Idaho National Engineering Laboratory

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DU-AGG Pilot Plant Design Study

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Lockheed Idaho Technologies Company

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ABSTRACT

The Idaho National Engineering Laboratory (INEL) is developing new methods to produce high-density aggregate (artificial rock) primarily consisting of depleted uranium oxide. The objective is to develop a low-cost method whereby uranium oxide powder ($U0_2$, U_30_8, or $U0_3$) can be processed to produce high-density aggregate pieces (DU-AGG) having physical properties suitable for disposal in low-level radioactive disposal facilities or for use as a component of high-density concrete used as shielding for radioactive materials.

A commercial company, G-M Systems, conducted a design study for a manufacturing pilot plant to process DU-AGG. The results of that study are included and summarized in this report. Also explained are design considerations, equipment capacities, the equipment list, system operation, layout of equipment in the plant, cost estimates, and the proposed plan and schedule.

CONTENTS

FIGURE

DU-AGG Pilot Plant Design Study

1. INTRODUCTION

1.1 Overview

The Department of Energy's Office of Environmental Restoration and Waste Management is sponsoring studies of alternative management strategies for depleted uranium (DU) stored throughout the DOE complex. The DU inventory includes about 555,000 metric tons of uranium hexafluoride and 20,000 metric tons of uranium oxides.

The Idaho National Engineering Laboratory (INEL) is developing new methods to produce high-density aggregate (artificial rock) primarily consisting of depleted uranium oxide.[1] The objective is to develop a low-cost method whereby uranium oxide powder ($U0_2$, U_30_8, or $U0_3$) can be processed to produce high-density aggregate pieces (DU-AGG) having physical properties suitable for disposal in low-level radioactive disposal facilities or for use as a component of high-density concrete used as shielding for radioactive materials.

The INEL previously demonstrated that dense DU oxide pellets could be used as large aggregate to replace conventional gravel in portland cement-based concrete[2] (DUCRETE). The INEL is currently conducting experiments using liquid phase sintering techniques to produce DU-AGG to be used as the aggregate in DUCRETE.

1.2 Goals for DU-AGG

Depleted uranium aggregate (DU-AGG) chemical composition is being optimized with respect to several technical parameters: (1) density, (2) microstructure (fine-grained with minimum of large porosity), (3) leach resistance (primarily for uranium but also any other elements that might cause degradation of mechanical properties or could be coupled to uranium leaching), (4) neutron and gamma ray attenuation when the DU-AGG is incorporated into portland cement to form a concrete (DUCRETE).

It is equally important that DU-AGG be produced at a low cost in order that DUCRETE can be economically viable for disposal[3] or to fabricate shielding structures such as storage casks for spent nuclear fuel.[4,5,6] Costs for fabricating storage casks from DUCRETE are estimated to be comparable to those for conventional concrete when using an estimate of \$2.20/kg (\$1.00/lb) of uranium for converting powdered $U0_3$ or U_30_8 into a dense $U0_2$ aggregate and \$0.12/kg for fabricating the DUCRETE into a cylindrical storage cask.[5] An estimate of \$4.20/kg (\$1.91/lb) was used for the cost for conversion of UF_6 to U_30_8.

1.3 Goals for the DU-AGG Manufacturing Pilot Plant

The goals of the DU-AGG manufacturing pilot plant are the following:

1. Produce relatively large quantities of DU-AGG.

   The plant should be able to process a maximum of 2 tons (4,000 lb) of UO_3 per hour; this translates into a capacity of 16 tons/day. Fast unit processes would be conducted during an 8-hour shift, while slower continuous processes (like furnace firing) could run unattended for 24 hours/day. Based on the maximum production rate of 16 tons/day, sufficient DU-AGG could be produced in 5 days to fabricate a storage cask for spent nuclear reactor fuel (approximately 55 to 65 tons, depending upon design). Running the pilot plant at the maximum production rate would consume the depleted UO_3 powder stored at Savannah River (20,000 tons) in less than 5 years.

2. Produce DU-AGG with acceptable physical, mechanical, and chemical properties such that it can be used to produce DUCRETE storage containers.

   Optimized chemical compositions and recommendation of initial processing parameters would be provided from bench-scale experiments conducted at the INEL on small batches. The primary acceptance criteria are high density coupled with a good microstructure (fine grain size, well-bonded grains, minimum porosity).

3. Demonstrate a fabrication process that can be projected to produce DU-AGG for less than $2.20/kg of uranium (in an oxide form).

   Production costs shall be closely accounted for during operation of the pilot plant to determine if the goal of $2.20/kg could be reached. Modifications to the process for a larger capacity plant will be recommended. The pilot plant will be designed to maximize material throughput with a minimum of labor costs and equipment depreciation costs.

   The liquid phase sintering process being developed at the INEL uses artificial basalt as a liquid phase sintering agent to reduce the sintering temperature of UO_2 from around 1,700°C to about 1,250°C. The lower sintering temperature reduces the production cost by allowing the use of less costly furnaces, increasing the production rate (faster throughput), and lowering the energy costs (less energy to heat the material to process temperature). The use of inexpensive raw materials (clay, dirt, etc.) to produce the basalt also lowers the production costs. Low-cost, large-volume fabrication methods were recommended by the INEL to be included in the fabrication scheme.

2. DESIGN STUDY

The design study for the DU-AGG manufacturing pilot plant was conducted by a commercial company that specializes in designing plants where large amounts of powdered materials are handled: G-M Bulk Handling Systems Company, Mr. Hal Gillman, Principal Engineer, P.O. Box 3823, Walnut Creek, CA 94598.

A full-color schematic for the DU-AGG process is shown in Figure 1.

2.1 Design Considerations

G-M Bulk Handling Systems Company (G-M Systems) designed the DU-AGG manufacturing pilot plant according to commercial standards with special considerations for handling of depleted uranium material. These considerations included exceptional provisions for dust control and movement of heavy (dense) materials. A special effort was made to precisely (as much as possible) derive the projected cost of the facility with the following considerations:

1. The plant would be built in an existing building.

2. All equipment was accurately priced based on firm prices received from vendors.

3. Equipment was sized to function up to the maximum production rate capacity of the plant.

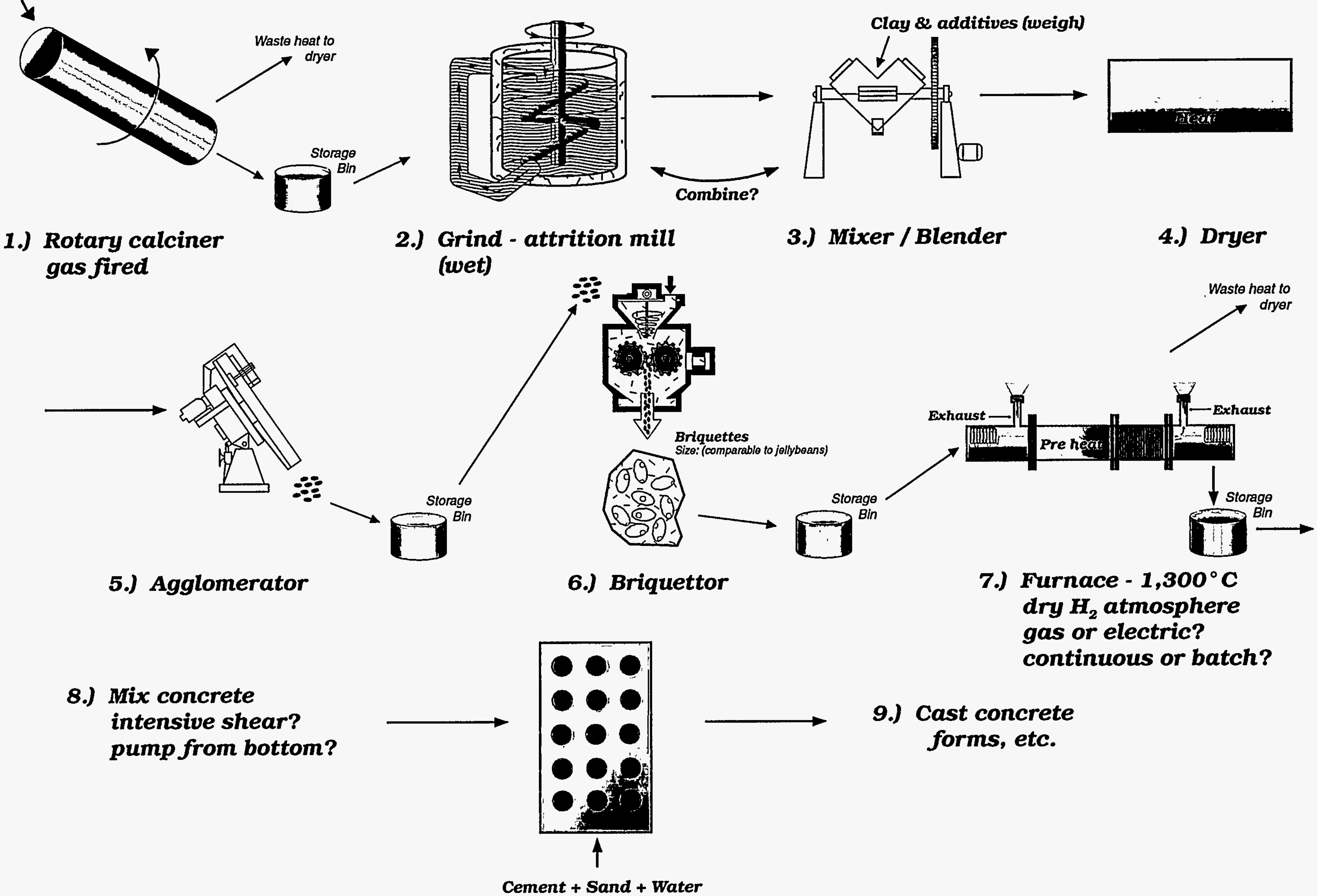
4. All of the steel support platforms, tanks, and hoppers were priced, designed, and detailed according to seismic standards. This was done in order to limit any additional engineering when various items were actually fabricated. Most items could be built from the detailed drawings provided by G-M Systems.

5. The entire system was designed to operate with manual or automatic electrical sequencing. The plant was designed to be operated by only two or three people: one person to handle the transfer of drums and Flo-Bins, one to operate the controls, and one to clean and maintain the system.

6. The closed-loop dust collection system was designed to eliminate all dust emissions at all feed and discharge locations. Dust accumulated in the dust collector hopper (from the pulse cleaning of the bags) will be deposited into closed drums. These drums will be transferred to the briquetting screen to be re-cycled back into the material processing system. A HEPA filtering system will be used in front of the vacuum to ensure that all air released to the outside atmosphere is clean.

Figure 1. Schematic of the DU-AGG process.

Ducrete Process



2.2 Results of the Design Study

The results of the design study conducted by G-M Systems were documented and are included in this report (Appendix A). Appendix A consists of six sections:

1. Summary of Project

2. Equipment Capacities and Mass Balances

   This section includes a detailed block process flow diagram that shows the equipment to be used that will accomplish the processes illustrated in Figure 1.

3. Equipment List

   This section also contains acquisition prices, shipping charges, charges associated with instrumentation and controls, cost of safety devices, installation charges, costs for ventilation, and even storage costs for equipment prior to installation.

4. System Operation

   This section describes how the material flows through the plant (dumping of material, sequence of operations, turning of switches, etc.).

5. Layout of Equipment in Plant

   Drawings are included for the overall plant floor plan, a schematic showing the process flow that includes illustrations of all the various stations, and detailed drawings of all the stations (includes dimensions of devices and steel framing, etc.).

6. Proposed Plan and Schedule

   The plan shows a logic diagram of the various steps that have to be accomplished and the estimated time it would take (based upon G-M Systems' extensive experience) to complete the installation in an industrial setting.

3. DISCUSSION OF THE DESIGN STUDY

3.1 Equipment Capacities & Equipment List

There are seven major "stations" in the process (see Section 3 in Appendix A):

A. Drum Dumping
B. Tank Storage & Calcining
C. Mixing & Blending
D. Drying
E. Agglomerator & Briquetting
F. Furnace
G. Dust Collection
H. Attrition Mill

One of the most crucial stations is the furnace. The furnace cost was given verbally by the local representative of Lindberg Furnace Co. to G-M Systems' President Hal Gillman and represents (at best) a guess to the actual characteristics needed in a continuous firing furnace. It was sized at 20 ft long with 3-ft inlet and outlet stations. The furnace included a variable-speed drive for a continuous belt conveyance system. Information is yet insufficient to determine the period of time (which translates to the length of furnace zone for a given translation rate) that the DU-AGG will have to spend in the pre-heat zone (to reduce $U0_3$ to $U0_2$), the time in the sintering zone to fully densify (entrance into the sintering before all of the oxygen is devolved could cause bubbling of the liquid phase), and the time in the cool-down zone (slow cool enhances the development of strong, leach-resistant crystalline phases like zirconolite and perovskite). Answers to questions related to minimum residence time needed in the various hot zones will be generated at the INEL in the bench-scale laboratory (using a Harper pusher-type furnace). Once this information is known, a furnace with proper characteristics can be specified for the pilot plant and give confidence to a calculation of maximum material throughput. The price of the furnace was inflated by 10% to cover estimating errors; however, this amount may prove to be insufficient.

All equipment was designed to exhibit a long life. Materials used to handle the heavy $U0_3$ material and all contact points were sized and designed to be made of heavy-gauge, abrasion-resistant stainless steel, including hoppers and bins, all chutes, elevator buckets, Flo-Bins, transfer points, and pneumatic conveying lines.

All fabricated equipment and structures were priced to include a final finish coat of epoxy paint to ensure easy maintenance and cleaning (especially for $U0_3$ and other ceramic powders).

3.2 System Operation and Layout of Equipment in the Plant

The mode of operation of the grinding operation (attrition mill) needs to be clarified. In particular, we need to determine if the sequence of operations for the material flow should be (a) calcine then grind, or (b) grind then calcine. Also, we need to determine if the clay/dirt/dry chemical additives can be added during milling or if a dry blending step needs to be added. In order to answer these questions, information from bench-top experiments needs to be provided before pilot plant operation can begin (possibly before the design plan is finalized).

The basis of the milling questions comes from a concern about hydration of the fine $U0_3$ powder during milling. Previous bench-top experiments utilized alcohol as a fluid when hand-grinding the powder in a mortar and pestle in order to avoid the possibility of hydration. However, the use of alcohol is not desirable in the pilot plant due to cost and safety considerations (danger of explosion). The needed information will clarify the following questions:

1. Does the $U0_3$ powder rehydrate during the attrition milling process?

   This question will be answered by performing TGA/DTA (thermo gravimetric analysis/ differential thermo analysis). TGA/DTA will determine if water is merely physically attached (water loss at around 100°C) or chemically reacted (water loss at higher temperatures such as 700 to 900°C). TGA gives weight loss as a function of temperature while DTA reveals if endothermic or exothermic reactions are taking place as a function of temperature.

2. Should the $U0_3$ powder be calcined after milling rather than before milling?

   If water chemically reacts with the $U0_3$ during attrition milling, it should be removed prior to sintering. This will prevent steaming of the parts (possible breakage) and possible foaming during formation of the liquid phase basalt. However, calcining after milling has the potential of agglomerating the powders (due to neck growth of the crystallites). This agglomeration negatively affects the sintering process and lowers the sintered densities.

   Physically attached water is easy to remove using simple drying procedures at low temperatures (80 to 150°C) that has no effect on the reactivity (sinterability) of the $U0_3$ crystallites.

3. Is dry milling a possibility?

   Dry milling is a possibility, but wet milling is generally preferred. Dry milling is not as efficient as wet milling. Also, for dry milling, it is often necessary to develop organic milling aids to prevent the powders from sticking to the grinding balls and the mill walls. These organic compounds can interfere with later stages of ceramic processing. Also, we intend to add clay and dirt into the mill during the grinding process. This addition will provide for good mixing without having a separate step of blending in these mill additions (e.g., "vee-blender"). Clay has a tendency to clump during dry milling.

Other system design considerations are as follows:

The agglomerator & briquetting system was designed to be completely self-contained. Transfer of all ingredients was made from various unit operations within the systems without exposure to the atmosphere. This feature was incorporated to prevent uranium oxide dust contamination and to prevent moisture uptake into the powders if the atmosphere is humid. The two vibrating disk screens were completely enclosed to ensure a dust-free atmosphere.

The vacuum-pneumatic, closed-loop conveying system for transferring fine particles from the screening operations back to the agglomerator & briquetting unit ensures that no discharge of small dust particles will be made to the atmosphere.

3.3 Proposed Plan and Schedule

The total estimated cost for the DU-AGG pilot plant was $2,571,870, and installation would be complete in 72 weeks (using commercial standards). However, the cost and duration could easily exceed this estimate because of the following major factors:

1. Furnace

   The furnace (Station F) has the slowest material throughput of the entire process, and if not sized properly could constitute a bottleneck. The total cost of installing the furnace station was estimated at $411,320, with $130,000 of this amount set aside for purchase of the furnace. However, it is conceivable that the acquisition cost might run as high as $700,000 to $1,000,000. Much more design information is needed before this important acquisition could proceed with confidence.

2. Environmental, Safety, and Health Regulations

   More information is needed with regard to the actual proposed site of the pilot plant. The site selection will determine the various state and federal environmental, safety, and health regulations for the construction and operation of the pilot plant. These regulations possibly could add tremendously to planning costs, construction costs, and operation costs. It is advisable that a couple of tentative sites be selected and a detailed investigation be completed on the applicable state and federal regulations.

4. CONCLUSIONS

G-M Systems designed a DU-AGG manufacturing pilot plant that will be able to process 16 tons/day of $U0_3$ powder into a hard, sintered $U0_2$-based material. The aggregate will be suitable for direct disposal or inclusion as the aggregate in portland cement to form DUCRETE.

The major strength of the design provided by G-M Systems is the automated material handling that will result in low operating labor costs while providing for excellent dust control. The automatic weighing, automatic feeding, and bin systems seem to be excellent designs. The major weakness in the present design is the furnace. More design information from experiments performed at the INEL, using a pusher type furnace, should greatly aid the specification of a better pilot plant furnace. It is likely that the pilot plant equipment cost estimate will increase when the furnace specification is finalized.

The G-M Systems' cost estimate for the DU-AGG manufacturing pilot plant is $2,571,870 with startup to take place 72 weeks after the beginning of the project. The cost estimate and installation schedule are based on a commercial installation in an existing building. Cost and schedule could be significantly impacted by environmental, safety, and health regulations that are site-dependent.

The primary systems operation difficulties are thought to be sequencing issues related to calcine and grinding stations. Resolution of these issues can be completed using information to be generated at the INEL. Resolution is predicted to have minimal effect on the projected plant cost or startup time.

5. REFERENCES

1. P. A. Lessing, *Development of DU-AGG (Depleted Uranium Aggregate)*, INEL-95/0315, Lockheed Martin Idaho Technologies Company, Idaho Falls, ID, September 1995.

2. P. A. Lessing, *Development of 'DUCRETE'*, INEL-94/0029, Idaho National Engineering Laboratory, Idaho Falls, ID, October 1994.

3. T. J. Hertzler, D. D. Nishimoto, M. D. Otis, *Depleted Uranium Disposal Options Evaluation*, EGG-MS-11297, Idaho National Engineering Laboratory, May 1994.

4. T. J. Hertzler and D. D. Nishimoto, *Depleted Uranium Management Alternatives*, EGG-MS-11416, Idaho National Engineering Laboratory, August 1994.

5. DOE, *Depleted Uranium: A DOE Management Challenge*, DOE/EM-0262, Office of Environmental Management, Office of Technology Development, October 1995, p. 11.

6. W. J. Quapp, P. A. Lessing, and C. R. Cooley, "Depleted Uranium Hexafluoride: The Source Material for Advanced Shielding Systems," *Third International Uranium Hexafluoride Conference, Dallas, TX, November 28, 1995.*

Appendix A

Manufacturing Facility for Depleted Uranium Aggregate

G-M SYSTEMS

P.O. Box 3823 • Walnut Creek, CA 94598 (510) 944-9447
FAX (510) 944-9407

MANUFACTURING FACILITY FOR DEPLETED URANIUM AGGREGATE

CONTRACT NO. C95-175800

SUBMITTED BY: H.M.Gillman
President

CONTENTS

1. SUMMARY OF PROJECT

1.1 OBJECTIVE

The objective of this engineering study is to design a facility to produce high desity aggregate primarily consisting of depleted uranium oxide. The design of the equipment outlined on the drawings and attachments would include a final process using a combination Agglomorator/ Briquetter, whereas depleted uranium oxide can be proccessed into a usable sized briquette.

1.2 The facility is designed to operate on the batching principle.

Combining the formed uranium briquette as an additive to concrete would form a usable, safe sheilding container.

1.3 The key functional criteria for depleted uranium aggregate would include:

a. Maximum usage of 50 million pounds of UO3 now in storage.

b. To maintain chemical stability in a closed loop enviroment.

c. High compression strength in a usabe aggregate container.

d. Low production cost using a completely automated system.

1.4 According to our findings there is 50 million pounds of U03 stored in 55 gallon drums at the Westinghouse Savannah River Company. (WSRS)

Based on this amount of product it is estimated that operating this new facility for a period of 4-5 years would deplete the product now in storage.

The new facility can be erected in an existing building or warehouse using 9000 square feet.

1.5 The total cost for all engineering, equipment, steel platforms, labor, handling equipment, electrical, piping and necessary concrete foundation work has been estimated at under $3,000,000.

2 EQUIPMENT CAPACITIES

2.1 The new manufacturing facility for proccessing depleted uranium oxide is designed to produce 16 tons per day of finished briquettes.

2.2 55 gallons drums of depleted U03 will be received by truck at the new site each weighing 1925 pounds, level full.

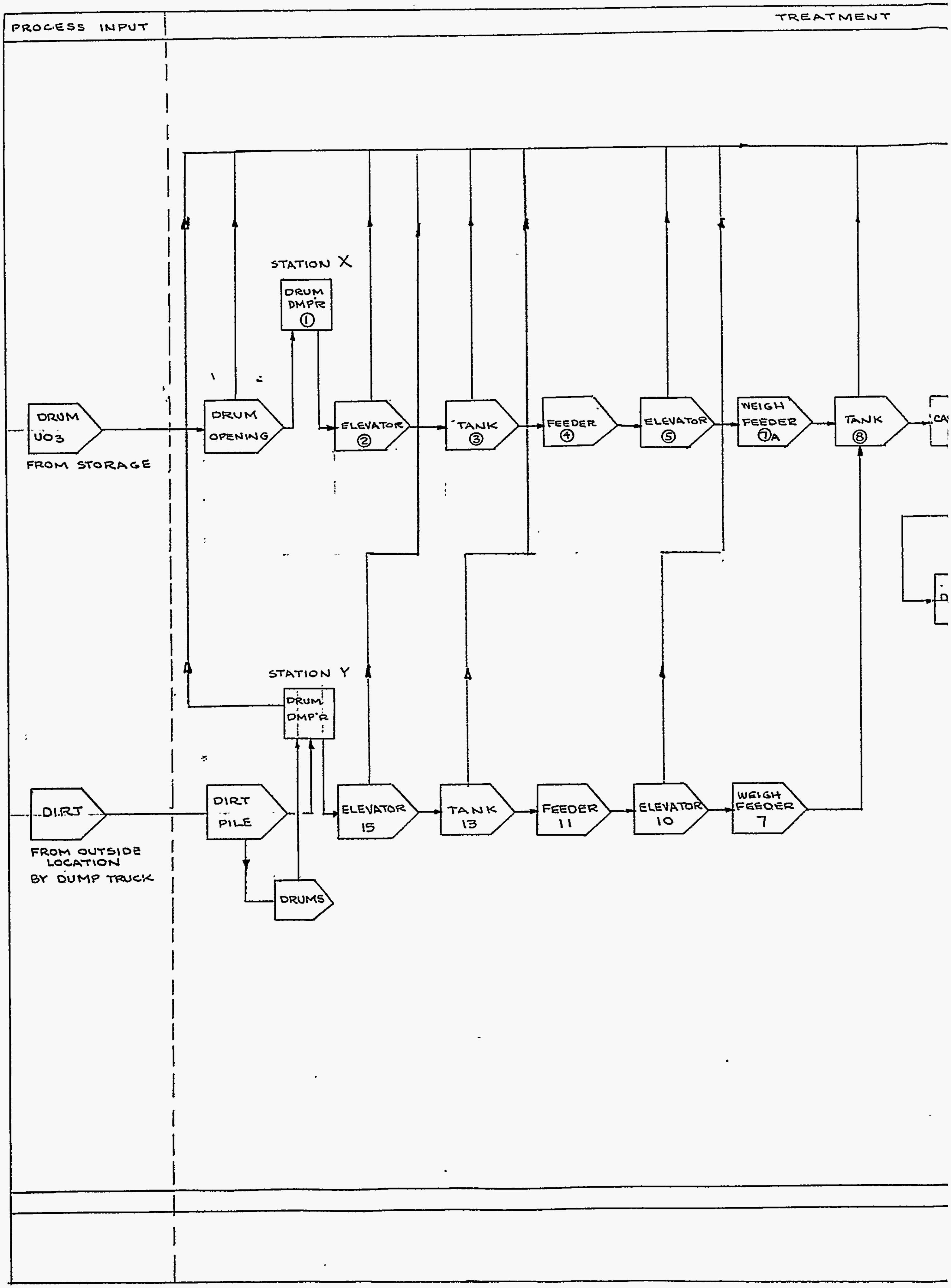
2.3 Planned FLO BINS, Item No. 22, will have the capacity of holding 2400 pounds each.

