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DESIGN SCOPE OF THE Z PLANT METAL CONTROL FACILITY PROJECT CGC-944

BY

H. D. HABERMAN

FINISHED PRODUCTS PROCESS DESIGN ENGINEERING
FACILITIES ENGINEERING OPERATION
CHEMICAL PROCESS DEPARTMENT

MARCH 12, 1962

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Page 1

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H. D. Haberman

Finished Products Process Design Engineering
Facilities Engineering
CHEMICAL PROCESSING DEPARTMENT

March 12, 1962

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TABLE OF CONTENTS

[redacted]

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[redacted]

Page

[redacted]

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I. INTRODUCTION

The steadily increasing plutonium production rates in the 234-5 Building has resulted in a large increase in the number of PR cans that are now being handled in the building. This has resulted in the available receiving and storage places for PR cans being taxed beyond their full capacity thereby necessitating the storage of PR cans within the building corridors. Accordingly, the ten-year business plan for the 234-5 Building, as documented in HW-65000, included a program for providing new receiving and storage facilities to alleviate this problem.

More recently, the specifications for weapons grade plutonium have become more rigid and now state that the Pu-240 content in 97.5 percent of the parts must be maintained with 95 percent confidence in the range of 6.0 ± 0.5 percent. The economics of reactor operation will prohibit operation in which all reactor feeds (normal, E-metal and NPR) can be maintained at this precise isotopic content. In order to achieve optimum economics in the over-all fuel cycle, it will, therefore, be necessary that the various feed materials of different isotopic content received in the 234-5 Building be blended with one another to insure the proper content of Pu-240.

The requirements for blending can be combined with the requirements for new receiving and storage facilities in such a manner that a single facility can accomplish both purposes.

II. PURPOSE

The purpose of this document is to present a complete process engineering design on the combined receiving, storing, and blending facility. This document will provide the basis for the preparation of all subsequent Title I and Title II designs of this combined facility which has been given the title of Metal Control Facility.

III. SUMMARY AND CONCLUSION

The Metal Control Facility will be located on the south side of the 234-5 Building adjacent to existing rooms 158, 159, and 159-A as shown on SK-2-6827. The following pieces of equipment will be installed in the new 1,440 sq. ft. building: two receiving tanks, ten storage tanks, three feed tanks, a vacuum transfer and sparge pump on the receiving tanks, a sparge unit on the feed tanks, a transfer and recirculating pump on each of the storage and

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feed tanks, an emergency storage tank, an overflow vessel and transfer pump, glove boxes, cell block, chemical add tank, and instrumentation. Building services will be taken from existing 234-5 Building facilities.

The Metal Control Facility is designed to receive, store, and blend plutonium nitrate solutions of 2000 MWD/T exposure. The amount of storage provided is 4000 liters.

The cost of the Metal Control Facility is estimated to be $850,000 including $100,000 for a mass spectrometer; the project cost estimate is shown in Appendix B.

IV. DISCUSSION

A. Design Capacity

The Metal Control Facility will have a capacity for storing 4000 liters of plutonium nitrate solutions. Since these solutions will average about 250 grams per liter, the storage capacity will be equivalent to about 1000 kg. of plutonium. The total amount of plutonium in storage at any one time will be a function of the following production variables: (1) the amounts of E-metal, normal feed, and NPR material being produced by the reactors; (2) the reactor schedules for charge and discharge of each of these materials; (3) the isotopic content of each of the three feed materials; (4) the scheduling and instantaneous rates of each of these three materials through the prime separation plants; (5) instantaneous rates of the button line and its capability to handle peak loads as produced by the separation plants operations.

The precise amount of storage that actually will be needed varies widely as changes in any of the above are made. Since the cost of the Metal Control Facility is relatively small in comparison with the economics of the over-all fuel cycle, it is important to provide storage capacity sufficiently high to prevent the Metal Control Facility from interfering with or limiting optimum reactor and separation plants operations and scheduling.

Storage requirements were calculated for a large number of assumed reactor and separation plants production cases. The production cases were established to reflect the wide range through which each of the production variables could fluctuate. Results were obtained in which storage requirements varied from values so low that existing facilities would be adequate to values in the order of 1200 kg. Since it can be shown that reactor production cases that lead to large amounts of storage can be offset somewhat by favorable separation plants scheduling, it is concluded that 4000 liters of storage will be sufficient to insure that the reactor and separation plants can be operated and scheduled according to the best possible economics. It is also expected that this amount of storage will normally provide some reserve to handle unusual or

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emergency situations such as temporary shutdowns of the button line or prime separation plants.

B. Design Philosophy

The building housing the storage and blending tanks will be located adjacent to the 234-5 Building to eliminate the need for separate service facilities and long runs of encased transfer piping from one building to another.

All tanks and equipment required to handle the solutions after removal from PR cans will be enclosed by either 18-inch thick concrete walls or lead-lined glove boxes for radiation protection of personnel. The tanks and piping inside the concrete cell will be of all-welded construction to eliminate leaks and the need for glove box enclosures inside the cells. Pumps, valves, and interconnecting piping will be enclosed in glove boxes outside the concrete cell to permit maintenance and contain contamination. Access to the cell and tanks--although not routinely needed--will be provided to facilitate any future changes or inspection that may be deemed necessary.

The operating portion of the building will be a shoe cover area and will be ventilated with Zone III supply air. Glove box air will be exhausted into the E-4 ventilation exhaust system. The cell block will be ventilated with Zone III supply air but will be at a lower pressure than the operating area.

C. Design Standards

Design of the Metal Control Facility shall be in accordance with the Hanford Standard Design Criteria, HWS-10006, and shall utilize all applicable Hanford Standard Design Criteria, Design Guides, Standards and Standard Specifications.

The following applicable Standard Design Criteria shall be used.

1. SDC-1.1 Standard Design Criteria, General.
2. SDC-1.2 Standard Design Criteria for Codes, Standards, and Specification
3. SDC-2.1 Standard Design Criteria, Architectural, General
4. SDC-4.1 Standard Structural Design Criteria for Conventional Constructors
5. SDC-7.1 Standard Electrical Design Criteria, General
6. SDC-7.4 Standard Design Criteria for Underground Power Distribution Systems
7. SDC-7.5 Standard Electrical Design Criteria for Interior Power and Lighting Systems

8. SDC-7.7 Standard Electrical Design Criteria for Plant Telephone System
9. SDC-7.8 Standard Electrical Design Criteria for Fire Alarm Systems

D. <u>Process Description</u> (Ref: attached EFD SK-2-6805)

The Metal Control Facility consists essentially of two receiving tanks, ten storage tanks, and three blending and feed tanks (called feed tanks throughout this report). Auxiliary equipment essential for the safe operation of the facility are liquid pumps, samplers for all tanks, a vacuum pump, an agitator sparge unit, valves, piping, an overflow receiver, chemical add tank, traps, a concrete cell block, glove boxes, and an emergency storage tank.

The procedure involved in operating the Metal Control Facility is not complicated. However, because the amounts and isotopic content of the normal reactor material, E-metal and NPR material may vary; and since the scheduling of the various types of material through the separations plants may vary, the Metal Control Facility must be sufficiently flexible to accommodate all feed material regardless of reactor and separations plant operation.

The required flexibility of operation has been achieved as follows: (1) by piping the Metal Control Facility so liquid stored in any one tank can be pumped to any of the other tanks, (2) by providing means of agitating the contents in any tank, (3) by providing samplers for all of the tanks, and (4) by providing piping for transferring the contents of any tank to or from the recovery facilities.

Plutonium nitrate solution is shipped to the 234-5 Building in PR cans. One batch of solution, about 20 to 40 liters, is contained in six PR cans.

All of the material comprising one batch will be emptied into one of the receiving tanks--RT-1 or RT-2. Transfer will be made by evacuating the receiving tank to about 26 inches Hg. Having transferred the contents of a PR can, a nitric acid rinse solution will be added to the can and also transferred to the receiving tank. The batch of solution in the receiving tank will then be agitated by air sparging and sampled for plutonium concentration. The quantity of plutonium contained in the batch will then be determined from the concentration and volume measurements.

Current specifications for weapons grade plutonium require a Pu-240 content of 6 $\pm$ 0.5 per cent; therefore by specifying isotopic content limits, the reactors must be operated in such a way that the average Pu-240 content of the three types of fuel elements meets the specifications. The average isotopic content of any one type of material is therefore established and known for the existing set of conditions.

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Assuming the average Pu-240 content of a batch of solution emptied into a receiving tank is known, the next step will be to transfer the solution to either a feed tank, a storage tank, or a portion to both. For example, if the solution is normal reactor material with an average Pu-240 content of six per cent, the entire contents will be transferred to a feed tank. If the Pu-240 content is high or low, and a suitable blending solution is in storage, a portion of the contents will be transferred to a feed tank and the remainder will go to a storage tank. The second solution will then be transferred from a storage tank to the feed tank in the amount necessary to blend to six per cent. If, at the time a batch of solution is transferred from PR cans to a receiving tank, there is no blendable solution in storage, the entire batch will go to storage until one of the separations plants is producing material suitable for blending.

Whenever the feed tank has been filled, the contents will be agitated and sampled for determination of Pu-240 content. The isotopic content will be determined by mass spectroscopy. If it is determined that the Pu-240 content is outside the specified limits, additional material must be added and the procedure of agitating and checking the Pu-240 content repeated.

Although the exposure of any one type of fuel element in the reactors varies over a wide range because the fuel elements are randomly selected for processing, the isotopic content of the plutonium nitrate solutions will be fairly constant and not require a mass spectrometer shot for each batch of solution. If in practice more than one mass spectrometer shot is required for a considerable number of batches of blended feed material, the number of shots can be reduced by putting all of one type of solution in a storage tank, determine the isotopic content and ratio of solutions required for blending, and blend according to the exact rather than average isotopic content.

E. Equipment

1. Glove Boxes (Ref: SK-2-6827, SK-2-6828)

The main functions of the glove boxes are to house the piping and equipment subject to leakage and routine maintenance, to prevent the spread of contamination to the operating area, shield the operators from harmful radiation, and provide a location for obtaining samples.

Glove boxes will be provided as shown on drawings SK-2-6827 and SK-2-6828.

The bottom row of glove boxes will contain piping, pumps and samplers, valves, the overflow receiver and chemical add vessels, and a monorail and hoist for servicing the equipment. The bottom of the glove boxes will be 30 inches above the operating floor. The depth of the

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glove box will be 24 inches, and the height will be five feet from the bottom of the glove box.

