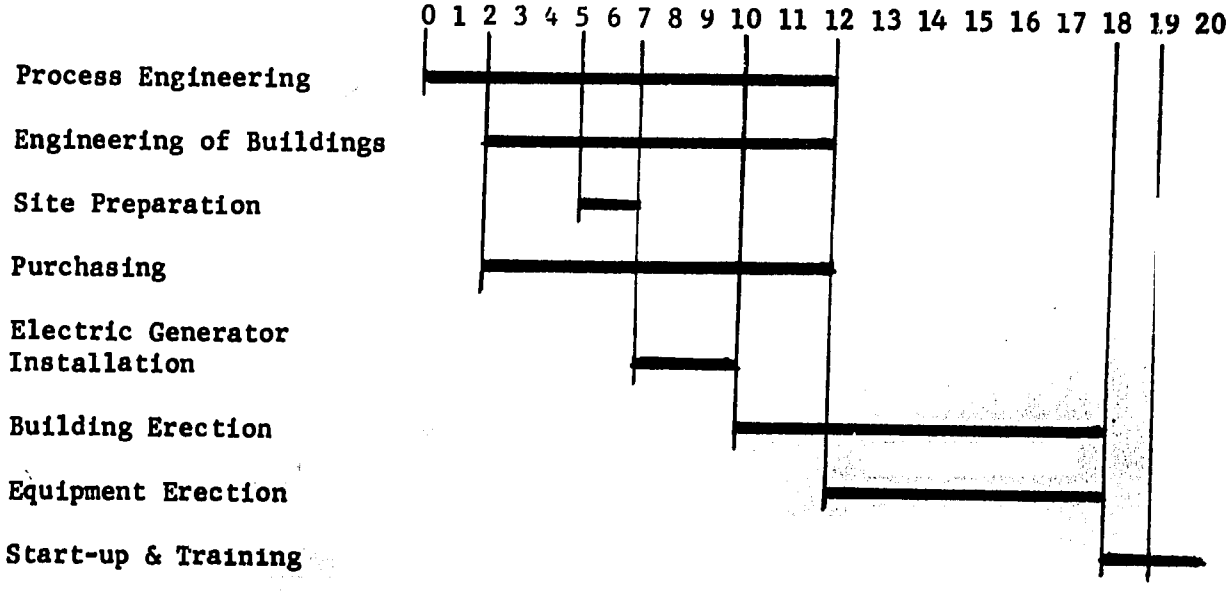
The programming of the entire project should be carefully planned to assure the accuracy of the financial forecast from the date the financing is assured; this includes engineering, purchasing, building erection, equipment installation, starting of production, employee training, and finally reaching capacity production.

The construction schedule (Figure XII-1) below has taken into account all of the above factors.

Building engineering will be started in Jordan by a Jordanian engineering company two months after Month Zero and upon receipt of plant layout and specifications from the glass engineering contractor. Purchasing of equipment by the Contractor will also start at Month Number 2.

Factory building erection will commence at Month 10 and be completed at Month 18. Equipment erection will consume 7 months from Month 12 to Month 18. Production training will start in the 19th month.

FIGURE XII-1
CONSTRUCTION SCHEDULE



NOTE: ELECTRIC GENERATOR TO BE INSTALLED BEFORE MAJOR CONSTRUCTION STARTS.

XIII FINANCIAL APPRAISAL

The financial aspects of this project can be reviewed by referring to tables XIII-1 through XIII-16. A summary of the most vital cost figures, including the return on investment can be found in table XIII-11, Condensed Financial Analysis. The return on total capital is estimated to be 14.5% with loan or 15.9% without a loan. In the capital formation plan it is anticipated that a loan will be required.

Table XIII-12 and Figure XIII-1, Break-Even Point Analysis, show that the break-even point of the plant is 42.0% of estimated sales. This favorably low level reflects a plant design which utilizes as much hand labor as practical and should give the plant management sufficient flexibility so that the various product lines (varied glass thicknesses and sheet sizes) can be efficiently scheduled to meet market demands while yielding a profit.

The market study covering the yearly average over a six-year period shows that 7,188 mt of glass will be consumed per year.

The manufacturing overhead costs are summarized in table XIII-1 while the details of power, water, fuel, supplies and depreciation may be found in tables XIII-3, 4, 5, 6, 9 and 14 respectively.

Table XIII-2 contains the cost of glass batch materials and miscellaneous materials.

Table XIII-7 gives an account of the anticipated start up costs including the foreign technicians expenses plus the training of Jordanians in Europe and material and labor until production is reached.

Table XIII-16 shows a favorable foreign exchange gain, which will benefit the economy of the Kingdom of Jordan.

All of the machinery and processes included in the design of this plant are free of all license and royalty fees.

Following discussions with N.P.C., and the Industrial Development Bank (I.D.B.) it is believed that the capital funds should be obtained from the following sources:

Equity	JD 450,000
I.D.B.	275,000
Suppliers Credit	143,000
Commercial Banks	38,000
	JD 906,000

TABLE XIII-1

MANUFACTURING OVERHEAD COST JD

		Contractor's Estimate*
Depreciation	(Table 14)	49,400
Management Salaries	" 9	17,100
Power	" 3	24,200
Water	" 4	400
Fuel	" 5	47,000
Supplies	" 6	12,800
	Total JD	150,900

TABLE XIII-2

TOTAL DIRECT MATERIAL COST JD

Glass Batch Materials		81,610
Miscellaneous		2,000
	Total JD	83,610

GLASS BATCH MATERIALS COST & QUANTITIES

Item	Mt/Year Rounded	JD/Mt	JD/Year
Sand	5970	1.000	5,970
Soda Ash	1800	29.020	52,236
Dolomite	900	3.900	3,510
Limestone	820	2.670	2,189
Salt Cake	630	15.020	9,462
Feldspar	240	22.740	5,457
Charcoal	28	11.494	322
Arsenic	26	95.000	2,470
		Batch Cost/Year JD	81,610

*Average of first six years based upon the contractors market survey of 7188 metric tons of sheet glass.

TABLE XIII-3

POWER COST PER YEAR

A. Production Equipment At 280 H.P.

1. 30 Days Per Month At 24 Hrs/Day = 720 Hrs/Month
2. 280 H.P. x 720 Hrs/Month = 201,600 H.P./Hrs x 0.7457 KW = 150,343 KWH/Month.

B. Batch Plant Equipment at 50 H.P.

1. 30 Days Per Month at 16 Hrs/Day = 480 Hrs/Month
2. 50 H.P. x 480 Hrs/Month = 24,000 H.P./Hrs x .7457 KW = 17,896 KWH/Month.

C. Machine Shop at 40 H.P.

1. 30 Days Per Month at 8 Hrs/Day = 240 Hrs/Month
2. 40 H.P. x 240 Hrs/Month = 9,600 H.P./Hrs. x .7457 KW = 7,158 KWH/Month.

D. Total KWH Per Month (A2 + B2 + C2) = 175,397 KWH.

E. Cost Breakdown Per Month

1.

50	KWH at	JD 0.030 =	JD	1.500
2,450	" "	" 0.015 =	JD	36.750
172,897	" "	" 0.011 =	JD	1,901.867

175,397 KWH Per Month JD 1,940 (Rounded)
x 12 Months

JD 23,280
Contingency 920

JD 24,200

NOTE: Jordanian electric power rates have been used to obtain the power cost per year; however, it is proposed that electricity be generated at the factory site.

TABLE XIII-4

WATER COST PER YEAR

1. Water Rate -- JD 0.065 per metric ton.

2. Total water used for machine cooling, tank draining, personal use and emergency -- 5,415 mt/year

3. Cost of Water JD 0.065 x 5415 =	JD 352
Contingency	35
Total Cost Per Year	JD 387
	Say 400

NOTE: Jordanian water rates have been used to obtain the water cost per year; however, it is proposed to use the water from the local wells. The cost of necessary equipment has been included.

TABLE XIII-5

FUEL COST PER YEAR

	JD Cost/Year
A. Fuel Oil - 7,070 mt Glass/Year	
1. Glass Furnace Primary Heat 11.66 mt Oil Per Day x 320 Days = 3,731 mt x JD 7.400/mt	27,610
B. Gas Oil	
1. Glass Furnace Secondary Heat 3,330 Liters Per Day x 320 Days = 1,065,600 Liters Per Year 1,065,600 x JD 0.0145 Per Liter =	15,451
2. Oil to Fire Steam Boilers to Preheat Fuel Oil for Glass Furnace 273 Liters Per Day x 320 Days = 87,360 Liters/Year x JD 0.0145 =	1,266
	44,327
Contingency 6%	2,673
	JD 47,000

TABLE XIII-6

COST OF SUPPLIES

		J.D.
Mechanical Maintenance Supplies		1,600
Pick-Up Truck Expenses		200
Passenger Car Expenses		200
Machine Shop Tools, Bits, Etc.		100
Lubrication		100
Refractory		6,600
Paper for Shipping Glass		3,800
Office Supplies		200
	JD	12,800

TABLE XIII-7

START-UP COSTS

	JD/Mo.	Period Of Stay (Mo.)	Total Cost JD
1. Technical Assistance Expenses			
Foreign Technicians In Jordan			
1 - Furnace Foreman	396	7	2,772
1 - " Operator	360	6	2,160
1 - Fourcault Foreman	396	7	2,772
1 - " Operator	360	6	2,160
1 - Debiteuse Maker	360	12	4,320
5 - Foreigners Living Exp. @ JD 5.350/Day	160	38	6,080
10 - Round Trip Air Tickets Plus Ground Travel @ JD 215.000 Each			2,150
2. Training of Jordanian Staff Abroad			
1 - General Superintendent	150	4	600
2 - Furnace Operators	50	(2 x 4 = 8)	400
2 - Fourcault Operators	50	(2 x 4 = 8)	400
5 - Jordanian Living Exp. @ JD 5.350/Day	160	20	3,200
5 - Round Trip Air Tickets Plus Ground Travel @ JD 215.000 Each			1,075
3. Material & Labor Till Production Is Reached			27,171
4. Registration & Administration			
Registration			1,000
Administration			11,000
Total Start-Up Cost -- JD			67,260

TABLE XIII-8

DIRECT LABOR MANPOWER REQUIREMENTS & TOTAL PAYROLL

Position	Monthly Salary Per Position - JD	Men	Total Monthly Salaries - JD	Annual Payroll - JD
Chief Furnace Operator	80	1	80	960
Asst. Furnace Operator	75	4	300	3,600
Chief Fourcault Operator	80	1	80	960
Asst. Fourcault Operator	75	8	600	7,200
Debiteuse Maker	80	1	80	960
Brick Layer	60	2	120	1,440
Batch Plant Operator	50	4	200	2,400
Cut-Off Checker	35	4	140	1,680
Cut-Off Operator	30	8	240	2,880
Elevator Operator	25	6	150	1,800
Carpenter	50	1	50	600
Storekeeper	30	1	30	360
Maintenance Mechanics	45	6	270	3,240
Labor Foreman	45	1	45	540
Labor	20	12	240	2,880
Fork Lift Operator	35	3	105	1,260
Shipping Clerk	35	1	35	420
Warehouse	25	4	100	1,200
Gate Guard	25	4	100	1,200

Totals

Men . . 72
Monthly Payroll . 2,965
Annual Payroll 35,580

Add: 17% Indemnities, Vacation, and Other Related Charges 6,049

Total Indirect Annual Labor Payroll and Related Charges . . . . . JD 41,629

TABLE XIII-9

MANAGEMENT MANPOWER REQUIREMENTS

AND TOTAL SALARIES

Position	Monthly Salary Per Position - JD	Men	Total Monthly Salaries - JD	Annual Payroll - JD
General Superintendent	225	1	225	2,700
Assistant Superintendent	160	1	160	1,920
Mechanical Engineer	100	1	100	1,200
Chemist	100	1	100	1,200
Assistant Chemist	75	1	75	900
Office Manager	75	1	75	900
Accountant	55	1	55	660
Bookkeeper	40	1	40	480
Secretary	40	2	80	960
Clerks	35	3	105	1,260
Salesman	55	1	55	660
First Aid Nurse	30	3	90	1,080
Janitor	20	3	60	720

Totals	Men . . 20	
	Monthly Payroll . 1,220	
	Annual Payroll	14,640
Add: 17% Indemnities, Vacation, and Other Related Charges		2,488

Total Indirect Annual Labor Payroll and Related Charges 17,128

TABLE XIII-10

CONDENSED FINANCIAL ANALYSIS (JD)

	TABLE	CONTRACTORS ESTIMATE
1. Working Capital		
Direct Material Inventory 90 Days	2	20,904
Direct Labor 30 Days	8	3,470
Manufacturing Overhead 30 Days	1	12,575
Reserve Sales Collection 30 Days	11	36,310
TOTAL		73,259
2. Fixed Investment		
Land		No Charge
Plant and Equipment	14	757,120
Start Up Costs	7	67,260
Contingency @ 1%		8,225
TOTAL		832,625
3. Total Capital Requirements		905,884

TABLE XIII-11

CONDENSED FINANCIAL ANALYSIS (JD)

		TABLE	CONTRACTORS ESTIMATE*
A.	Annual Gross Sales		435,720
B.	Total Manufacturing Cost		276,140
	Direct Labor	8	41,630
	Direct Materials	2	83,610
	Manufacturing Overheads (incl. Depreciation)	1	150,900
C.	Total Administrative Cost		18,270
	Interest on Loan		12,800
	Insurance		1,600
	Legal		1,500
	Auditing		1,500
	Contingencies 5%		870
D.	Advertising & Sales Expense		10,000
E.	Total Cost		
	1. With Loan		304,610
	2. Without Loan		291,610
F.	Net Profit During First 6 Years (Yearly)		
	1. With Loan		131,310
	2. Without Loan		144,110
G.	Return on Total Capital		
	1. With Loan		14.5
	2. Without Loan		15.9
H.	Total Capital Requirements	10	905,884

* Average first six years based upon the contractor's market survey of 7,188 Metric ton per year.