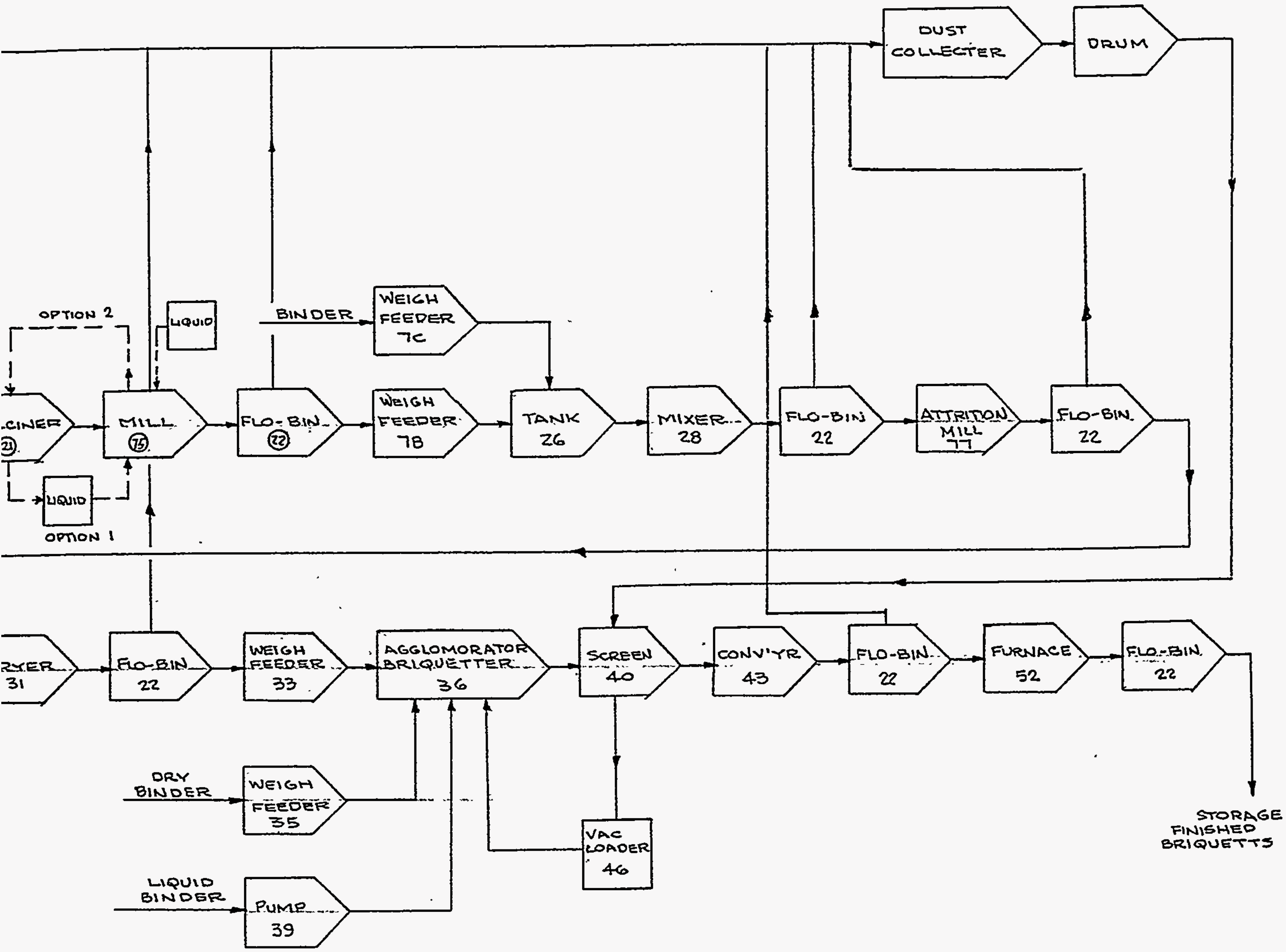
2.4 EQUIPMENT CAPACITIES:

Item No.	Item / H.P.	Capacity pounds/ hour	Operating Time/ hours
2	Bucket Elevator, 7.5	4100	8
4	Screw Feeder, 5	4000	8
5	Bucket Elevator, 5	4100	8
7	Gravimetric Feeder, DC	0-6400	8
7A	" "	0-6400	8
10	Bucket Elevator, 5	4100	8

2.4 (Cont)

Item No.	Item	Capacity pounds/hr	Operating time/ hr.
11	Screw Feeder, 5	4000	8
15	Bucket Elevator, 7.5	4100	8
21	Calciner, Gas fired at 1000 Deg.	6000	8
23	Gravimetric Feeder,DC	0-6400	8
28	Mixer, 10	6000	8
7B	Gravimetric Feeder,DC	0- 6400	8
7C	" "	0-6400	8
31	Dryer, Gas fired, 20,000 CFM	6000	8
33	Gravimetric Feeder,DC	0-6400	8
35	" "	0-6400	8
36	Agglomorater/Briquetter Total 70 HP	4000	8
40	Vibrating Screen,5	4100	8
41	Belt conveyor 5,DC	0-4100	8
46	Vacuum Loader, 7.5	3000	8
52	Belt Furnace, 30 KW 1300 Deg. C	1340	24
54	Dust collector & Fan, 40	11,000 CFM	24


PROCESS INPUT
TREATMENT
STATION X
DRUM DMP'R ①
DRUM UO3
FROM STORAGE
DRUM OPENING
ELEVATOR ②
TANK ③
FEEDER ④
ELEVATOR ⑤
WEIGH FEEDER ⑦A
TANK ⑧
STATION Y
DRUM DMP'R
DIRT
FROM OUTSIDE LOCATION BY DUMP TRUCK
DIRT PILE
DRUMS
ELEVATOR 15
TANK 13
FEEDER 11
ELEVATOR 10
WEIGH FEEDER 7



G/M SYSTEMS

1-23-96

FLOW DIAGRAM- DEPLETED URANIUM AGGREGATE SYSTEM

LOCKHEED IDAHO TECHNOLOGIES
IDAHO FALLS, ID

95-162-F

3. EQUIPMENT LIST

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000's
SYSTEM: A...DRUM DUMPING STATION				
ITEM NO.	ITEM			
A	Enclosure	4.00	1	4.00
76	Drum Crusher	18.00	1	18.00
	Fork Lift Truck	10.00	1	10.00
	Front End Loader	18.00	1	18.00
PROCESS EQUIPMENT SUB TOTAL				50.00
MISC INSTR. & CONTROLS (13%)				6.50
PIPING (25%)				12.50
SAFETY SYSTEMS (25%)				12.50
ELECTRICAL (10%)				5.00
SHIPPING (5%)				2.50
EQUIPMENT SUB TOTAL				89.00
INSTALLATION..Direct Labor (25%)				22.0
ENGINEERING (33%)				29.0
SYSTEM TOTAL				140.00
STORAGE				25.00
VENTING SYSTEMS				10.00
GRAND TOTAL				175.00

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000's
SYSTEM: B...Tank Storage & Calcining Station				
ITEM NO.	ITEM From Sheet No.		3	158.00
20	Slide Gate	2.50	1	2.50
21-21A	Calciner...1000 Deg. C	120.00	1	120.00
22	Flow Bins..3000 pound cap.	1.00	5	5.00
59-A,B	Level Controls	.30	6	1.80
75	Mill 4000 P/Hr Max.	18.00	1	18.00
PROCESS EQUIPMENT SUB TOTAL				305.00
MISC INSTR. & CONTROLS (13%)				36.65
PIPING (25%)				76.25
SAFETY SYSTEMS (25%)				76.25
ELECTRICAL (10%)				30.50
SHIPPING (5%)				15.25
EQUIPMENT SUB TOTAL				538.90
INSTALLATION..Direct Labor (25%)				134.70
ENGINEERING (33%)				177.83
SYSTEM TOTAL				851.43
STORAGE				20.00
VENTING SYSTEMS				40.00
GRAND TOTAL				911.43

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000'S
SYSTEM: B...Tank Storage & Calcining Station				
ITEM NO.	ITEM			
1	Drum Dumper	2.00	2	14.00
2	Elevator, 4100 #/hr	18.00	1	18.00
3	Storage Tank, 363 cu. ft.	12.00	1	12.00
4	Screw Feeder, 4000 #/hr	8.00	1	8.00
5	Elevator, 4100 #/hr	18.00	1	18.00
6	Chute	.50	1	.50
7	Feeder,Weigh 6400 C/F/H	8.00	1	8.00
7A	Feeder, Weigh 6400 C/F/H	8.00	1	8.00
8	Surge Bin, 14 Cu. Ft.	10.00	1	10.00
9	Chute	.50	1	.50
10	Elevator, 4100 #/hr	7.50	1	7.50
10A	Cover Plate	.50	1	.50
11	Screw Feeder, 4000 #/hr	8.00	1	8.00
12	Support Legs	.50	2	1.00
13	Storage Tank, 45 cu. ft.	20.00	1	20.00
14	Downspout	.50	1	.50
15	Elevator, 4100 #/hr	6.00	1	6.00
16	Platform	11.00	1	11.00
17	Downspout	.50	1	.50
18	Spout	.50	1	.50
19	Slide Gate, Pneumatic	2.50	2	5.00

Total..........158.00

G/M SYSTEM

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000's
SYSTEM: C...MIXING & BLENDING STATION				
ITEM NO.	ITEM			
	From Sheet No.		5	50.00
PROCESS EQUIPMENT SUB TOTAL				50.00
MISC INSTR. & CONTROLS (13%)				6.50
PIPING (25%)				12.50
SAFETY SYSTEMS (25%)				12.50
ELECTRICAL (10%)				5.00
SHIPPING (5%)				2.50
EQUIPMENT SUB TOTAL				89.00
INSTALLATION..Direct Labor (25%)				22.00
ENGINEERING (33%)				29.00
SYSTEM TOTAL				140.00
STORAGE				7.00
VENTING SYSTEMS				3.00
GRAND TOTAL				150.00

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000'S
SYSTEM: C....Mixing & Blending Station				
ITEM NO.	ITEM			
7B	Feeder, Weigh 6400 C/F/H	8.00	1	8.00
7C	Feeder, Weigh, 6400 C/F/H	8.00	1	8.00
7E	Chute	.50	1	.50
7D	Hopper	1.00	1	1.00
26	Hopper	3.00	1	3.00
27	Pneumatic Slide Gate	2.50	1	2.50
28	Mixer, 18 cu. ft.	20.00	1	20.00
28A	Mixer Support	3.00	1	3.00
29	Platform	4.00	1	4.00
	Total to page 4			50.00

G/M SYSTEM

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000's
SYSTEM: D....Drying Station				
ITEM NO.	ITEM			
7A1	Chute	.50	1	.500
31	Dryer	60.00	1	60.00
32	Platform	9.00	1	9.00
72	Support	9.00	1	9.00
73	Chute	.50	1	.50
PROCESS EQUIPMENT SUB TOTAL				79.00
MISC INSTR. & CONTROLS (13%)				10.20
PIPING (25%)				19.75
SAFETY SYSTEMS (25%)				19.75
ELECTRICAL (10%)				7.90
SHIPPING (5%)				3.95
EQUIPMENT SUB TOTAL				140.55
INSTALLATION..Direct Labor (25%)				35.13
ENGINEERING (33%)				46.20
SYSTEM TOTAL				221.88
STORAGE				7.00
VENTING SYSTEMS				20.00
GRAND TOTAL				248.88

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000's
SYSTEM: E...Agglomorator & Briquetting Station				
ITEM NO.	ITEM			
	Total from sheet 8.....			167.95
PROCESS EQUIPMENT SUB TOTAL				167.95
MISC INSTR. & CONTROLS (13%)				21.83
PIPING (25%)				41.00
SAFETY SYSTEMS (25%)				41.00
ELECTRICAL (10%)				16.79
SHIPPING (5%)				8.39
EQUIPMENT SUB TOTAL				296.96
INSTALLATION..Direct Labor (25%)				74.24
ENGINEERING (33%)				97.68
SYSTEM TOTAL				468.88
STORAGE				7.00
VENTING SYSTEMS				20.00
GRAND TOTAL				495.88

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000'S
SYSTEM: E...Agglomorator & Briquetting Station				
ITEM NO.	ITEM			
33	Feeder, Weigh, 6400C/F/H	8.00	1	8.00
34	Support	8.00	1	8.00
35	Feeder, Weigh, 6400 C/F/H	8.00	1	8.00
36	Agglomorator & Briquetter	105.00	1	105.00
37	Hopper	.70	1	.70
39	Liquid Pump & Tank	4.00	1	4.00
40	Vibrating Screen, 5000 #/hr	5.50	1	5.50
41	Belt conveyor, 2500 #/hr	11.00	1	11.00
42	Supports	.75	1	.75
43	Chute	.50	1	.50
44	Vacuum Box	.50	1	.50
45	Conveying Lines	2.00	Lot	2.00
46	Vacuum Loader	6.50	1	6.50
47	Hopper	3.50	1	3.50
48	Support	.50	1	.50
65	Air Line	1.00	Lot	1.00
66	Hepa Filter	.50	1	.50
67	Vacuum Pump	2.00	1	2.00
	Total to Sheet No. 7.........			167.95

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000's
SYSTEM: F....Furnace Station				
ITEM NO.	ITEM			
50	Platform	6.00	1	6.00
51	Chute	.50	1	.50
52	Furnace, 1500 Deg. C	130.00	1	130.00
53	Chute	.50	1	.50
PROCESS EQUIPMENT SUB TOTAL				137.00
MISC INSTR. & CONTROLS (13%)				17.81
PIPING (25%)				34.25
SAFETY SYSTEMS (25%)				34.25
ELECTRICAL (10%)				13.70
SHIPPING (5%)				6.30
EQUIPMENT SUB TOTAL				243.31
INSTALLATION..Direct Labor (25%)				60.82
ENGINEERING (33%)				80.19
SYSTEM TOTAL				384.32
STORAGE				7.00
VENTING SYSTEMS				20.00
GRAND TOTAL				411.32

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000's
SYSTEM: D...Dust Collection Station				
ITEM NO.	ITEM			
	Total from sheet No. 11			52.50
PROCESS EQUIPMENT SUB TOTAL				52.50
MISC INSTR. & CONTROLS (13%)				6.80
PIPING (25%)				13.12
SAFETY SYSTEMS (25%)				13.12
ELECTRICAL (10%)				5.25
SHIPPING (5%)				2.62
EQUIPMENT SUB TOTAL				93.41
INSTALLATION..Direct Labor (25%)				23.36
ENGINEERING (33%)				30.00
SYSTEM TOTAL				146.77
STORAGE				7.00
VENTING SYSTEMS				-
GRAND TOTAL				153.76

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000'S
SYSTEM: G....Dust Collection Station				
ITEM NO.	ITEM			
54	Dust Collector, 11,000 CFM	30.00	1	30.00
55	Hepa Filter	6.00	1	6.00
56	Rotary Air Lock Feeder	4.00	1	4.00
57	Drum Cover	.30	1	.30
58	Air Compressor, 125 PSI	4.00	1	4.00
68	Bag Shaker	2.00	1	2.00
70	Level Controls	.20	1	.20
71	Fan and Silenser	6.00	1	6.00
	Total to sheet No.		10	52.50

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000's
SYSTEM: H Attrition Mill				
ITEM NO.	ITEM			
77	Attrition Mill ..Union			
	Process Co.	60.00		60.00
PROCESS EQUIPMENT SUB TOTAL				60.00
MISC INSTR. & CONTROLS (13%)				7.80
PIPING (25%)				15.00
SAFETY SYSTEMS (25%)				15.00
ELECTRICAL (10%)				6.00
SHIPPING (5%)				3.00
EQUIPMENT SUB TOTAL				106.80
INSTALLATION..Direct Labor (25%)				26.70
ENGINEERING (33%)				34.00
SYSTEM TOTAL				167.50
STORAGE				-
VENTING SYSTEMS				5.00
GRAND TOTAL				172.50

DEPLETED URANIUM EQUIPMENT LIST DESCRIPTION		EQUIP COST (EACH) $000'S	EQUIP QTY	EQUIP COST TOTAL $000'S
SYSTEM: TOTAL COST FOR ALL STATIONS				
ITEM NO.	ITEM			
STATION	DESCRIPTION			
A	Drum Dumping			175.00
B	Tank Storage & Calcining			911.43
C	Mixing & Blending			150.00
D	Drying			248.88
E	Agglomoration & Briquetting			495.88
F	Furnace			411.32
G	Dust Collection			153.75
H	Attrition Mill			172.50
		Total	....	2571.87

4. SYSTEM OPERATION

G-M SYSTEMS
P.O. Box 3823 • Walnut Creek, CA 94598 (510) 944-9447
FAX (510) 944-9407

SYSTEM OPERATION

REference P.O. No. C95-175800
Project: Manufacturing Facility for Depleted Uranium Aggregate
Reference Drawing No. 95-162-1, (2) sheets and related drawings.

1A. System will include one Motor Control Center (MCC) which will contain all motor starters, disconnects, heaters and safety devices.

1B. Also included will be oneSystems control Panel (CP). It will contain all switches, relays, disconnects and lights. Panel will be designed to operate the entire System in either a hand or automatic mode for each station.

1C. STATIONS:

A. Drum opening
B. Tank storage and Calcining
C. Mixing and Blending
D. Drying
E. Agglomoration and Briquetting
F. Furnace
G. Dust Collection

2. Drum opening Station A.

2a. This station is a manually operating system.

2b. Operator will turn on (MCC) and System Control Panel (CP) He will also turn on Dust Collector on the AUTO mode.

2c. Using a fork lift truck, operator will move drum of product into the drum opening station. The top of the drum will be removed and placed in a designated container within the enclosure.

2d. Once opened, the operator will then transfer the drum and place it on Item 1. (drum lifter) at Station "X".

2e. At the same time, an additional drum of selected filler, will be placed on the opposite drum lifter at Station "Y".

3. Operator will then activate the (CP) for all equipment relating to STATION "B", setting all switches in the AUTO mode, which includes equipment item numbers: 1,2,4,5, panel 23, 21,10,11, and 15.

4. Item No. 23 is a central individual solid state control panel programmed to operate items 7A & 7B, gravametric weigh feeders.

4a. Operator will pre-set this panel to the designated amount of materials to be discharged. Feeders will continue to operate until the pre-set weight is satisfied.

5. Each steel storage tank, Items 3 & 13, will hold 20,000 pounds of product and are furnished with: high and low level controls, sight glasses, air operated slide gate valves, dust collector vents and support legs.

6. STATION B...operation

6a. Operator activates (CP) and turns on all swithces for equipment numbers 1,2,3,13,15, gates 19 & 20 in the AUTO mode.

Note: Gates 19 & 20 have to be closed before the system will operate and will interlock to perform this function.

6b. As soon as all of the equipment indicated above has been activate operator will tranport product drums to dump stations, "X" & Y"Y. Equipment 1 & 1A. This equipment is manually operated. Operator will continue to dump drums until high level controls 59A & 59C are activated at which time an alarm horn will sound indicating that tanks are full.

6c. Operator will silence alarm and stop dumping drums.

Note: Positioning of the high level control device will allow operator to dupm one more drum if desired after alarm is sounded, or complete dumping of the active drum.

6d. All emptied drums will be transported to a designated area for disposal.

7. Item equipment No. 8, Batch holding hopper will have the capacity to contain 3,000 pounds of mixed ingrediants of UO3 and binder by presellected weight.

7a. After pre-sellected amounts of product to be weighed, by each feeder, operator will activate switches, in the AUTO mode for equipment numbers: 4,5,7A,7B, 10, 11.

Gates 19 and 19A will open.

7b. Products will continue to be conveyed into Hopper #8 until total batch weight is satisfied. Feeders 7 & 7A will shut down. In turn elevators #5, 10 and screw feeders #4 & 11 will stop. Gates #19 & 19A willclose.

7c. Operator will then open Gat #20 and materials will convey into the Calciner, No. 21. When low level control #8A is activated gate No.20 will close after a one minute time delay. This allows hopper to empty. Hopper No. 8 is now ready for another batch.

The closing of Gate #20 will re-activate the conveying system as outlined in paragraph 6 on page 2. Since system is in the AUTO mode the system will continue to operate on a batching cycle.

7d. The Gas fired Calciner, Item #21, is hand operated by its own control panel. Temperature and operating time are manually set by the operator. After a predesignated time mixed products are discharged into a 3000 pound capacity FLO BIN, item #22.

7e. Station "B" operates in an AUTO mode as a continuous batch system until suitable quantity of FLO BINS have been filled for production.

8. STATION "C" operation.

8a. Batch hopper #26 is designed to hold 4,000 pounds of mixed products from Fedders #7B and 7C.

8b. This system is a weigh feeding and batching system. Similar to Station "B", the feeders are controlled by panel #23A for selecting a pre-set delivery rate of product.

8c. Filled FLO BINS containing 3000 pounds of product from the calcining station are placed above one feeder station #7B. In turn binder material is hand dumped into weigh feeder above weigh feeder no. 7C.

8d. Operator will then activate panel 23A which will start both feeders 7B & 7C. They will contineu to operate until pre-set amount of material to be weighed is conveyed into holding hopper #26.

8e. As soon as set-point is activated fedders will stop. Panel indicator light will tel operator to manually open gate # 27 and ingrediants will dump intothe MIXER/ BLENDER #28. As soon as low level control #20A is activated gate # 27 will close after a one minute time delay.

8f. As soon as Gate #27 closes, Feeders 7B & 7C will start again and refill the batch hopper. Feeders will continue to operate until batch is satisfied.

As lonf as Mixer # 28 is running, gate # 27 cannot be opened.

8g. Dumping Mixer #28 is a manual operation. Opening air operated dump gate # 28A will empty mixer into 3000 pound FLO BIN #22. Once Mixer is empty operator closes gate #28 and re-opens gate # 27. This operation allows Mixer to accept another batch of ingrediants. As soon as level control 26A is activated gate # 27 will close and feeding cycle starts again.

9. DRYING STATION "D" Operation

9a. The drying system is a manually operted system. It has a seperate control panel for temperature and speed complete with timing controls. This systems will tie into the (CP) for its stop start operation.

9b. Flo Bins are moved by Fork lift trucks onto the platform above the Dryer and after manual hook to downspout operator opens slide gate. The Flo-Bin is emptied into the Dryer and an other one can be moved in place. Each Flo Bin will hold 3000 pounds of materials.

9c. After drying cycle is complete productis manually conveyed into another waiting Flo Bin which is transfered to STATION E,

10. AGGLOMERATING AND BRIQUETTING STATION "E".

10a. Ingrediants transfered in Flo Bins from Station D, are moved and elevated into position for processing along with additional ingrediants which are manually fed into Hopper #37 and also from liquid binder stored in item #39.

This station is a completely self contained unit,all factory mounted, ready for use. It includes a control panel, mixing chamber (agglomorater) feed pump,all motors and gear reducers.

Additional equipment furnished seperate from the unit above is screen #40, conveyor #41, pneumatic loader #46 and related filter and vacuum pump, including a central control panel.

10b. When the Briquetting System is activated all of the related equipment shown will operate at the same time. The system is completely automatic.

10c. This system will operate as long as operator replaces spent Flo Bins with new filled units.

10d. Final product produced by the Briquetter will be conveyed thru a two deck vibrating screen. Acceptable briquetts will be conveyed onto a slide belt conveyor and deposited into product Flo Bins.

10e. Fines and oversize products produced by the Briquetter will be removed from the bottom deck of the screen and conveyed back into the system for re-cycling.

10f. The entire Briquetting System is completely automatic. When set in the AUTO mode in the (CP) all of the equipment will operate. The shut down of any of the related equipment turns off the entire system.

11 FURNACE STATION "F"

11a. The furnace station is a self contained, belt driven electrically controlled unit. It will accept finished briquetts from Flo Bins placed on a platform above the Furnace. Briquetts will convey down a special feeder chute into the furnace.

11b. Briquetts will move thru the furnace at a regulated temperture and speed. The electrical control panel will be activated from the main (CP)

11c. Treated and dried briquetts will be conveyed into Flo Bins for storage and further usage.

12 DUST COLLECTION STATION "G".

12a. The dust collector is a unit sized to handle all of the necessary points of the entire system where dust is emitted during the system operation. The unit is furnished complete with filter bags, an automatic electric bag shaker,rotary air lock feeder and support legs. An electrical starter panel is furnished to operate the motor shaker.

12b. Collector will receive all air borne dust from all the points indicated and after being filtered thru the bags will be deposited into drums thru the rotary air lock for re use or disposal.