The location of the upper rows of glove boxes is determined by the equipment being served. The glove boxes serving the receiving tanks RT-1 and RT-2 and feed tanks FT-1, FT-2, and FT-3 will contain valves, air sparge and vacuum pumps, the vacuum trap, the vent and overflow trap, and associated piping.

The glove boxes will be shielded in accordance with the section of this report, Shielding, p. 15. Specification HWS-8124, General Specification for Glove-Type Hoods, describes materials and methods which will be followed in constructing the glove boxes. This document and attached drawings will supersede in cases of disagreement.

2. Cell Block (Ref: Drawing SK-2-6827)

The layout of the cell block is shown on drawing SK-2-6827. All of the tanks will be completely enclosed in the cell block. The outside wall of the cell block will be constructed of 18-inch thick concrete for protection of personnel from radiation and for contamination control.

The cell block is subdivided into individual cells by one-foot thick concrete walls to prevent tank interaction. Cell I will contain receiving tanks RT-1 and RT-2 and the feed tanks FT-1, FT-2, and FT-3. Each of cells II through VI will contain two storage tanks spaced four feet apart. A steel door in the side of the cell block is provided for admittance to the tank cells. Each cell floor will have a drain connecting to the emergency storage tank. Cell floors will slope to the drain to prevent plutonium nitrate solution from accumulating on the floor in the event a leak develops in one of the tanks.

The cell block will be constructed in two steps. The floor and walls will be poured first. The roof will be left off to permit installation of the tanks. After the tanks have been installed, the top of the cell block will be poured.

3. Tanks (Ref: Drawing SK-2-6829)

All tanks used in the Metal Control Facility will be fabricated from Type 304-L stainless steel pipe and tubing. The construction of the tanks is shown on drawing SK-2-6829. Fabrication of the tanks will be in accordance with HWS-5938, Specification for Fabrication of Stainless Steel Vessels for Mild Corrosive Radioactive Service.

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Two receiving tanks, RT-1 and RT-2, will be provided to receive in either tank one batch of plutonium nitrate solution shipped to the 234-5 Building. Vacuum transfer will be used to transfer the solution from the PR can to the tank. The receiving tanks will be five inches in inner diameter by 16 feet long with a working volume of 50 liters. The receiving tanks will be installed vertically. Weld fittings will be provided for inlet, vent, air sparge, air purge liquid level indicators and outlet.

Three vertical feed tanks, FT-1, FT-2, and FT-3, are provided for blending plutonium nitrate solutions and to serve as feed tanks to Task I. The five-inch I.D. tanks will be 24 feet long with a working volume of 80 liters. Weld fittings will be provided on the feed tanks for filling, draining, air sparging, vent, and air purge liquid level indication.

Ten vertical storage tanks are provided with a total working volume of 4,000 liters. Each tank will be constructed of five 24-ft. lengths of five-inch I.D. tubing manifolded at the top and bottom. Each tank will have five weld fittings--one each for inlet, outlet, and vent and two for the air purge liquid level indicators.

The need for an emergency storage tank is discussed under Criticality, Section K, of this report. The capacity of the emergency storage tank is 400 liters. The tank will be constructed from 5 3/4-inch tubing with end manifolding similar to the storage tanks. The tank will be situated horizontally in sleeves poured in the concrete floor of the cell block. Because of the potential hazard of solids buildup in the tank, each section will be provided with a flushout connection in the glove box.

4. Pumps

All pumps used in the Metal Control Facility will be of the inline canned type, Model GB-1½K Chempump, modified with hydroclone and sample valve according to drawing H-2-43558, Model GA Chempump Arrangement. The pump will have a capacity of 35 gpm with a head of 75 feet of plutonium nitrate solution. The material of construction will be Type 316 stainless steel.

5. Vacuum and Agitator Sparge Pump

A vacuum pump will be provided for vacuum transfer operations in the receiving tanks and overflow receiver and for air sparging the contents in the receiving tanks. The pump will have a minimum capacity of 6 cfm at 25 inches Hg vacuum. The pump will be constructed of Type 347 stainless steel.

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Vacuum transfer will be accomplished by closing the valve in the vent of the tank to be evacuated. The vacuum pump discharge is routed to the main vent and overflow header. Transfer of solution can take place as the tank is being evacuated or after evacuation has taken place.

Air sparge mixing is obtained by drawing the air from the space above the liquid and routing the pump discharge to the bottom of the tank. The tank vent system will remain open in this case.

6. Agitator Sparge Unit (Ref: Drawing H-3-5630)

A subcritical tank agitator sparge unit will be used to mix the solutions in the feed tanks.

Agitation of the liquid in a tank is obtained by drawing the air from the space above the liquid and returning the air to the bottom of the tank. A violent bubbling action is obtained which results in thorough mixing in a short period of time.

The tank agitator sparge unit was developed by Hanford Laboratories. Tests being conducted indicate mixing by sparging requires one-eighth the time required for mixing by recirculating fluids.

7. Piping

All pipe and tubing containing nitrate solutions or exposed to the corrosive atmosphere of plutonium nitrate solutions will be Type 304-L stainless steel. All tubing connections required inside the glove boxes one-half inch and under will utilize Koncentrik fittings. All piping larger than one-half inch will be flanged.

Four encased one-inch lines, including two spares, will be provided for transferring solutions to and from the recovery facilities. Two encased one-inch lines, including a spare, will serve to transfer blended feed solutions to Task I.

F. Building Location (Ref: Drawing SK-2-6827)

The Metal Control Facility will be located adjacent to the 234-5 Building as shown on drawing SK-2-6827. Factors influencing the proposed location are (1) the new feed tanks will be located so the piping to the 234-5 Building will be minimal, (2) existing facilities such as change rooms in the 234-5 Building can be used by operating personnel, (3) existing ventilation facilities and utilities are nearby, and (4) there are no large drain lines that will be covered or require relocating.

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The proposed building location will require the relocation of some existing facilities. The following services for the analytical laboratory will have to be relocated: three compressed gas cylinder manifolds with steam service and drain, safety shower, hose bib, and three acid drum racks.

An HF cylinder storage pad located along the south wall of the 234-5 Building opposite Rm. 159 will have to be relocated along with the fresh-air mask manifold. A new access to the HF storage pad will require changing a six-inch 225-pound steam line.

The poppy probe repair room, Rm. 159-A, and the operations office, Rm. 164, will have to be relocated to provide space for the corridor connecting the Metal Control Facility and the 234-5 Building. Rooms 168 and 169, now used as storage space for PR cans, will be released for other purposes.

G. Architectural (Ref: Drawing SK-2-6827 and SK-2-6834)

The building housing the Metal Control Facility will be 60 feet long by 24 feet wide. The height of the building will be about 31 feet. Drawing SK-2-6827 shows the architectural arrangement of the building.

The building will be of reinforced concrete construction except for the roofing. The exterior walls will be one foot thick unless the wall serves as shielding in which case the thickness will be 18 inches.

The roof is to be of open web steel joist framing, steel decking, rigid insulation and graveled, built up roofing.

Interior concrete surfaces are to be finished according to HW-4798-S, Standard Specification for Placing Reinforced Concrete. All interior concrete surfaces except the floors will have an F-4 finish described as an exceptionally smooth-formed concrete surface with sack-rubbed finish. The floors will have a U-3 finish which is steel troweled without burnishing. The exterior concrete walls will have an F-3 finish defined as a smooth-formed concrete surface with defective concrete repaired and with fins, etc. removed and small surface defects filled.

The doors will be steel flush panel hollow metal type except for the shielding door into the cell block. All doors will be equipped with closers. Panic hardware is to be used on doors at required exits. There will be two separate doors to the outside. One door, used for bringing PR cans into the building, will be located on the south side of the facility; the door will be equipped with a key lock operable from the inside only. A second door, to be used for emergency exit only, will be located along the west wall of the facility.

 [redacted]

The walls and ceiling of the operating room and air lock will be finished with light-colored latex base paint or enamel. The floor will be covered with vinyl-asbestos tile.

Two safety showers will be installed as shown on SK-2-6827 per specification HWS-10001, Section B-3-7.

The floor and walls of the cell block will be finished with acid resistant paint. The concrete ceiling in the cell block will not require painting.

Architectural details are shown on drawing SK-2-6834.

H. Ventilation (Ref: Drawing SK-2-6827, SK-2-6830)

The ventilation supply and exhaust system for the Metal Control Facility will (1) provide air flow control and air decontamination as a protective measure for the building occupants, and (2) provide air conditioning within acceptable limits established for occupant comfort and process control.

Although the entire Metal Control Facility is regarded as being susceptible to radioactive contamination, the potential decreases from the glove boxes to the cell block to the operating room. The ventilation supply and exhaust system is designed to maintain a flow of air from spaces of lower contamination potential to spaces of higher contamination potential.

The occupied spaces of the building will be ventilated with 100 percent fresh air at a design rate of not less than 15 air changes per hour. Each space is provided with a stable, measurable flow of supply air. The air balance criteria is based on air flow rather than static pressure control although the design is such that preferred static pressure will be maintained. To facilitate air balance, the supply and exhaust systems will be equipped with manual dampers necessary to give a reasonable degree of operating stability.

The supply air will be furnished by existing supply ventilation units in the 234-5 Building. The supply airduct will tie into existing ductwork as shown on drawing SK-2-6827. The exhaust air system will connect to existing exhaust units in the 234-5 Building. Exhaust air falls into two categories: Zone III exhaust and Zone IV exhaust. The operating space and cell block will exhaust to the Zone III exhaust system with the cell block maintained slightly negative with respect to the operating room. The glove box will connect to the existing filter box and exhaust to the Zone IV exhaust system. The filtration at the glove box, the existing filter box, and the filtration in rooms 309 and 310 provide a total of three filtering steps for the glove box air.

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All Zone IV exhaust system components will be fabricated from stainless steel.

I. Instrumentation

Instrumentation shall be provided for accountability, operability, and safety.

All tanks will utilize a purge dip tube and transmitter system for liquid level determination. The dip tubes will be externally connected to the top and bottom of the tanks. The receiving tanks will be equipped with manometers in addition to the transmitters for more accurate liquid level determination required for accountability. Connections will be provided for future manometer installations on all other tank dip tube air lines. Space is provided in the upper glove boxes for manometers for the three feed tanks.

Instrument air will be provided by the 234-5 Building instrument dry air system. An air regulator will control the pressure in the system. Instrument air flow in the individual dip tubes will be regulated by a valve at the rotameter.

High and low liquid level alarms will be incorporated in the liquid level instrumentation. The low level alarm is for pump protection. High level alarm will warn the operator to prevent overflowing the tanks. Warning will be both audible and visual.