TABLE XIII-12

BREAK-EVEN POINT ANALYSIS (JD)

		TABLE	CONTRACTORS ESTIMATE*
1.	Sales		435,720
2.	Variable Cost		209,640
	Direct Materials	2	83,610
	Power	3	24,200
	Fuel	5	47,000
	Water	4	400
	Direct Labor	8	41,630
	Supplies	6	12,800
3.	Fixed Cost		95,000
	Depreciation	14	49,630
	Management Salaries	9	17,100
	Administrative Costs	11	18,270
	Advertising & Sales Expense	11	10.000
4.	Break-Even Point %		42.0
5.	Break-Even Capacity mt/year		3,018

* Average of first six years based upon contractor's Market Survey of 7,188 metric tons per year.

TABLE XIII-13

BREAKDOWN OF CAPITAL REQUIREMENTS, 000 JD

	1973	1974	1975	1976
1. Company Registration Fees	1			
2. Company Administrative Expenses	2	2	3	2
3. Water Line Installation		1		
4. Electrical Power Installation		48		
5. Engineering		33	34	5
6. Equipment Costs Upon Purchase		50	78	
7. Equipment Costs Upon Shipment		25	103	
8. Construction Costs		25	199	25
9. Equipment Costs Upon Acceptance				129
10. Start-Up Costs				66
11. Working Capital				75
TOTALS Total Capital Requirements JD 906,000	3 +	184 +	417 +	302 = 906

TABLE XIII-14

SCHEDULE OF DEPRECIATION

Item	Depreciable Capital Acquisition Cost (JD)	No. of Yrs. Depreciation	Depreciation Per Year	Depreciation at End of 20 Yrs.	Salvage Value At End of 20 Yrs.
Buildings	181,800	50	3,636	72,720	109,080
Equipment					
Furnace & Kilns	273,500	20	13,675	273,500	0
Processing	108,140	20	5,407	108,140	0
Material Handling	76,280	10	7,628	76,280	0
Workshop, Lab & Maintenance Tools	15,300	10	1,530	15,300	0
Spare Parts	28,900	10	2,890	28,900	0
Erection Supervision & Expense	19,000	10	1,900	19,000	0
Engineering & Management	54,200	10	5,420	54,200	0
Start-Up Costs	67,260	10	6,726	67,260	0
Contingency	8,225	10	823	8,225	0
TOTALS	832,625		49,635	723,525	109,080

TABLE XIII-16

LABOR PRODUCTIVITY*

1.	Production Value per Person Employed, JD	4,736
2.	Value added per worker, JD	4,890

*Based on the average Annual Sales over the First Six Years.

TABLE XIII-16

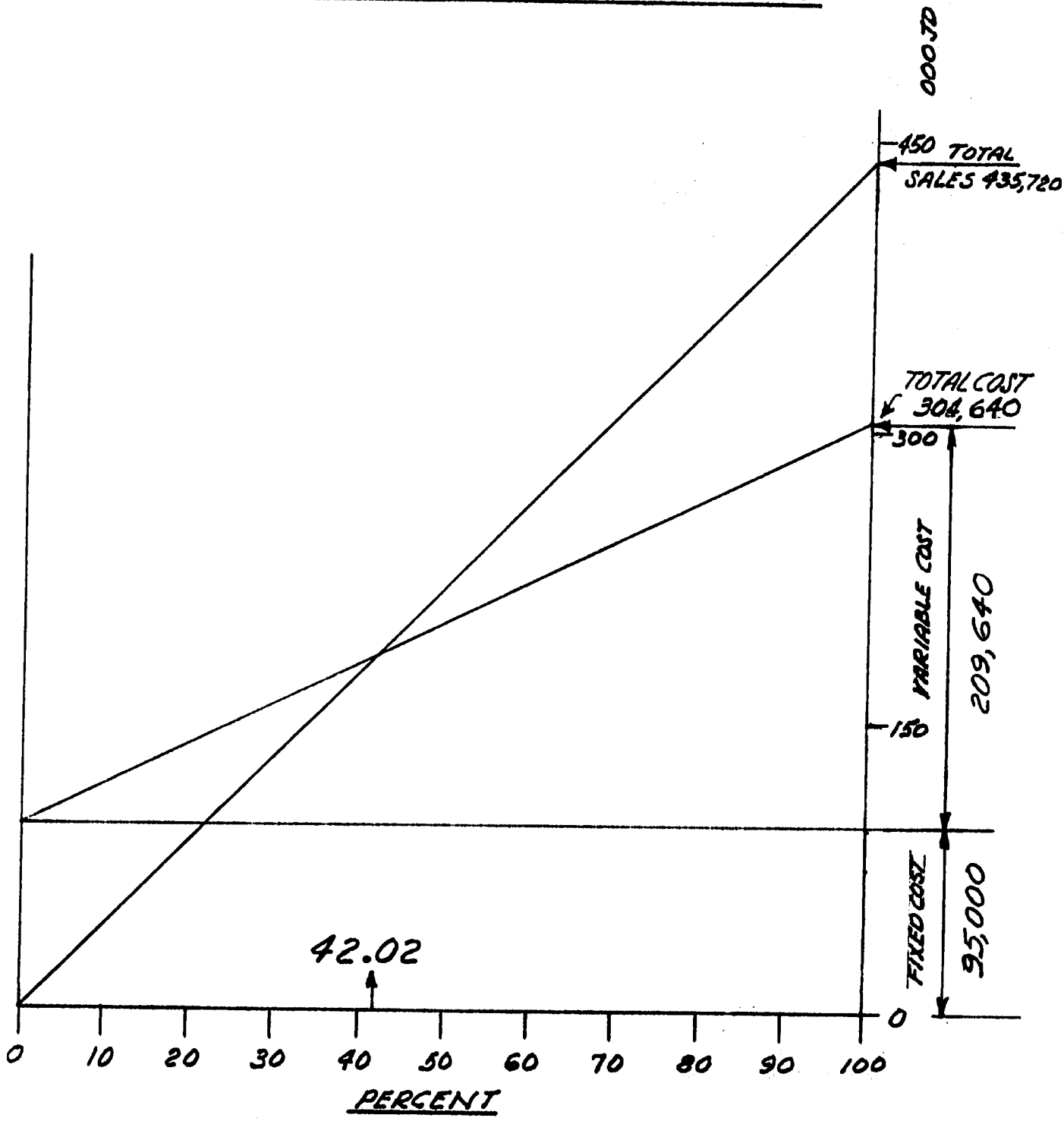
FOREIGN EXCHANGE GAIN*

		JD
1.	Export Earnings	224,700
2.	Import Savings	+210,904
		435,604
3.	Import Raw Material	- 64,490
4.	Gain in Foreign Exchange	371,114

*Based on the Average Annual Sales over the First Six Years.

FIGURE XIII-1

BREAK-EVEN POINT ANALYSIS



XIV RECOMMENDATIONS

Based upon the results of technical feasibility investigations, economic profitability studies and market research it is recommended that a sheet glass manufacturing plant and sand quarry be established in Jordan as soon as possible.

This recommendation is based upon the following:

(1) The chemical analyses of the Jordanian silica sand, limestone and feldspar together with melting tests on these minerals indicate that they will produce a good sheet glass. Field surveys show that these materials occur in large quantities.

(2) The financial appraisal in Chapter XIII shows an estimated annual gross sales of JD 435,720 that is expected to result in a return on total capital investment of 14.5% and a gain in foreign exchange of JD 371,110 per year. The analysis of break-even point reflects a favorable level of 42.0%.

(3) The marketing study shows that sufficient demand exists to justify the need for an economically-sized manufacturing plant. More than half of the demand is based upon projected domestic consumption while the necessary export market is based upon rather low shares of the market in a small number of countries that do not currently manufacture their own sheet glass.

(4) An ample supply of dependable management personnel and labor is available in Jordan.

It is further recommended that the sheet glass production unit be brought into operation as early as possible in order to:

(1) Increase the inflow of foreign currencies through the export of a new Jordanian product.

(2) Increase employment opportunities for Jordanian personnel.

(3) Present a profitable opportunity for Jordanian investors.

(4) Discourage the building of additional new sheet glass facilities in the Jordan export market area.

APPENDIX

TITLE	PAGE
Report of Plant Site Investigations	A-1
Tests on Ras En Naqb Glass Sand	A-5
Sand Quarrying and Beneficiation	A-11
Contractors Review of Ras En Naqb	A-18
Exhibits	A-20

REPORT OF PLANT SITE INVESTIGATIONS

The two-machine sheet glass factory as described in the "Glass, Building Material, and Components Industry" Prefeasibility Study dated February 1972 will be designed to produce twenty (20) mt of glass per day or 600 mt per month. The 600 mt will be marketed as follows:

Jordan	328 mt per month
Saudi Arabia	128 mt per month
Kuwait	84 mt per month
Gulf States	40 mt per month
Sudan	20 mt per month

The Contractor with the assistance of the N.P.C., N.R.A., and others made a study of a number of sites before selecting the one most suitable for the sheet glass plant.

Four factory sites were given a preliminary investigation and finally eliminated due to the lack of water or other factors. These are briefly described below.

(1) Quweira area near the road to Ram was considered; however, the watertable in that area is approximately 250 m below ground level. This site would require that the majority of raw materials would have to be shipped south and then the glass north, and this would add to the total shipping cost.

(2) Another location considered is approximately 20 km northwest of Ma'an where the water table is at 150 m. The site is between the Desert Highway and the town of Udhruh and would require building a roadway up to 15 km long to reach the site.

(3) Another site in the Ma'an area is 10 km almost due west of Ma'an about 2 km off of a paved roadway and adjacent to the well that furnishes water to the city of Ma'an. Although some additional water is thought to be available, the Contractor believes that for long-range planning (for the city and its industries) it would be better not to locate the sheet glass plant in this area. Furthermore, a 2 km roadway capable of carrying industrial traffic would have to be built and maintained.

(4) Madaba was considered, but the lack of water in this area eliminated this site.

The five plant site locations that offered the best potential are listed below.

PLANT SITE NO. 1 JORDAN REFINERY FARM - ZARQA

Due north and adjacent to the Jordan refinery plant there is a plot of ground, consisting of 992 dunums, owned by the Petroleum Company and, known as their farm. It is understood that Jordan Petroleum Company is willing to sell a portion of this farm for the use of a glass manufacturing site. There is a very good well on this farm that produces 400 m^3 of water per hour, and they are willing to sell to the glass factory all the water required. This site is also on the railroad, and a siding could easily be installed to receive raw material and to ship finished glass. Oil for the glass furnace could be pumped directly from the refinery, and some savings in fuel transportation might be achieved. The Jordan Power Company is preparing to install a new generating station about 3 km northeast of the factory site.

This site was eliminated because the area is already well industrialized, and it is understood that the Government of Jordan wishes to extend employment opportunities to less industrialized areas. Another reason being that since the site is north of Amman, the shipment of glass for export plus the potential sales in Aqaba would require excessive transportation charges.

PLANT SITE NO. 2 EL HASA

The phosphate mines property was visited by the Contractor and various areas were inspected that are adjacent to their property, but in the Contractor's opinion, were not the most suitable sites in this area due to the distance to the main highway and the necessity of drilling a well for water. There is a site on the southern end of the Village of El Hasa 2 km west of the main highway that is level ground, government owned, and has a drilled well that can produce 500 m^3 per hour. This site would require its own power generating station and also the building and maintenance of a hard surface road to the factory site.

PLANT SITE NO. 3 QA DISA

This site has three operating wells each of which can produce over 100m^3 per hour of some of the best quality water in Jordan. Well No. S19 is located 27 km east of the Desert Highway at a point 42 km north of Aqaba. Well No. S22 is approximately 2 km north of S19 and Well No. S2 is approximately 10 km east of S19. There is plenty of level land between these wells for a glass plant to be located; a supply of sand is within a 15 km radius, and it is understood to be of the same quality as Ras En Naqb sand. The extension of the railroad to Aqaba will pass through the area very close to Well S22.

PLANT SITE NO. 3 QA DISA (Continued)

In the Contractor's opinion this is not a good site for a sheet glass plant, because this site would require building and maintaining a 7 km hard surface roadway for industrial trucking. This location is also undesirable from the standpoint of transporting the finished product. Of all the sites considered, it is the most distant from the center of consumption.

PLANT SITE NO. 4 WUHEIDA AREA

The site in the Wuheida area is on the paved road to Petra, 2 km northwest of the main Desert Highway and a total distance of 18.5 km southwest of Ma'an. The property is government owned and has four wells each of which has a capacity ranging from 53 to 180 m^3 per hour. Wells designated as S61A, S40, and S59 are located on the north side of the road, and Well No. S60 on the south side of the road. The wells are not being used at present. In the opinion of the Contractor, this is the best site for a glass manufacturing plant.

TESTS ON RAS EN NAQB GLASS SAND

I. INTRODUCTION

In 1970 a report, "Glass Sand of Ras En Naqb," was published by Mr. Y. F. Nimry and Mr. M. S. Haddadin of the Minerals Resources Division of the Natural Resources Authority. This report recommended, and the Contractor concurred, that further testing follow the preliminary work. The National Planning Council authorized the Contractor to carry on tests concerning beneficiation and melting on the Ras en Naqb sand.

Based on the Nimry & Haddadin (N & H) report, the general appearance of the sand and the scarcity of water at the proposed quarry site it was not considered appropriate to investigate the process of wet beneficiation. It was concluded that dry beneficiation methods should be investigated including ordinary screening, gravity separation and magnetic separation. It was also believed advisable to conduct melting tests on raw and beneficiated sand.

The necessary samples were collected by the N.R.A. and shipped via air freight to the Contractor who reshipped portions to various laboratories for testing. All chemical analyses were performed by the laboratories of Hartford Division, Emhart Corporation who also did the melting tests.

II. PROPERTIES OF RAW SAND

The following screen analysis shows the particle size distribution of the raw sand as received from Jordan.