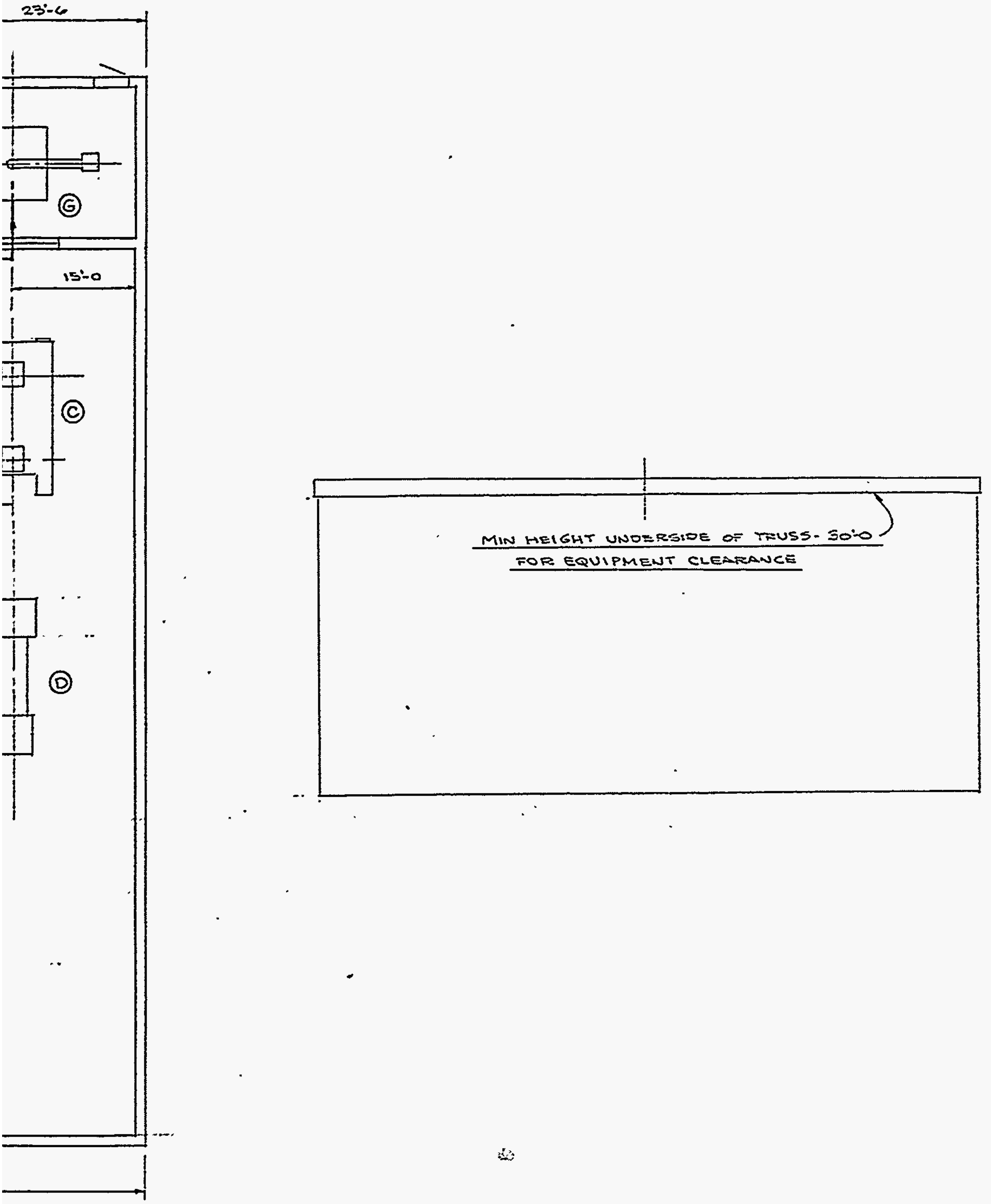
12c. An industrial type radial blade fan will be used to move, by vacuum, all air borne particles into the bag house collector. Exit air from the fan will be cleaned by a hepa filter and silencer.

12d. This system will operate at all times whenever any of the STATIONS are in service. It will be controlled by an ON/OFF switch located in the (CP). The motor shaker, air lock feeder and fan will all operate at the same time.

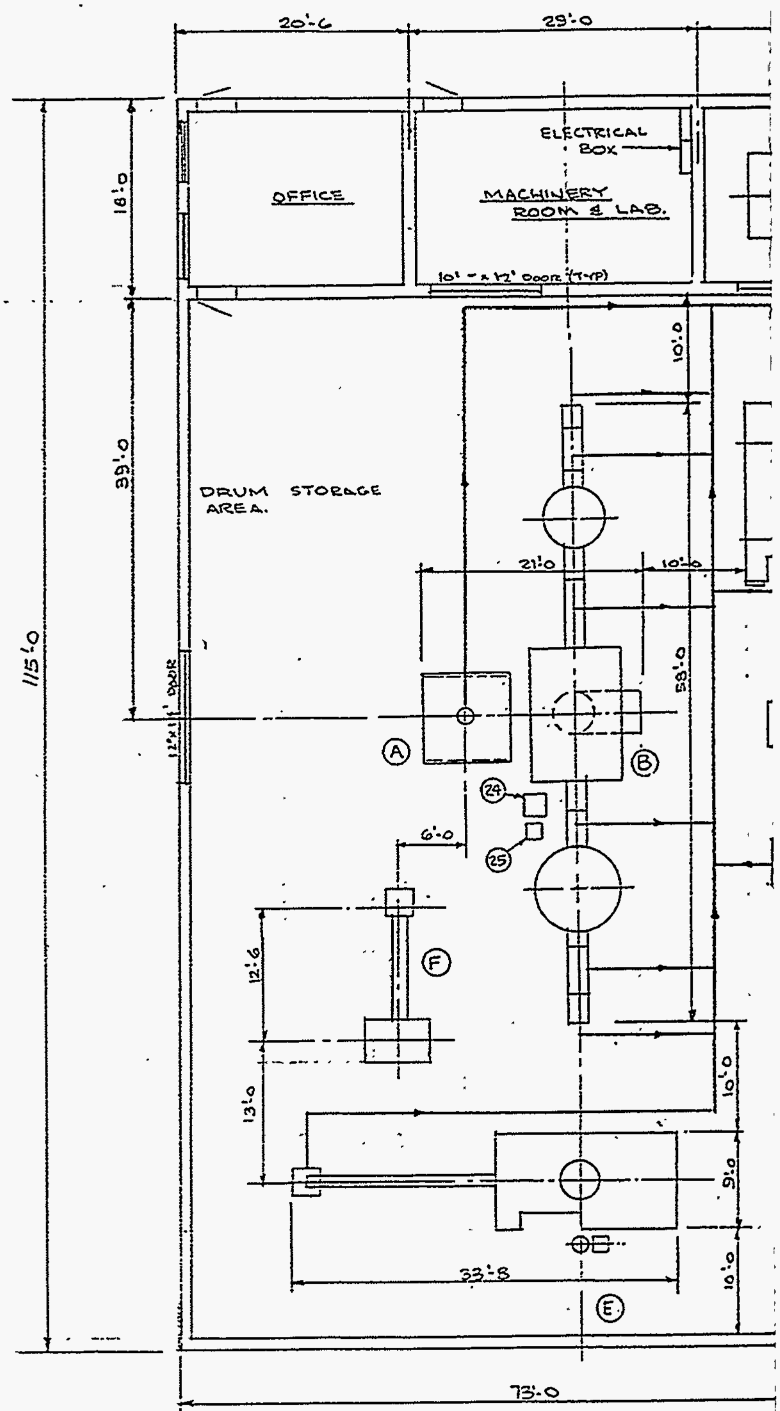
13 AIR COMPRESSOR, Item #58

13a. The Air Compressor is controlled by a swith in the (CP) and in the (MCC). It is furnished to supply compressed air to all air operated devices in the System and will operate at all times with the Dust Collector.

5. EQUIPMENT PLANT LAYOUT



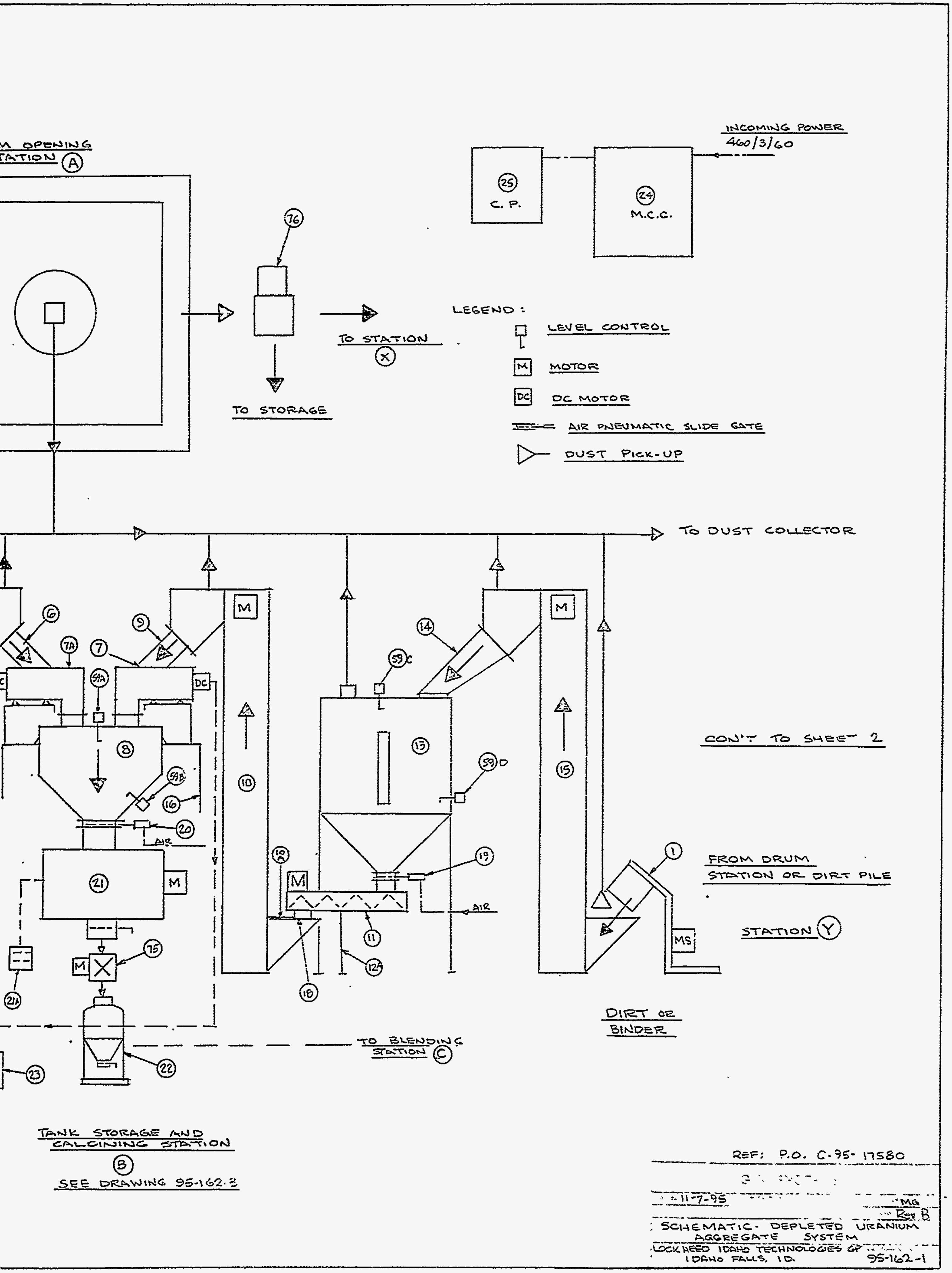
1/8" = 1'-0"
2-16-95
FLOOR PLAN EQUIPMENT LAYOUT
LOCKHEED IDAHO TECHNOLOGIES CO
IDAHO FALLS, ID
95-162-17



FLOOR PLAN

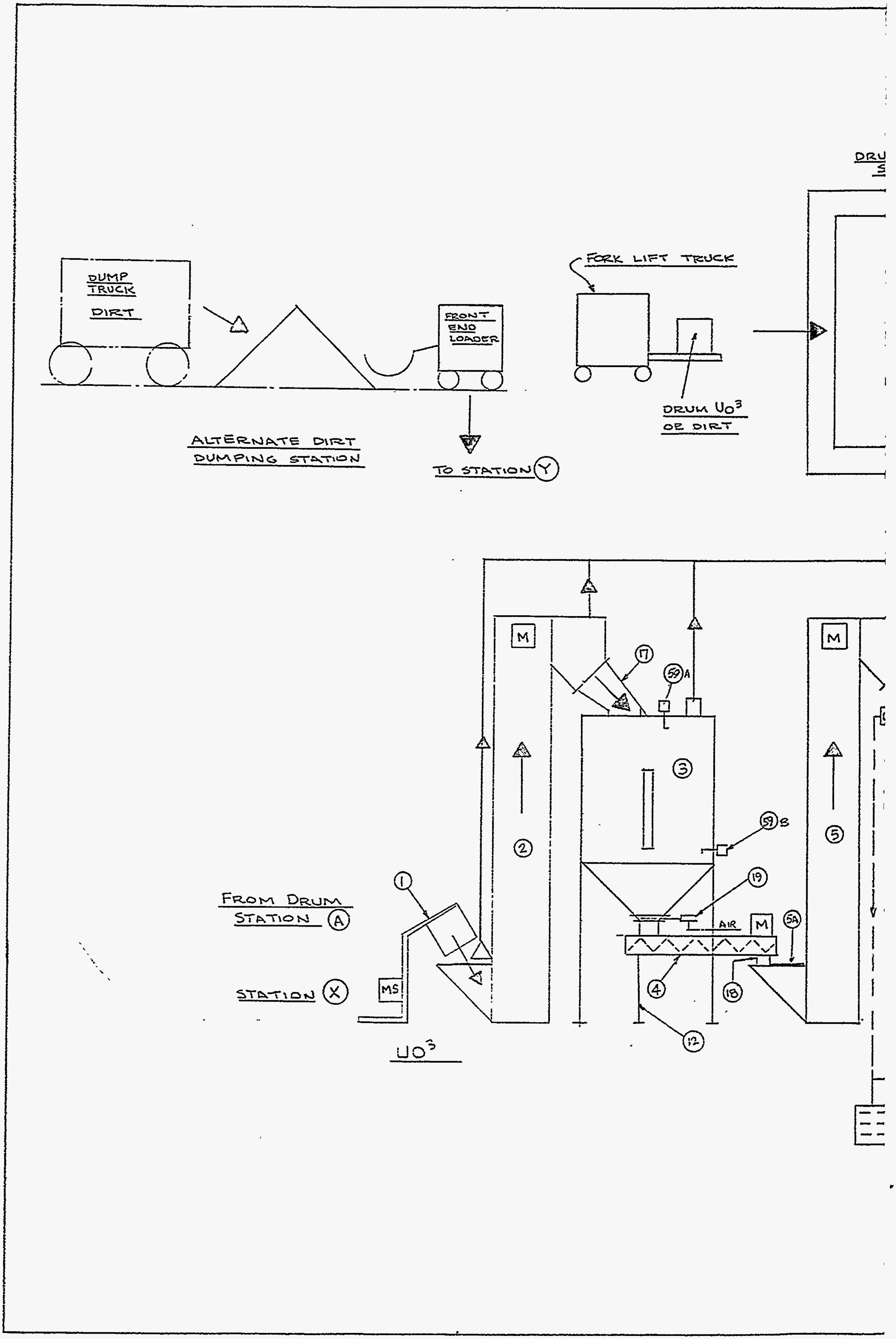
PLANT LAYOUT

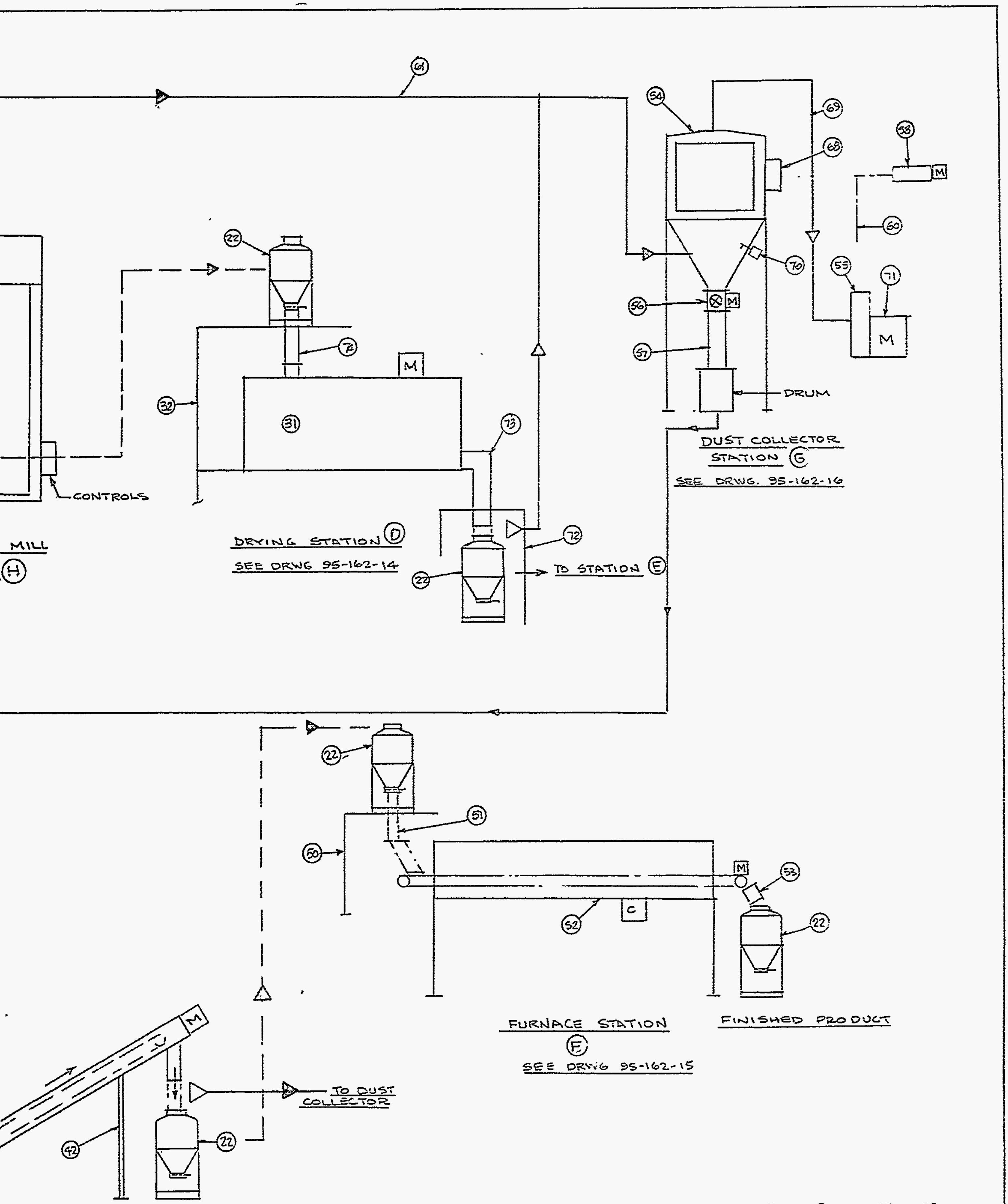
SCALE 1/8" = 1'-0



M OPENING
TATION (A)
INCOMING POWER
460/3/60
25
C. P.
24
M.C.C.
76
TO STATION
(X)
TO STORAGE
LEGEND:
LEVEL CONTROL
M MOTOR
DC DC MOTOR
AIR PNEUMATIC SLIDE GATE
DUST PICK-UP
TO DUST COLLECTOR
CON'T TO SHEET 2
FROM DRUM
STATION OR DIRT PILE
STATION (Y)
DIRT OR
BINDER
TO BLENDING
STATION (C)
AIR
MS
TANK STORAGE AND
CALCINING STATION
(B)
SEE DRAWING 95-162-3
REF: P.O. C-95-17580
11-7-95
MG
Rev B
SCHEMATIC - DEPLETED URANIUM
AGGREGATE SYSTEM
LOCKHEED IDAHO TECHNOLOGIES CO
IDAHO FALLS, ID.
95-162-1

SHEET 1
OF 2


DRU
DUMP TRUCK
DIRT
FRONT END LOADER
FORK LIFT TRUCK
DRUM UO^3 OR DIRT
ALTERNATE DIRT DUMPING STATION
TO STATION Y
M
17
59A
3
59B
19
AIR
5A
2
5
1
FROM DRUM STATION A
STATION X
MS
4
18
12
UO^3



REF. P.O. C-95-17580

11-7-95

MG

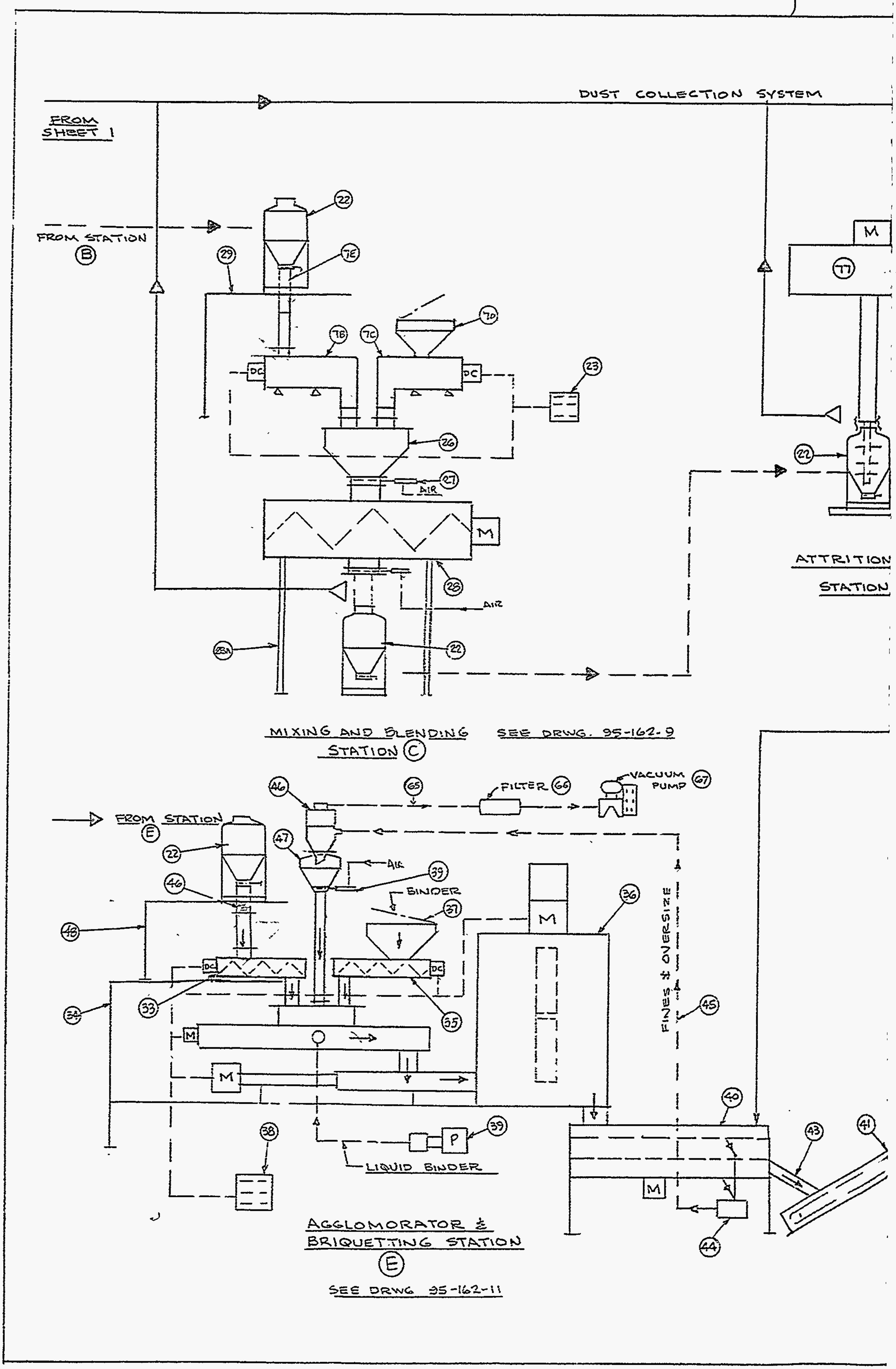
REV B

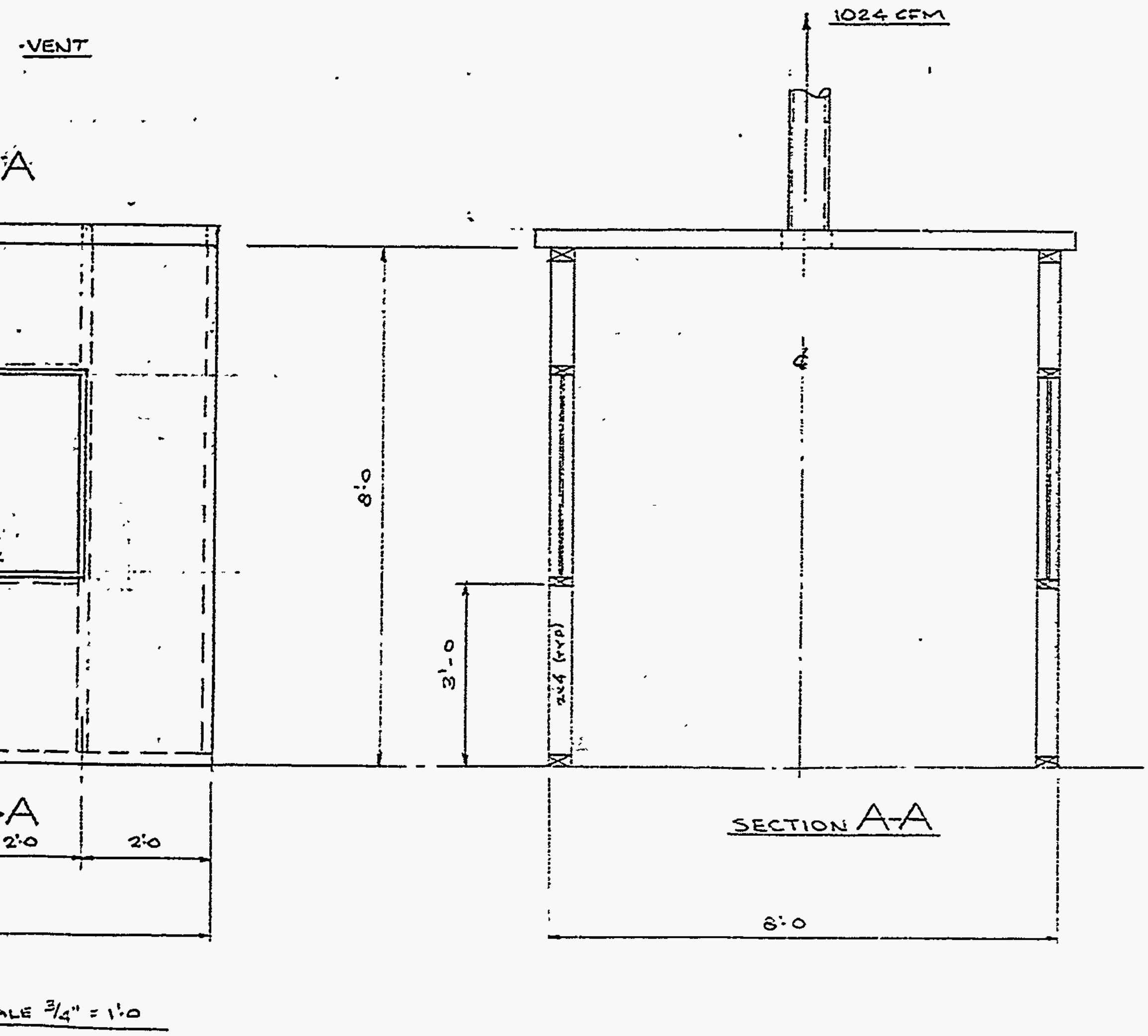
SCHEMATIC - DEPLETED URANIUM AGGREGATE SYSTEM

LOCKHEED IDAHO TECHNOLOGIES CO.
IDAHO FALLS, ID

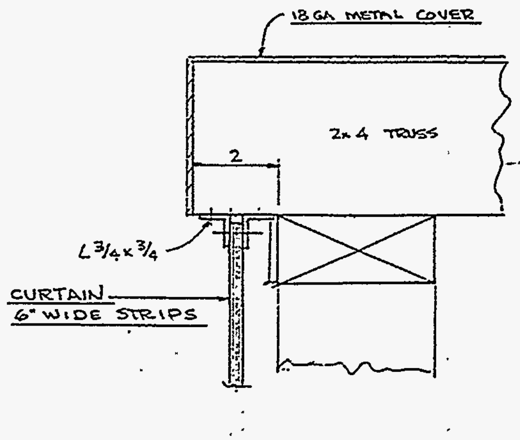
95-162-1

SHEET 2 OF 2

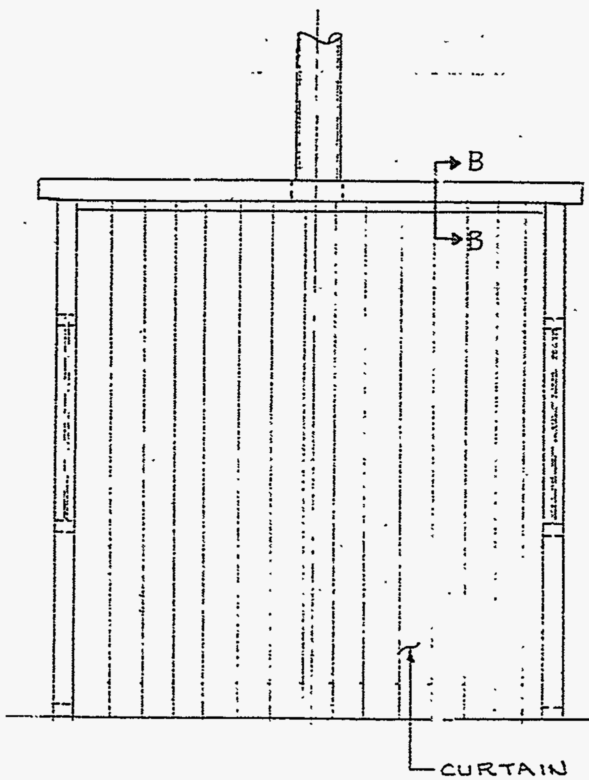

DUST COLLECTION SYSTEM
FROM SHEET 1
FROM STATION (B)
AIR
MIXING AND BLENDING STATION (C)
SEE DRWG. 95-162-9
ATTRITION STATION
FROM STATION (E)
FILTER
VACUUM PUMP
BINDER
FINES & OVERSIZE
LIQUID BINDER
AGGLOMORATOR & BRIQUETTING STATION (E)
SEE DRWG 95-162-11