The purge dip tube in the emergency storage tank will indicate the presence of liquid greater than 0.5 inches. Actual liquid level is not required since the tank will be emptied whenever liquid is indicated regardless of the quantity as a safety precaution.

J. Shielding

The general philosophy governing the amount of shielding that is required, or may be required in the future, is the same as that used on Project CAC-880[1], The Plutonium Reclamation Facility. The sections applicable are repeated below:

1. Radiation exposure to employees should be minimized to the extent practical. Any new facility should have shielding to reduce dose rates in normally occupied areas (control room, offices, etc.) to 0.1 mrem/hr. It should also have the inherent capability of permitting process work areas (glove box areas) to be shielded in such a manner that dose rates

1. Braden, D. E., Design Scope of the Z Plant Plutonium Reclamation Facility, Project CAC-880, HW-66916, 10-17-60.

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approach one or two mrem/hr so dependence upon administrative procedures in radiation control zones can be reduced.

2. The anticipated gamma dose through glove boxes, even though shielded with one-inch equivalent lead, will be high enough that a reserve of three r/yr must be allowed for potential gamma exposure. Uncertainties in shielding measurement techniques require that the total measured dose, including neutron exposure, be something on the order of four rem/yr to insure against exceeding the HAPO limit of five rem/yr. Planning should, therefore, limit neutron dose to something less than one rem/yr. The chronic neutron dose which workers would receive from an unshielded facility would preclude this.

3. Measurement of neutrons is in an undeveloped state of art and shifting a major fraction of radiation dose from gamma to neutrons should be avoided. Gamma to neutron dose-rate ratios must be maintained at three or greater since gamma exposure will remain the primary measurement criterion for total exposure until neutron measurement techniques are vastly improved.

The Metal Control Facility is designed to handle material with exposure of up to 2,000 MWD/T with the following isotopic content by weight:

Pu^{238}	< 0.02 %
Pu^{239}	> 85
Pu^{240}	< 11
Pu^{241}	< 3
Pu^{242}	< 1

The outer walls of the cell block will be 18 inches thick to reduce dose rates outside the building and to other normally occupied spaces to 0.1 mrem/hr in accordance with (1) above. The neutron dose rate to operators in the operating room will be about 0.38 mrem/hr through the concrete.

Present estimates of dose rates indicate that one inch of lead equivalent is needed on the glove boxes to reduce the dose rates to one to two mrem/hr. Because the exact dose rates are not known, one-half inch of lead or one inch high-density lead glass will be provided initially with provisions for increasing the thickness if measurements indicate more shielding is required.

One-half-inch lead equivalent will reduce the gamma dose rate to less than five mrem/hr. Since the actual amount of plutonium in the glove box is low, the neutron dose rate will be about 0.3 mrem/hr.

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The anticipated total dose rate from both cell and glove box shielded as specified is about five mrem/hr -.4 mrem/hr neutron and $<$.1 mrem/hr gamma from the cell block, and 4.2 mrem/hr gamma and .3 mrem/hr neutron from the glove box. The total dose is not expected to vary appreciably if the isotopic composition of the feed changes. On the basis of the above shielding, changing the feed to 10,000 MWD/T exposure material will cause an increase in exposure from 5 to $7\frac{1}{2}$ mrem/hr.

K. Criticality

Because of the danger of nuclear chain reactions occurring spontaneously when large quantities of fissile material are accumulated under certain conditions of geometry, isotopic content, reflection, and many other factors, favorable design and isolation of the tanks containing the fissile material is very important. It is imperative that the size and location of all equipment that could possibly become filled with plutonium nitrate solution of high concentration never assume an unsafe geometry. The storage capacity of the facility is based on plutonium concentrations of 250 g/liter; however, solutions with plutonium concentrations of 500 g/l in at least 2 M HNO_3 can be safely stored.

All tanks that will contain plutonium solution will have an inner diameter no larger than 5.0 inches and a wall thickness no greater than one-half inch. The tanks must be isolated from one another by a distance, center-to-center, of two feet in one direction and four feet in a direction perpendicular to the first in a 2 x 5 array. This array must be isolated from every other array by one foot of concrete. There is no limit to the number of arrays possible under the above conditions.

The one-inch headers connecting the sections of five-inch pipe must be spaced above or below the array a distance of six inches. The overall cell arrangement of tanks and piping must meet the dimensions shown on SK-2-6828 and SK-2-6829.

The possibility always exists for leaks in the tanks or other components of the facility. The quantity of material contained in one storage tank spread over the area of either a glove box or the cell block would form an unsafe slab. For this reason, a geometrically favorable emergency storage tank is provided. Each cell in the cell block will have a drain connecting to the emergency storage tank. The hoods will be provided with sumps to catch small spills. Each sump will have an overflow to the emergency storage tank to eliminate the danger of large spills or uncontrollable leaks.

A detector is provided to show the presence of solution in the emergency storage tank. Material that has spilled into the emergency storage tank must be transferred out immediately.

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L. Contamination Control

The following means for controlling contamination have been incorporated into the design of the Metal Control Facility:

1. All pipe and tubing located in the cell block will be of all-welded construction to minimize the possibilities for leaks.

2. All equipment which will require routine maintenance and all piping connections, either screwed or flanged, are located in glove boxes.

3. Manometers which may become contaminated are located in glove boxes.

4. All process lines required to pass from one glove box to another will be encased in stainless steel pipe.

5. Transfer piping from the feed tanks to the recovery facilities and Task I will be encased in stainless steel pipe.

6. The ventilation system is designed to maintain the hood pressure negative with respect to the cell block and operating room; the cell block pressure will be maintained negative with respect to the operating room.

7. Air sampling facilities will be provided for monitoring Zone III areas.

8. Sinks and safety showers will be provided for flushing contamination from the skin or wounds.

9. A decontamination hood is provided for decontamination of PR cans after they are emptied.

10. Chemical addition lines will be designed to prevent backup of decontamination.

M. Electrical

The primary power supply shall be obtained from a new circuit breaker to be installed in a spare space in the existing 480 Volts A.C., three phase, 60 cycle switchgear located in Room 266. A new feeder shall be routed to the vicinity of the Metal Control Facility and shall be terminated in a new motor control center.

Motor starters and relays shall be located in the new motor control center. Push buttons, indicator lights, and other control components

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shall be located on panels mounted near the pumps. Motors 1/3 HP and larger shall be 440 Volts, A.C., three phase. Control voltages shall be 120 Volts maximum.

Lighting, instrument power and receptacles shall be supplied from a new 480-120/240 Volt A.C. transformer and panelboard located near the facility. The circuit breaker for the lighting feeder shall be mounted in the new motor control center (see above).

General lighting shall be furnished by industrial type fluorescent fixtures. Hood lighting shall be designed to fit each hood, using either fluorescent or incandescent fixtures as required. Lighting for evacuation during power outages shall be furnished from battery powered units.

Emergency power if required will be furnished from existing panels and switchgear.

Constant voltage outlets will be connected to the existing 234-5 constant voltage system.

Communications raceways and outlet boxes shall be designed into the new facility.

N. Hazards

1. Criticality Hazards

The tanks, piping and equipment used for storing and blending plutonium nitrate solutions in the Metal Control Facility are of a geometrically-favorable configuration for solutions with plutonium concentrations up to 500 g/l in at least 2 M HNO_3. Administrative control must be maintained to assure that accumulations of plutonium in the form of solids do not occur in the various tanks and associated piping and equipment.

The emergency storage tank is provided to prevent unsafe volumes of plutonium solution on cell and glove box floors. Material that has drained to the emergency storage tank must be reprocessed as rapidly as possible to insure adequate emergency storage volumne at all times.

2. Chemical Hazards

The chemicals associated with the Metal Control Facility are plutonium nitrate solutions and dilute nitric acid.

Plutonium is a highly radiotoxic material. Ingested plutonium deposits mainly in bones, marrow, liver, spleen and lymph nodes.

DECLASSIFIED

[redacted]

When unloading PR cans, workers must avoid breathing mists or vapors and avoid contact of the solutions with the skin and especially cuts or other open wounds.

Nitric acid is corrosive and increases the flammibility of many organic materials. When taken internally or brought into contact with the skin or eyes, it causes severe burns and intense pain, with possible loss of sight in the case of the eyes and possible death if ingested. Contact with all parts of the body and absorptive clothing of workers shall be avoided. Contact with cotton or other forms of cellulose or other organic material shall be prevented.

O. Fire Protection

All of the operations in the Metal Control Facility of a chemical nature involve wet chemistry of uncombustible materials. There are no explosion or fire hazards involved in the blending operation. Therefore, sprinklers and fire detection equipment are not deemed necessary in the cell block or glove boxes.

In the operating portion of the building there exists a potential fire hazard because of the combustible material likely to be found there. However, sprinklers will not be permitted in this area for two reasons: (1) the water may cause the spread of radioactive material, and (2) there may exist a criticality hazard if water flows uncontrolled in a room containing full PR cans. The operating portion of the building will, therefore, be provided with a heat-sensitive fire detector, dry fire extinguisher, and manually-operated alarms at the exits.

[redacted]

[redacted]

APPENDIX A

REFERENCES

1. HW-65000, 10 Year Business Plan Z Plant Plutonium Conversion Program, W. N. Mobley, December 10, 1959.

2. HW-66916, Design Scope of the Z Plant Plutonium Reclamation Facility, Project CAC-880, D. E. Braden, October 17, 1960.