SCREEN ANALYSIS

RAW RAS EN NAQB SAND

FROM C-E TYLER SIEVE TEST REPORTS

(SEE EXHIBITS NOS. 1, 2, 3, and 4)

Sieve No.	% On Test No. 1 Feed	% on Test No. 2 Feed
16	1.1	1.3
20	1.8	1.9
30	5.9	6.4
40	18.3	17.5
50	35.6	34.1
70	18.6	18.2
80	7.0	7.3
100	5.9	6.3
140	3.9	4.9
Pan	1.9	2.1

The Contractor believes that the sand to be used for the production of glass should be between 30 and 100 mesh. The analysis shown above, therefore, indicates that approximately 18.9% of the sand quarried will have to be discarded as noted in Exhibits No. 3 & 4.

Samples of raw Jordan sand from Trench No. 1 and Trench No. 9 were sent to the Hartford Division for chemical analysis, and their results are reported in Exhibit No. 5 for Sample C-1-R (from Trench No. 1) and Exhibit No. 6 for C-9-R (from Trench No. 9).

The unbeneficiated sand from Trench No. 1 showed a content of 0.036% Fe_2O_3 which compares with 0.028% for samples shown in the N & H report in 1970.

The raw sample from Trench No. 9 showed an iron level of 0.033% which is lower than had been anticipated when noting that N & H reported a content of 0.139%. It should be noted that the latest sample from Trench No. 9 was intended to be used only in melting tests to determine the effect of its relatively high iron content on the color of the finished glass. This sample was only a small "grab" sample and not a large comprehensive sample as taken in 1970.

III. BENEFICIATION TESTS

Dry Screening

A sample of raw sand as received from Jordan was sent to the C-E Tyler Company for screening tests to determine the best means of removing sand particles coarser than 30 mesh and finer than 100 mesh. The results are reported in Exhibits Nos. 1, 2, 3, and 4, and it will be noted that Test No. 2 gave the best results and indicated that 10,543 pounds on 4.8 mt of properly sized sand could be produced per hour.

The cost of the vibrating screens to produce the 4.8 mt per hour of sand with the desired grain sizing is quoted at U.S. $6,573.00 (JD 2,347.) as noted in Exhibit No. 7.

NOTE: The above quotation of JD 2,347 is included in the Capital Cost estimate of sand quarrying.

Gravity Separation

The Triple S Dynamics Company of Dallas, Texas USA manufactures a machine which makes separations of minerals based on specific gravity, and it was decided that Ras en Naqb sand could be tested in this equipment to determine its ability to improve the quality of the sand. Exhibit No. 8 (Triple/S Dynamics test report No. S-73-19) shows the results of investigations made by that firm. After this test was run, all four cuts of test No. 4 were sent to Hartford Division for a check on the Fe_2O_3 content. The analyses are as reported in exhibits 9, 10, 11, & 12 attached and are as follows:

Test No. 4	Cut #1	0.10	Fe_2O_3
	Cut #2	0.025	Fe_2O_3
	Cut #3	0.024	Fe_2O_3
	Cut #4	0.032	Fe_2O_3

The cost of Triple S production-scale equipment to yield a production of 3.6 mt per hour is U.S. $15,640.00 (JD 5,586) F.O.B. Breckenridge, Texas, U.S.A. as quoted in Exhibit No. 13. It should also be noted that screening equipment was quoted separately at a cost of U.S. $9,490.00 (JD 3,389).

Magnetic Separation

Attached is Exhibit No. 14, the Exolon Company Laboratory Test Report No. 1880 covering their tests using the dry magnetic process. The "not removed" or residual sample received from The Exolon Company was sent to Hartford Division and their analysis designated as Exhibit 15 (Sample C-1-B-E) shows an Fe_2O_3 content of 0.023%.

The cost of the equipment required to produce 3.6 mt per hour by the Exolon process is U.S. $30,157 (JD 10,770) including spare parts boxed for export Pier Side, New York. This quotation is presented as Exhibit No. 16.

Exhibit No. 17 (Eriez Magnetics Research Request 2056) describes work done on magnetic separation in the Eriez laboratory. The two beneficiated samples were sent to Hartford Division, and chemical analysis as reported in Exhibits No. 18 and 19 showed that the Fe_2O_3 content was 0.021% in both cases.

The cost quoted by Eriez Magnetics for equipment to produce five mt per hour is U.S. $23,545.00 - (JD 8,409) FOB Erie, PA, USA, as shown in Exhibit No. 20.

IV. MELTING TESTS

Twelve test melts were made and cast into glass bars 20 x 20 x 150 mm in size; each bar being from the same basic batch but with varying sources of the sand, limestone, and feldspar as shown in Exhibit No. 21, Hartford Division Reports No. 7304038,39 and 40. The 12 test melt bars will be delivered to the National Planning Council. All tests melts resulted in clear glass quite suitable for window glass.

Although these tests were conducted principally to evaluate the Ras en Naqb sand, it was thought advisable to test Jordanian limestone, a sample (No. SD-30) of which was available from investigations done in connection with the Ceramic Combined Plant I. This was taken from a quarry located across the highway from the automatic bakery in Amman. A chemical analysis of this limestone was done in the Contractor's laboratory and indicated an Fe_2O_3 content of 0.40%. This sample of Amman limestone contains considerably more iron than the 0.1% that is usually judged desirable, however, the melt test bars containing this limestone all yielded a satisfactory color.

The Jordanian feldspar (N.R.A. Ore No. II Test No. 1) used in the test melts was from a sample of 130 grams supplied by N.R.A. laboratories. It had been beneficiated by froth flotation and magnetic separation and the chemical analysis was reported by N.R.A. as follows;

Al_2O_3	$Si\ O_2$	Fe_2O_3
19.46%	66.07%	0.32%

A portion of the above 130 gram sample (Marked F-1 Feldspar) was sent to Hartford Division for an analysis of its Fe_2O_3 content and their test No. C-19 showed an Fe_2O_3 content of 0.12%. See Exhibit No. 22 Preliminary lab scale beneficiation in USA on a different sample of Jordanian feldspar resulted in an Fe_2O_3 content of 0.12%. These beneficiation tests are continuing and will be covered later in a separate report.

V. CONCLUSIONS

There are nine different qualities of glass sand as recommended by the American Ceramic Society and the National Bureau of Standards (See Exhibit No. 23), and it is very gratifying to note that the raw sand from Ras en Naqb contains as little as 0.036% Fe_2O_3.

This sand, without any beneficiation, lies between grade No. two and grade No. three. It is, therefore, recommended that this sand need only to be crushed and screened to -30 +100 mesh for the manufacture of good window glass.

The 6.7% of undersize sand as shown in C-E Tyler Exhibit No. 4 could possibly be used by other industries such as the manufacture of filters, paint, rubber, plastic, abrasives, cleaning compounds, polishing mediums, sanding and polishing papers and others. It is possible that some of the oversized grains might be used locally as aggregate in concrete.

SAND QUARRYING AND BENEFICIATION

I. SAND REQUIREMENTS

It is projected that at the beginning of glass production the rate of draw will be 18.52 mt of saleable glass per day (as noted on Page VII-2 of the main report) from a melted weight of 31.06 mt of glass drawn per day (as noted on Page VIII-1). To produce this quantity of glass will require 15.42 mt of sand per day or 0.83 mt of sand for each ton of saleable glass.

The production figure of 5930 mt (as noted on page VII-1) should not be used to calculate the sand requirements as it is quite possible that during the first few years the plant will be producing glass during 360 days.

The 320 days used on Page VII-1 to calculate raw material requirements is an average over the life of the furnace. Under normal operating conditions it should be five years or more before a major furnace repair is required which will necessitate that production be stopped and the furnace cooled and drained.

Consumption at the daily rate of 15.42 mt of sand for 360 days equals 5551 net per year.

By the year 1980 the forcasted annual consumption is 8,280 mt based on an average of 320 days per year. Drawing glass at this rate for 360 days would result in a production of 9315 mt of saleable glass per year, which will require 9315 x 0.83 or 7730 mt of sand per year.

Due to the rainy season it is assumed that the sand crushing and screening plant may operate only nine months per year of 232 working days. This would require a daily production of 7730 mt ÷ 232 or 33 mt per day.

When a third glass-drawing machine is installed the sand consumption will be 33 x 1.5 or 49 mt of sand per day during a nine months quarrying and screening operation. The capacity of this facility is based upon this figure and assuming seven effective hours per day would result in a production of approximately seven metric tons per hour.

The daily requirement of 49 mt sand per day x 1.3 (10% blasting loss and 20% crushing and screening loss) is equivalent to 64 gross mt per day which will need to be blasted. Operating at this average rate for 232 days per year will yield 14,800 mt of sand blasted per year which will be required for the ultimate production on three glass-drawing machines.

II. QUARRYING PROCEDURE

After the quarry site is selected, the weathered surface should be skimmed and cleaned to a depth of approximately 25 cm by hand labor or by a ripper and bulldozer. This work can be done while the equipment for crushing and screening and the storage shed for the refined sand are being erected.

The face of the quarry is recommended to be 60 m wide by 5 m high with a blasting depth of 1.5 m perpendicular to the vertical face. A blast of this size will produce about 900 mt and the following blasting layout is recommended.

Twenty-five vertical holes, 65 mm in diameter, will be drilled to a depth of 5.5 m and in a line 1.5 m in from the face. On a 60 m length of quarry face, this layout would place the drilled holes in a straight line on 2.5 m centers.

The year's requirement of 14,840 mt can be obtained by 16 blasts of the above size. Sixteen blasts of 25 holes each equals a total of 400 holes to be drilled. Modern air-driven drilling equipment would require about 20 minutes to drill a 65 mm diameter hole, 5.5 deep; therefore, the total drilling time, which includes moving the rig, would be approximately 133 hours for one year of operation.

Because of the high capital cost of modern drilling equipment with accessories, and the very short time required per year, it is recommended that the equipment be rented for one month per year or the drilling be done by an outside contractor.

All of the holes required will be drilled during the one month period and the holes will be plugged until they are to be used for blasting.

The blasting will be done as required by the crushing and screening personnel.

III. BENEFICIATION PROCEDURES

The blasted sandstone and rock will be conveyed from the quarry face to the beneficiation equipment shown on Drawing 30372-SC-5 Page A-54 via the ten-ton dump truck after being loaded by the front end loader.

The sandstone will be dumped in front of the two hoppers and manually charged into the hopper over the jaw crusher or impactor. If the sandstone is 150 mm or less, it will be charged into the impactor hopper while the larger pieces will go into the jaw crusher hopper. The impactor hopper will be protected by a grid with 150 mm, square openings.

Both the jaw crusher and the impactor discharge into the elevator and the material is then conveyed to the double surface screen. The top surface screen will be 30 mesh, and the material that will not pass 30 mesh is returned via a chute to the impactor for further reduction in size. The sand that passes the 30 mesh top screen and is retained on the 100 mesh bottom screen is chuted to the portable belt conveyor which has a magnetic head pulley to remove any tramp iron before depositing the sand in the sand storage shed.

The fine sand that passes the 100 mesh screen is discharged via the undersize chute.

After sufficient sand has been brought from the quarry face to the crusher hoppers to satisfy the beneficiation equipment requirements for several hours, the ten-ton dump truck will be loaded with sand from the storage shed by means of the front end loader. The sand will then be delivered to the glass factory.

An explosive-storage room and guard house will be located within the sand storage shed.

IV. QUARRYING & BENEFICIATING COST

A. Personnel

	Monthly Wage JD
1 - Foreman	75
1 - Crusher Operator	45
1 - Screen "	45
1 - Front End Loader Operator; he also acts as Blaster & Drill Operator	50
1 - Maintenance Man; he also acts as Assistant Blaster & Driller	45
1 - Truck Driver	45
1 - Guard	25
	JD 330
Add 17% Indemnities	56
	JD 386

JD 386 x 12 = JD 4,632 Per Year

B. Drilling Cost

1 Mo. Rental Charge on Drill & Air Compressor	JD 650
Maintenance & Supplies for Drilling Equip.	130
	JD 780

C. Blasting Cost

	JD/Hole
Primer (1 kg - No. 60 Dynamite)	0.221
Ammonium Nitrate	0.435
Blasting Cap	0.285
	JD 0.941

JD x 0.941 x 400 Holes =	JD 376
Blasting Machine, Galvanometer, Bit Grinder, Etc. = JD 1,071 (Capital Cost)	
JD 1,071÷5 Year Depreciation	214
	JD 590

D. Capital Cost

15 m x 30 m Covered Area for Refined Sand = 450 M^2 @ JD 8.000/M^2	JD	3,600
Camping facilities & Explosive storage		1,000
1 - Jaw Crusher 410 mm x 230 mm		3,220
1 - Impactor Crusher		2,430
1 - 200 mm x 127 mm bucket elevator		2,270
1 - Double Surface Screen		2,410
1 - Lot, Hoppers, Chutes & Structural Supports		2,140
1 - 450 mm x 10 m Portable Belt Conveyor with Magnetic Head Pulley		1,430
Estimated Erection Cost of Above Items		4,300
1 - Diesel Motor Generator for Electric Power		2,900
1 - 1.5 m^3 Front End Loader		9,500
1 - 10 mt Dump Truck		6,070
1 - Lot Spare Parts for Above Equipment		980
Contingency		1,000
	JD	43,250

43.250/Ten Year Depreciation = JD 4,325/Year

E. Summation

		JD/Year
A. Personnel		4,630
D. Capital Cost		4,330
	JD	8,960
B. Drilling Cost		780
C. Blasting "		590
	JD	1,370

F. Equipment Use

The camp site, personnel, and equipment will be used as follows:

Processing Sand	- 77%
Processing Dolomite	- 12%
Processing Limestone	- 11%

of the time.

G. Processing Cost

Limestone and Dolomite will be quarried at another site where the cost of drilling and blasting is included in the purchase price.

Limestone
0.11 x JD 8,960 = JD 985 to be added to cost of limestone.

Dolomite
0.12 x JD 8,960 = JD 1,075 to be added to cost of dolomite.

Sand

0.77 x JD 8,960 =	JD 6,899
Cost of Drilling	780
" " Blasting	590
	JD 8,269

It is assumed that the raw sand will be royalty free.

JD 8,285/14,800 mt - JD 0.560: per mt.

Contractors Review Of:

GLASS SAND OF RAS EN NAQB
(Report On Phase I)
Natural Resources Authority
Mineral Resources Division
April 1970
By
Y. F. Nimry
And
M. S. Haddadin

The Contractor reviewed this report and found the general plan of exploration, mapping and sampling to be quite satisfactory.