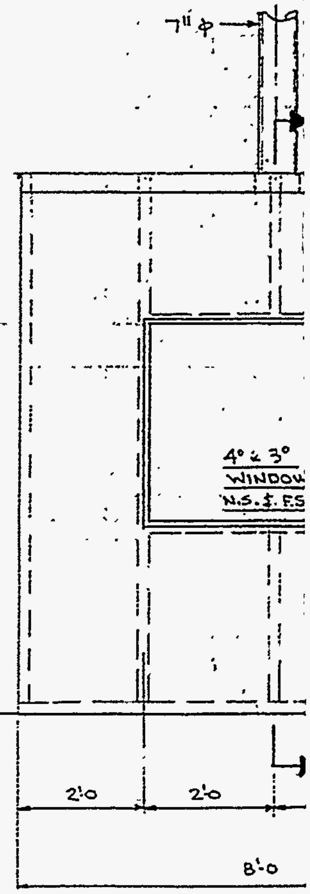


SHOWN
..-5-95
ARRG'T & DETAILS - DRUM
OPENING STATION A
LOCKHEED TECHNOLOGIES GP
IDAHO FALLS, ID
95-60-2

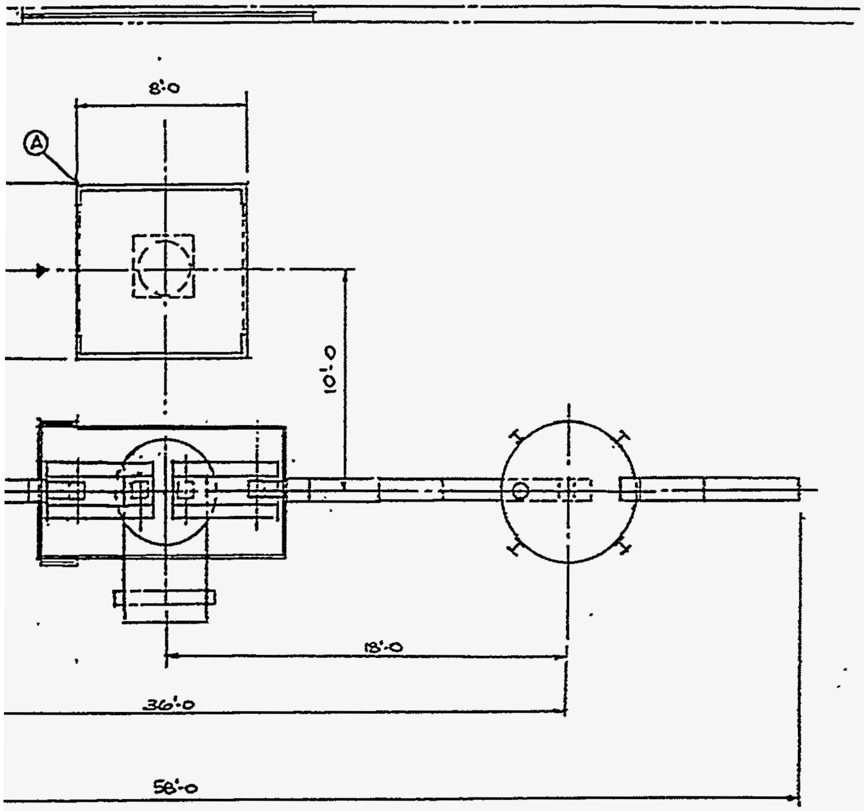


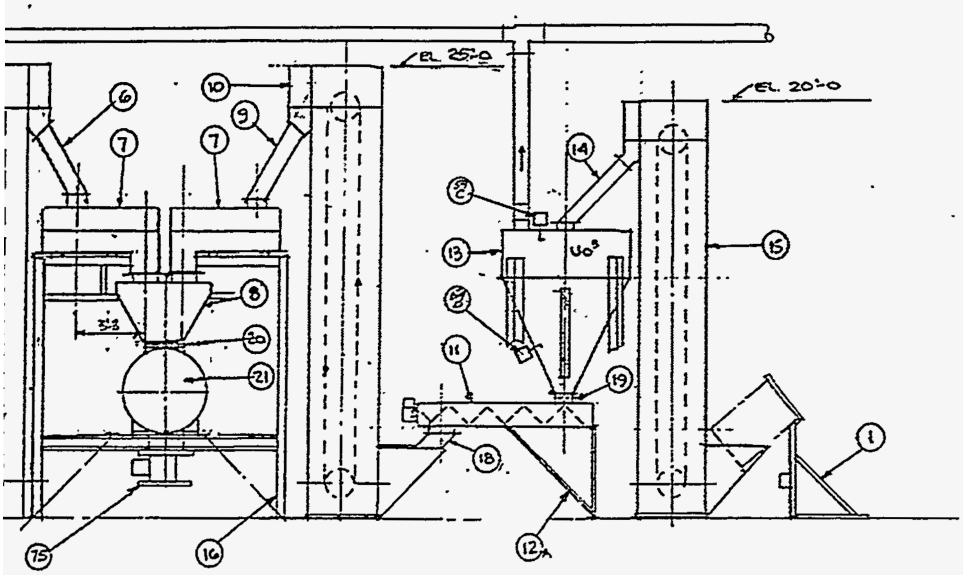
SECTION B-B
SCALE 1/2" = 1'-0





SC





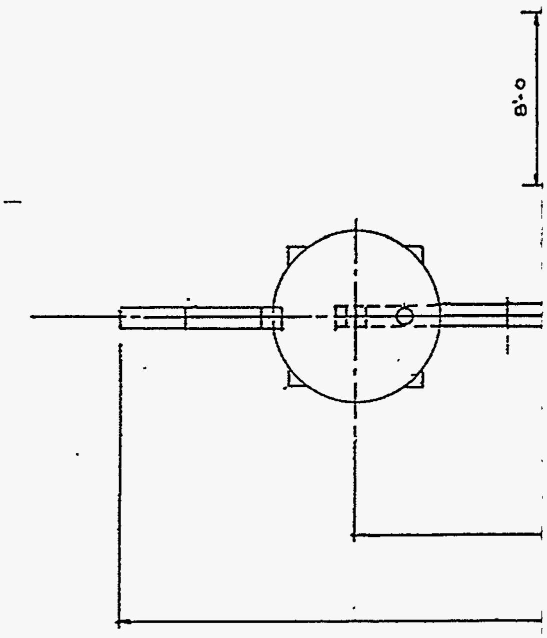
SYSTEMS

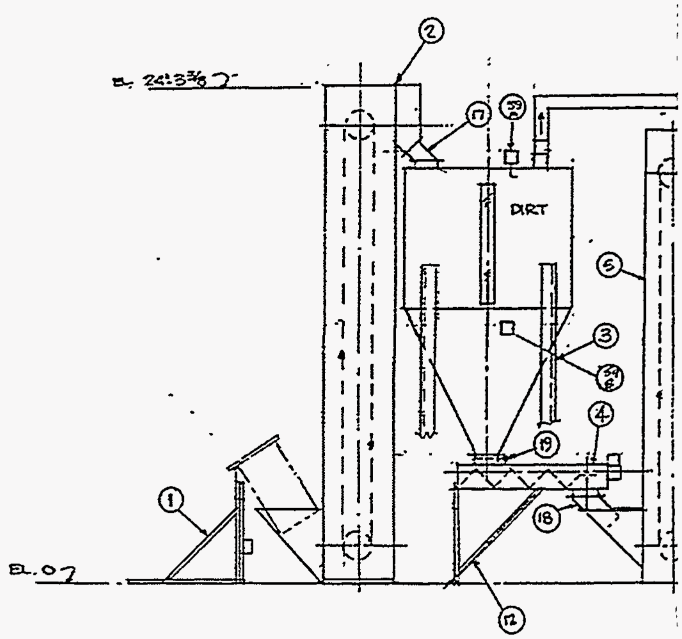
1/4" = 1'-0	H.M. GILLMAN	HS
11-16-95		REV A

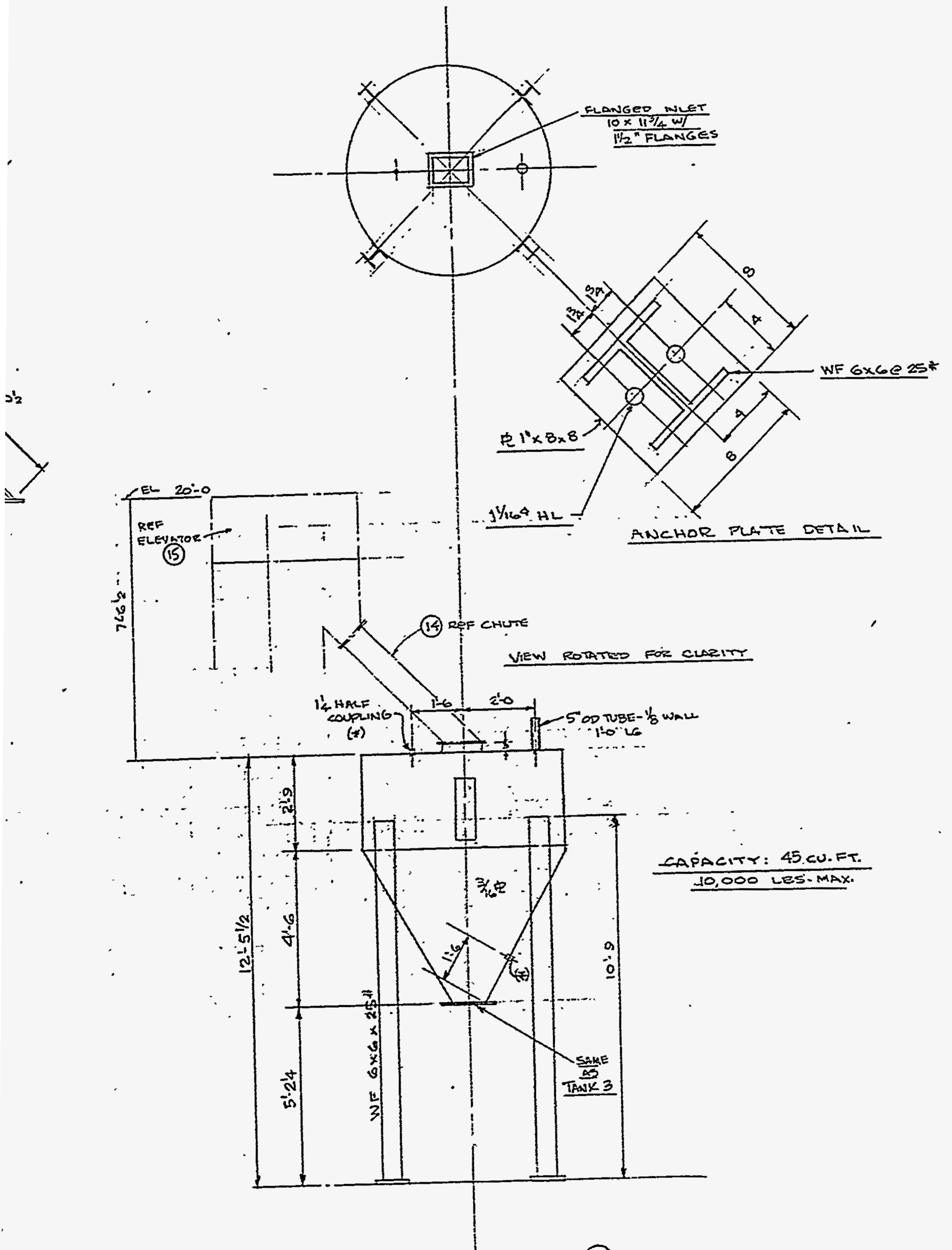
GENERAL ARR'G'T - TANK STORAGE & CALCINING STATION B

LOCKHEED TECHNOLOGIES GP.
IDAHO FALLS, ID

95-162-3

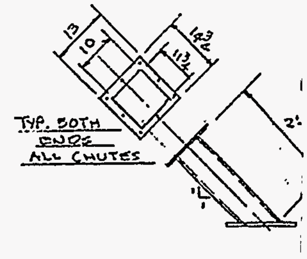

8'-0


EL. 24'-3⅜"
DIRT
EL. 0
1
2
3
4
5
12
17
18
19

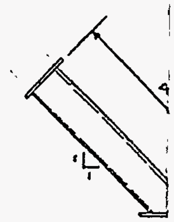


STORAGE TANK MK (13)
(1) REQ'D
SCALE ½" = 1'-0

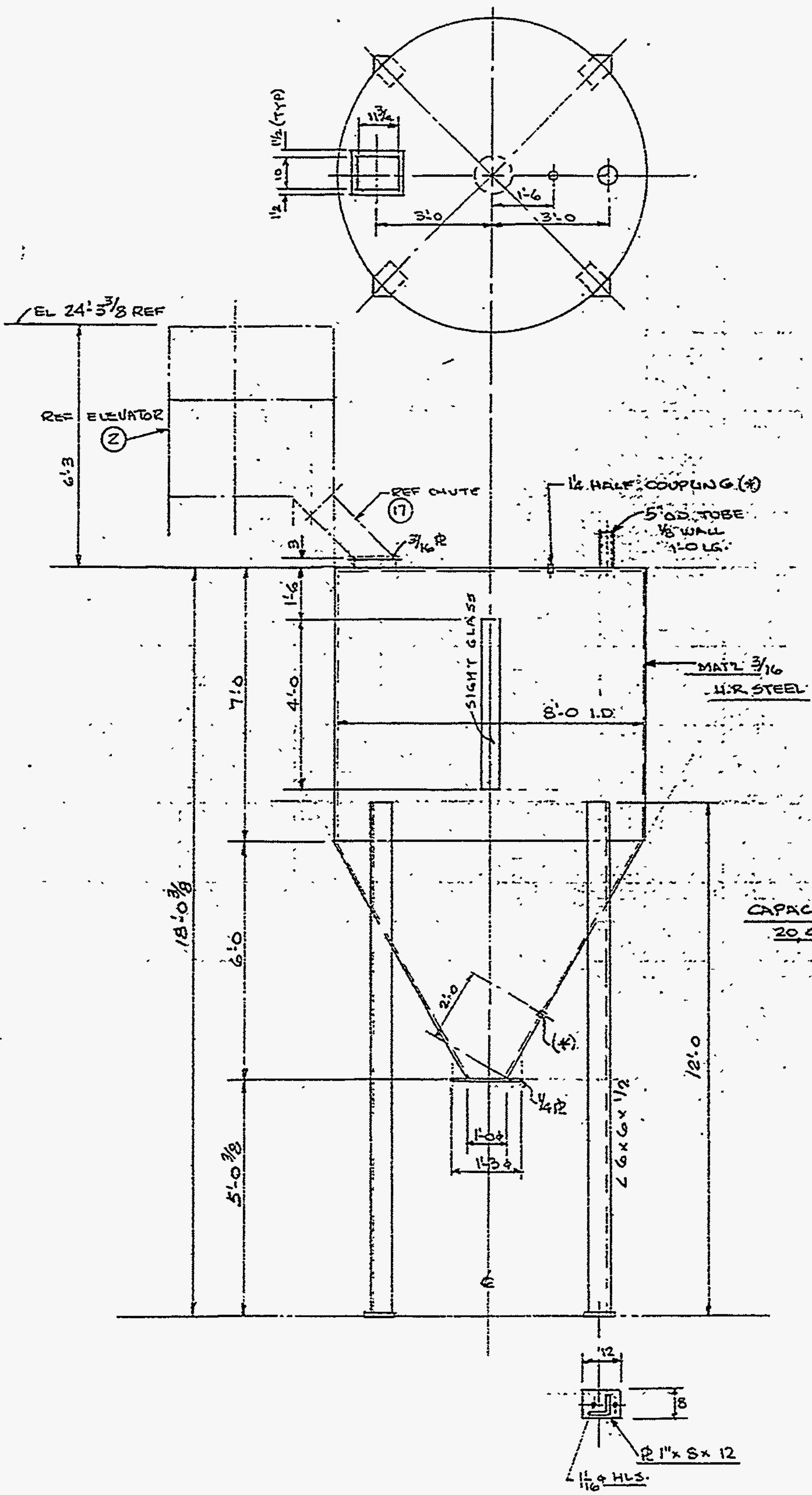
SHOWN
11-25-95
DETAILS - TANKS, STORAGE FOR
SYSTEM B
LOCKHEED TECHNOLOGIES GP
IDAHO FALLS, ID
95-…-4



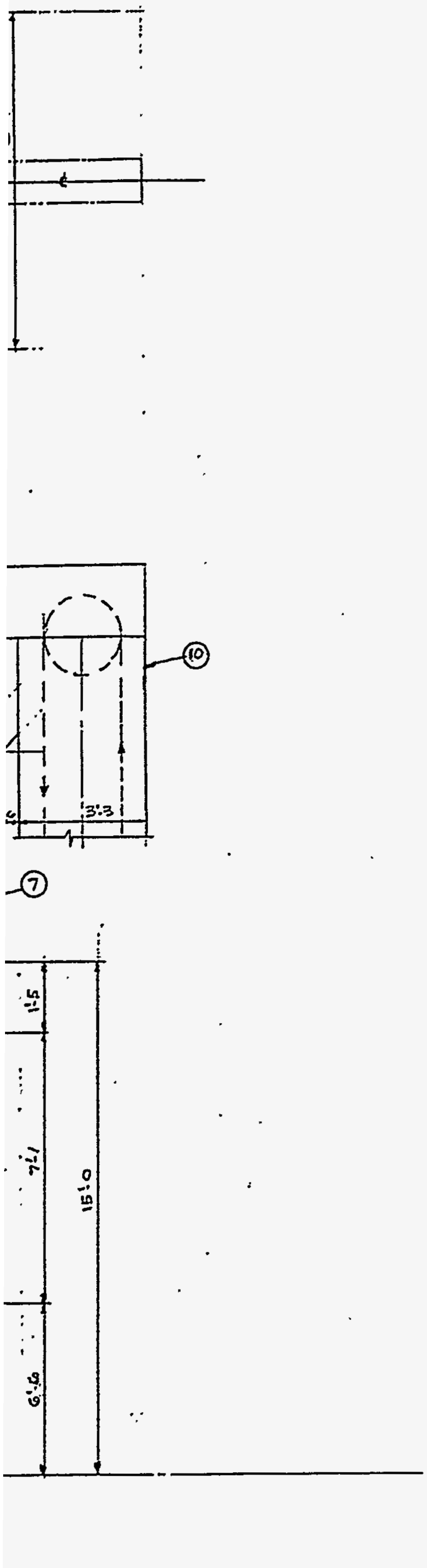
CHUTE MK (17)
(1) REQ'D



CHUTE MK (14)
(1) REQ'D



STORAGE TANK MK (3)
(1) REQ'D
SCALE 1/2" = 1'0

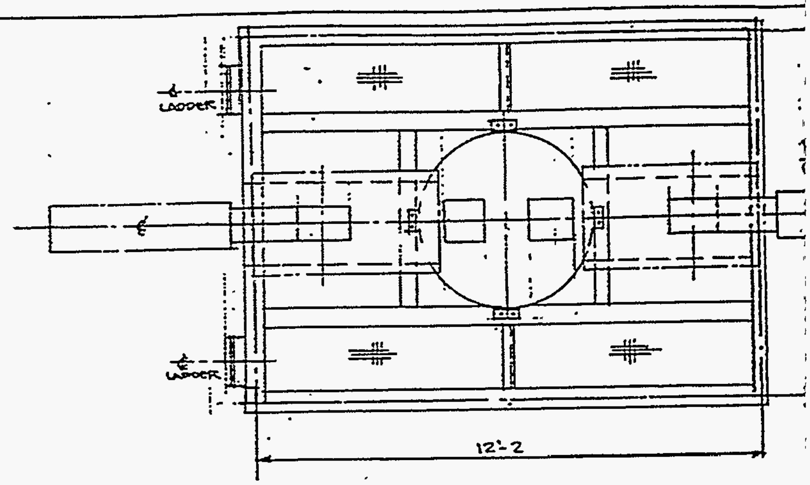


G/M SYSTEMS

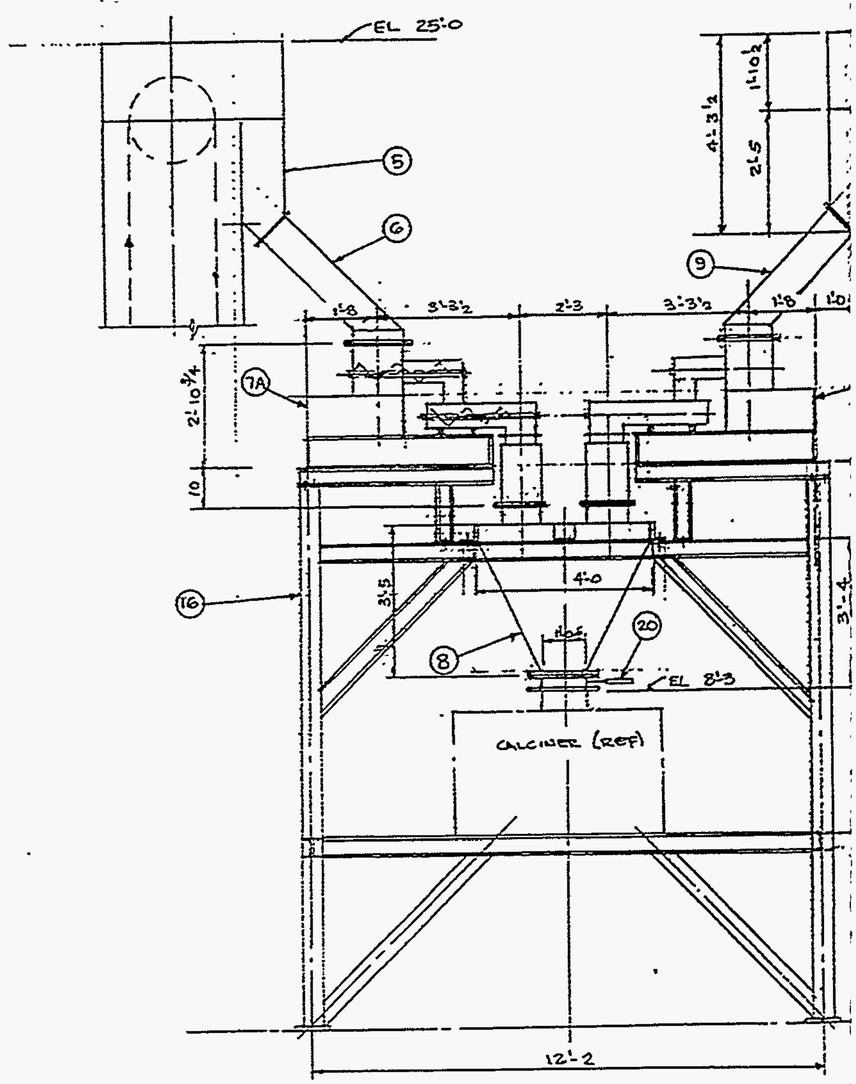
SCALE 1/2" = 1'-0 | APPROVED BY: H. Gillman (signature) | DRAWN BY: HG
DATE: 11-23-95 | | REV A