[redacted]

[redacted]

APPENDIX B

Z PLANT METAL CONTROL FACILITY
PROJECT CGC-944
PROJECT COST ESTIMATE

Item	Estimate
Structure	$ 110,000
*Engineered Equipment	245,000
Piping	40,000
Ventilation	12,500
**Electrical	26,000
***Instrumentation	24,500
Equipment Installation	33,000
Minor Construction	30,000
Total Erection Cost	$ 521,000
Project Management	16,000
Supervision of Construction	8,500
Project Start-up	20,000
Contingency	142,000
Escalation	28,000
General Overhead	19,500
Design Services	95,000
Total Project Cost	$ 850,000

* Including $90,000 for Mass Spectrometer
** Including $ 5,000 for Mass Spectrometer
*** Including $ 5,000 for Mass Spectrometer

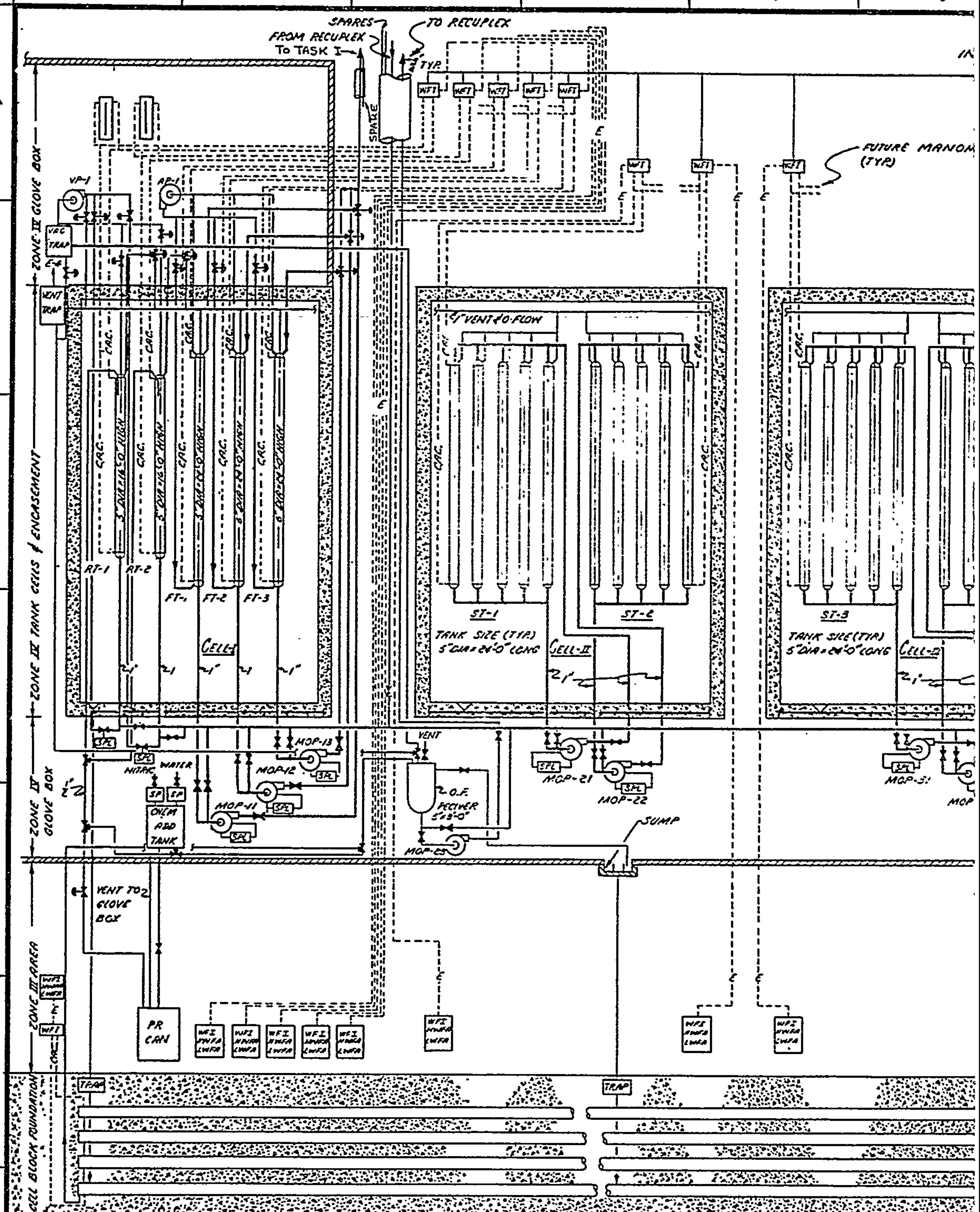
[redacted]

APPENDIX C

Z PLANT METAL CONTROL FACILITY
PROJECT CGC-944
PROJECT COST ESTIMATE

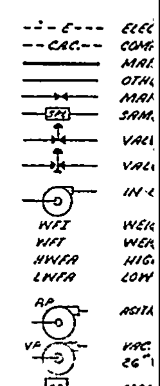
Drawing Number	Title
SK-2-6805	Engineering Flow Diagram
SK-2-6827	Building Arrangement
SK-2-6828	Glove Box Piping Arrangement
SK-2-6829	Tank Arrangements
SK-2-6830	Ventilation Flow Diagram
SK-2-6834	Architectural

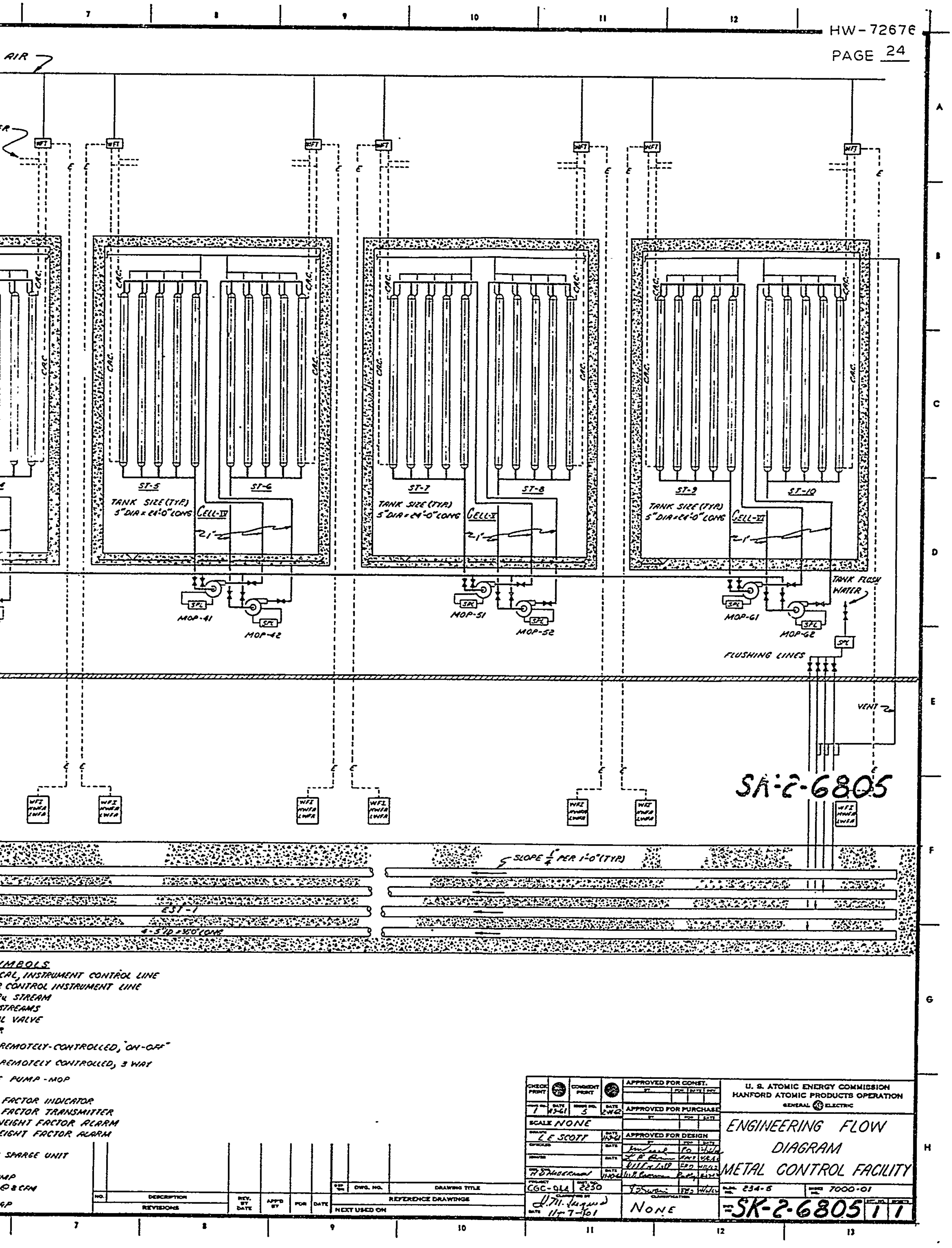
 [redacted]