It is very gratifying that such large reserves of glass sand have been found and that the quality is good. Average iron (Fe_2O_3) content ranges from 0.02 to 0.04. According to international standards, this sand would therefore be rated as suitable for the manufacture of first quality window glass.

The Contractor estimates that the proven reserves reported by the authors will last the glass industry and a projected export demand for glass sand for more than 100 years.

The Contractor essentially agrees with the conclusions and recommendation beginning on P. 37. However, modern glass making technology attaches less importance to the grain size of the sand than in former years. It may also be proven that there is little need for beneficiation, other than dry screening.

A decrease in the percentage of Al_2O_3 from dry to wet-sieved samples in the middle fraction indicates that an appreciable amount of the Al_2O_3 is in the fine part of that fraction. Even though the fine particles may be found to contain a

preponderance of the Al_2O_3 (or any other compound) beneficiation could be avoided by careful handling of raw materials to prevent segregation of the various grain sizes during the manufacturing process. Segregation of grain sizes generally causes the glass to melt at uneven rates resulting in probable defects in the finished product.

More important than the distribution of Al_2O_3 through the various size fractions of a given sample is the uniformity of the Al_2O_3 from one part of the quarry to another so that a constant percentage of this material will be supplied in the sand to the glass melting tank from batch to batch.

Please mention above number and order

SIEVE TESTS

...AD... ..ITH

Tyler Standard Screen Scale Sieves

Name Swindell Dressler Date 4-4-73 Test Number 19-163

Address Pittsburgh, Pa Made by L.R.S.

Material Jordan Raw Sand Moisture

SCREEN SCALE BRITISH				(A) Feed			(B)			(C) Test #1 +30 oversize			(D) Test #1 -30+100 Product			(E) Test #1 -100 Fines			(F)		
				Time: 5 Minutes			Time: Minutes			Time: 5 Minutes			Time: 5 Minutes			Time: 5 Minutes			Time: Minutes		
Openings Inches	Openings Millimeters	~~Tyler Mesh~~	U.S. No.	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)
.046		14	16		1.1	1.1					9.8	9.8									
.0328		18	20		1.8	2.9					17.1	26.9									
.0232		25	30		5.9	8.8					43.8	70.7		1.6	1.6						
.0164		36	40		18.3	27.1					26.6	97.3		18.5	20.1						
.0116		52	50		35.6	62.7					1.6	98.9		42.7	62.8						
.0082		72	70		18.6	81.3					.3	99.2		22.8	85.6						
.0069		85	80		7.0	88.3					.2	99.4		9.0	94.6						
.0058		100	100		5.9	94.2					.2	99.6		4.3	98.9		40.2	40.2			
.0041		150	140		3.9	98.1					.2	99.8		.8	99.7		41.4	81.6			
.0000	.000	Pan	Pan		1.9	100.0					.2	100.0		.3	100.0		18.4	100.0			
			Totals																		

REMARKS

A-20

EXHIBIT NO. 1.

By L.R.Smith

Note: Sieves omitted may be indicated with a dash (—) in weight column.

W. S. TYLER, INCORPORATED, MENTOR, OHIO 44060, U. S. A. 1-71

The W. S. Tyler Company

DIVISION OF W. S. TYLER, INCORPORATED
Mentor, Ohio, U.S.A. 44060

CUSTOMER SERVICE LABORATORY

DATE 4-4-73 TEST NO. 19-163

FOR Swindell Dressler EXHIBIT NO. 2.

MATERIAL Jordan Raw Sand

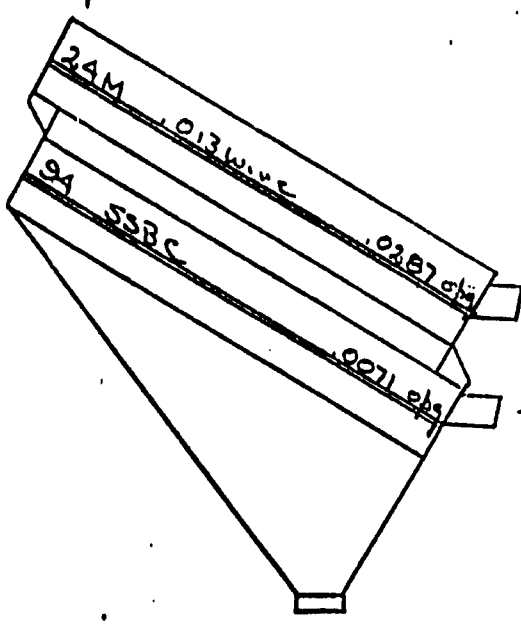
Lbs./Cub.Ft. 96#

Feed Rate to give 5 TPH Product

Separation +30, -30+100, -100

Test #1

15,000#/hr



1586#/hr 12.2%

10,010#/hr 77.0%

1404#/hr
10.8%

1.-3X10 2S
Hummer
30° Screen angle

30372

Form No. L-2
Please mention above when ordering

SIEVE TESTS
MADE WITH

Tyler Standard Screen Scale Sieves

Name Swindell Dressler Date 4-4-73 Test Number 19-163

Address Pittsburgh Pennsylvania Made by LRS

Material Jordan Raw Sand Moisture

SCREEN SCALE BRITISH				(A) Feed			(B)			(C) Test #2 +30 oversize			(D) Test #2 -30 +100 Product			(E) Test #2 -100 Fines			(F)		
				Time: C Minutes			Time: Minutes			Time: Minutes			Time: Minutes			Time: Minutes			Time: Minutes		
Openings Inches	Openings Millimeters	Tyler Mesh	U.S. No.	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)	Weight Between Sieves	% Between Sieves	Cum. % (Total % on each Sieve)	Weight Between Sieves	% Between Sieves	C (T on eac Sieve
.046		14	16		1.3	1.3					10.8	10.8									
.0328		18	20		1.9	3.2					15.7	26.5									
.0232		25	30		6.4	9.6					44.0	70.5		1.3	1.3						
.0164		36	40		17.5	27.1					26.3	96.8		17.6	18.9						
.0116		52	50		34.1	61.2					1.8	98.6		41.7	60.6						
.0082		72	70		18.2	79.4					.4	99.0		22.4	83.0						
.0069		85	80		7.3	86.7					.3	99.3		8.9	91.9						
.0058		100	100		6.3	93.0					.3	99.6		6.8	98.7		11.6	11.6			
.0041		150	140		4.9	97.9					.2	99.8		1.0	99.7		61.0	72.6			
.0000	.000	Pan	Pan		2.1						.2	100.0		.3	100.0		27.4	100.0			
			Totals																		

REMARKS

A-22

EXHIBIT NO. 3.

By

Note: Sieves omitted may be indicated with a dash (—) in weight column.

W. S. TYLER, INCORPORATED, MENTOR, OHIO 44060, U. S. A. 1-71

The W. S. Tyler Company

DIVISION OF W. S. TYLER, INCORPORATED
Mentor, Ohio, U. S. A. 44060

CUSTOMER SERVICE LABORATORY

DATE 4-4-73 TEST NO. 19-163

FOR Swindell Dressler EXHIBIT NO. 4.

MATERIAL Jordan Raw Sand

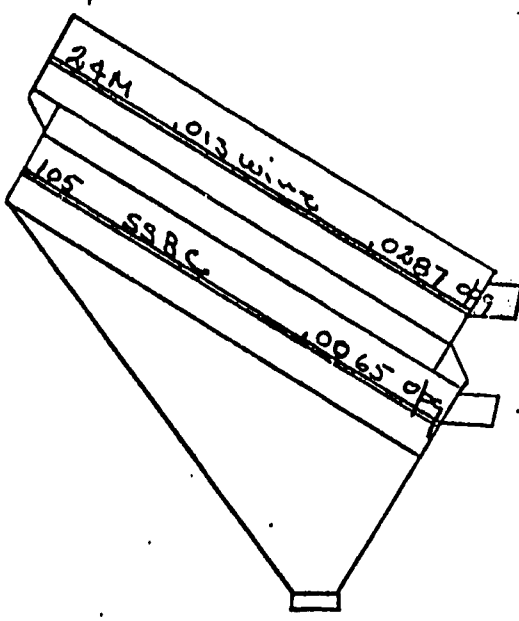
Lbs./Cub.Ft. 96#

Feed Rate To give 5 TPH Product

Separation +30, -30+100, -100

Test #2

13,000 #/hr



1586 #/hr 12.2%

10,543 #/hr 81.1%

871 #/hr

6.7%

3'x10'-2S

Hummer

30° Screen angle

30372

EXHIBIT NO. 5.

HARTFORD DIVISION

EMHART CORPORATION
GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD, CONNECTICUT 06102 U.S.A.

Report No. 7303109

Swindell Dressler Company
441 Smithfield Street
Pittsburgh, Penn. 15222

Attn: Mr. W. A. Esselstyn

Reported 3/26/73
Reference PO# 173129
Sample C-1-R Sand
Source
Marked
Received 3/19/73
Tests (C-10)(C-18)Fe_2O_3,Cr_2O_3

CHEMICAL ANALYSIS

Silica (SiO_2)	98.9
Alumina (Al_2O_3)	0.77
Iron Oxide (Fe_2O_3)	0.036
Calcia (CaO)]	0.00
Magnesia (MgO)	0.00
Soda (Na_2O)	0.01
Potassia (K_2O)	0.00
Chromium Oxide (Cr_2O_3)	0.0005
Ign. Loss (1200°C.)	0.31
TOTAL	100.0

Leo E. Stadler

pjm

30372

FORM 16A

EXHIBIT NO. 6.

HARTFORD DIVISION

EMHART CORPORATION
GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD, CONNECTICUT 06102 U.S.A.

Report No. 7303108

Swindell Dressler Company
441 Smithfield Street
Pittsburgh, Penn. 15222

Attn: Mr. W. A. Esselstyn

Reported 3/26/73
Reference PO# 173129
Sample C-9-R Sand
Source
Marked
Received 3/19/73
Tests (C-10)(C-18)Fe_2O_3,Cr_2O_3

CHEMICAL ANALYSIS

Silica (SiO_2)	97.1
Alumina (Al_2O_3)	1.94
Iron Oxide (Fe_2O_3)	0.033
Calcia (CaO)	0.10
Magnesia (MgO)	0.00
Soda (Na_2O)	0.01
Potassia (K_2O)	0.00
Chromium Oxide (Cr_2O_3)	0.0007
Ign. Loss (1200°C.)	0.78
TOTAL	100.0

RECEIVED
MAR 28 1973
DEPT. 423

Leo E. Stadler

pjm

30372

FORM 16A

EXHIBIT NO. 7.

TYLER

QUOTATION

W. S. TYLER, INCORPORATED
A SUBSIDIARY OF COMBUSTION ENGINEERING, INC.
8200 TYLER BOULEVARD,
TELETYPE: 255-4001

SCREENING DIVISION
MENTOR, OHIO 44060
TELEX: 98-5416
TELEPHONE: 216-255-9131

FOR Swindell Dressler, Inc.
Pittsburgh, Pennsylvania
For: Jordon Glass Sand Project

DATE April 5, 1973

Proposal #73-184-1-AH-4/5

QUANTITY		EXPORT PRICE
1	- 3' wide x 10' long, two surface, Type 38 Tyler Hummer Electric Vibrating Screen equipped with two V-50 vibrators, standard aluminum dust covers; dust-proofing throughout; flanged discharge chutes on both decks, per preliminary drawings H-1275 and H-1469. PRICE . . .	$4,821.00
1	- 3' Steel Plate Balance Gate Feeder with extension, per preliminary drawing B-5243 and installed at 30° angle. PRICE . . .	$ 220.00
X 1	- 3' x 10' Collecting Fines Hopper, flanged with round opening, for bolting to lower flanges of Hummer body, per preliminary drawing B-9596 and installed at 30° angle. PRICE . . .	$ 548.00
1	- Model #818-S2 Tyler Solid State Power Unit for operation off of one phase of 230 volt, 60 cycle line current, per V-20039. Maximum power requirement 15 KVA. Capacity four V-50 vibrators. PRICE . . .	$ 699.00
2	- 3' x 5' sections, 24 mesh, .013" diameter tinned steel wire with heavily rolled tinned steel backing cloth (half sandwich) with reinforced hooked edges. $39.50 EACH PRICE . . .	$ 79.00
2	- 3' x 5' sections, 105 mesh stainless steel bolting cloth, .003" diameter wire with heavily rolled tinned steel backing cloth with reinforced edges. PRICE EACH $103.00 . .	$ 206.00
	TOTAL PRICE FOR ABOVE EQUIPMENT F.O.B. MENTOR, OHIO WITH FREIGHT ALLOWED TO NEW YORK CITY PORT OF EXIT. - - - - -	$6,573.00

Estimated Weight 4025 lbs.

X THIS HOPPER MAY BE SUPPLIED LOCALLY

THIS QUOTATION IS SUBMITTED SUBJECT TO THE TERMS AND CONDITIONS ON THE REVERSE HEREOF.

F.O.B. MENTOR, OHIO

SHIPMENT: 5 to 6 weeks after receipt of order and final approved drawings.

TERMS: 30 days Net

W. S. TYLER, INCORPORATED

BY Aron W. Hajde
Aron W. Hajde

EXHIBIT NO. 8.

March 8, 1973

LABORATORY TEST REPORT

TRIPLE/8 DYNAMICS

SWINDELL-DRESSLER COMPANY
A DIVISION OF PULLMAN IND.
441 Smithfield Street
Pittsburgh, Pennsylvania 15222
Phone: Area 412/562-7000

TEST NO: S-73-19
DATE: 3-6-73
BY: Howell C.Willis
FILE: PIT187DO

MATERIAL: Jordan Sand Beneficiation Project
Material No. 30372 Jordan Sand
(0.025% to 0.043% Fe_2O_3 content)

TEST PURPOSE: To reduce Fe_2O_3 content to 0.02% or better.