LAYOUT & ARRG'T FEEDING SYSTEM FOR STATION B

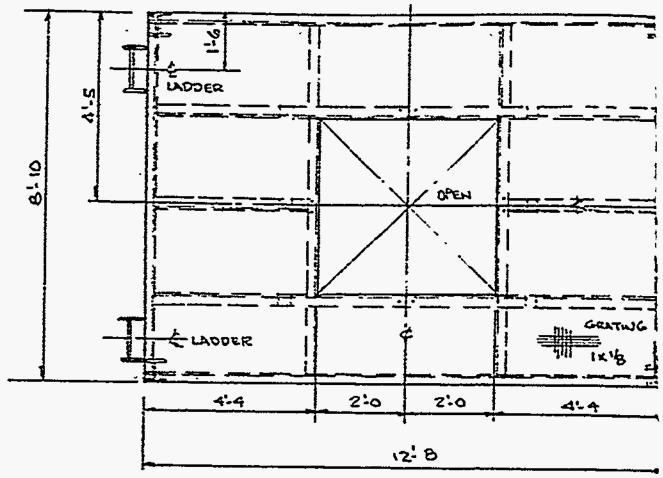
LOCKHEED TECHNOLOGIES GRP. IDAHO FALL, ID | 95-162-5



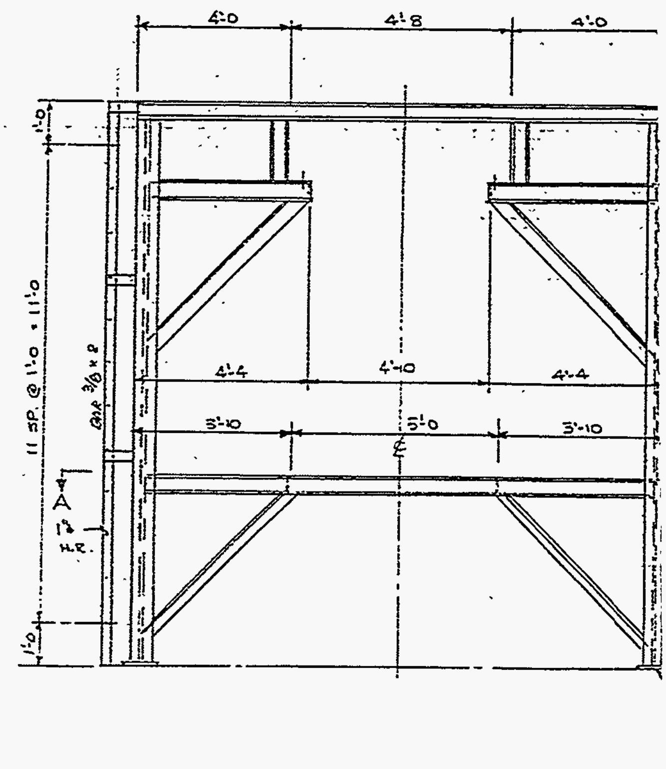
LADDER
LADDER
12'-2

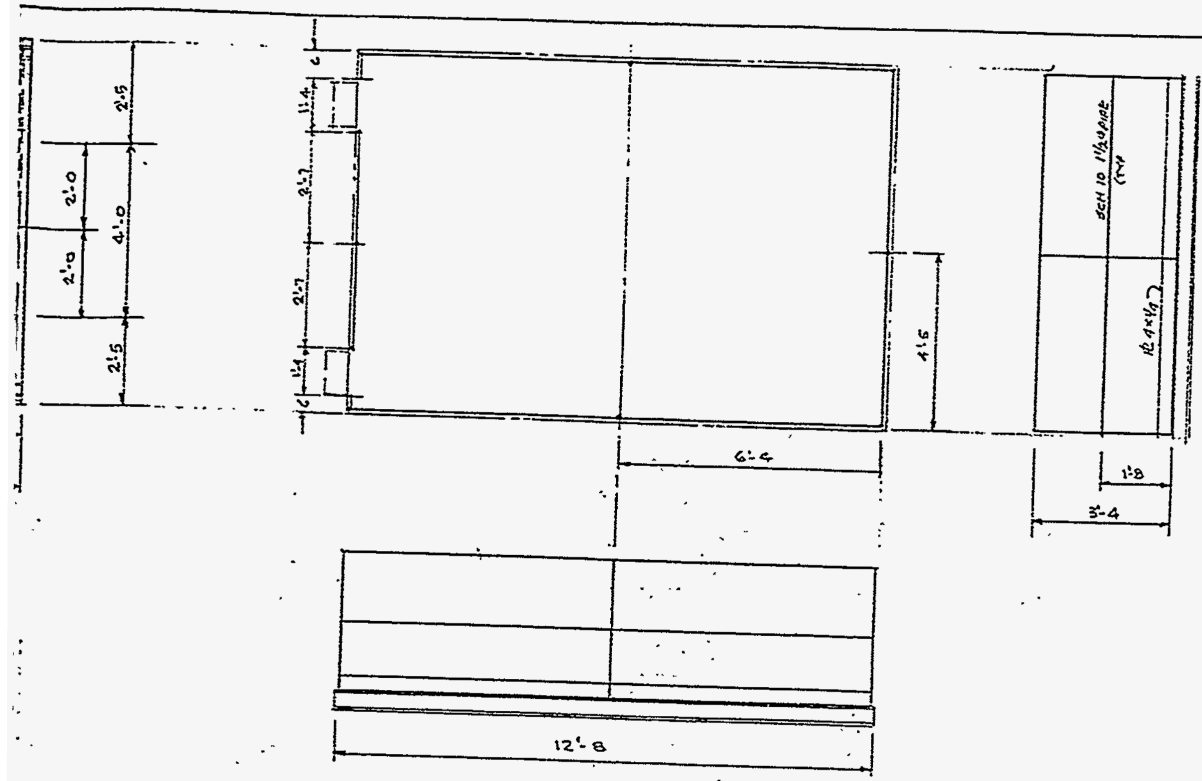


EL 25'-0
5
6
9
1'-8
3'-3½
2'-3
3'-3½
1'-8
4'-3½
1'-10½
2'-5
2'-10¾
7A
10
16
3'-5
4'-0
8
20
EL 8'-3
CALCINER (REF)
12'-2

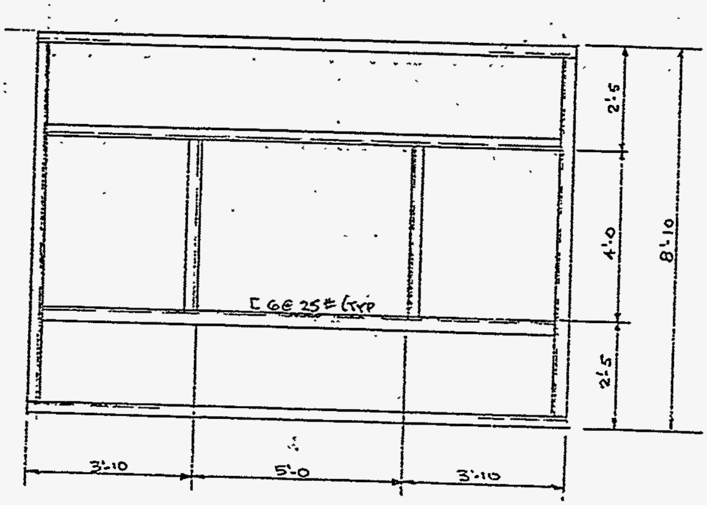

1'-6
4'-5
8'-10
LADDER
OPEN
LADDER
GRATING
1x1/8
4'-4
2'-0
2'-0
4'-4
12'-8

PLAN VIEW

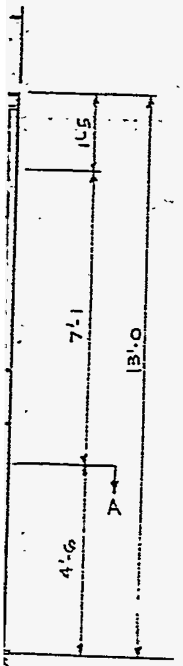

4'-0
4'-8
4'-0
1'-0
11 SP. @ 1'-0 = 11'-0
BAR 3/8 x 2
A
1 1/2 H.R.
4'-4
4'-0
4'-4
3'-10
5'-0
3'-10
1'-0



HANDRAIL DETAILS



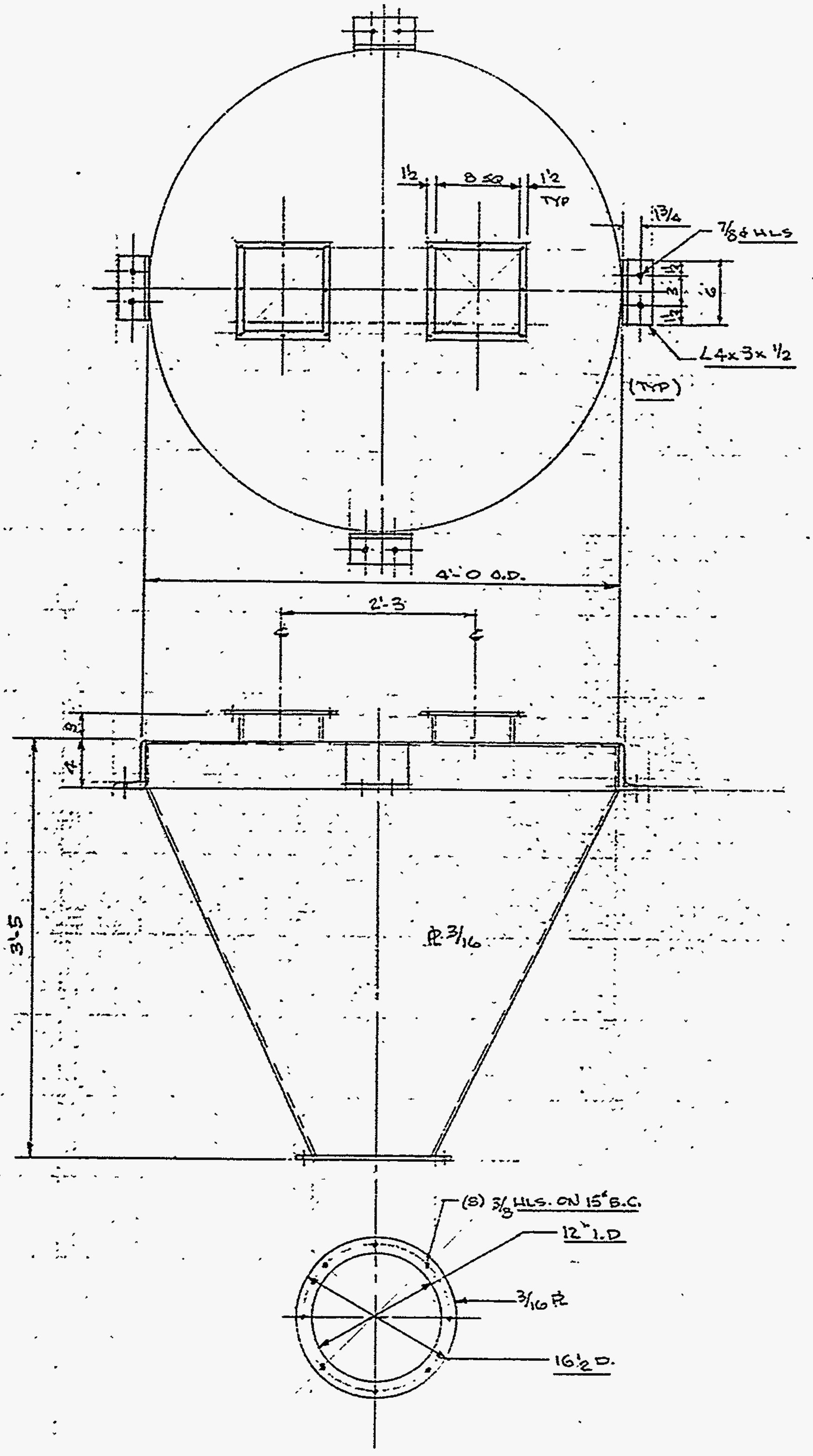
VIEW A-A



FOR ANCHOR
BOLT PLATE DETAIL
SEE DRAWING

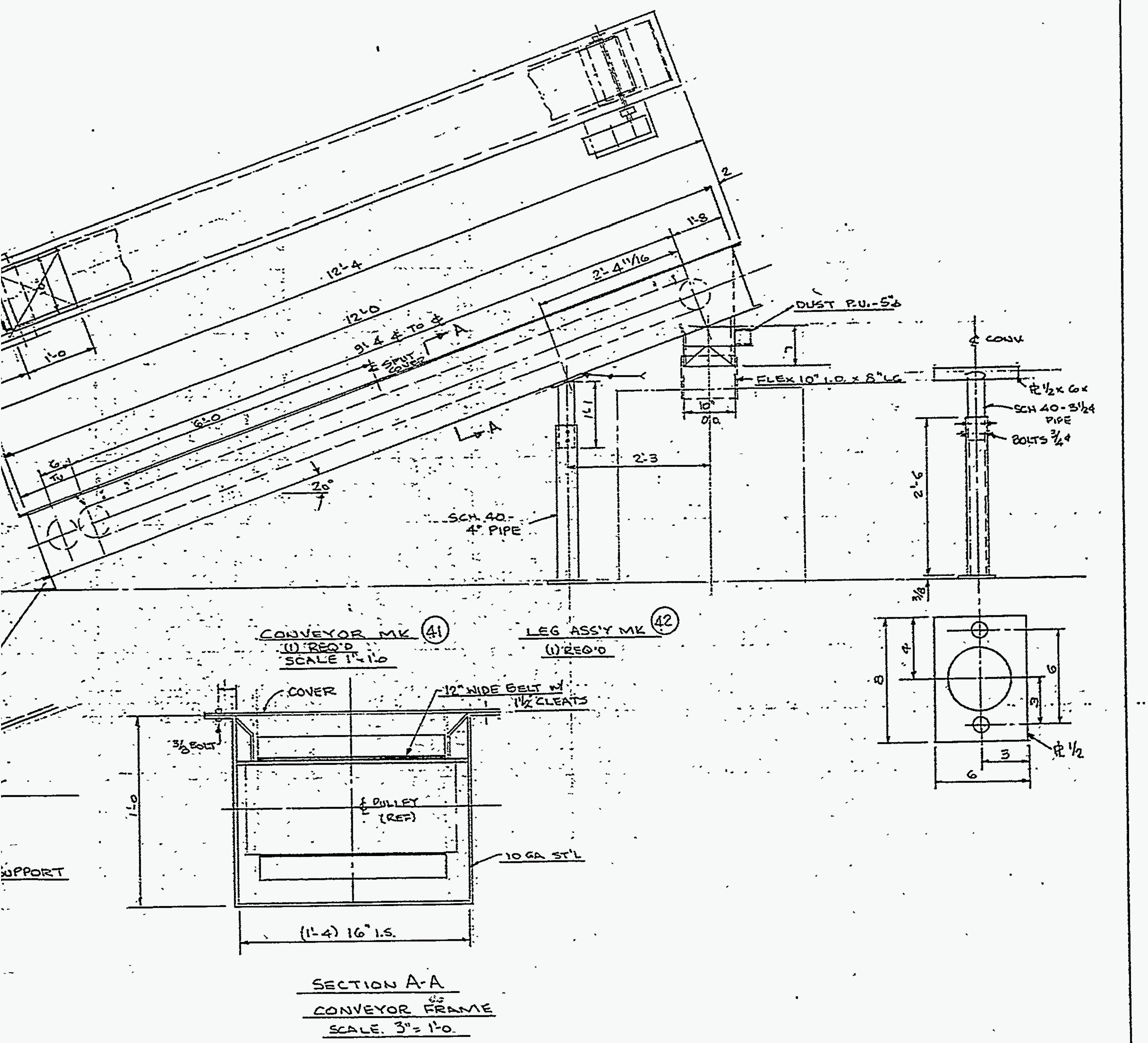
1/2"=1'0
12-1-95
Wm Gillman
B.K

DETAIL - PLATFORM FOR FEEDING
SYSTEM B
LOCKHEED TECHNOLOGIES CO.
IDAHO FALLS ID
SS-162-6



HOPPER MK (8)
(1) REQ'D
SCALE 1½" = 1'-0

DETAIL TAIL S

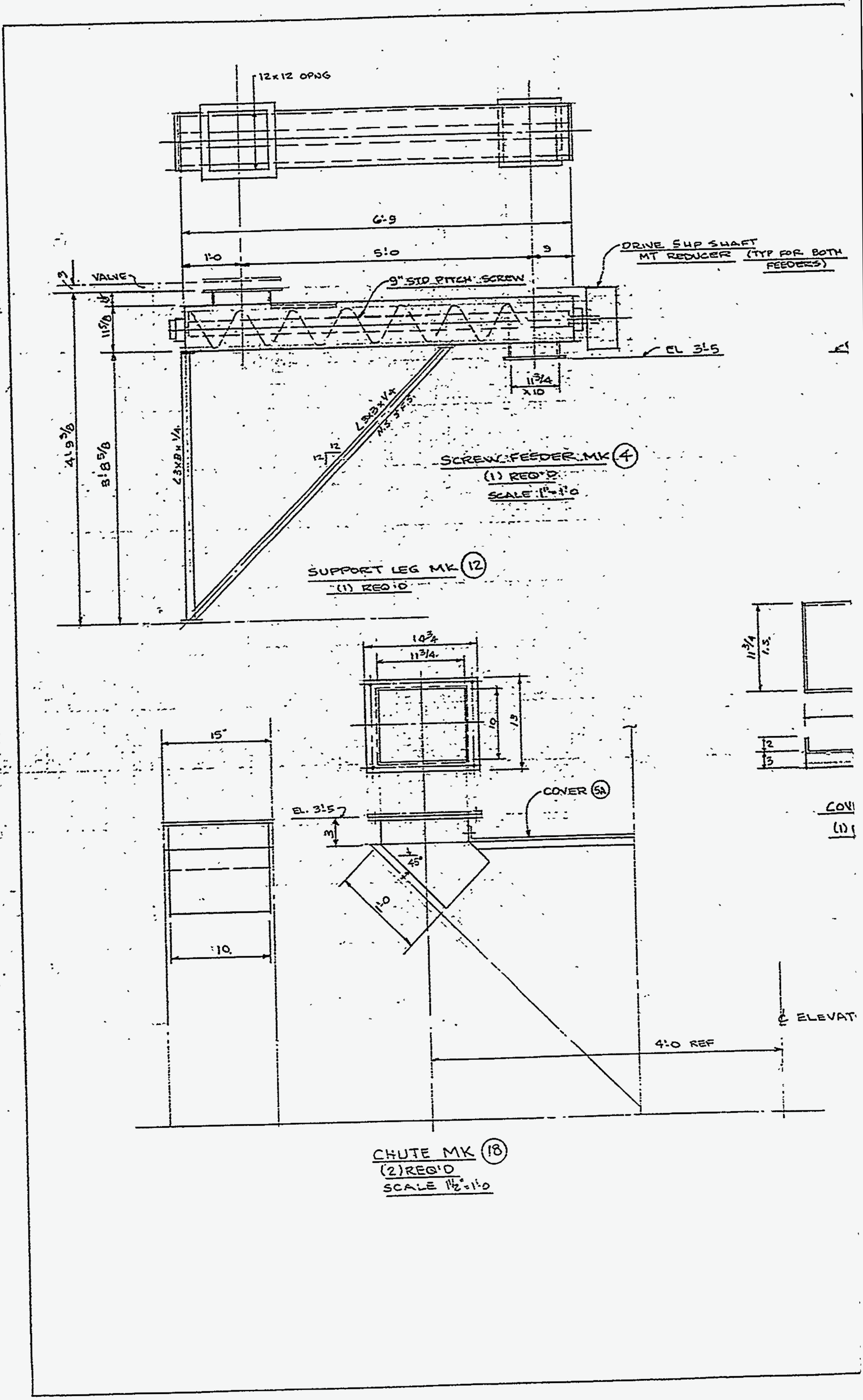


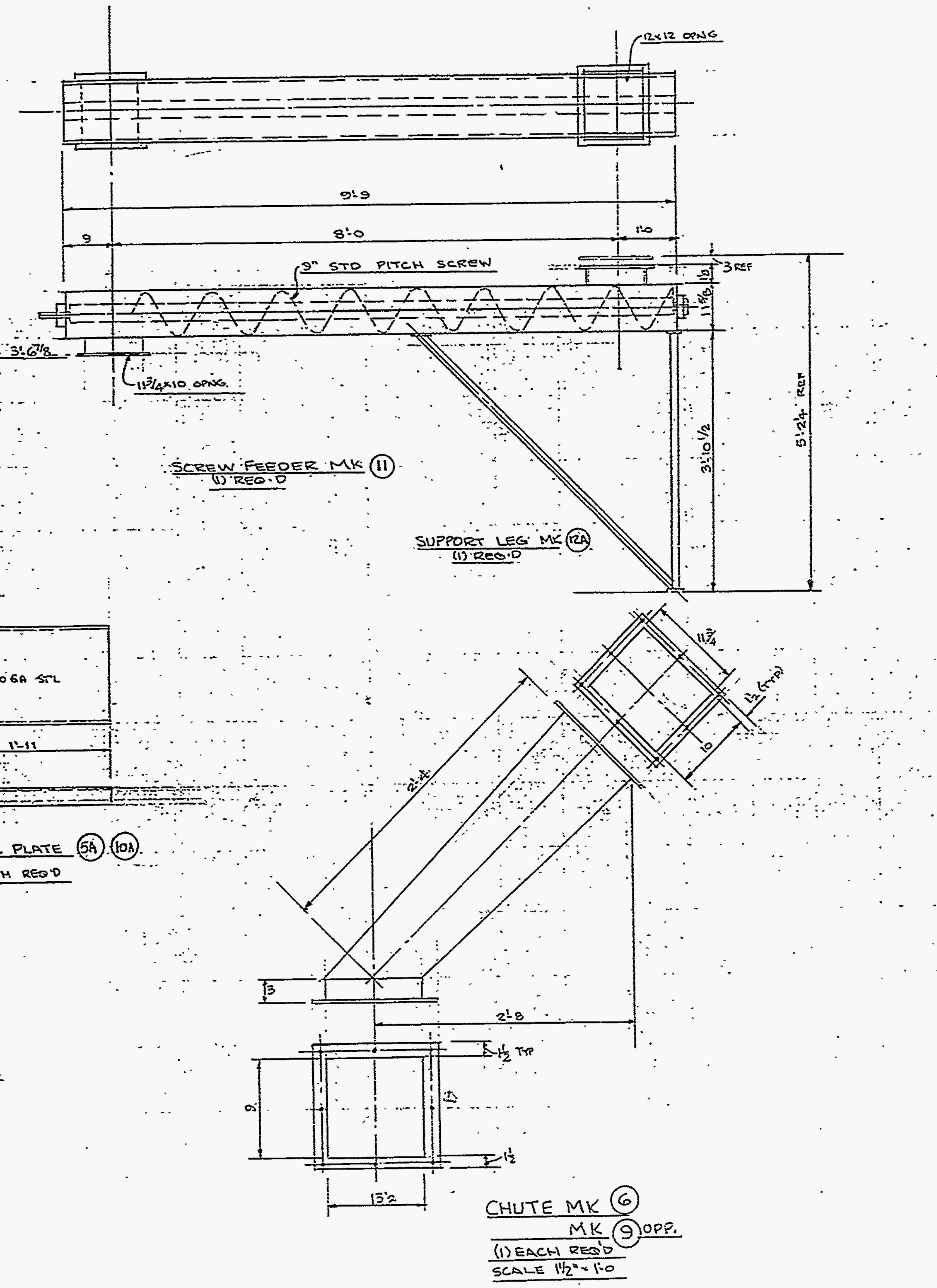
SHOWN
12-4-95

DETAIL TANK 9, & CONVEYOR 41
LEG DETAIL 42

LOOKHEED TECHNOLOGIES, GRP.
IDAHO FALL, ID

95-162-7


12x12 OPNG
6'-9
1'-0
5'-0
9
DRIVE SHP SHAFT MT REDUCER (TYP FOR BOTH FEEDERS)
VALVE
9" STD PITCH SCREW
EL 3'-5
11 3/4
x10
4'-9 3/8
3'-8 5/8
11 5/8
L3x3x1/4
L3x3x1/4
N.S. 3 F.S.
SCREW FEEDER MK 4
(1) REQ'D
SCALE 1"=1'-0
SUPPORT LEG MK 12
(1) REQ'D
14 3/4
11 3/4
10
13
15"
10
EL. 3'-5
3
COVER 5A
45°
1'-0
4'-0 REF
℄ ELEVAT
COV
(1)
CHUTE MK 18
(2) REQ'D
SCALE 1½"=1'-0