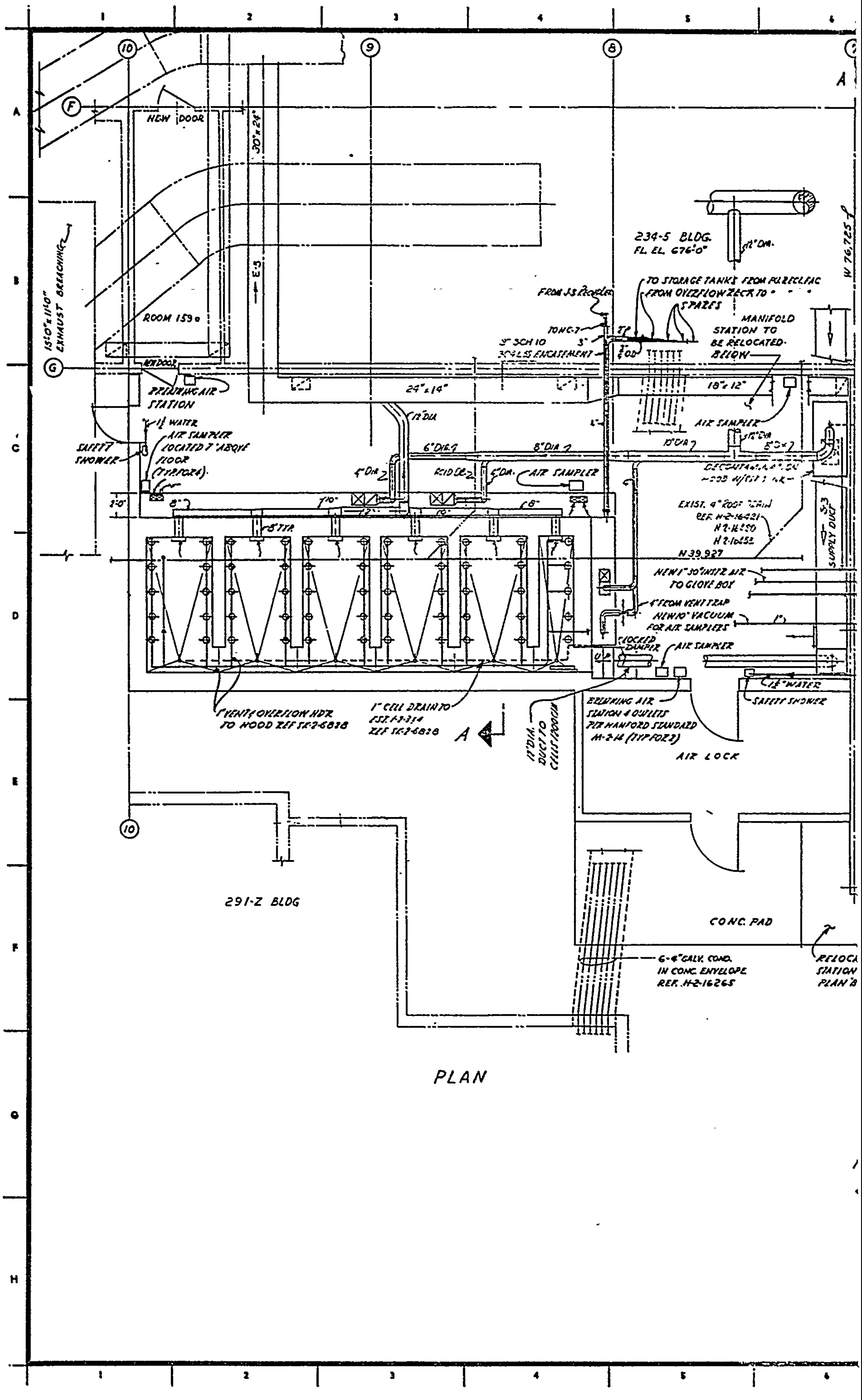


Notes

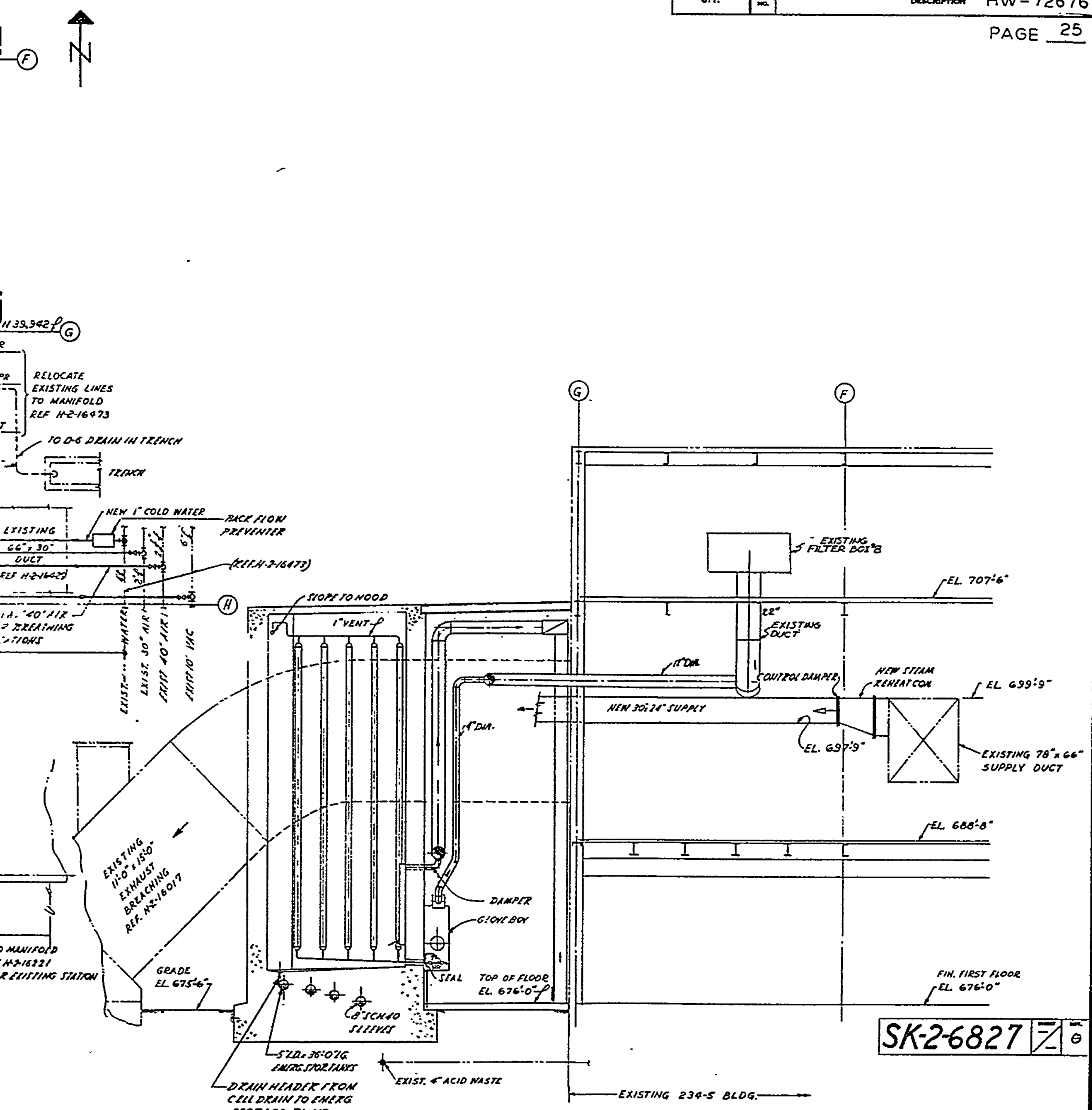
1. ALL GLOVE-BOX TRANSFER & RECIRCULATION PUMPS SHALL BE IN-LINE MODEL GB CHEMPUMPS MODIFIED PER HANFORD LABORATORIES OPERATION RECOMMENDATION WITH CYCLONE SEPARATORS FOR RECIRCULATED BEARING LUBRICANT STREAMS.
2. ALL GLOVE-BOX OFF-ON VALVES SHALL BE BALL VALVE WITH THOSE OPERATED ROUTINELY EQUIPPED WITH REMOTELY-CONTROLLED OPERATORS.
3. ALL GLOVE-BOX SAMPLERS SHALL BE "IN-LINE" SAMPLERS LOCATED ON IN-LINE PUMP RECIRCULATION LINES WHERE FEASIBLE
4. VESSEL CONSTRUCTION MATERIAL SHALL BE PYREX GLASS FOR GLOVE-BOX VESSELS & TYPE 304L SST FOR ALL CELL VESSELS.
5. GLOVE-BOX & CELL PIPING SHALL BE TUBING, 0.049" MIN. WALL THICKNESS, TYPE 304 SST WITH KONCENTRIC FITTINGS UP TO & INCLUDING ½ DIAMETER PIPING; FOR PIPING GREATER THAN ½ DIAMETER SCH 40 TYPE 304L SST. WITH WELDED FLANGE SHALL BE USED.
6. ALL WEIGHT FACTOR INSTRUMENTATION SHALL USE AIR-PURGED DIP TUBES
7. AGITATOR SPARGE UNIT SHALL BE IN ACCORDANCE WITH DWG. NO. H-3-5630, SUB CRITICAL AGITATOR SPARGE UNIT
8. VENT & VAC. TRAPS TO BE SIMILAR TO THAT SHOWN ON H-2-19423
9. SEAL POTS TO BE SIMILAR TO THOSE ON DWG. NO. H-2-29701




AIR
WFT
CAC
ST-5
ST-6
ST-7
ST-8
ST-9
ST-10
TANK SIZE (TYP.) 5" DIA x 24'-0" LONG
CELL-IV
CELL-V
CELL-VI
MOP-41
MOP-42
MOP-51
MOP-52
MOP-61
MOP-62
SPL
TANK FLUSH WATER
FLUSHING LINES
VENT
WFI HWFA LWFA
SK-2-6805
SLOPE 1/4" PER 1'-0" (TYP)
EST-1
4-5" D x 30'-0" LONG
...MBOLS
...CAL, INSTRUMENT CONTROL LINE
... CONTROL INSTRUMENT LINE
... STREAM
...STREAMS
...L VALVE
REMOTELY-CONTROLLED, "ON-OFF"
REMOTELY CONTROLLED, 3 WAY
PUMP - MOP
FACTOR INDICATOR
FACTOR TRANSMITTER
WEIGHT FACTOR ALARM
...EIGHT FACTOR ALARM
SPARGE UNIT
...MP
...@ 8 CFM
...GP
NO. DESCRIPTION REVISIONS
REV. BY DATE
APP'D BY
FOR DATE
DWG. NO. DRAWING TITLE
REFERENCE DRAWINGS
NEXT USED ON
CHECK PRINT
COMMENT PRINT
APPROVED FOR CONST.
APPROVED FOR PURCHASE
APPROVED FOR DESIGN
SCALE NONE
L E SCOTT
CGC-914 2230
NONE
U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC
ENGINEERING FLOW DIAGRAM
METAL CONTROL FACILITY
234-5
7000-01
SK-2-6805 1 1



NEW DOOR
30"x24"
ROOM 159a
15'0"x11'0" EXHAUST BREACHING
234-5 BLDG.
FL. EL. 676'0"
12"DIA.
TO STORAGE TANKS FROM PUREX
FROM OVERFLOW
SPARES
MANIFOLD STATION TO BE RELOCATED. BELOW
3" SCH 10
BREATHING AIR STATION
24"x14"
18"x12"
12"DIA
1½ WATER
AIR SAMPLER LOCATED 7' ABOVE FLOOR (TYP FOR 4)
SAFETY SHOWER
6"DIA
8"DIA
4"DIA
5"DIA
AIR SAMPLER
EXIST. 4" ROOF DRAIN
N 39,927
W 76,725
SUPPLY DUCT
NEW 1" 30 PSIG AIR TO GLOVE BOX
4" FROM VENT TRAP
NEW 10" VACUUM FOR AIR SAMPLERS
LOCKED DAMPER
AIR SAMPLER
1½" WATER
SAFETY SHOWER
1" VENT & OVERFLOW HDR TO HOOD REF SK-2-6828
1" CELL DRAIN TO REF SK-2-6828
A
12"DIA. DUCT TO CELLS/POUCH
BREATHING AIR STATION 4 OUTLETS PER HANFORD STANDARD M-2-14 (TYP FOR 2)
AIR LOCK
291-Z BLDG
CONC. PAD
6-4" GALV. COND. IN CONC. ENVELOPE REF. H-2-16265
PLAN



SK-2-6827

SECTION A-A

...TE:
...L PIPING THRU CELL WALL SHALL BE SEALED
...4 EXHAUST DUCT SHALL BE 304-L SS
...-3 AND E-3 DUCTS SHALL BE GALVANIZED STEEL