EQUIPMENT USED:

1. SIEVE ANALYSIS - 3 Minute Ro-Tap.
2. SCREEN - 1' x 2' RESONANT LABORATORY SCREEN with 40 mesh and 150 mesh decks.
3. SEPARATOR - V-135A LABORATORY GRAVITY MODEL

SIEVE ANALYSIS: 3 Minute Ro-Tap

TYLER NO.	GRAMS RETAINED	PERCENT
42 Mesh	220.7	29.6%
48 Mesh	180.6	24.2%
65 Mesh	210.5	28.2%
100 Mesh	104.8	15.4%
150 Mesh	27.7	3.7%
Pan	1.5	.1%

SCREENING: The entire quantity of material was screened through 40 mesh and 150 mesh screen cloth on the 1' x 2' Resonant Screen. The + 40 mesh and - 150 mesh products were collected and set aside. The - 40 mesh, + 150 mesh product was collected and used for the following listed Gravity Separator test.

1031 SOUTH HASKELL AVENUE □ DALLAS, TEXAS 75223 □ AREA CODE 214 821-9143

TEST NO. 1: 2 Minutes. Deck slope set such that discharge from the deck was evenly distributed.

Cut #1 -	2 Lbs. 8-1/2 Ozs.	14.3%
Cut #2 -	5 Lbs. 3-1/2 Ozs.	29.6%
Cut #3 -	5 Lbs. 0 Ozs.	28.3%
Cut #4 -	4 Lbs. 14-1/2 Ozs.	27.8%

Total -17.65 Lbs./ 2 Min. = 530 Lbs./Hr.

TEST NO. 2: - Deck slope was increased and deck air decreased slightly providing a greater concentration from the light end of the deck. Test time - 1 minute, 35 seconds

Cut #1 -	13-1/2 Ozs.	6.0 %
Cut #2 -	2 Lbs 11-1/2 Ozs.	19.5%
Cut #3 -	4 Lbs. 1/2 Oz.	28.8%
Cut #4 -	6 Lbs. 7 Ozs.	46.0%

Total - 14.03 Lbs./ 1.58 Minutes = 532 Lbs./Hr.

TEST NO. 3: - Deck slope decreased and air decreased, thus, effecting a heavier concentration at the heavy end of the deck. Time of test: 2 minutes.

Cut #1 -	5 lbs. 10 Ozs.	30.7%
Cut #2 -	6 Lbs. 14 Ozs.	37.6%
Cut #3 -	4 Lbs. 4-1/2 Ozs.	23.4%
Cut #4 -	1 Lb. 9-1/2 Ozs.	8.7%

Total - 18.38 Lbs./ 2 Minutes = 552 Lbs./Hr.

TEST NO. 4: - The deck slope and air settings were adjusted to achieve the smallest possible concentration at the heavy end of the deck. - Time of test:3.5 minutes.

Cut #1 -	7-1/2 Ozs.	1.52%
Cut #2 -	3 Lbs. 9-1/2 Ozs.	11.6 %
Cut #3 -	5 Lbs. 7 Ozs.	17.6 %
Cut #4 -	21 Lbs. 6 Ozs.	69.2 %

Total - 30.88 Lbs./3.5 Min. = 530 Lbs./Hr.

Samples from each test and each cut were taken and packaged in separate plastic bags with the test number and cut number identified.

The cut number designates the point along the Gravity Separator deck at which the material was discharged. Cut #1 designates the point at the top of the deck where the heavy material was discharged. Cut #4 designates the light end of the deck where the light material was discharged. Cut No. 2 and No. 3 represent the intermediate points.

CONCLUSIONS:

No conclusions could be made as to the success or failure of these tests. We were unable to determine the results by visual examination. Test samples are being returned for customer's analysis will determine the success or failure.

TRIPLE/S DYNAMICS, INC.

Howell C. Willis

Howell C. Willis

mcg

HARTFORD DIVISION *EXHIBIT NO. 9.*

EMHART CORPORATION
GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD CONNECTICUT 06102 U.S.A.

Report No. 7303113

Swindell Dressler Company
441 Smithfield Street
Pittsburgh, Penn. 15222

Attn: Mr. W. A. Esselst

Reported 3/26/73
Reference PO# 173129
Sample Sand
Source
Marked Cut #1
Received 3/19/73
Tests (C-19)Fe_2O_3

CHEMICAL ANALYSIS
Iron Oxide (Fe_2O_3) 0.10

Leo E. Stadler

pjm

HARTFORD DIVISION *EXHIBIT NO. 10.*

EMHART CORPORATION
GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD CONNECTICUT 06102 U.S.A.

Report No. 7303114

Swindell Dressler Company
441 Smithfield Street
Pittsburgh, Penn. 15222

Attn: Mr. W. A. Esselstyn

Reported 3/26/73
Reference PO# 173129
Sample Sand
Source
Marked Cut #2
Received 3/19/73
Tests (C-19)Fe_2O_3

CHEMICAL ANALYSIS
Iron Oxide (Fe_2O_3) 0.025

Leo E. Stadler

pjm

HARTFORD DIVISION

EXHIBIT NO. 11.

EMHART CORPORATION
GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD, CONNECTICUT 06101, U.S.A.

Report No. 7303115

- Swindell Dressler Company
  441 Smithfield Street
- Pittsburgh, Penn. 15222
- Attn: Mr. W. A. Esselstyn

Reported 3/26/73
Reference PO# 173129
Sample Sand
Source
Marked Cut #3
Received 3/19/73
Tests (C-19)Fe_2O_3

CHEMICAL ANALYSIS
Iron Oxide (Fe_2O_3) 0.024

Leo E. Stadler

pjm

HARTFORD DIVISION

EXHIBIT NO. 12.

EMHART CORPORATION
GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD, CONNECTICUT 06101, U.S.A.

Report No. 7303116

- Swindell Dressler Company
  441 Smithfield Street
- Pittsburgh, Penn. 15222
- Attn: Mr. W. A. Esselstyn

Reported 3/26/73
Reference PO# 173129
Sample Sand
Source
Marked Cut #4
Received 3/19/73
Tests (C-19)Fe_2O_3

CHEMICAL ANALYSIS
Iron Oxide (Fe_2O_3) 0.032

Leo E. Stadler

pjm

30372

PROPOSAL

EXHIBIT NO. 13.

TRIPLE/8 DYNAMICS SYSTEMS, INC.

1031 SOUTH HASKELL AVENUE ☐ DALLAS, TEXAS 75223

CABLE "TRIDYNAMIC"
Telephone: 214 821-9143

Proposal to:

Mr. W. A. Esselstyn, Project Manager
SWINDELL-DRESSLER COMPANY, A DIVISION
OF PULLMAN INCORPORATED
441 Smithfield St.
Pittsburgh, Pennsylvania 15222

Proposal No. 187DO
Date Apr.12,1973
Your Inquiry No.

ITEM NO.	QTY.	DESCRIPTION	UNIT PRICE	AMOUNT
		To process 25 tons per 8-hour day of Jordan Sand and concentrate Fe_2O_3 content to approximately .02%.		
1	2	SUTTON-STEELE MODEL BX-255AR(E) GRAVITY SEPARATORS, ONE RIGHT-HAND AND ONE LEFT-HAND, SPECIALLY DESIGNED FOR ABRASION-RESISTANT OPERATION, with integrally mounted fiberglass exhaust hood, No. 200 deck assembly, drive and drive guard for 10 HP, 1750 RPM electric motor, less motor and controls.....	$4,980.00	$9,960.00
		Options:		
2	2	10 HP, 1750 RPM, 3/60/230-460 volt, TEFC electric motor and slide base, mounted, less motor controls.....	320.00	640.00
		Option:		
3	2	Set of exhaust system components (4,500 CFM capacity) including: No. 35 Blower, No. 30 TP Cyclone, 12" Blast Gate, 10 HP drive and 10 HP, 1750 RPM electric motor	$2,620.00	$5,040.00
		Option:		
4	1	Exhaust system (9,000 CFM capacity consisting of: No. 50 blower (Continued)		

RIPLE/S DYNAMICS SYSTEMS, INC.

F. O. B.:

SHIPMENT:

TERMS:

This proposal is made subject to the terms of the following attachments which become a part hereof.

☐ Standard Conditions of Sale. ☐ Other:

This proposal is void unless accepted within 30 days from date hereof, and, in the meantime, is subject to change without notice. It supersedes all previous quotations and agreements relative to this transaction.

PROPOSAL

TRIPLE / 8 DYNAMICS SYSTEMS, INC.

1031 SOUTH HASKELL AVENUE ☐ DALLAS, TEXAS 75223

CABLE "TRIDYNAMIC"
Telephone: 214 821-0143

Proposal to: Mr. W. A. Esselstyn, Project Mgr.
SWINDELL-DRESSLER COMPANY

Proposal No. 187DO
Date Apr.12,1973
Your Inquiry No.

ITEM NO.	QTY.	DESCRIPTION	UNIT PRICE	AMOUNT
		No. 48 TP Cyclone, 15" Blast Gate, 15 HP, blower drive and motor		$4,520.00
5		To screen Jordan Sand, separating it into three fractions as follows: + 30 mesh; - 30 mesh + 100 mesh; at the rate of 25 TP 8-hour day.		
	1	OVERSTROM 4' x 10' 2-deck SERIES 1000 INCLINED VIBRATING SCREEN with helical steel isolation springs, 2 non-blinding screen decks with 30 mesh and 100 mesh stainless steel wire cloth, drive and drive guard for 10 HP, 1750 RPM electric motor, less motor and controls		
		A. Open Construction	$5,195.00	
		B. Completely dust-tite construction	$9,170.00	
	1	10 HP, 1750 RPM, 3/60/230-460 volt, TEFC electric motor, less motor controls	$ 320.00	$ 320.00

TRIPLE/8 DYNAMICS SYSTEMS, INC.

Howell C. Willis

Howell C. Willis

F. O. B.: Breckenridge, Texas

SHIPMENT: Approx.8 weeks after drawing approval.

TERMS: Net 10 Days

mcg

This proposal is made subject to the terms of the following attachments which become a part hereof.

☒ Standard Conditions of Sale. ☐ Other:

This proposal is void unless accepted within 30 days from date hereof, and, in the meantime, is subject to change without notice. It supersedes all previous quotations and agreements relative to this transaction.

THE EXOLON COMPANY
TONAWANDA, NEW YORK

EXHIBIT NO. 14

LABORATORY TEST REPORT SHEET

Material: Jordan Glass Sand
Sent by: Swindell-Dressler Company
Test No. 1880
Method of Treatment: Date Rec'd 2/9/73 Date Tested 2/17/73

Magnetic Induction

RESULT OF TEST

The sample was separated as received with the following results:

Run No.	1
Size	As Rec'd. **
*Feed Rate lbs/hr/rotor inch	108#

Products of Separation	% Weight	% Fe_2O_3
1st Removed	0.1	
2nd "	1.1	
3rd "	1.6	
Not "	97.2	0.02
	100.0	
Original		0.04

*Equivalent to approximately 3240 lbs/hr/Single 30" Separator
" " " 6480 lbs/hr/Double 30" Separator

**Screen Analysis (U.S.Std.Sieves)

20 -	--
30 -	T
40 -	T
50 -	36
70 -	37
100 -	18
140 -	9
200 -	T
-200 -	T

Date 2/19/73

THE EXOLON COMPANY

By JPJ

30372

HARTFORD DIVISION

EXHIBIT NO. 15.

EMHART CORPORATION
GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD, CONNECTICUT 06102 U.S.A.

Report No. 7303110

Swindell Dressler Company
441 Smithfield Street
Pittsburgh, Penn. 15222

ATtn: Mr. W. A. Esselstyn

Reported 3/26/73
Reference PO# 173129
Sample C-1-B-E Sand
Source
Marked
Received 3/19/73
Tests (C-19)Fe_2O_3

CHEMICAL ANALYSIS
Iron Oxide (Fe_2O_3) 0.023

Leo E. Stadler

pjm

EXHIBIT NO. 16.

THE EXOLON COMPANY
TONAWANDA, NEW YORK
U. S. A.

PROPOSAL

EXOLON EQUIPMENT

DATE February 22, 1973

SUBMITTED BY The Exolon Company

TO Swindell-Dressler Company
Div. of Pullman, Inc.
441 Smithfield Street
Pittsburgh, Pa. 15222

FOR Jordan

PROPOSAL — EXOLON EQUIPMENT

EQUIPMENT

ONE - Standard 85805, Double 30", Type D-1A, Exolon Magnetic Separator equipped as follows:

Driving unit consisting of Variable Speed Transmission, Speed Reducers, and driving motor for 3 phase, 50 hertz, 220/380 volt current specifications, or one of other specifications of equal costs. If more costly motor is required the difference shall be added to the amount to be paid.

Two Vibrator Feeders for single phase, 50 hertz, 220 volt current specifications.

Six Single Knife Edges (one for each rotor).

Six Rubber Blade Rotor Brushes (one at each rotor).

Crating for Export Shipment in one piece, $814.00, not included in the amount given below. Crate specifications are as follows:

Weight:	Net	13,500 pounds	Size:	Height	8'-1"
	Gross	16,000 "		Width	6'-5½"
				Length	10'-0"

Displacement: 525.4 Cubic Feet

Inland Freight: Tonawanda, New York to SS pier New York, New York, approximately $545.00, not included below.

Forwarding Fees: Approximately $65.00, not included below.

PRICE: **UNCRATED** $25,513.00

~~CRATED FOR EXPORT~~

F. O. B. TONAWANDA, NEW YORK

FIRM FOR 60 **DAYS AFTER WHICH SUBJECT TO CHANGE WITHOUT NOTICE.**

Any tax imposed by any present or future law, Federal, State, or any other Governmental Agency, on the sale of articles covered hereby, shall be added to the amount to be paid.

TERMS AND CONDITIONS: Irrevocable Letter of Credit in U. S. Funds in our favor at Marine Midland Trust Company of Western New York, Buffalo, N. Y., U.S.A.

SHIPMENT: Approximately 22 to 24 weeks after date of receipt of order and full specifications.