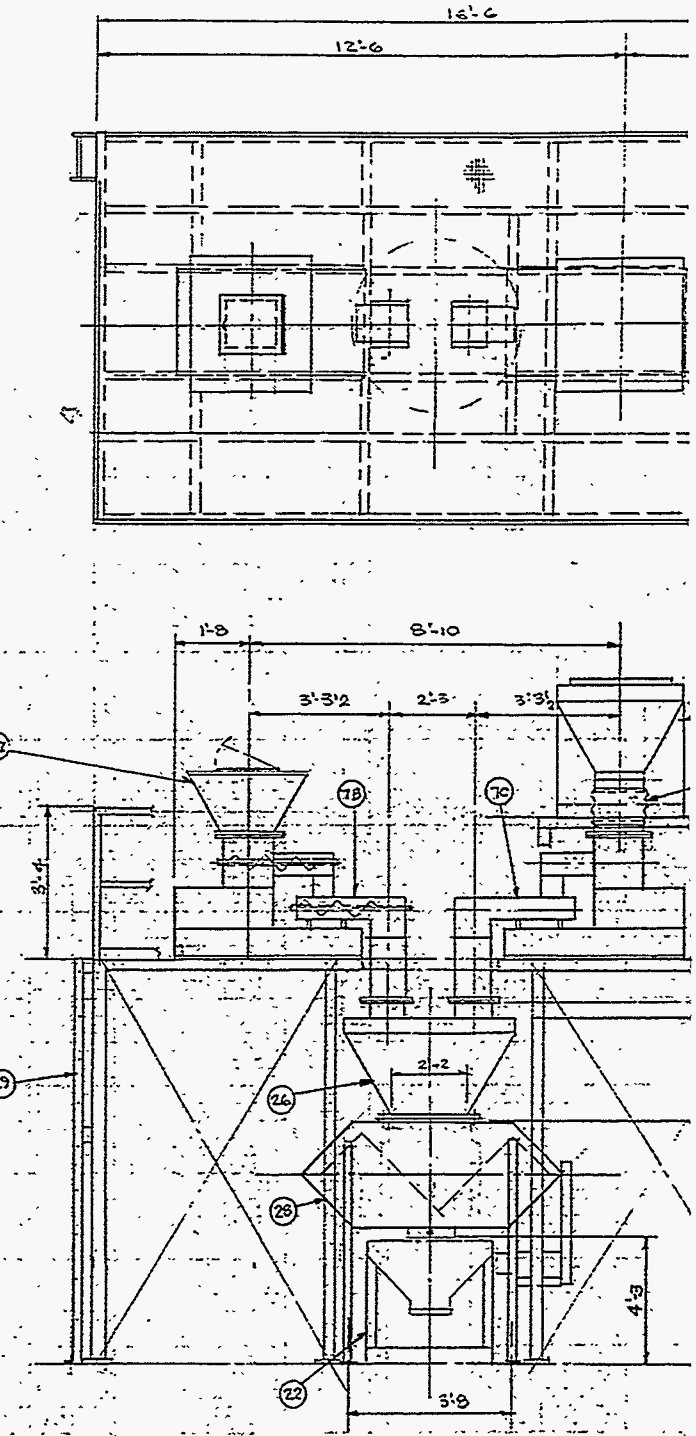


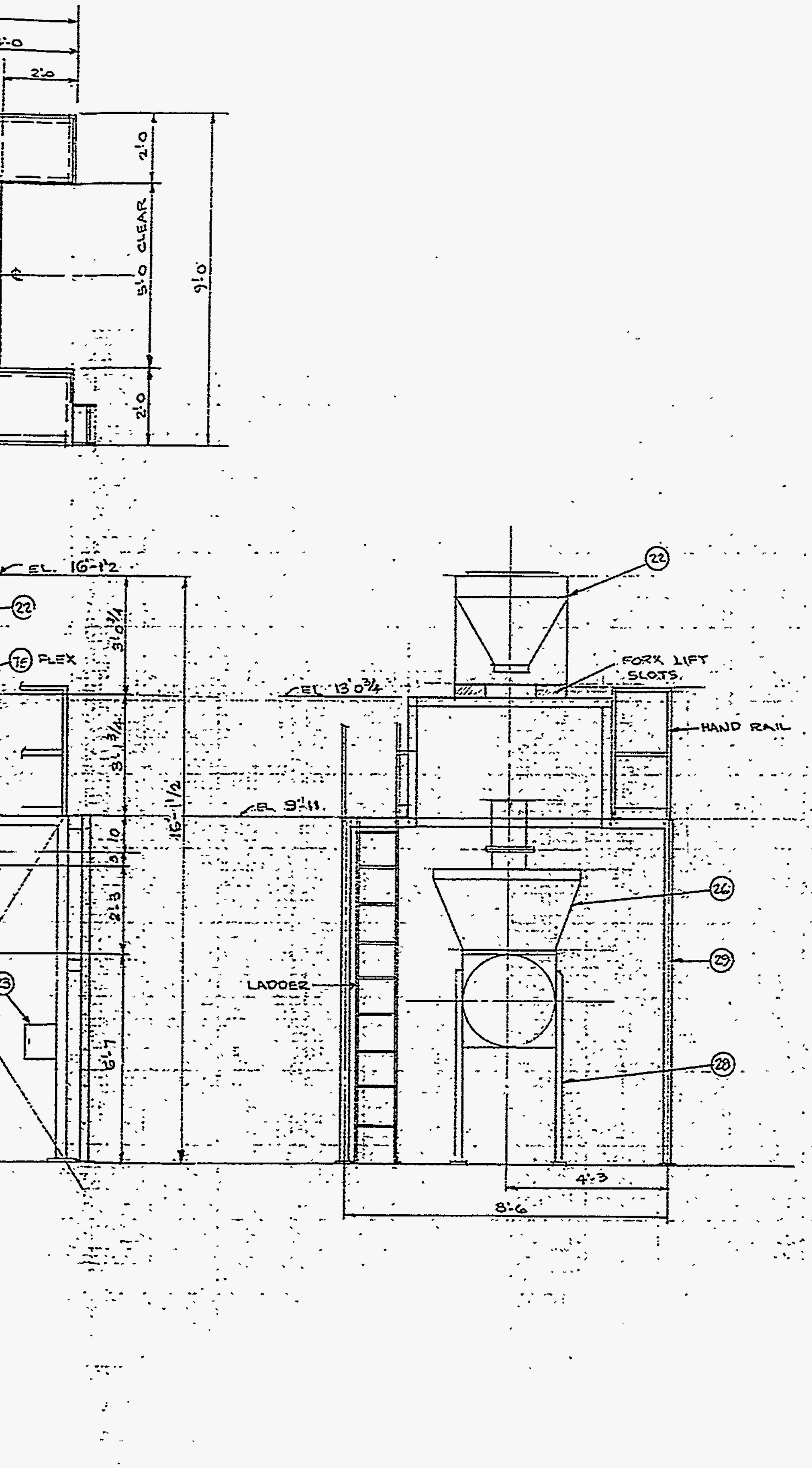
G/M SYSTEMS

DETAILS: CONVEYORS 4 & 11 - LEG
DETAILS & HOPPERS 15,6,9

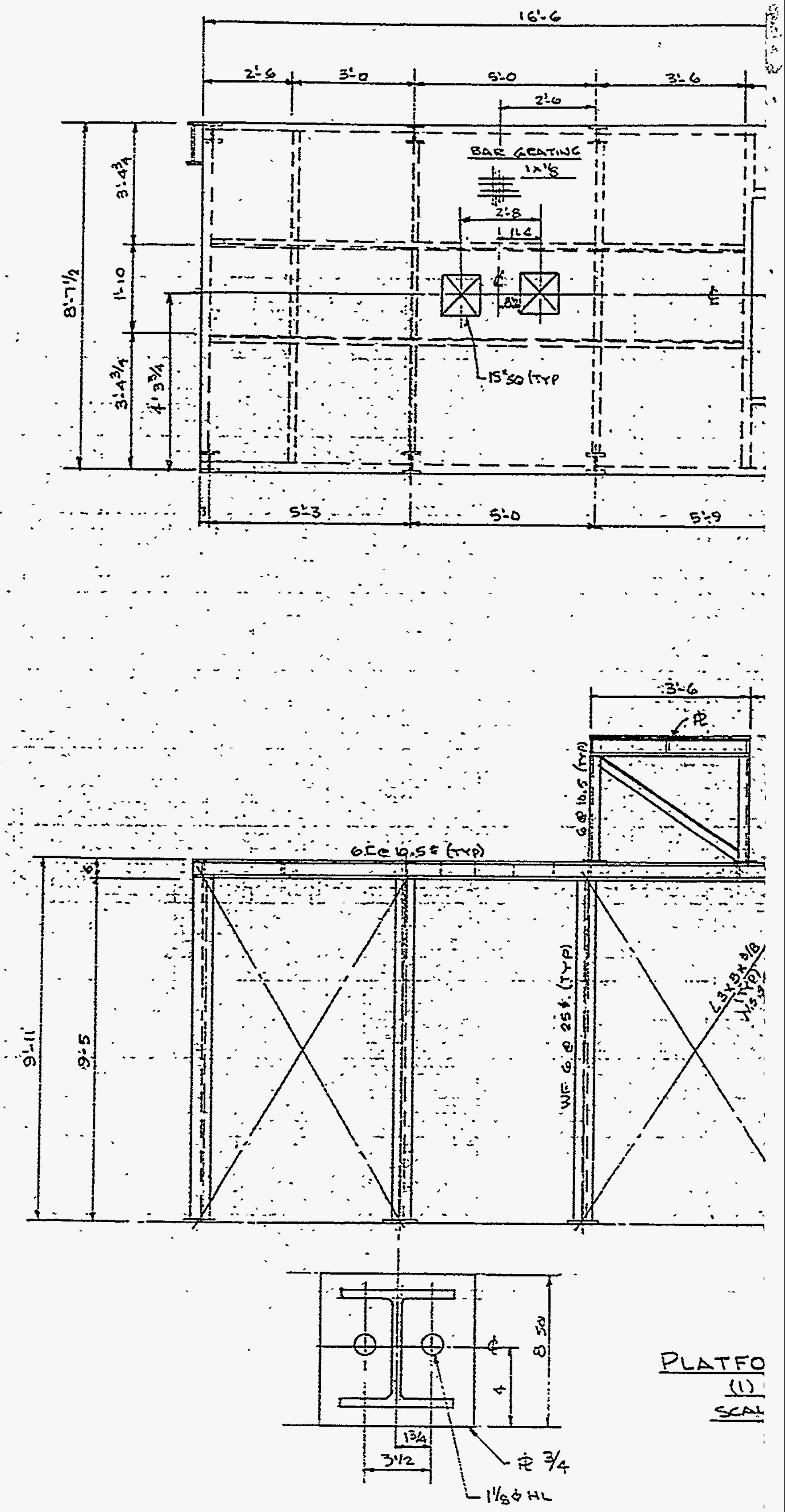
LOCKHEED TECHNOLOGIES GP.
IDAHO FALLS, ID

95-162-8


16'-6
12'-6
1'-8
8'-10
3'-3½
2'-3
3'-3½
3'-4
2'-2
4'-3
5'-8
31
7B
7C
29
26
28
22

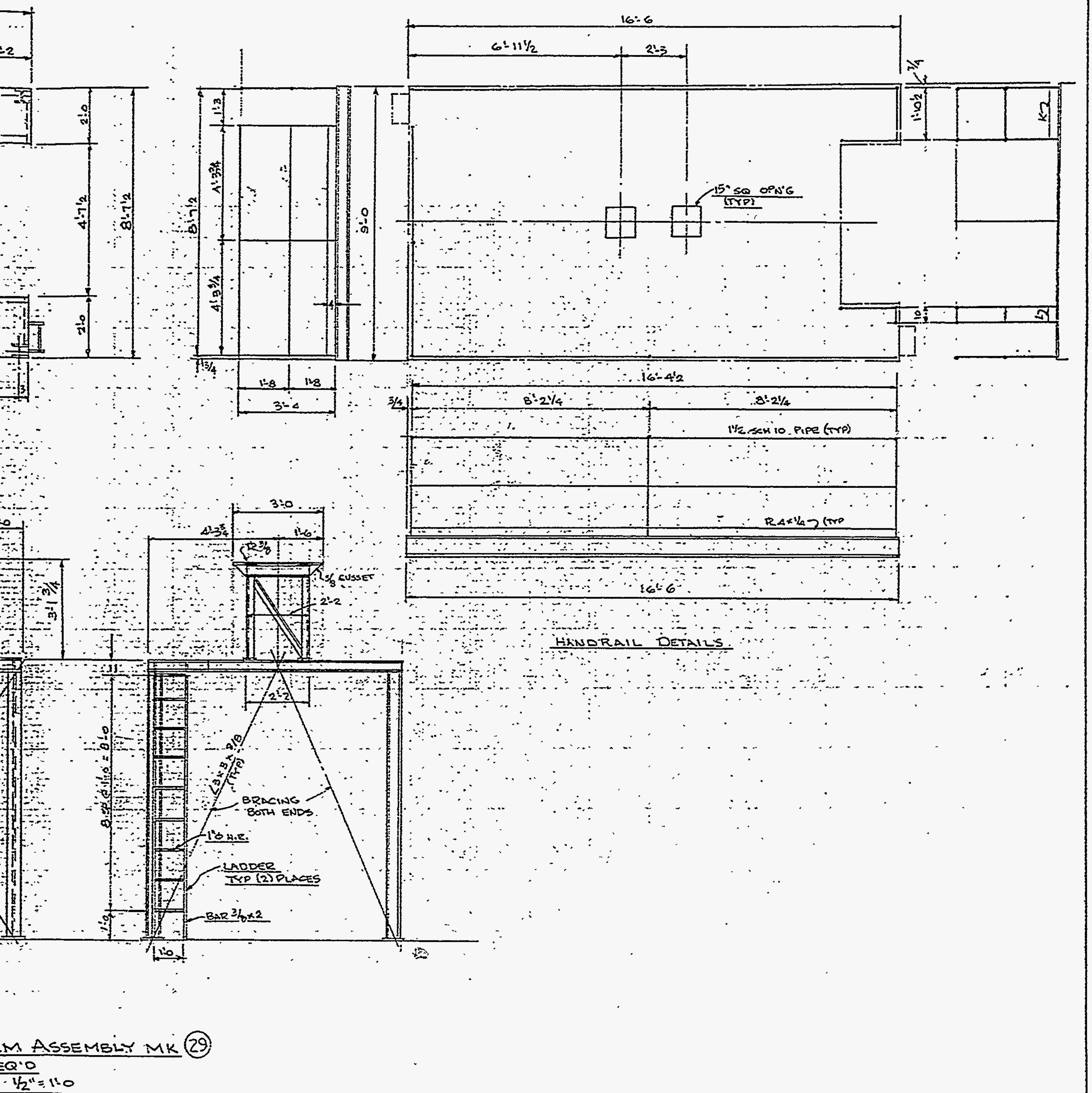


G/M SYSTEMS		
SCALE 1/4"=1'0 DATE 12-6-95	APPROVED BY [signature]	DRAWN BY M.G. REVISED
LAYOUT, EQUIPMENT FOR MIXING & BLENDING SYSTEM B		
LOCKHEED TECHNOLOGIES GRP. IDAHO FALLS, ID		DRAWING NUMBER 95-162-9



TYPICAL
ANCHOR BOLT PLATE
SCALE 1/4" = 1"