SCOPE

DWG. NO.	DRAWING TITLE
SK-2-6834	ARCH. METAL CONTROL FAC ADD
SK-2-6820	HOOD PIPING ARRANGEMENT
H-2-16721	PLANS & DET. OF GAS BOTTLE ENCLOSURES
H-2-14035	PERMANENT PLOT PLAN
H-2-16429	DUCT LEVEL PLAN VENTILATION
H-2-43501	PLOT PLAN
H-2-16473	DUCT LEVEL PLAN-SERV. PIPING
H-2-16421	UNDERG'D SERV.-SEWER & WATER
H-2-16265	ELEC. SERV. ENTRANCES-UNDERG'D
H-2-16183	ROOF PLAN & SECTIONS
H-2-16137	SECTIONS & DETAILS
H-2-16132	FIRST FLOOR PLAN

REFERENCE DRAWINGS

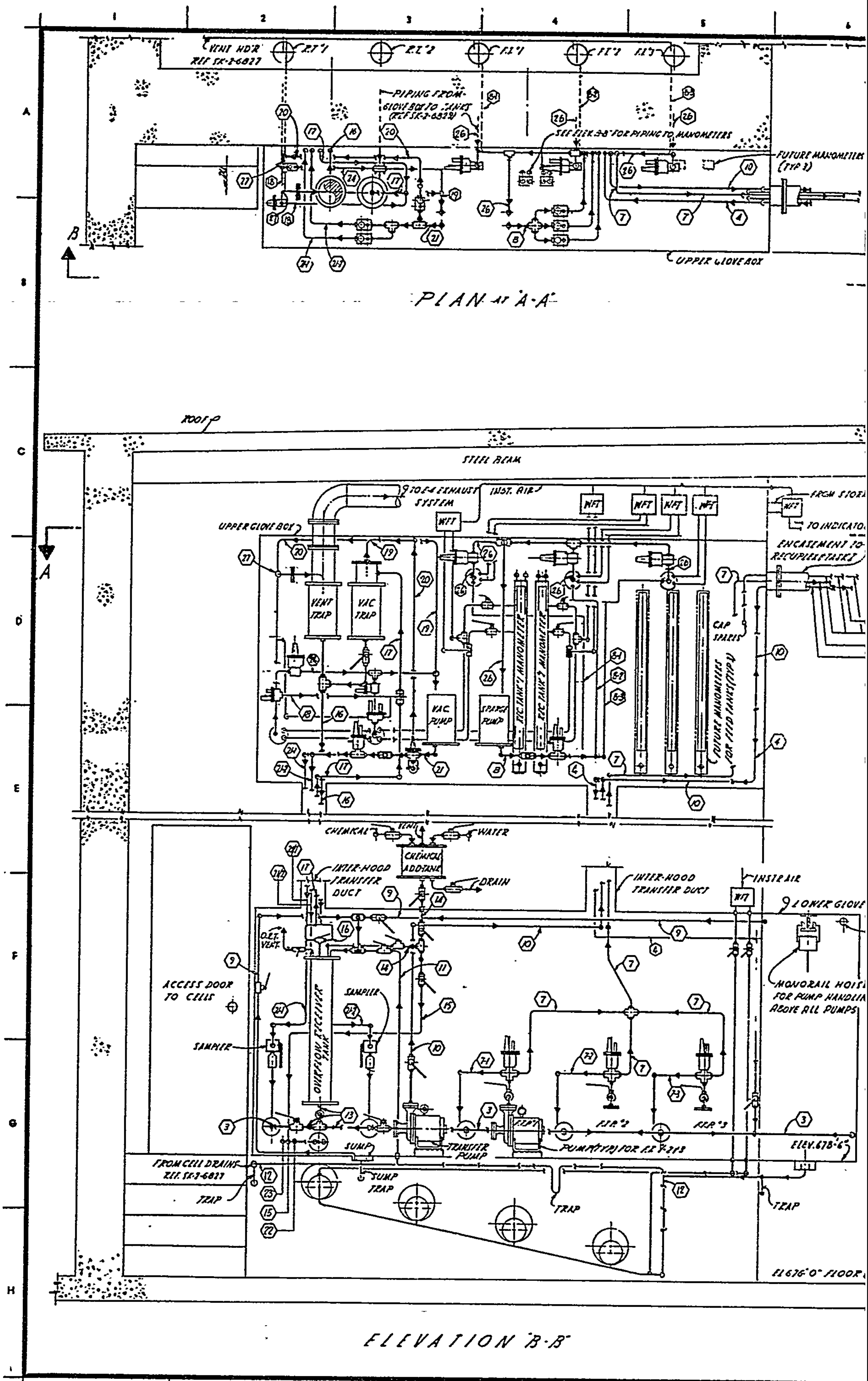
NEXT USED ON

U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC

BUILDING ARRANGEMENT

METAL CONTROL FACILITY

Drawn: W.E. WHYTOCK
T. HAMALAINEN
Project: CGC-944 | 10626
Date: 11/14/61
Classification: NONE
Bldg. No. 234-5 | 0110
SK-2-6827

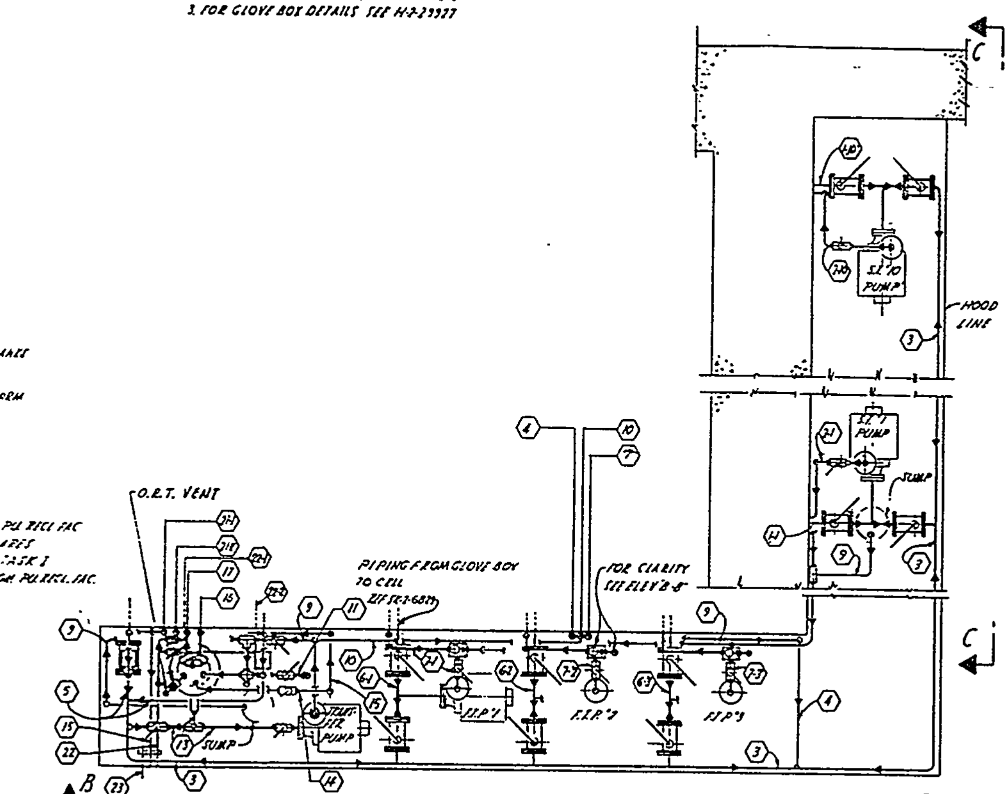


VENT HDR REF SK-2-6827
PIPING FROM GLOVE BOX TO TANKS
SEE ELEV. B-B FOR PIPING TO MANOMETERS
FUTURE MANOMETERS
UPPER GLOVE BOX
PLAN AT "A-A"
ROOF
STEEL BEAM
TO E-4 EXHAUST SYSTEM
INST. AIR
UPPER GLOVE BOX
VENT TRAP
VAC TRAP
VAC PUMP
SPARGE PUMP
CAP SPARES
FUTURE MANOMETERS FOR FEED TANKS
ENCASEMENT TO RECUPLEX TANKS
CHEMICAL
VENT
WATER
CHEMICAL ADD TANK
DRAIN
INTER-HOOD TRANSFER DUCT
INSTR AIR
LOWER GLOVE
ACCESS DOOR TO CELLS
SAMPLER
OVERFLOW RECEIVER TANK
MONORAIL HOIST FOR PUMP HANDLING ABOVE ALL PUMPS
SUMP
TRANSFER PUMP
PUMP (TYP.) FOR FR-2-3
FROM CELL DRAINS REF. SK-2-6827
TRAP
SUMP TRAP
ELEV. 678'-6"
EL 676'-0" FLOOR
ELEVATION "B-B"

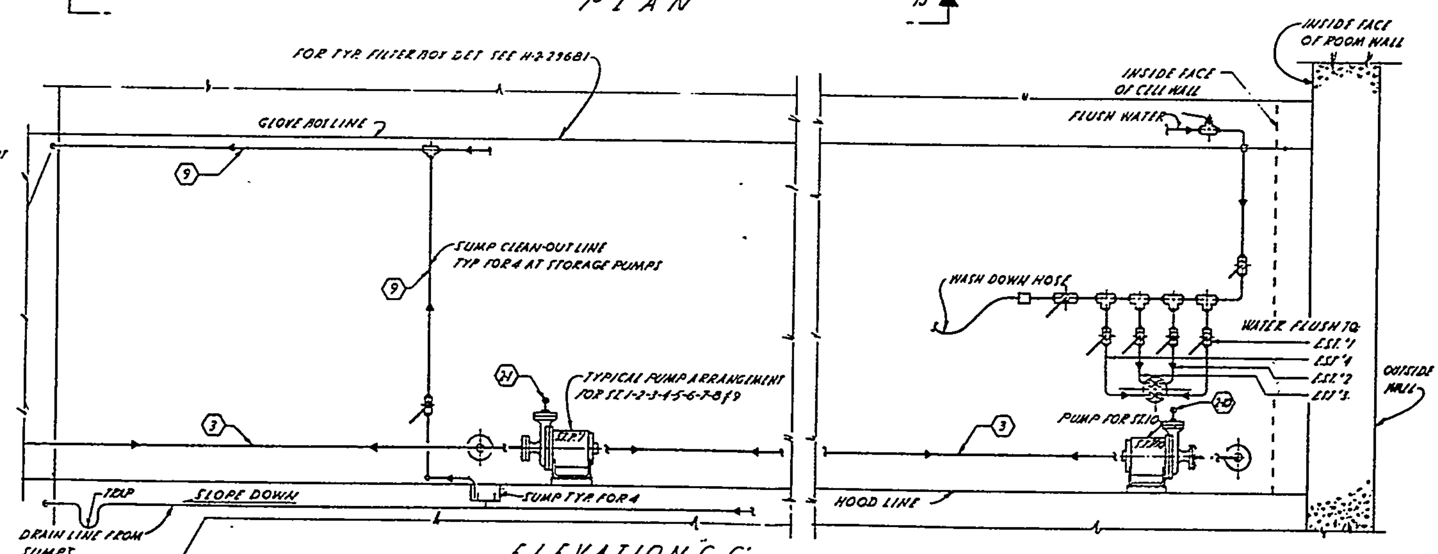
NOTES:
1. FOR GENERAL NOTES SEE SK-2-6805
2. S.T. - STORAGE TANK
   F.T. - FEED TANK
   R.T. - RECEIVING TANK
   O.R.T. - OVERFLOW RECEIVER TANK
   E.S.T. - EMERGENCY STORAGE TANK
   --P. - PUMP
   WFT - WEIGHT FACTOR TRANSMITTER
3. FOR GLOVE BOX DETAILS SEE H-2-29927