REMARKS: **The right is reserved to modify shipping date in case of damage to Company's machinery or works, or labor trouble, or any serious conditions or circumstances affecting adversely usual performance.**

THE EXOLON COMPANY

J. P. Jansen

2/22/73

By J. P. Jansen
Manager
Machinery Manufacturing
30372

[redacted]

ONE - Silicon Rectifier Power Conversion unit of 2 KW at 125 volts D.C. Output designed to operate from 220 or 380 volts, 3 phase, 50 hertz Alternating Current. This unit will be mounted in a convection cooled Nema 1 wall mounted cabinet with front inspection door. It will consist of the following components:

Three pole 600 volt AC Starter with overload relays and start-stop pushbuttons.

Isolating transformer with one 5% tap above and below normal for line voltage adjustment.

Current limiting fuses in each secondary.

Silicon rectifier full wave bridge.

Selenium Surge Suppressor, Pilot Lamp, D. C. Line fuses and terminals, D. C. voltmemter and D. C. ammeter.

Price f.o.b. Tonawanda, New York $1,231.00
Crated for Export Shipment

THE EXOLON COMPANY

JPJ
2/22/73

DESCRIPTION CONTINUED

Recommended Spare Parts for Standard 85805, Double 30", Type D-1A, Exolon Magnetic Separator described on page 2 of this proposal:

Amount	Description	Price Each	Total
4	311-K Bearing	$14.59	$58.36
2	SK11 Sleeve	13.90	27.80
2	10N Locknut	.89	1.78
2	10W Lockwasher	.19	.38
4	1880 (1879) Seal	2.80	11.20
2	976 Seal	2.28	4.56
2	C-3338-2 Sleeve, #4	8.19	16.38
2	C-3338-3 Spacer, #11	11.68	23.36
2	C-3338-4 Spacer, #12	11.68	23.36
1	4" Rotor (Bare)	634.48	634.48
2	60B V-Belt	4.86	9.72
4	68B V-Belt	5.38	21.44
8	22312K Bearing	45.05	360.40
4	SK112 Sleeve	19.45	77.80
4	N-11 Locknut	1.04	4.16
4	W-11 Lockwasher	.19	.76
16	2039 (2038) Seal	3.28	50.88
4	1194 (1192) Seal	1.85	7.40
4	C-3256-2 Sleeve, #6	9.27	37.08
4	C-3256-3 Spacer, #17	15.18	60.72
4	C-3256-4 Spacer, #18	17.11	68.44
1	T100 DB V-Belt	130.03	130.03
2	1720 or 2660 V-Belt	2.74	5.48
4	#126 Coupling	29.54	118.16
2	C-3230-1 (700-19) V.F. Coil	28.08	56.16
1	C-3230-2 Armature	42.50	42.50
1	C-3230-3 Core	46.72	46.72
1	D-8690A VF Control	181.00	181.00
2	5" Rotor (Bare)	976.72	1,953.44

Net Total, f.o.b. Tonawanda, New York, Crated $4,033.95

Crated for Export in <u>one</u> box of the following specifications:

Weight: Net 662 pounds
Gross 806 "

Size: Height 1'-6½"
Width 1'-5½"
Length 6'-0"

Displacement: 14 Cubic Feet

Shipment: With Magnetic Separator with no additional cost for freight from Tonawanda, New York to SS pier New York, New York.

JPJ
2/22/73

EXHIBIT NO. 17.

Central Test Laboratory
REPORT OF TEST

ERIEZ MAGNETICS

Date: April 3, 1973 Research Request: 2056

Test Made For: Swindell Dressler Co.

Address

City State

PROBLEM: Removal of ferrous contamination from sand.

DISCUSSION & CONCLUSION: The sample brought in by the customer was screened so that we had a sample of -30 +100 mesh material to test on the I.M.R. Two test were run on the I.M.R. at 100 lbs. per in. per hr. The only difference in the test was a wide splitter setting in test 2 as compared to test 1. The analysis of the cleaned samples was done by the customer and reported to G.D. Sealy over the phone.

Flow sheet and results can be found on attached flow sheet.

RECOMMENDATIONS: Based on analysis reported, we would recommend the use of 3 Roll I.M.R.'s with the first roll being used as a scalping roll. Sizing of units to be based on a feed of 100 lbs/in./hr.

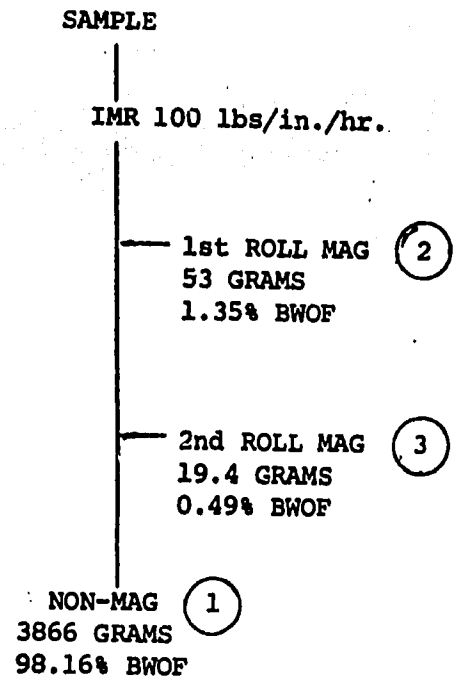
John Palmer
Research Tech.

JP/kjf

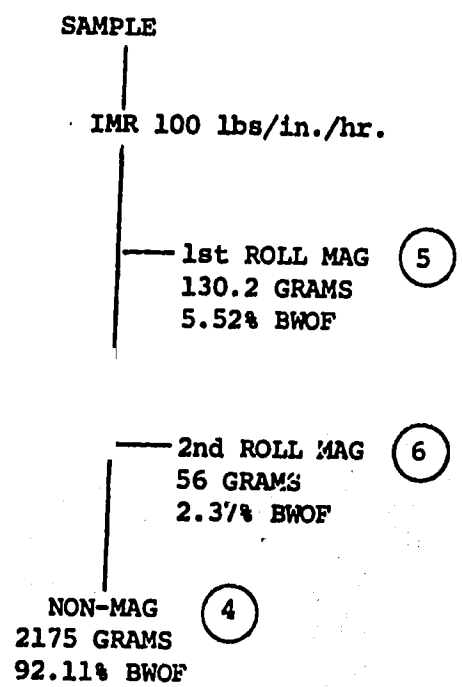
FLOW SHEET

MATERIAL SCREENED TO -30 +100 MESH

TEST 1



TEST 2



*BWOF - By weight of feed

30372

HARTFORD DIVISION

EXHIBIT NO. 18.

EMHART CORPORATION

GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD, CONNECTICUT 06102 U.S.A.

Report No. 7303111

- Swindell Dressler Company
  441 Smithfield Street
- Pittsburgh, Penn. 15222
- Attn: Mr. W. A. Esselstyn

Reported 3/26/73
Reference PO# 173129
Sample E-1 Sand
Source
Marked
Received 3/19/73
Tests C-19 Fe_2O_3

CHEMICAL ANALYSIS
Iron Oxide (Fe_2O_3) 0.021

Leo E. Stadler

pjm

HARTFORD DIVISION

EXHIBIT NO. 19.

EMHART CORPORATION

GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD, CONNECTICUT 06102 U.S.A.

Report No 7303112

- Swindell Dressler Company
  441 Smithfield Street
- Pittsburgh, Penn. 15222
- Attn: Mr. W. A. Esselstyn

Reported 3/26/73
Reference PO# 173129
Sample E-2 Sand
Source
Marked
Received 3/19/73
Tests (C-19) Fe_2O_3

CHEMICAL ANALYSIS
Iron Oxide (Fe_2O_3) 0.021

Leo E. Stadler

pjm

EXHIBIT NO. 20.

ERIEZ MAGNETICS

ASBURY ROAD AT AIRPORT • ERIE, PENNSYLVANIA 16512, U.S.A.
814/833-9881
TLX: 91-4470

HEADQUARTERS DIVISION

April 5, 1973

Swindell-Dressler Company
441 Smithfield Street
Pittsburgh, Pennsylvania 15222

Attention: Mr. W. A. Esselstyn
Project Manager
Ceramics and Glass

SUBJECT: JORDAN SANDS PROJECT
ERIEZ QUOTATION NO. S3-592

This, Mr. Esselstyn, is in regard to the magnetic separation tests conducted on the sample of Jordan sands during your visit of February 28. Chemical analysis results which you provided indicate that we were able to reduce the Fe content in the sand from .036 to .021.

You have indicated that you do not need as good a grade as that obtained and therefore we can feed the separator at a higher volume. Also, since there was very little minus 100 mesh material you have decided to just screen off the plus 30 mesh material.

Based on the above information we are pleased to quote on the required equipment as follows:

ITEM 1 - SCREENING FEEDER

1 - Volumatic Feeder Machine, consisting of:

6 cu. ft. mild steel hopper with supporting framework.
50A Feeder having a 9" x 38" mild steel tray incorporating a 30 mesh screen with discharge for oversize.
G/115 volt control.

PRICE ---------- 1,261.00

ITEM 2 - FEEDER MACHINE FOR IMR'S

1 - Volumatic Feeder Machine, consisting of a 6 cu. ft. hopper with double pant leg opening with slide gates each opening to a 28" x 20" stainless steel tray mounted on two 45A Feeders with supporting framework and G/115 volt control on each feeder.

PRICE ----------$ 3,609.00

THE WORLD AUTHORITY IN MAGNETICS AS APPLIED TO SYSTEMS AND COMPONENTS FOR POLLUTION CONTROL, MATERIAL MOVEMENT, SEPARATION, PURIFICATION, BENEFICIATION, RECLAMATION AND AUTOMATION
Manufacturing Affiliates in: AUSTRALIA • BRAZIL • CANADA • FRANCE • GREAT BRITAIN • JAPAN • MEXICO • SO. AFRICA

ITEM 3 - IMR SEPARATOR

1 - Eriez 60" (30" back to back) standard 3 roll IMR Separator, first roll scalper, second and third roll high intensity, rated 3600 watts, complete with two 3 hp motors and drive, fully assembled and ready for operation and as further described in the enclosed Bulletin SB-540.

APPROXIMATE SHIPPING WEIGHT ----- 14,000 lbs.

PRICE ---------- $ 19,360.00

ITEM 4

To convert 230/460 volt, 60 cycle, 3 phase AC to 115 volt DC for the above IMR Separator, we recommend:

1 - Silicon Rectifier, Model 35C, 3.5 kw, normal convection cooled, full wave bridge circuit with fused AC switch in a NEMA 1 enclosure:

SHIPPING WEIGHT ---------- 220 lbs.

PRICE ---------- $ 576.00

ITEM 5

1 - Eriez 30" wide 3 roll standard IMR Separator, first roll scalper and second and third roll high intensity, complete with one 3 hp motor and drive, rated 1800 watts, fully assembled and ready for operation and as further described in Bulletin SB-540.

APPROXIMATE SHIPPING WEIGHT ----- 11,000 lbs.

PRICE ---------- $ 10,194.00

ITEM 6

To convert 230/460 volt, 60 cycle, 3 phase AC to 115 volt DC for the above IMR separator, we recommend:

1 - Silicon Rectifier, Model 20C, 2 kw, normal convection cooled, full wave bridge circuit with fused AC switch in a NEMA 1 enclosure:

SHIPPING WEIGHT ---------- 190 lbs.

PRICE ---------- $ 362.00

Above quoted prices are net with all discounts deducted.

F.O.B. Erie, Pennsylvania, terms net thirty days.

Current estimated delivery approximately 6-8 weeks.

Items 5 and 6 are offered in addition to Items 3 and 4 for your consideration. These would be required for increased capacities or product purity as obtained in the laboratory tests.

I am enclosing Test Report RR 2056 covering the tests conducted during your visit.

We trust the above information and quotation is complete and meets with your approval, although should you have any questions or be in need of further information, please contact us directly or through Mr. Don Peepels at our -

PITTSBURGH DISTRICT OFFICE
3471 BABCOCK BOULEVARD
PITTSBURGH, PENNSYLVANIA 15237

TEL: 412/931-2440

We wish to thank you, Mr. Esselstyn, for this opportunity to quote on the required equipment and we ask for your business.

Sincerely,

ERIEZ MAGNETICS

G. D. SEALY - SALES ENGINEER - SEPARATION
CONCENTRATION/BENEFICIATION

bdf

Encl. Bulletins SB-540, SB-620, Research Report 2056
Vibratory Bulletins VB-3200A, VB-3000 and VT-3955A

cc: Pittsburgh District Office

EXHIBIT NO. 21.

EMHART CORPORATION
GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD, CONNECTICUT 06102 U.S.A.

Report No. 7304038, 39 & 40

Swindell Dressler Company
441 Smithfield Street
Pittsburgh, Penn. 15222

Attn: Mr. W. A. Esselstyn

Reported 4/17/73
Reference PO# 173129
Sample Test Melts
Source EGTL
Marked
Received 4/9/73
Tests M-2

Test melts were made using different raw materials intended for use in the manufacture of flat glass. The purpose of the melts was to see what color the materials would produce in the glass.

The batch used for the tests was supplied by Swindell-Dressler and is shown in Table I.

TABLE I
BATCH

MATERIAL	Kg per Batch
Sand	453.60
Soda Ash	136.90
Dolomite, Raw	68.50
Limestone	62.50
Salt Cake	48.10
Feldspar	18.20
Charcoal	2.15
Arsenic Oxide	2.04

This batch was scaled down to 200 grams sand basis for the Laboratory scale melts. The weighed batches were ball milled for 30 minutes to homogenize the materials and melted at 2650°F for two hours in a gas fired furnace. At the end of the melting period the glass was cast into bars about 3/4 x 3/4 x 6 inches and annealed.

A total of twelve melts were made. The raw materials used in each melt are shown in Table II.