PLATFO
(1)
SCAL



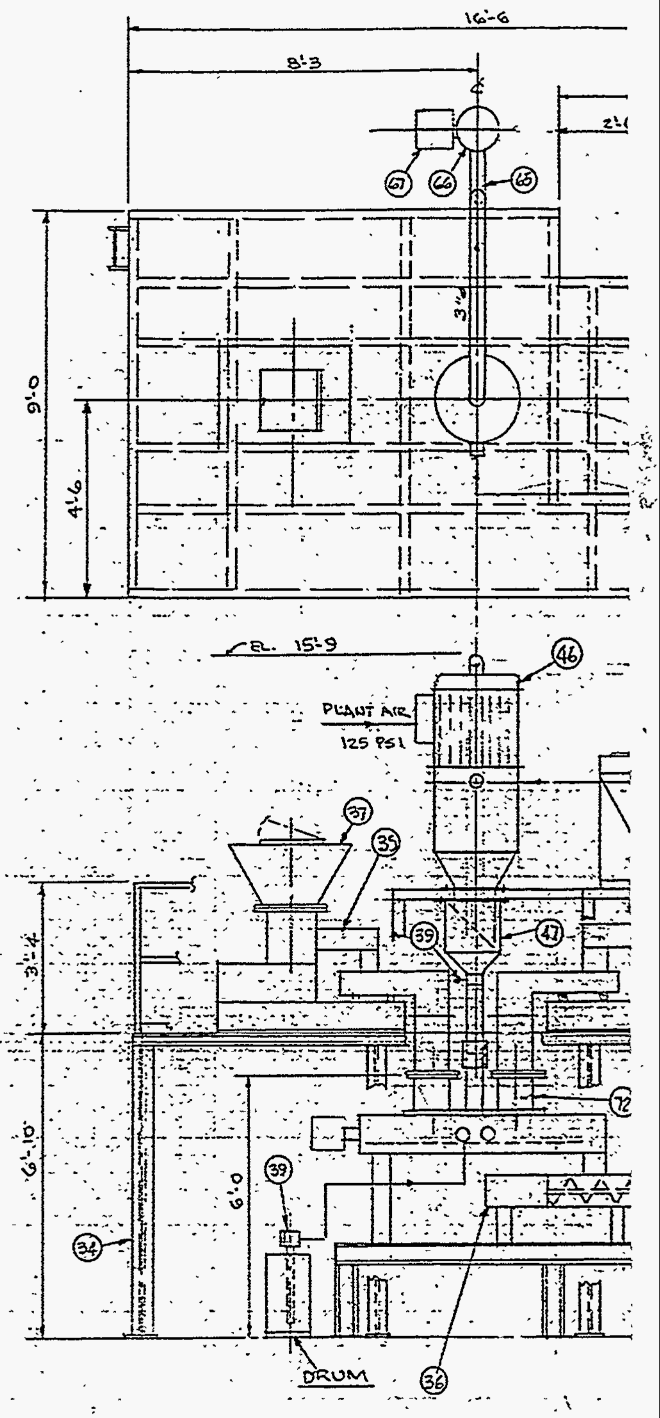
DETAIL - STRUCTURAL PLATFORM F/C MIXING & BLENDING SYSTEM B

LOCKHEED TECHNOLOGIES GRP. IDAHO FALLS ID

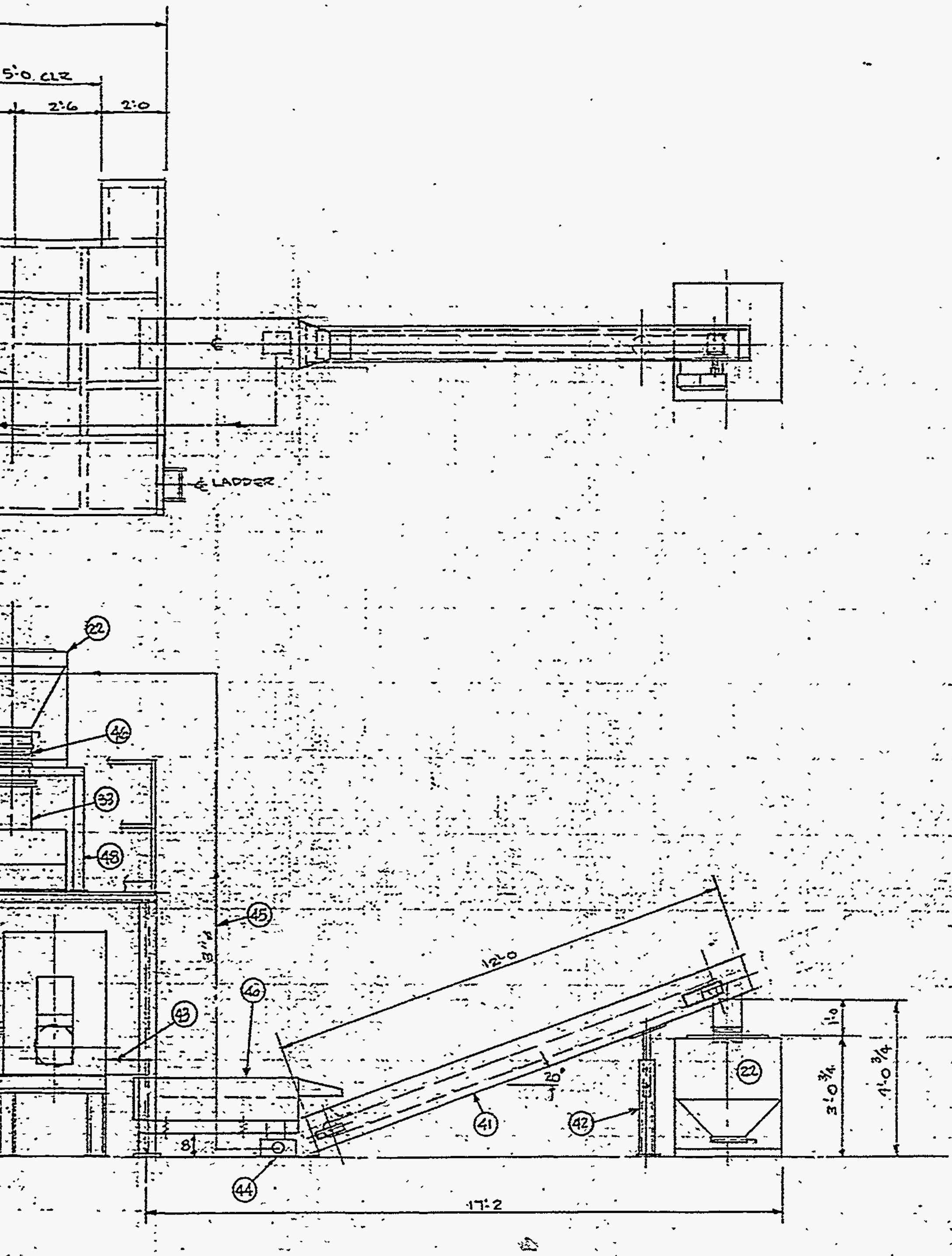
95-162-10

G/M SYSTEMS

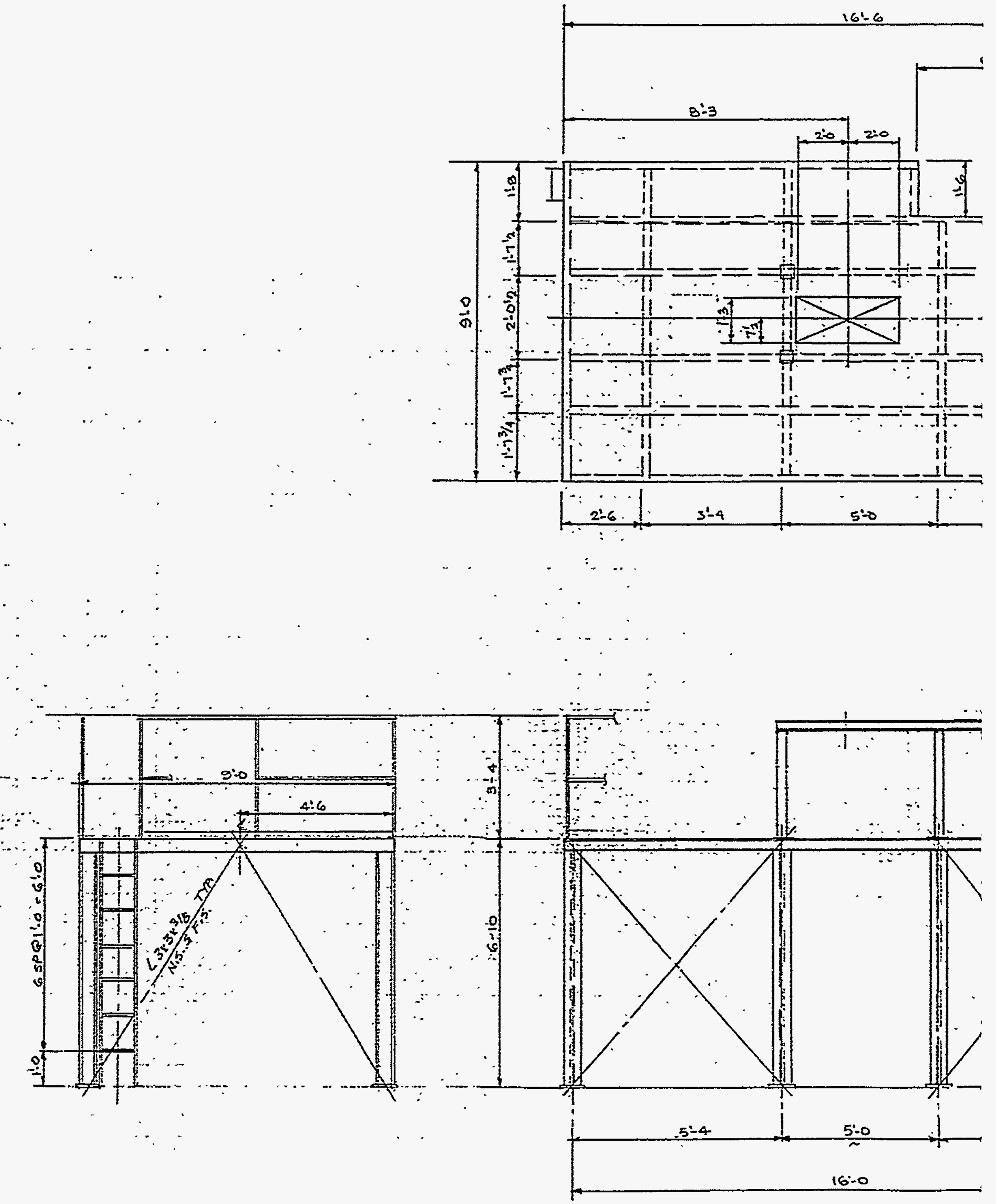
½" = 1'-0 11-30-95



16'-6
8'-3
9'-0
4'-6
EL. 15'-9
PLANT AIR
125 PSI
3'-4
6'-10
6'-0
DRUM
67
66
65
46
37
35
59
47
72
39
34
36

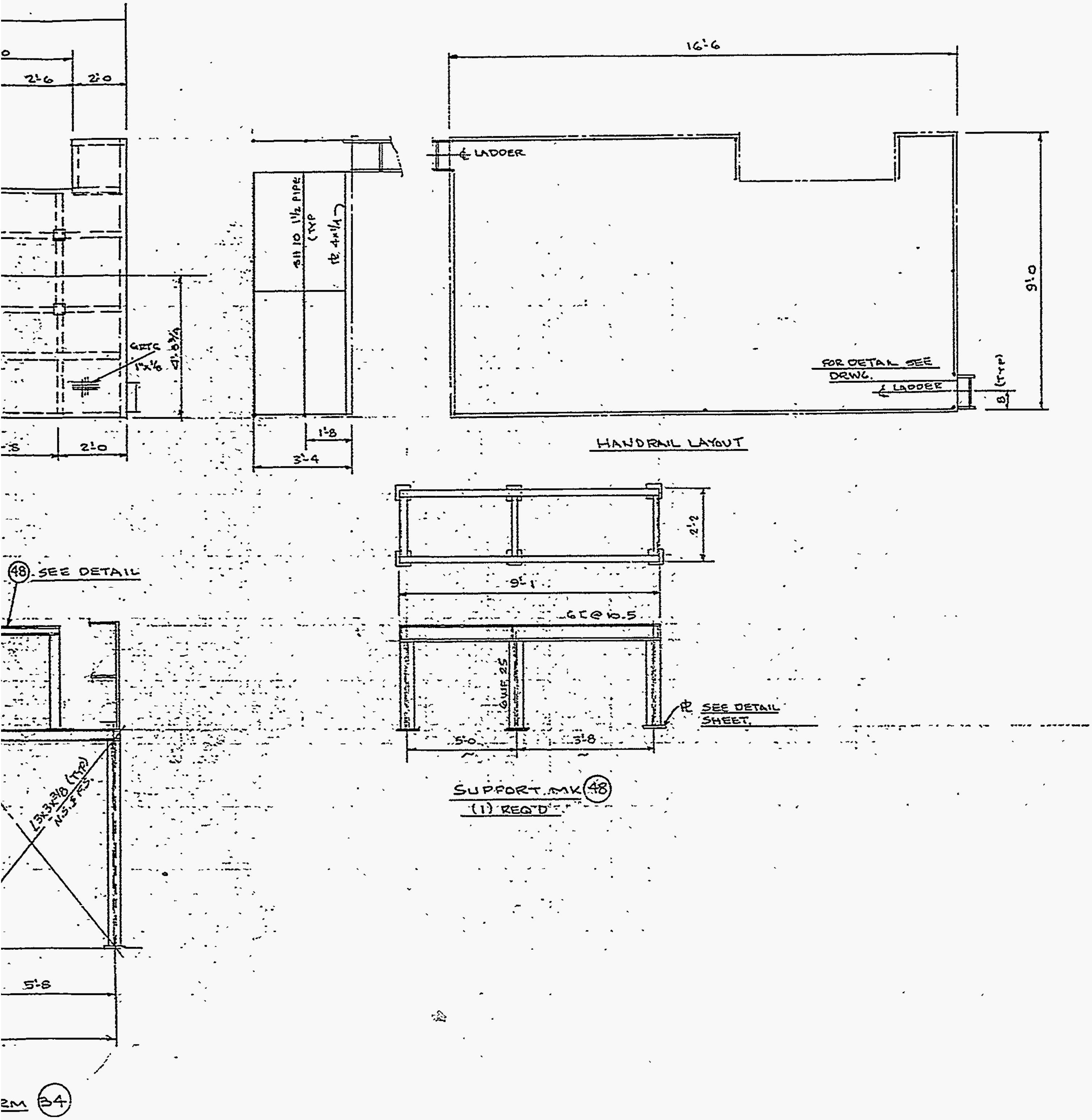


G/M SYSTEMS		
SCALE 1/2 = 1'0	APPROVED BY Hm Killman	DRAWN BY H.G.
DATE 12-6-95		
LAYOUT - EQUIPMENT FOR AGGLOMERATOR & BRIQUETTING SYSTEM E		
LOCKHEED TECHNOLOGIES GRP. IDAHO FALLS, ID		95-162-11



DETAIL SUPPORT PLATF

(1) REQ'D



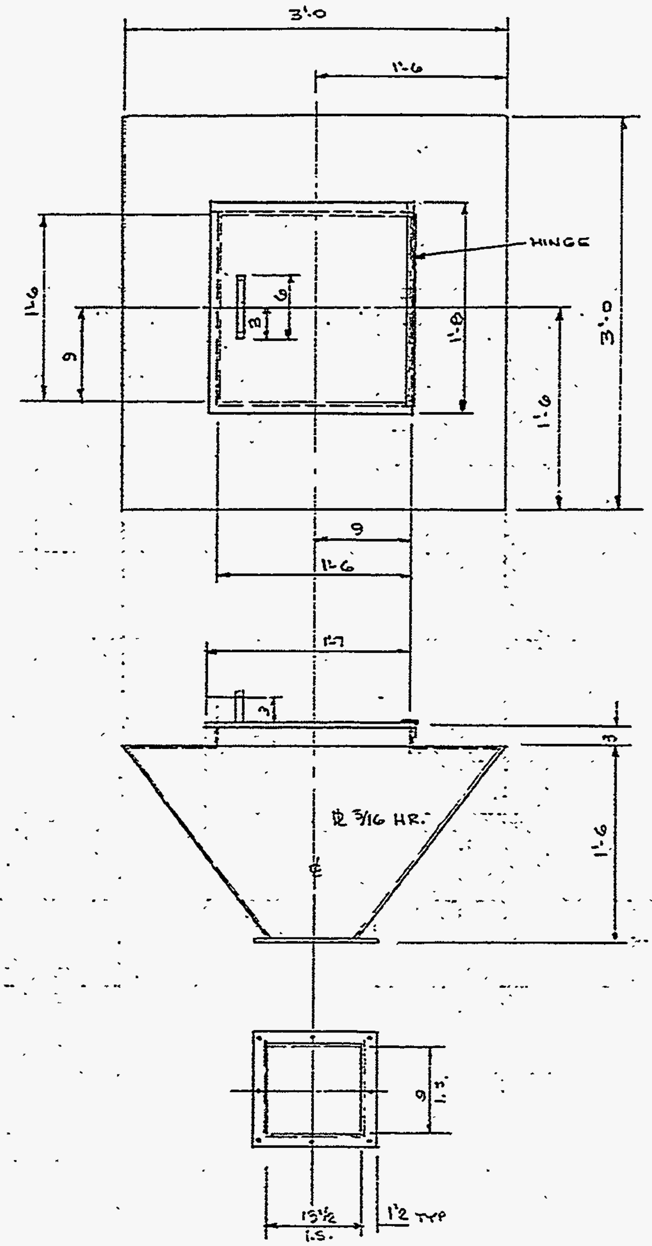
G/M SYSTEMS

½"=1'-0 | 12-7-95 | B.K.

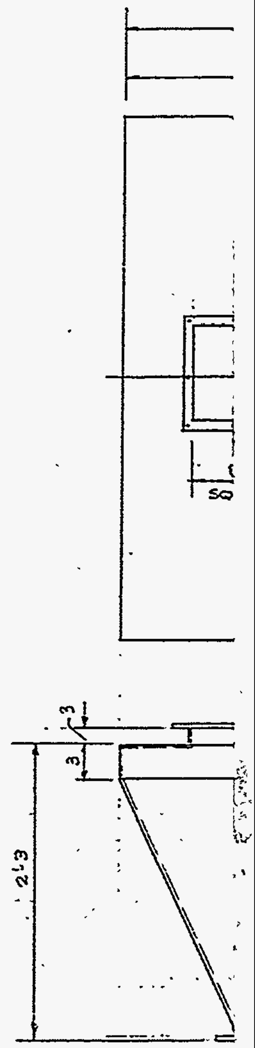
DETAILS - STRUTURAL PLATFORM. ITEM NO. 34 & 48

LOCKHEED TECHNOLOGY GRP. IDAHO FALLS, ID

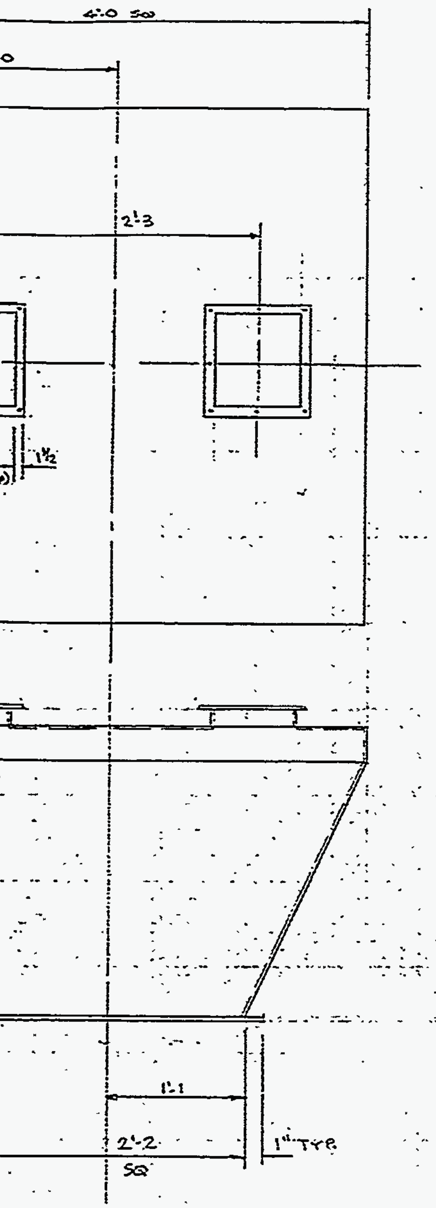
155-162-12



DETAIL HOPPER MK (37)
(2) REQ'D
SCALE 1½" = 1'-0

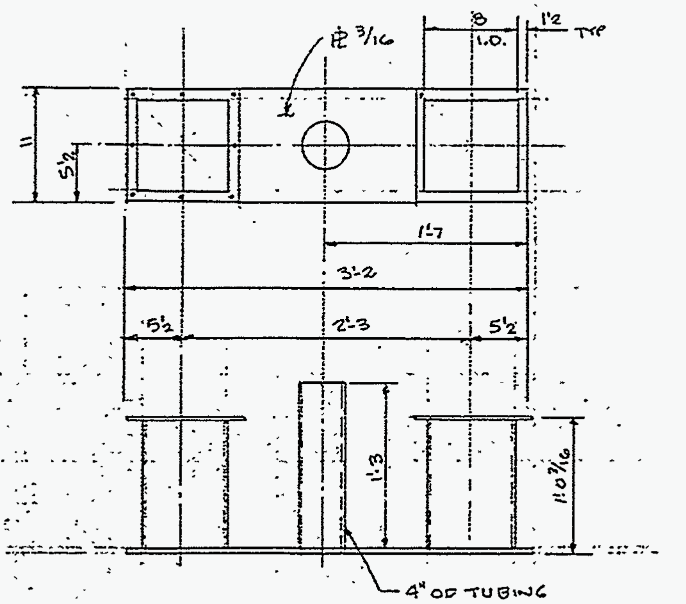


DE



AIL HOPPER MK (26)

(1) REQ'D

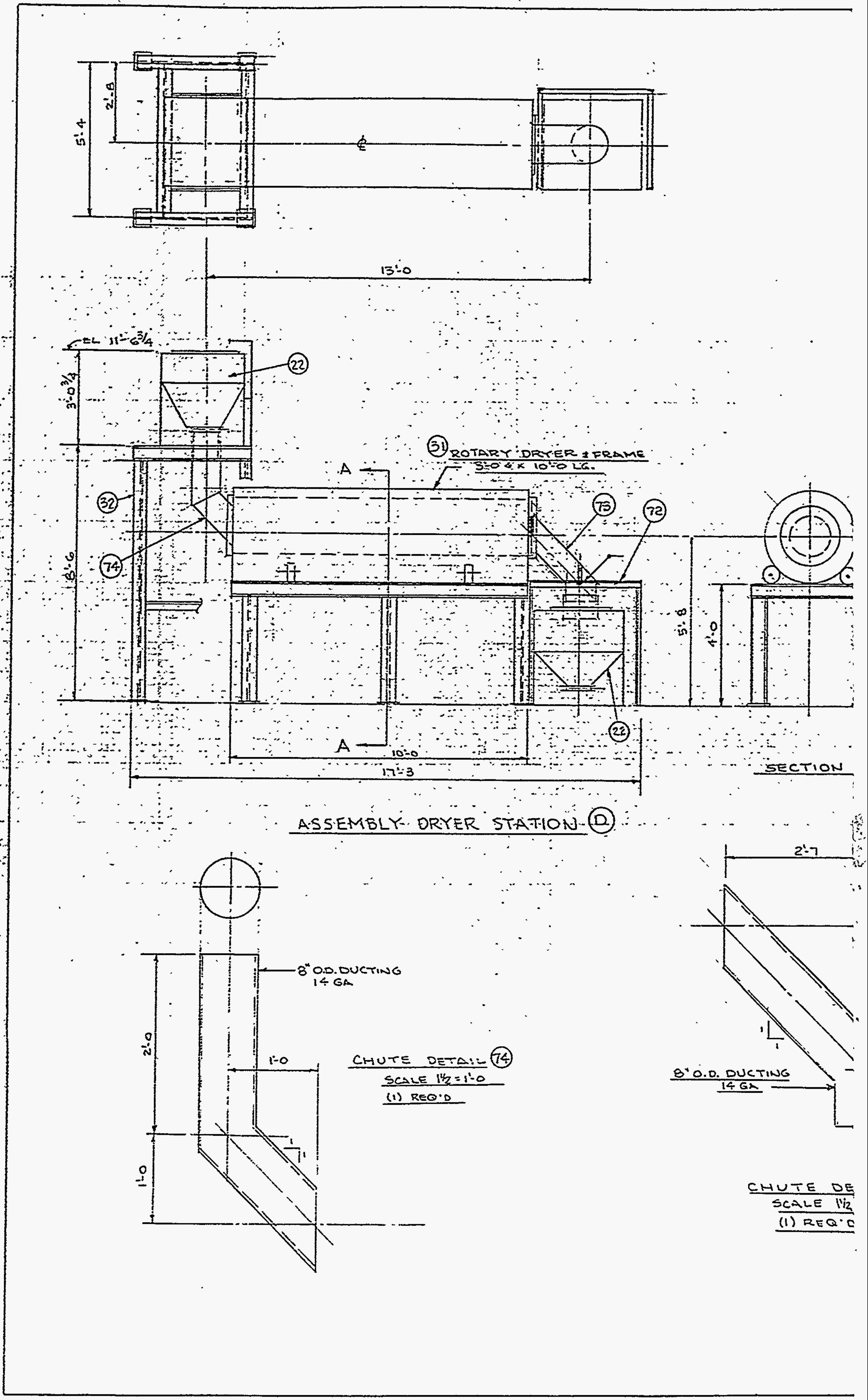


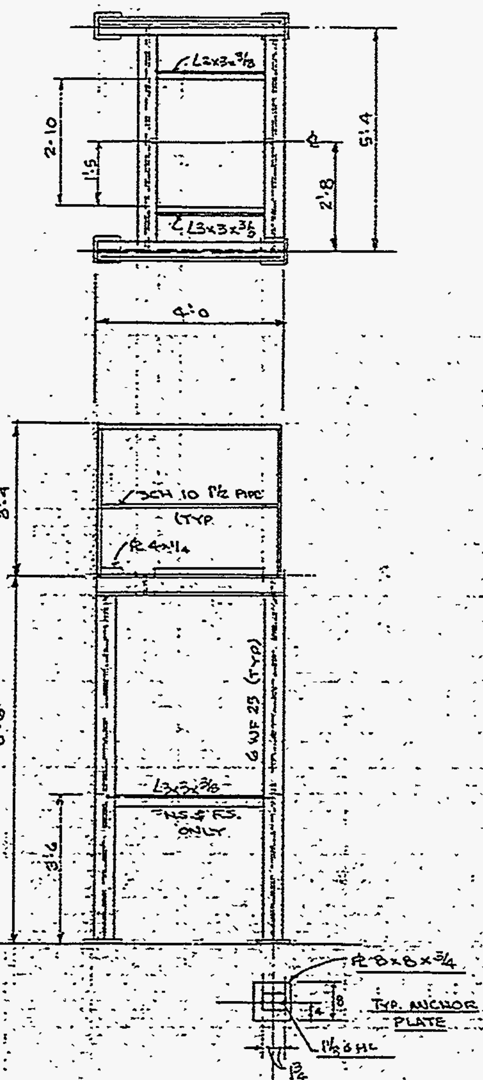
DETAIL HOPPER (71)

ASS'Y MK

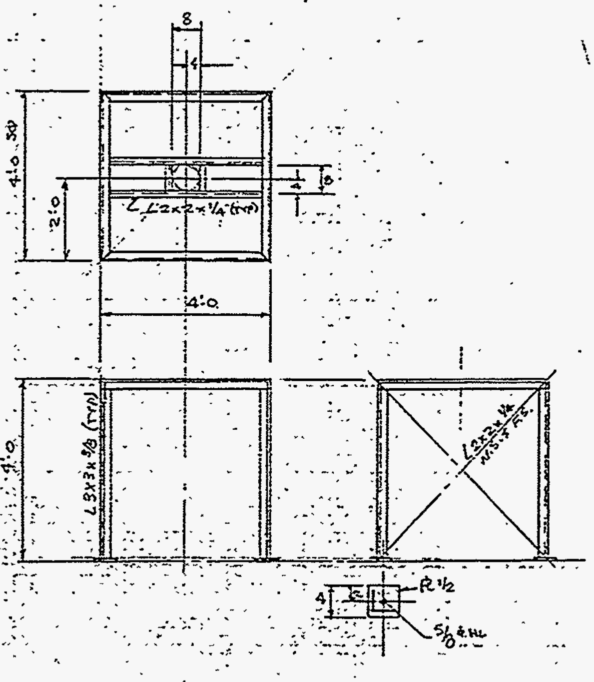
(1) REQ'D

1½" = 1'-0	
12-8-95	
DETAILS - HOPPERS 37 & 26 AND 71	
LOCKHEED TECHNOLOGIES GRP IDAHO FALLS, ID	95-161-13

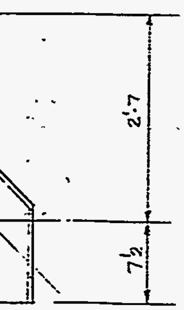

5'-4
2'-8
13'-0
EL 11'-6 3/4
3'-0 3/4
22
31 ROTARY DRYER & FRAME
5'-0 Ø x 10'-0 LG.
A
32
74
75
72
8'-6
5'-8
4'-0
22
10'-0
17'-3
SECTION
ASSEMBLY DRYER STATION D
2'-7
8" O.D. DUCTING
14 GA
2'-0
1'-0
1'-0
CHUTE DETAIL 74
SCALE 1½=1'-0
(1) REQ'D
8" O.D. DUCTING
14 GA
CHUTE DE
SCALE 1½
(1) REQ'D



PLATFORM DETAIL (32)
(1) REQ'D

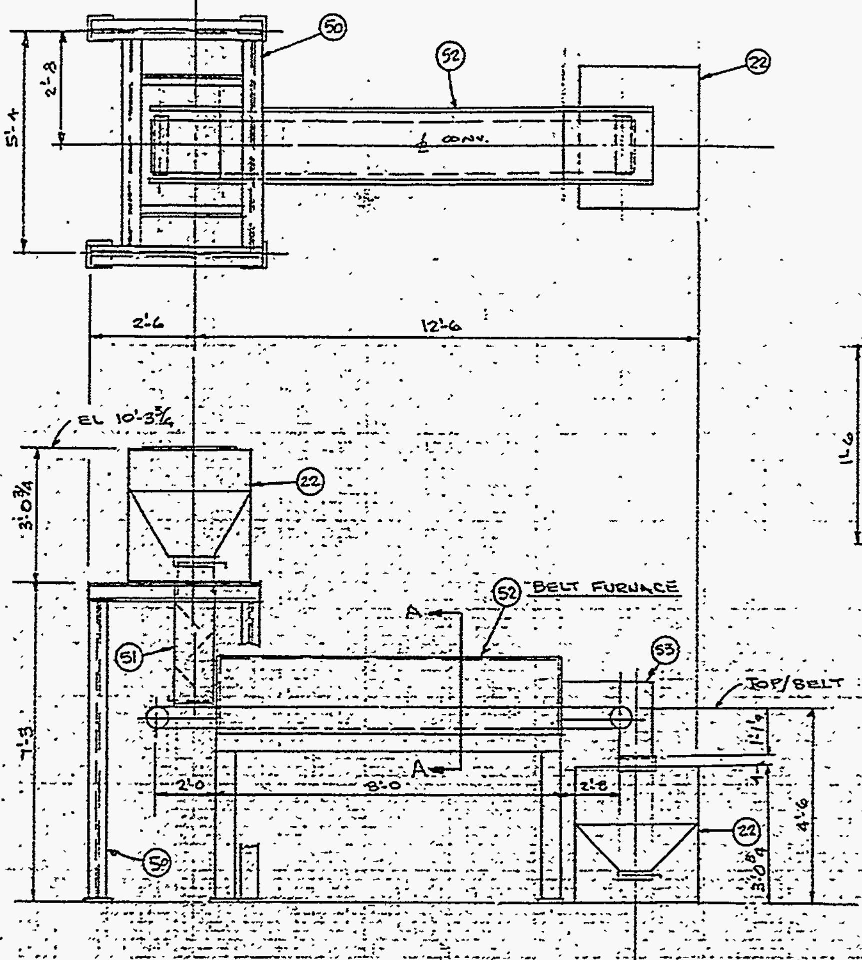


PLATFORM DETAIL ITEM (72)
1-REQ'D



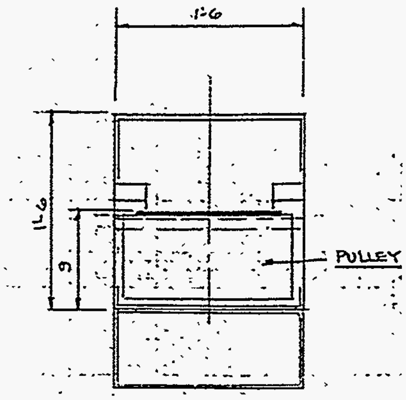
...AIL (73)
...1.0

SHOWN
12-8-95
ARRG'T & DETAILS FOR DRYER STATION D
LOCKHEED TECHNOLOGIES
IDAHO FALLS, ID. 95162-14



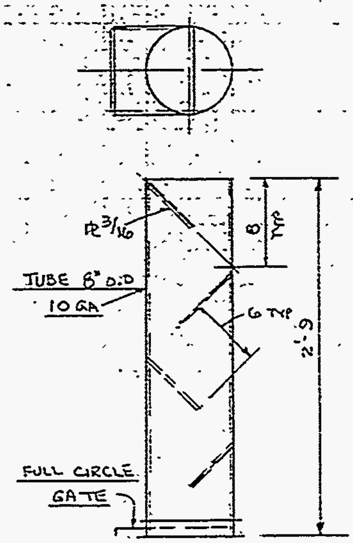
ASSEMBLY FURNACE STATION (F)

SCALE ½" = 1'-0



SECTION A-A

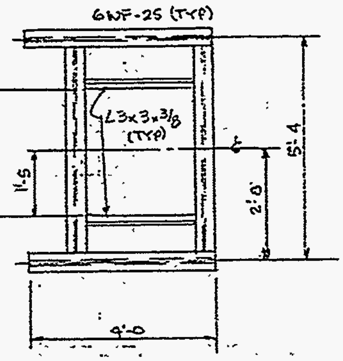
SCALE 1½" = 1'-0

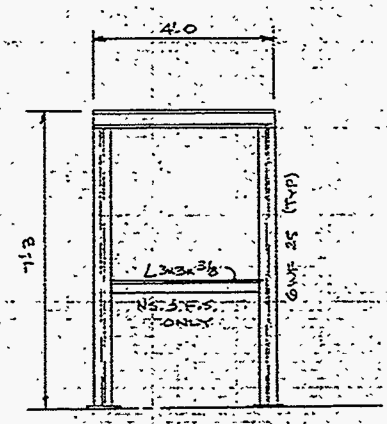


CHUTE DETAIL (51)

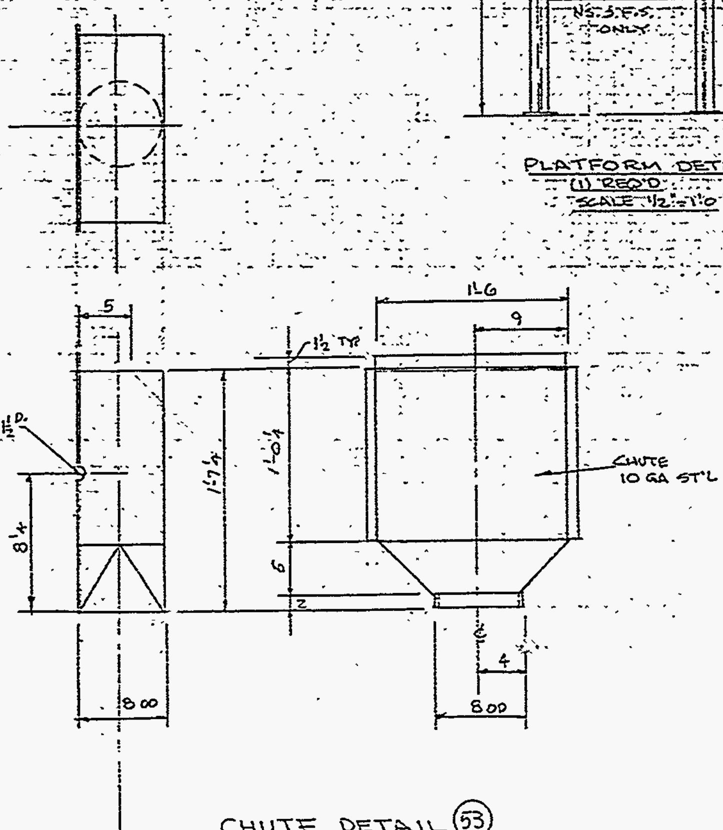
SCALE 1½" = 1'0

(1) REQ'D





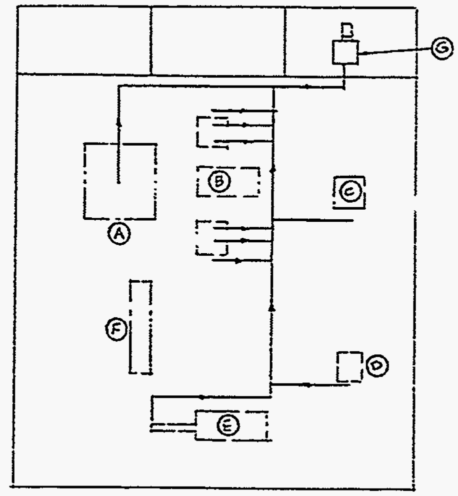
PLATFORM DETAIL (50)
(1) REQ'D
SCALE 1/2" = 1'-0