LINE DATA

STREAM	LINE SIZE	FROM	TO
1-1 THRU 1-10	1" P	S.T. 1 THRU S.T. 10	S.T. PUMP SUCTION 1-10 & (3)
2-1 THRU 2-10	3/4" O.D.	S.T. PUMP DISCHARGE 1 THRU 10	S.T. 1 THRU 10
3	1" P	SUCTION HDR S.T. 1-10	TO ALL PUMP SUCTION
4	3/4" O.D.	PU RECL. FAC	(3)
5	1" P	R.T 1 & 2	(3)
6-1-2-3	1" P	F.T. 1-2 & 3	F.T. PUMP SUCT 1-2 & 3 & (3)
7-1-2-3	3/4" O.D.	F.T. PUMP DISCH. 1-2 & 3	F.T. 1-2-3 & TANK 5
8-1-2-3	1/2" O.D.	SPARGE PUMP DISCH.	FT 1-2 & 3
9	1/2" O.D	ALL SUMPS	O.R.T.
10	3/4" O.D	TRANSFER PUMP	PU RECL. FAC.
11	1/2" O.D	E.S.T 1-2-3 & 4	O.R.T.
12	1" P	ALL CELL DRAINS	EST
13	3/4" O.D	O.R.T.	TRANSFER PUMP & (5)
14	1/2" O.D.	CHEMICAL ADD TANK	O.R.T.
15	1/2" O.D	CHEMICAL ADD TANK	P.R. CAN
16	1/2" O.D	VENT & VAC TRAPS	O.R.T.
17	1/2" O.D	ORT	VAC. TRAP
18	1/2" O.D	RT 1 & 2	(17) & (21)
19	1/2" O.D	VAC. TRAP	VAC PUMP SUCTION
20	1/2" O.D.	VAC PUMP DISCH.	VENT HDR.
21-1-2	1/2" O.D.	VAC PUMP DISCH.	R.T. 1 & 2
22	1/2" O.D.	P.R. CAN	R.T. 1 & 2
23	1/2" O.D	P.R. CAN	VENT IN HOOD
24	3/4" O.D	R.T. 1 & 2	(19)
25	1" P	ALL SUMPS	(12)
26	3/4" O.D.	FEED TANKS 1-2 & 3	SPARGE PUMP SUCTION
27	1" P	VENT HDR	VENT TRAP



PLAN



ELEVATION "C-C"

SCOPE

DWG. NO.	DRAWING TITLE
SK-2-6834	ARCH METAL CONTROL FAC ADD.
SK-2-6829	TANK ARRANGEMENT & CELL PIPING
SK-2-6830	VENTILATION FLOW DIAGRAM
SK-2-6827	PLOT PLAN AND SECTION
SK-2-6805	ENGINEERING FLOW DIAGRAM