...cont./

TABLE II
TEST MELTS

EB-1	Trench No. 9 Raw Sand	&	All	Rest	U.S.	Batch	Materials
EB-2	Trench No. 1 Raw Sand	"	"	"	"	"	"
EB-3	Trench No. 1 - SSS Sand Cut #3	"	"	"	"	"	"
EB-4	Trench No. 1 - Exolon Sand	"	"	"	"	"	"
EB-5	Trench No. 1 - Eriez Sand E1	"	"	"	"	"	"
EB-6	Trench No. 1 - Eriez Sand E1 & SD-30 Limestone	"	"	"	"	"	"
EB-7	Trench No. 1 Exolon Sand & SD-30 Limestone	"	"	"	"	"	"
EB-8	U.S. Sand & SD-30 Limestone	"	"	"	"	"	"
EB-9	U.S. Sand & Jordan Feldspar	"	"	"	"	"	"
EB-10	Trench #1 Raw Sand & Jordan Feldspar	"	"	"	"	"	"
EB-11	Trench #1 Eriez Sand E-1 & Jordan Feldspar	"	"	"	"	"	"
EB-12	All Materials U.S. Batch	"	"	"	"	"	"

The test bars were marked on the bars with a diamond marking pencil and sent to Mr. W. A. Esselstyn on April 13, 1973.

The iron content of the U.S. Sand and limestone used in the melts was not known. These two raw materials were analyzed for iron oxide at the request of Mr. Esselstyn. The results are as follows:

MATERIAL	IRON OXIDE (Fe_2O_3)
U.S. Sand	0.022%
Limestone	0.12%

Leo E. Stadler

pjm

HARTFORD DIVISION

EXHIBIT NO. 22.

EMHART CORPORATION
GLASS TESTING LABORATORIES
P. O. BOX 1620
HARTFORD, CONNECTICUT 06102 U.S.A

Report No. 7303117

Swindell Dressler Company
441 Smithfield Street
Pittsburgh, Penn. 15222

Attn: Mr. W. A. Esselstyn

Reported 3/26/73
Reference PO# 173129
Sample F-1 Feldspar
Source
Marked
Received 3/19/73
Tests (C-19) Fe_2O_3

CHEMICAL ANALYSIS

Iron Oxide (Fe_2O_3)	0.12

Leo E. Stadler

pjm

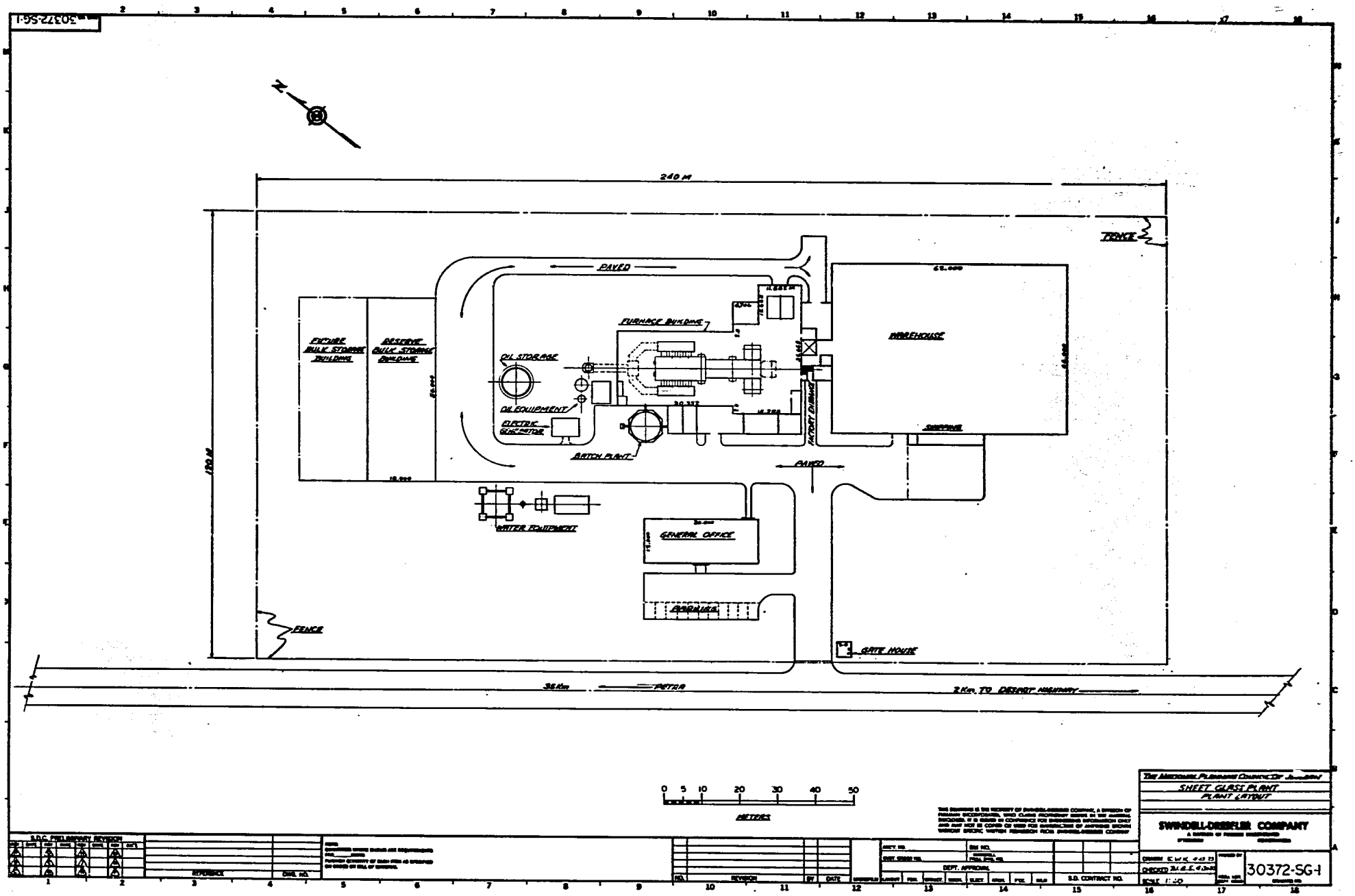
FORM 16A

EXHIBIT NO. 23

Specifications for Chemical Composition of Glass Sands[1]

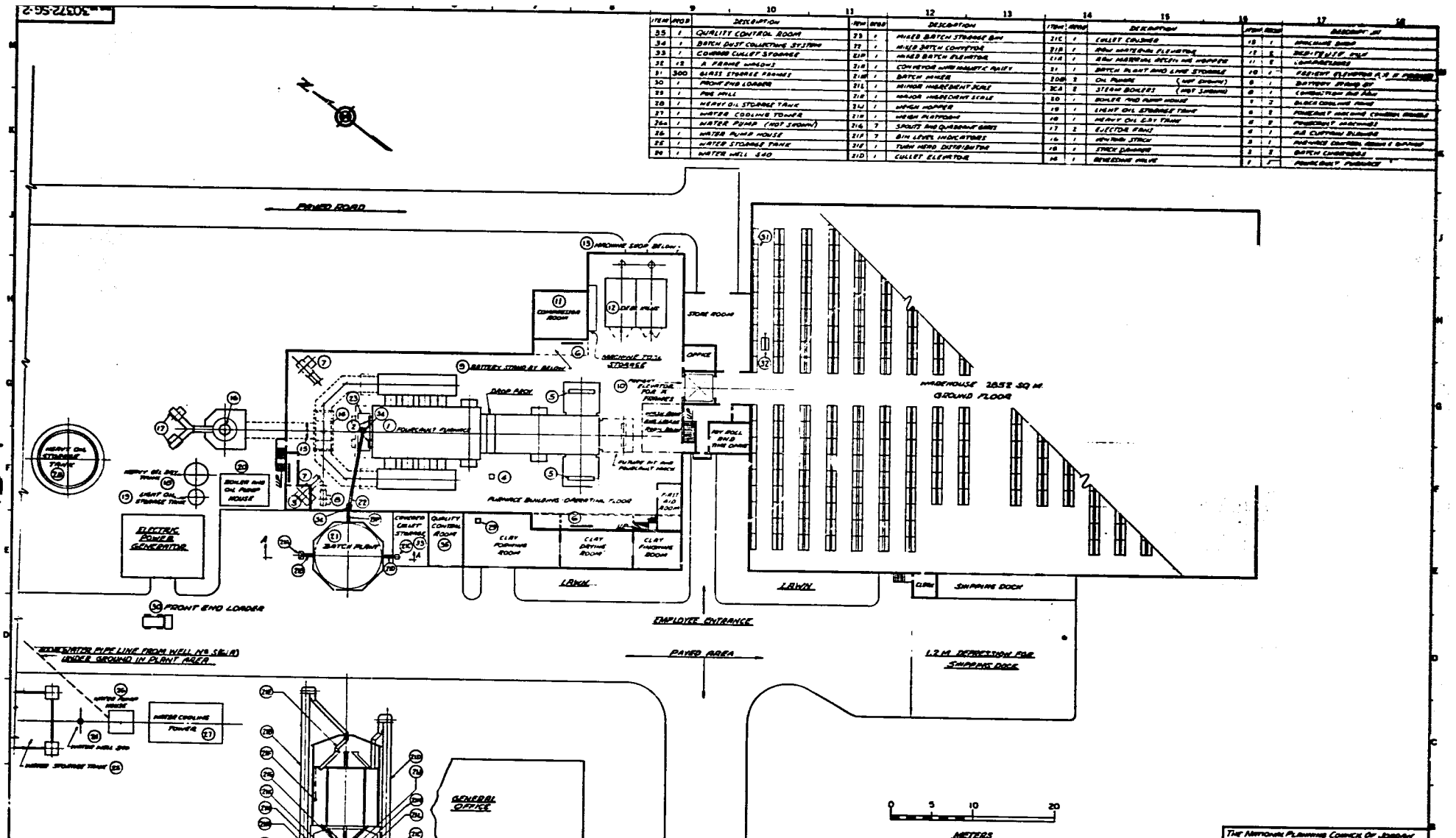
Qualities	SiO_2 min	Al_2O_3 max	Fe_2O_3 max	CaO + MgO max
1st quality (optical glass)	99.8	0.1	0.02	0.1
2nd quality (flint containers and tableware)	98.5	0.5	0.085	0.2
3rd quality (flint glass)	95.0	4.0	0.035	0.5
4th quality (sheet and plate glass)	98.5	0.5	0.06	0.5
5th quality (sheet and plate glass)	95.0	4.0	0.06	0.5
6th quality (green glass containers and window glass)	98.0	0.5	0.3	0.5
7th quality (green glass)	95.0	4.0	0.3	0.5
8th quality (amber glass containers)	98.0	0.5	1.0	0.5
9th quality (amber glass)	95.0	4.0	1.0	0.5

[1]Recommended by the American Ceramic Society and the National Bureau of Standards.

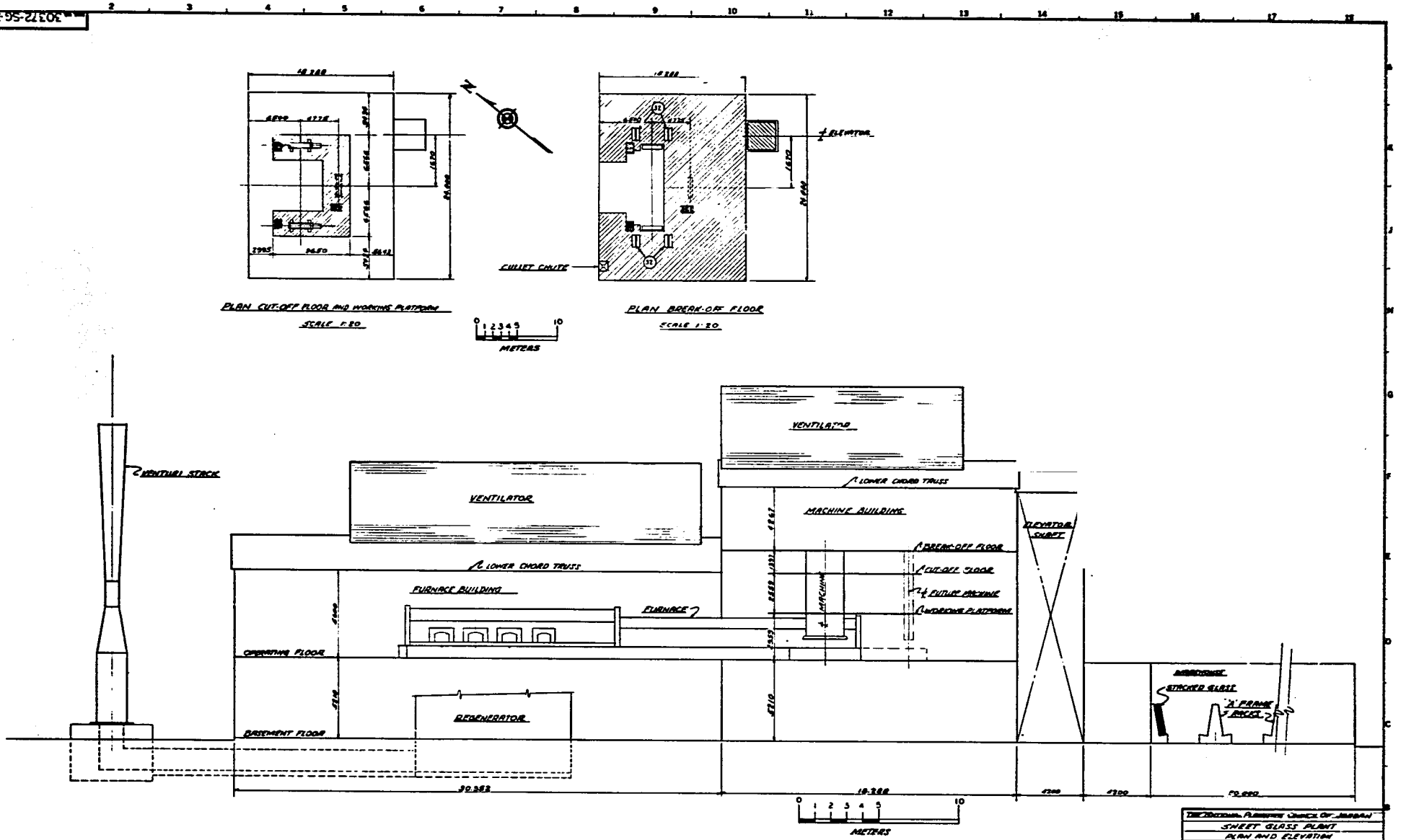

240 M
PAVED
FENCE
FURNACE BUILDING
OIL STORAGE
OIL EQUIPMENT
ELECTRIC GENERATOR
BATCH PLANT
FACTORY BUILDING
WAREHOUSE
SHIPPING
PAVED
WATER EQUIPMENT
GENERAL OFFICE
PARKING
GATE HOUSE
FENCE
36 Km
PETER
2 Km. TO DESERT HIGHWAY
METERS
SHEET GLASS PLANT
PLANT LAYOUT
SWINDELL-DRESSLER COMPANY
30372-SG-1
A.F.C. PRELIMINARY REVISION
REVISION
DATE
DEPT. APPROVAL
S.O. CONTRACT NO.