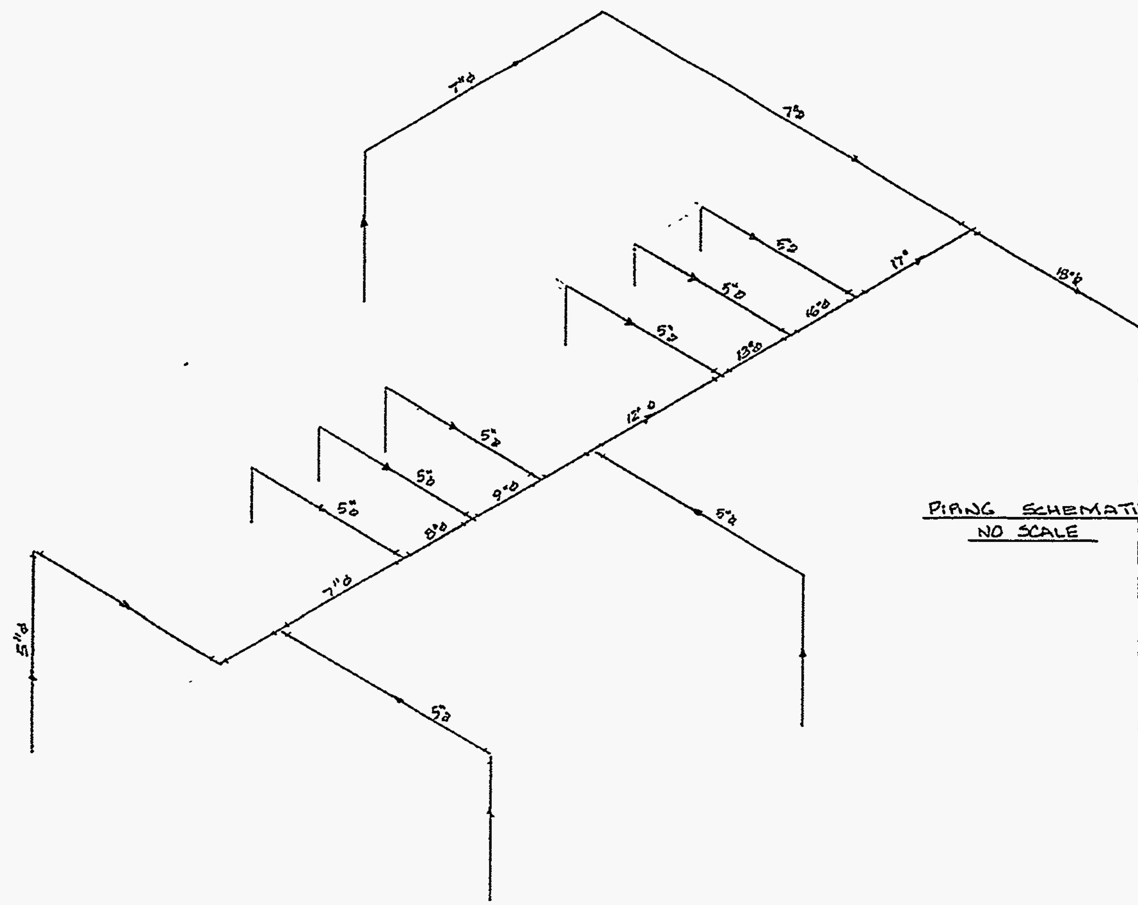
CHUTE DETAIL (53)
SCALE 1 1/2" = 1'-0
(1) REQ'D

G/M SYSTEMS

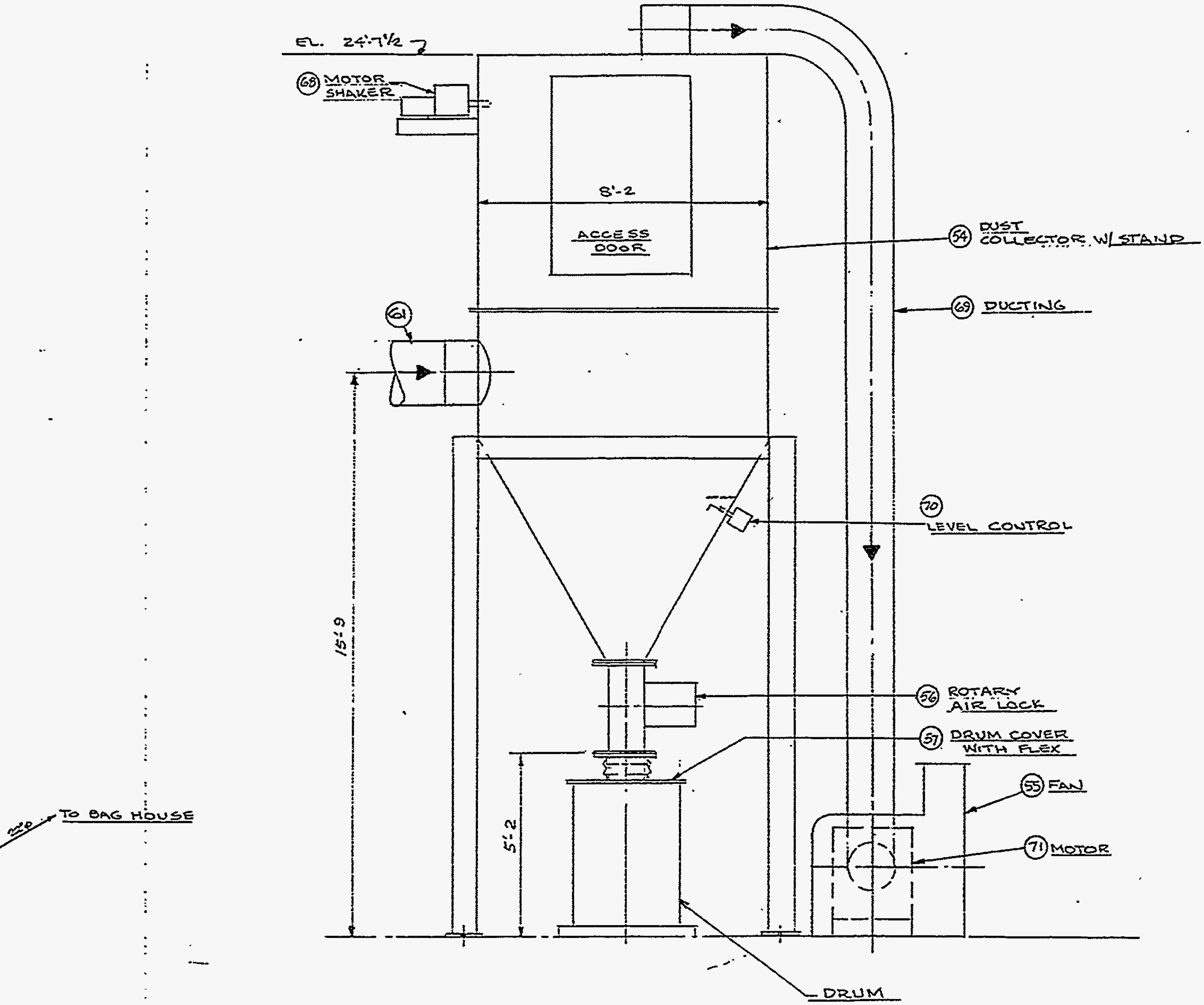
AS SHOWN		
12-6-95		
ARRG'T & DETAILS FOR FURNACE STATION F		
LOCKHEED TECHNOLOGIES GP. IDAHO FALLS, ID.		95-162-15



BAG HOUSE PIPING
LAYOUT

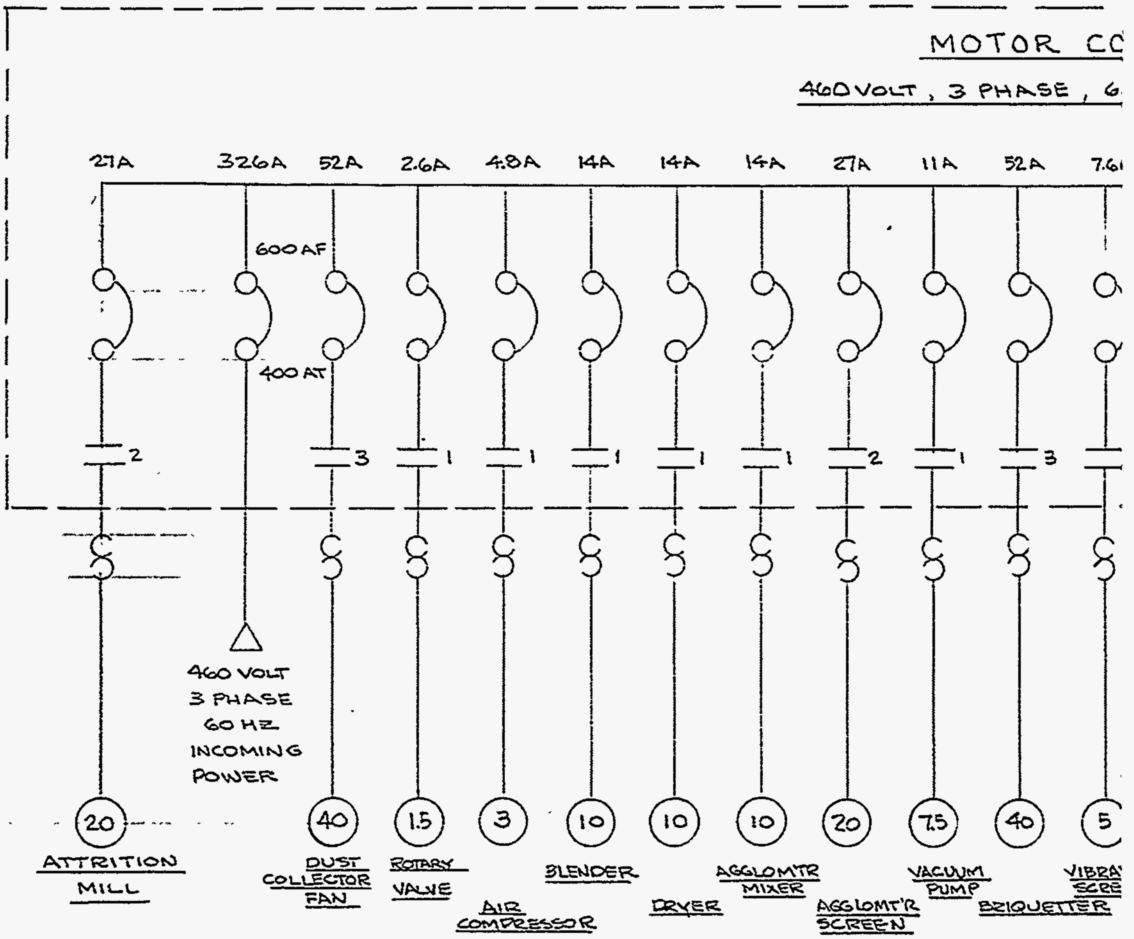


PIPING SCHEMATI
NO SCALE



DUST COLLECTOR ASSEMBLY
SCALE 1/2" = 1'-0

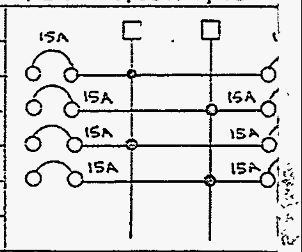
SHOWN
11-25-95
NG
GENERAL ARRG'T - DUST COLLECTION SYSTEM 6
LOCKHEED TECHNOLOGIES GCI
IDAHO FALLS, ID
95-162 6

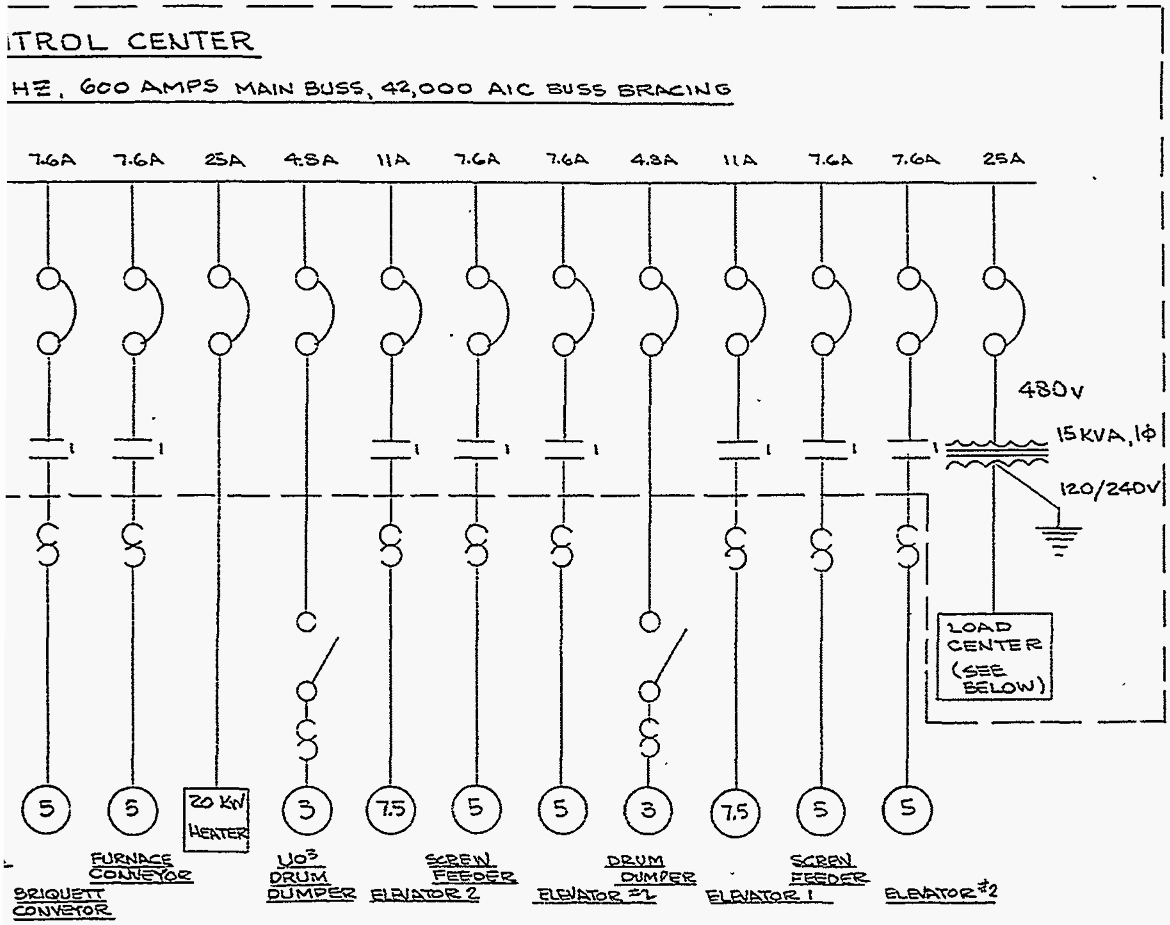


LOAD CENTER

240 VOLT, 1 PHASE, 3 WIRE, 60 HZ, 60 AM

LOAD	AMPS
BLENDER WEIGH FEEDER CONTROL PANEL	10
AGGLOMORATOR AND BRIQUETTER CONTROL PANEL	10
SYSTEM CONTROL PANEL	7
SPARE	
SPARE	
SPARE	





MAIN BUSS, 10,000 AIC

AMPS	LOAD
10	CALCINER WEIGH FEEDER CONTROL PANEL
5	CALCINER CONTROL PANEL
7	LIQUID BINDER PUMP
	SPARE
	SPARE
	SPARE

B/W SYSTEMS

1-8-96 | WH | REV A

ELECTRICAL ONE-LINE DIAGRAM
DEPLETED URANIUM AGGREGATE
LOCKHEED IDAHO TECHNOLOGIES CO. IDAHO FALLS, ID

95-162-E

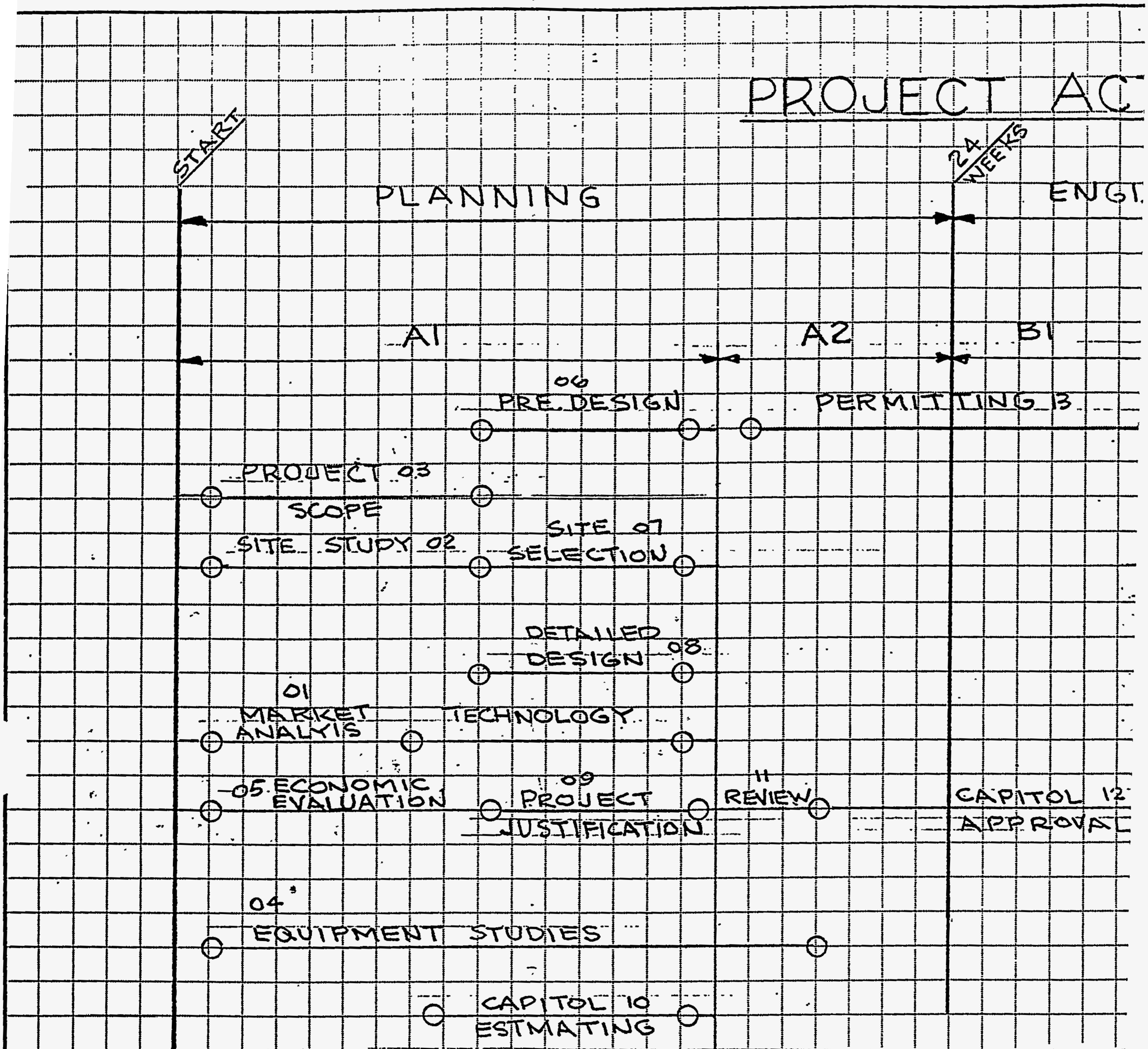
6 PROPOSED PLAN AND SCHEDULE

6.1 The recommended approach would be to either find a suitable facility in an existing building or build a new building. The cost outlined outlined in paragraph 1.5 indicates that the facility be in an existing building.

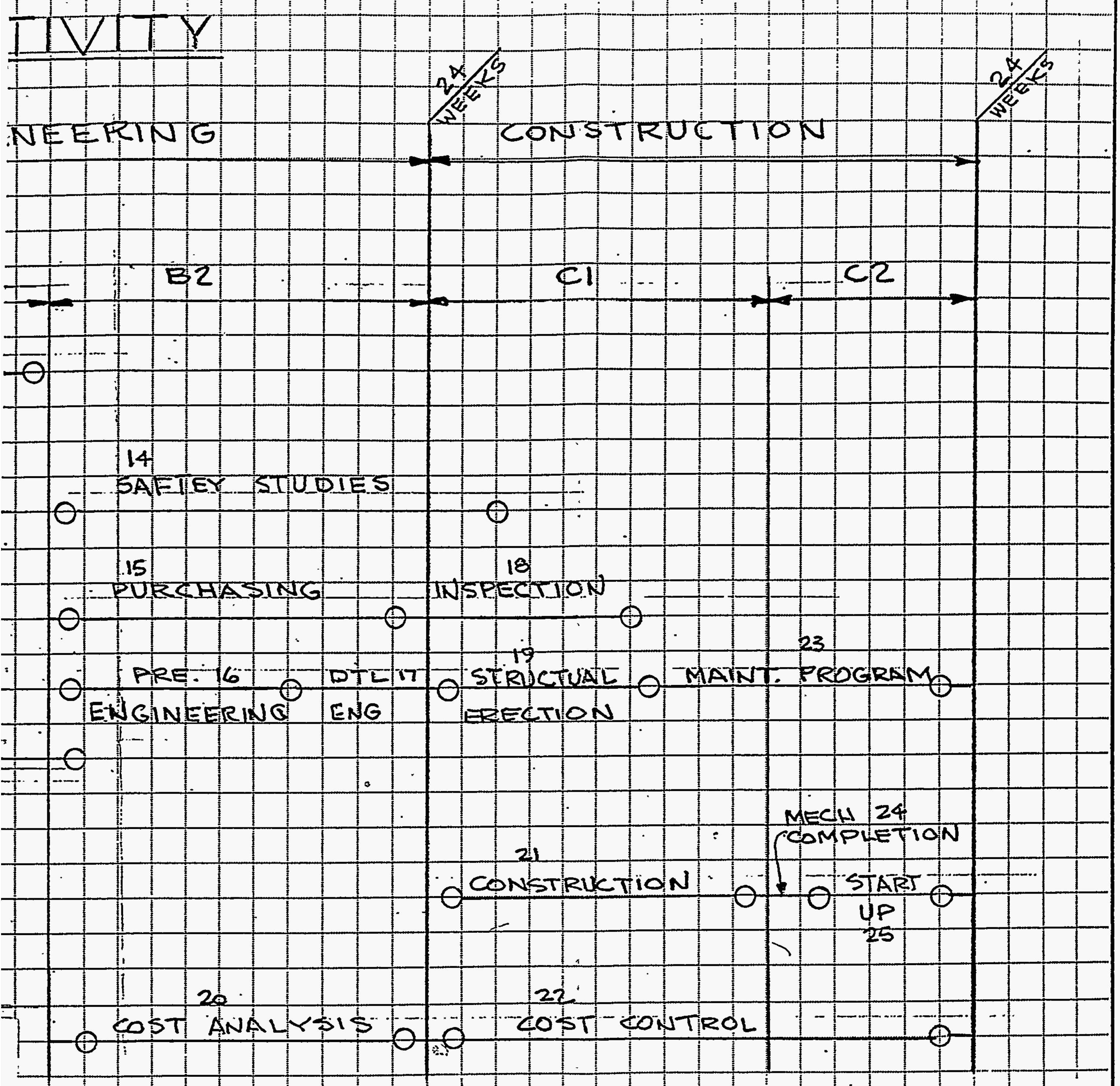
6.2 Upon completion and approval of all drawings long lead equipment can be placed on order.

6.3 It is estimated that all equipment can be on the site for construction within 20-24 weeks.

6.4 Installation of all of the equipment can be completed under 200 days after delivery.



01 Market Analyis
02 Site Study
03 Project Scope
04 Equipment Studies
05 Economic Evaluation
06 Preliminary Design
07 Site Selection
08 Detailed Design
09 Project Justification
10 Capital Estimating
11 Review
12 Capitol Approval
13 Permitting
14 Safety Studies
15 Purchasing
16 Preliminary Engineerin
17 Detail Engineering
18 Inspection
19 Structural Erection
20 Cost Analyis
21 Construction
22 Cost Control
23 Maintenence Program
24 Mechanical Completion
25 Start-up



RE: P.O. C-95-17580

FOR: LOCKHEED IDAHO TECHNOLOGIES GROUP

G / M SYSTEMS
P.O. BOX 3823
WALNUT CREEK, CA 94598

JOB: MANUFACTURING FACILITY FOR DEPLETED URANIUM AGGREGATE

SHEET NO. 1 OF 1

CALCULATED BY ______ DATE 1-3-96

CHECKED BY ______ DATE ______

SCALE —