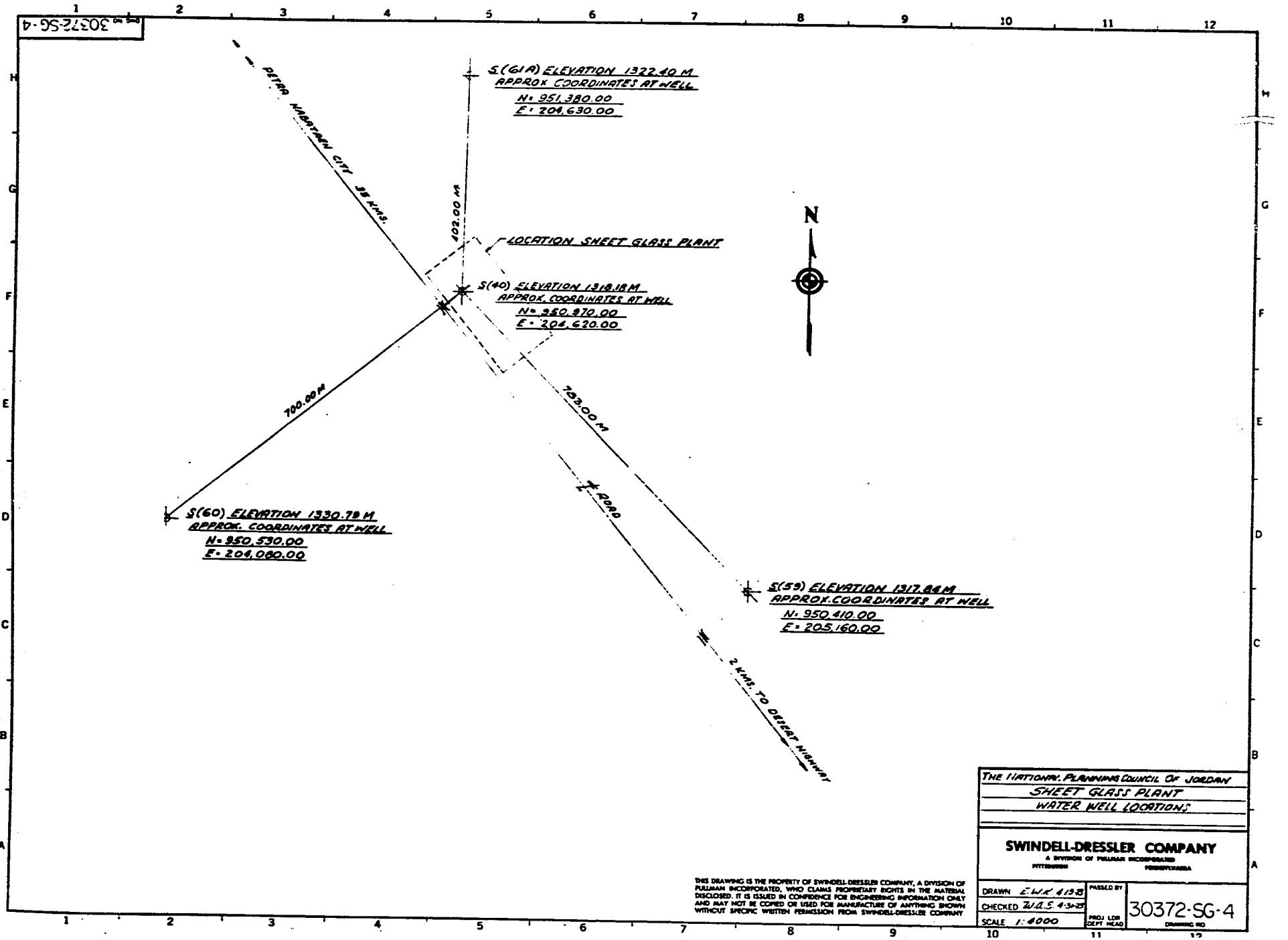
A-50

ITEM	REQD	DESCRIPTION	ITEM	REQD	DESCRIPTION	ITEM	REQD	DESCRIPTION	ITEM	REQD	DESCRIPTION
35	1	QUALITY CONTROL ROOM	23	1	MIXED BATCH STORAGE BIN	21C	1	CULLET CRUSHER	19	1	[illegible]
34	1	BATCH DUST COLLECTING SYSTEM	22	1	MIXED BATCH CONVEYOR	21B	1	RAW MATERIAL ELEVATOR	17	2	[illegible]
33	1	COARSE CULLET STORAGE	21P	1	MIXED BATCH ELEVATOR	21A	1	RAW MATERIAL BATCH WEIGHER HOPPER	11	2	COMPRESSORS
32	12	A FRAME WINDOWS	21N	1	CONVEYOR WITH MAGNETIC PULLEY	21	1	BATCH PLANT AND LINE STORAGE	10	1	FREIGHT ELEVATOR A.S.E. PRESSED
31	300	GLASS STORAGE FRAMES	21M	1	BATCH MIXER	20B	2	OIL PUMPS (NOT SHOWN)	8	1	BATTERY STAND BY
30	1	FRONT END LOADER	21L	1	MINOR INGREDIENT SCALE	20A	2	STEAM BOILERS (NOT SHOWN)	6	1	CONVEYOR BELT BELOW
29	1	PIPE MILL	21K	1	MAJOR INGREDIENT SCALE	20	1	BOILER AND PUMP HOUSE	5	2	BLACK COAL AND FUEL
28	1	HEAVY OIL STORAGE TANK	21J	1	WEIGH HOPPER	19	1	LIGHT OIL STORAGE TANK	4	2	FOREHEARTH WORKING CONDITION [illegible]
27	1	WATER COOLING TOWER	21H	1	WEIGH PLATFORM	18	1	HEAVY OIL DAY TANK	3	2	FOREHEARTH UNDERNEATH
26B	1	WATER PUMP (NOT SHOWN)	21G	7	SPOUTS AND QUADRANT GATES	17	2	EJECTOR FANS	2	1	AIR CURTAIN BLOWER
26	1	WATER PUMP HOUSE	21F	7	BIN LEVEL INDICATORS	16	1	WEIGHT STICK	3	1	FOREHEARTH CONTROL CABINET & CONTROL
25	1	WATER STORAGE TANK	21E	1	TURN HEAD DISTRIBUTOR	15	1	STACK DAMPER	2	2	BATCH CONVEYORS
24	1	WATER WELL 500	21D	1	CULLET ELEVATOR	14	1	BENECHINE VALVE	1	1	FOREHEARTH FURNACE



A-51


PLAN CUT-OFF FLOOR AND WORKING PLATFORM
SCALE 1:20
PLAN BREAK-OFF FLOOR
SCALE 1:20
CULLET CHUTE
METERS
VENTURI STACK
VENTILATOR
LOWER CHORD TRUSS
MACHINE BUILDING
ELEVATOR SHAFT
BREAK-OFF FLOOR
CUT-OFF FLOOR
FUTURE MACHINE
WORKING PLATFORM
FURNACE BUILDING
FURNACE
MACHINE
OPERATING FLOOR
BASEMENT FLOOR
REGENERATOR
WAREHOUSE
STACKED GLASS
FRAME
BRACE
SECTION ELEVATION A-A FROM DRAWING 30372-SG-2
SCALE 1:10
SHEET GLASS PLANT
PLAN AND ELEVATION
SWINDELL-DRESSLER COMPANY
30372-SG-3
A-52


S(61A) ELEVATION 1322.40 M
APPROX COORDINATES AT WELL
N: 951,380.00
E: 204,630.00
PETRA MADABA CITY 38 KMS.
402.00 M
LOCATION SHEET GLASS PLANT
S(40) ELEVATION 1318.18 M
APPROX. COORDINATES AT WELL
N: 950,970.00
E: 204,620.00
N
700.00 M
723.00 M
ROAD
S(60) ELEVATION 1330.79 M
APPROX. COORDINATES AT WELL
N: 950,530.00
E: 204,080.00
S(59) ELEVATION 1317.84 M
APPROX. COORDINATES AT WELL
N: 950,410.00
E: 205,160.00
2 KMS. TO DESERT HIGHWAY
THE NATIONAL PLANNING COUNCIL OF JORDAN
SHEET GLASS PLANT
WATER WELL LOCATIONS
SWINDELL-DRESSLER COMPANY
A DIVISION OF PULLMAN INCORPORATED
PITTSBURGH PENNSYLVANIA
DRAWN E.W.K. 4-19-83
CHECKED W.A.S. 4-30-83
SCALE 1:4000
PASSED BY
PROJ. LDR
DEPT HEAD
30372-SG-4
DRAWING NO
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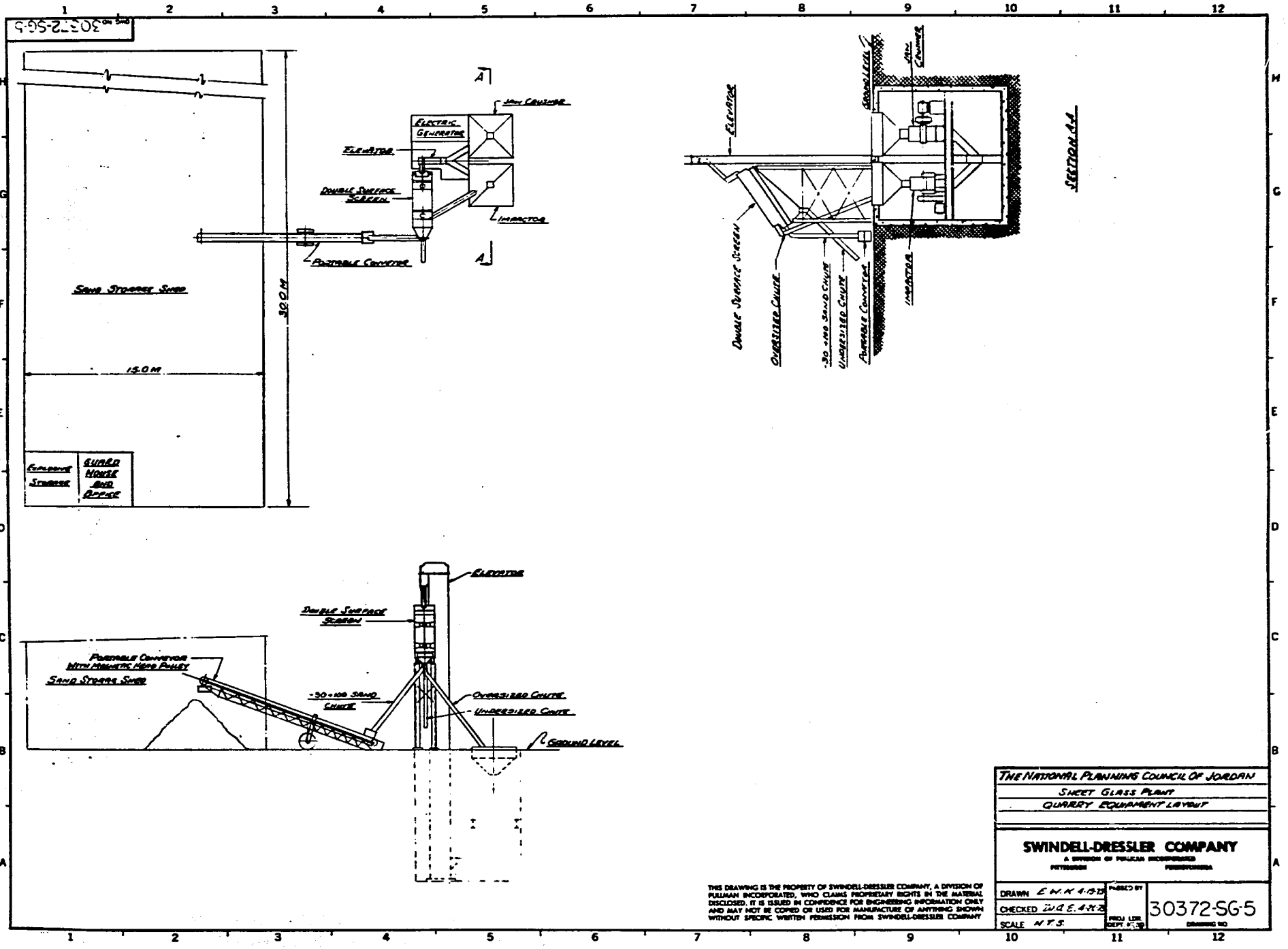
Sand Stopper Shed
15.0 M
30.0 M
Equipment Stopper
Guard House and Office
Jaw Crusher
Electric Generator
Elevator
Double Surface Screen
Impactor
Portable Conveyor
A
A
Elevator
Ground Level
Jaw Crusher
Double Surface Screen
Oversized Chute
-30 +100 Sand Chute
Undersized Chute
Portable Conveyor
Impactor
Section A-A
Elevator
Double Surface Screen
Portable Conveyor with Magnetic Head Pulley
Sand Stopper Shed
-30 +100 Sand Chute
Oversized Chute
Undersized Chute
Ground Level
The National Planning Council of Jordan
Sheet Glass Plant
Quarry Equipment Layout
SWINDELL-DRESSLER COMPANY
A Division of Pullman Incorporated
Pittsburgh Pennsylvania
Drawn E.W.K. 4-19-73
Checked W.G.E. 4-19-73
Scale N.T.S.
Project by
Proj. Eng. Dept. 4130
30372-SG-5
Drawing No.
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