REFERENCE DRAWINGS

NEXT USED ON

REVISIONS

SCALE NONE
DRAWN SHIPMAN
DRAWN T. HAMALAINEN
PROJECT CGC-944
DATE 1/19/62
CLASSIFICATION NONE

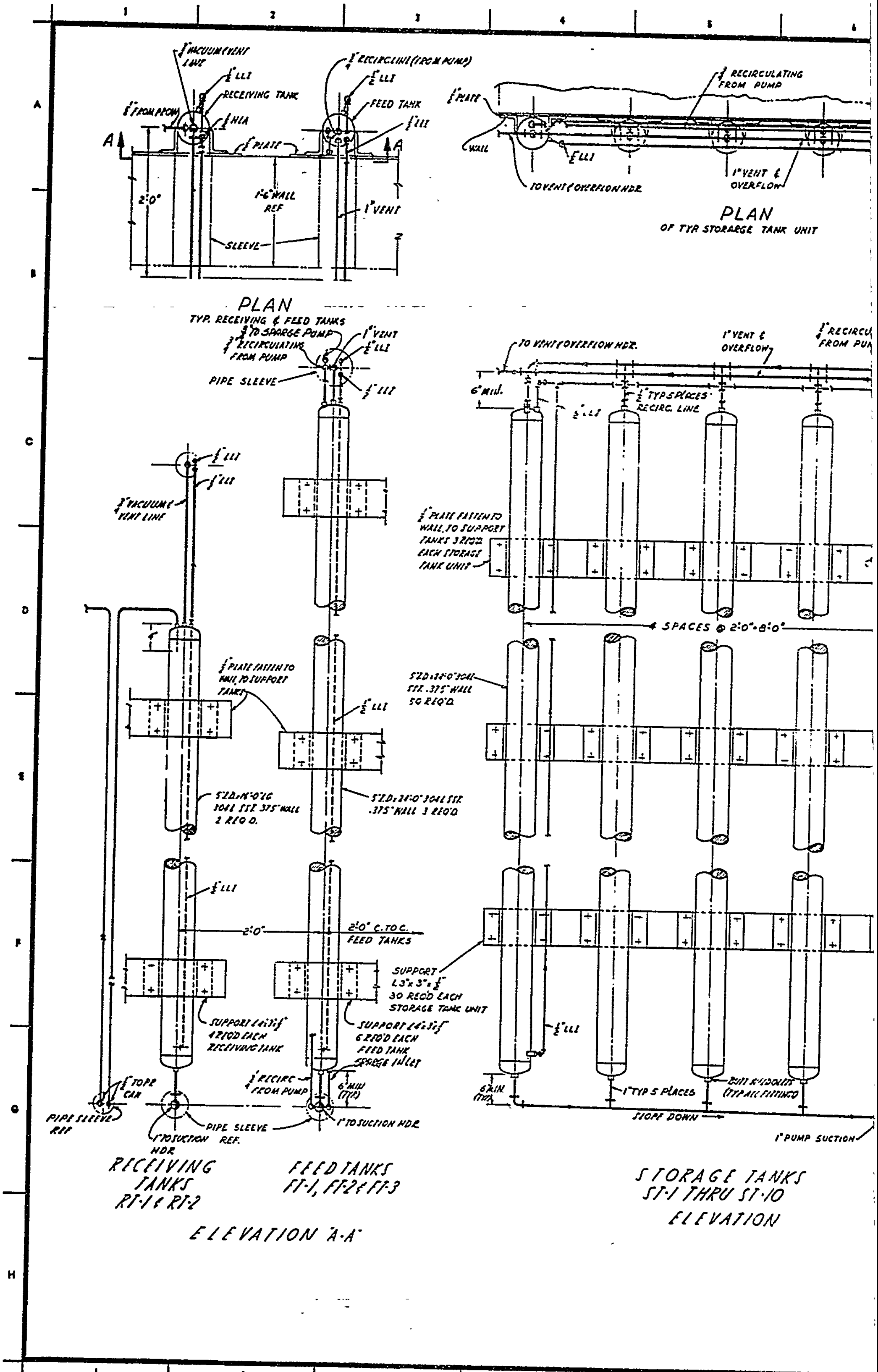
APPROVED FOR CONST.
APPROVED FOR PURCHASE
APPROVED FOR DESIGN

U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC

ARRANGEMENT GLOVE BOX PIPING

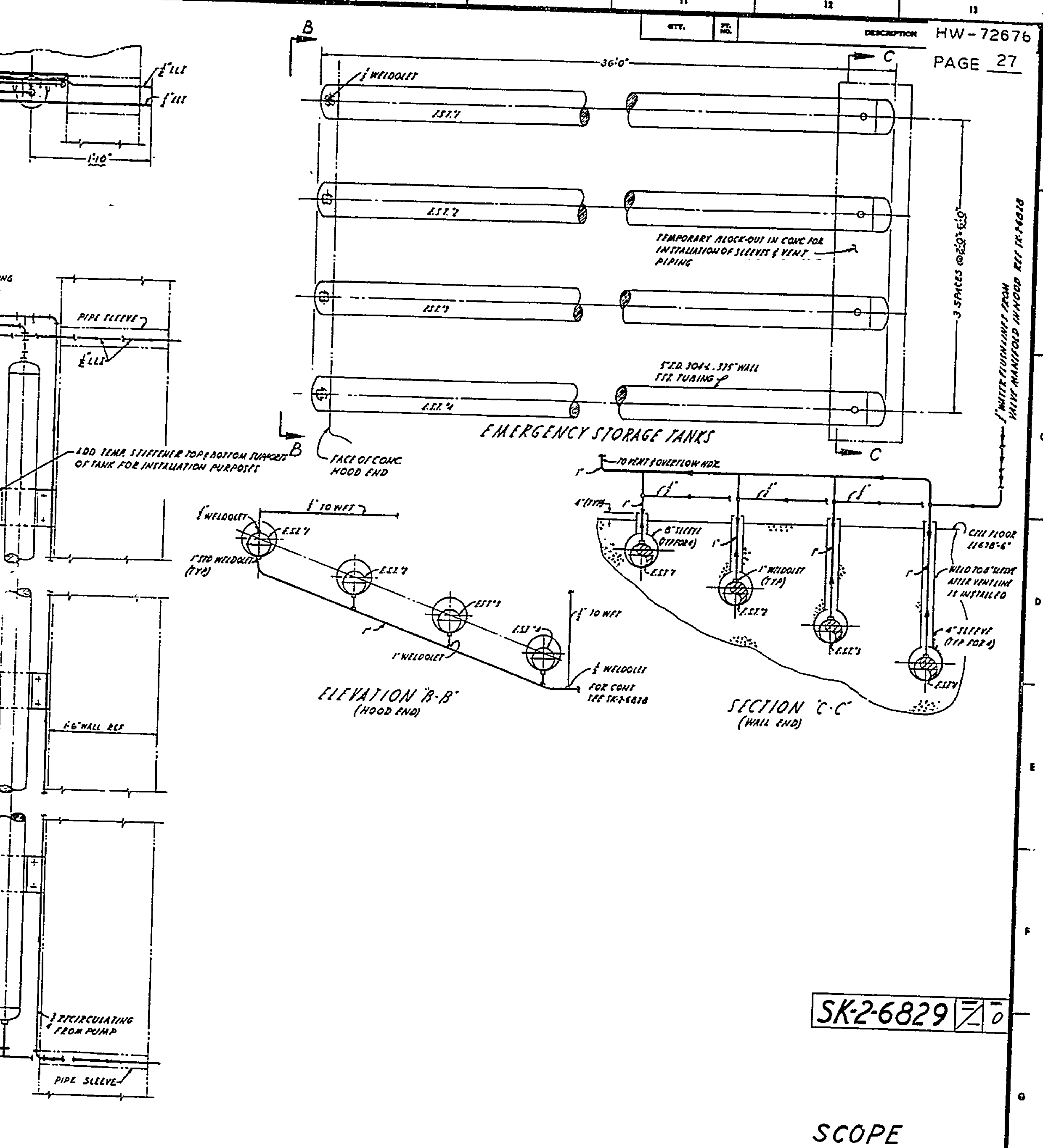
METAL CONTROL FACILITY

BLDG. NO. 234-5
INDEX NO. 8407-1
DWG. NO. SK-2-6828



PLAN
TYP. RECEIVING & FEED TANKS
PLAN
OF TYP STORAGE TANK UNIT
RECEIVING TANK
FEED TANK
RECIRCULATING FROM PUMP
TO VENT & OVERFLOW HDR.
1" VENT & OVERFLOW
1'-6" WALL REF
1" VENT
SLEEVE
2'-0"
PIPE SLEEVE
4 SPACES @ 2'-0" = 8'-0"
SUPPORT L3"x3"x ¼" 30 REQ'D EACH STORAGE TANK UNIT
2'-0" C. TO C. FEED TANKS
1" TYP 5 PLACES
SLOPE DOWN
1" PUMP SUCTION
1" TO SUCTION HDR
RECEIVING TANKS RT-1 & RT-2
FEED TANKS FT-1, FT-2 & FT-3
ELEVATION "A-A"
STORAGE TANKS ST-1 THRU ST-10
ELEVATION

HW-72676
PAGE 27



SK-2-6829 0

SCOPE

DWG. NO.	DRAWING TITLE
SK-2-6834	ARCH. METAL CONTROL FAC. A&D
SK-2-6828	HOOD PIPING ARRANGEMENT
SK-2-6805	ENGINEERING FLOW DIAGRAM

REFERENCE DRAWINGS

NEXT USED ON

REVISIONS

APPROVED FOR CONST.
APPROVED FOR PURCHASE
APPROVED FOR DESIGN

W.E. WHYTOCK
T. HAMALAINEN
CGC-944 / 10626
11/14/61

SCALE NONE

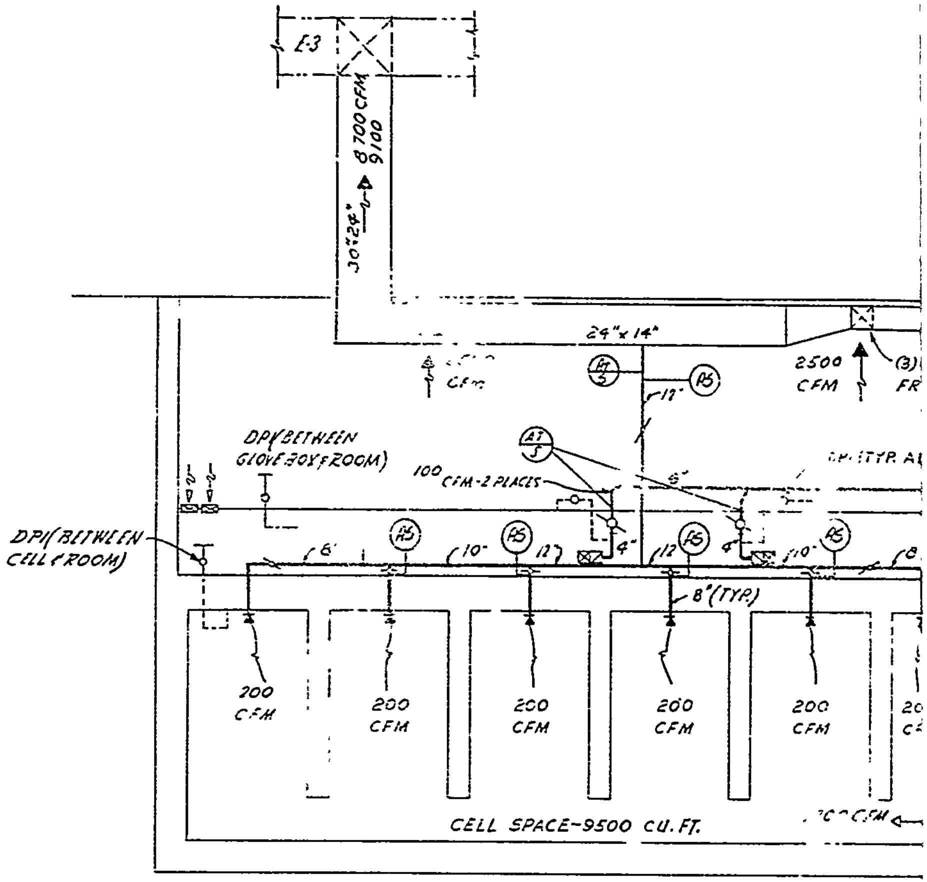
U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC

TANK ARRANGEMENTS

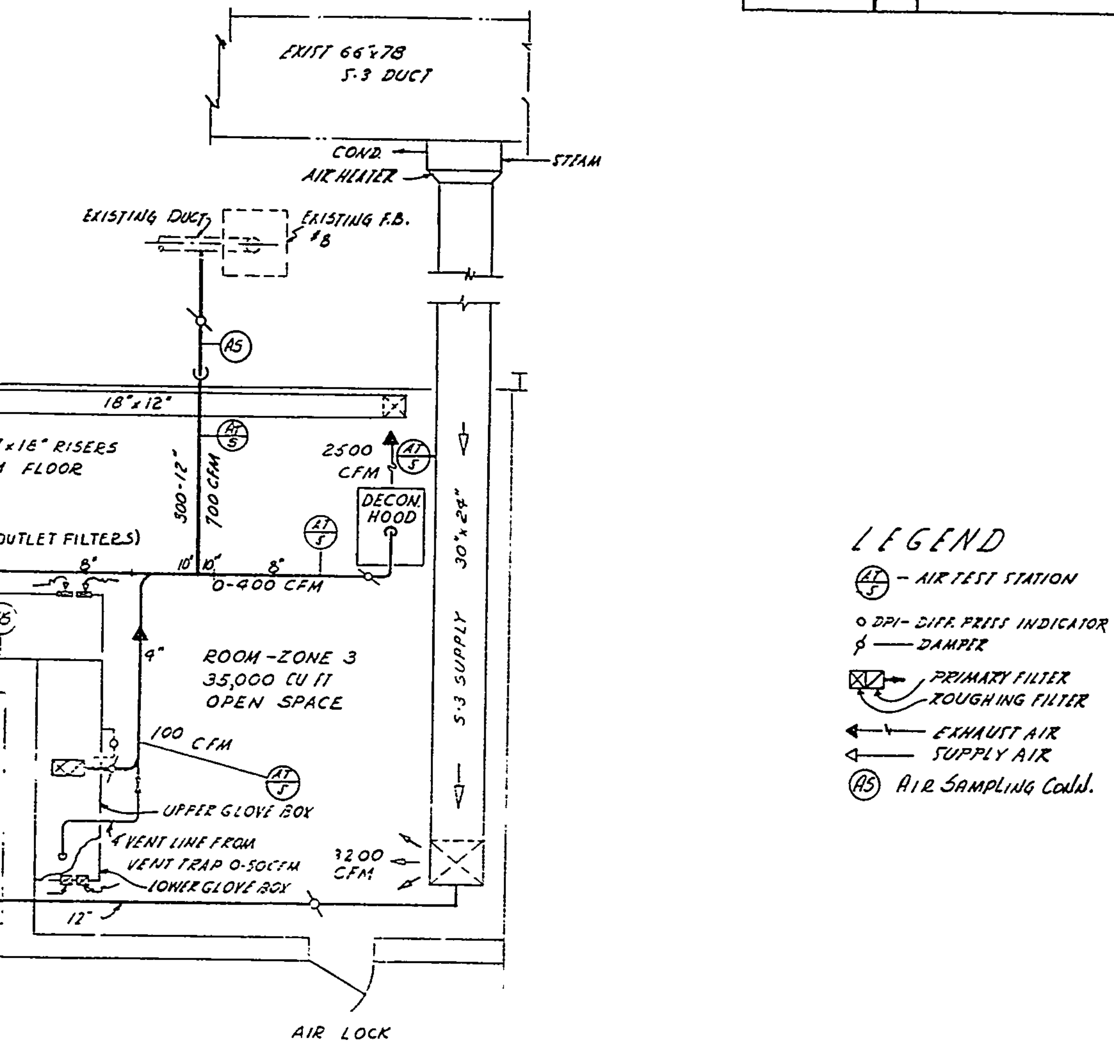
METAL CONTROL FACILITY

234-5 2500-01

SK-2-6829



E-3
8700 CFM
9100
30"x24"
24"x14"
2500
CFM
DPI (BETWEEN
GLOVE BOX & ROOM)
100 CFM-2 PLACES
DPI (BETWEEN
CELL & ROOM)
8"(TYP)
200
CFM
CELL SPACE-9500 CU. FT.
NO
DESCRIPTIO
REVISIONS



SK-2-6830 | SHEET — | REV. 0

REV. BY DATE	APP'D BY	FOR	DATE	REF. DWG. NO.	DRAWING TITLE
				REFERENCE DRAWINGS	
				NEXT USED ON	

CHECK PRINT / COMMENT PRINT	
SCALE	NONE
DRAWN	W.E. WHYTOCK
DES. ENG.	T. HAMALAINEN
PROJECT	CGC-944
UNIT NO.	00626
DATE	11/15/61
APPROVED FOR CONST.	
APPROVED FOR PURCHASE	
APPROVED FOR DESIGN	
CLASSIFICATION	NONE

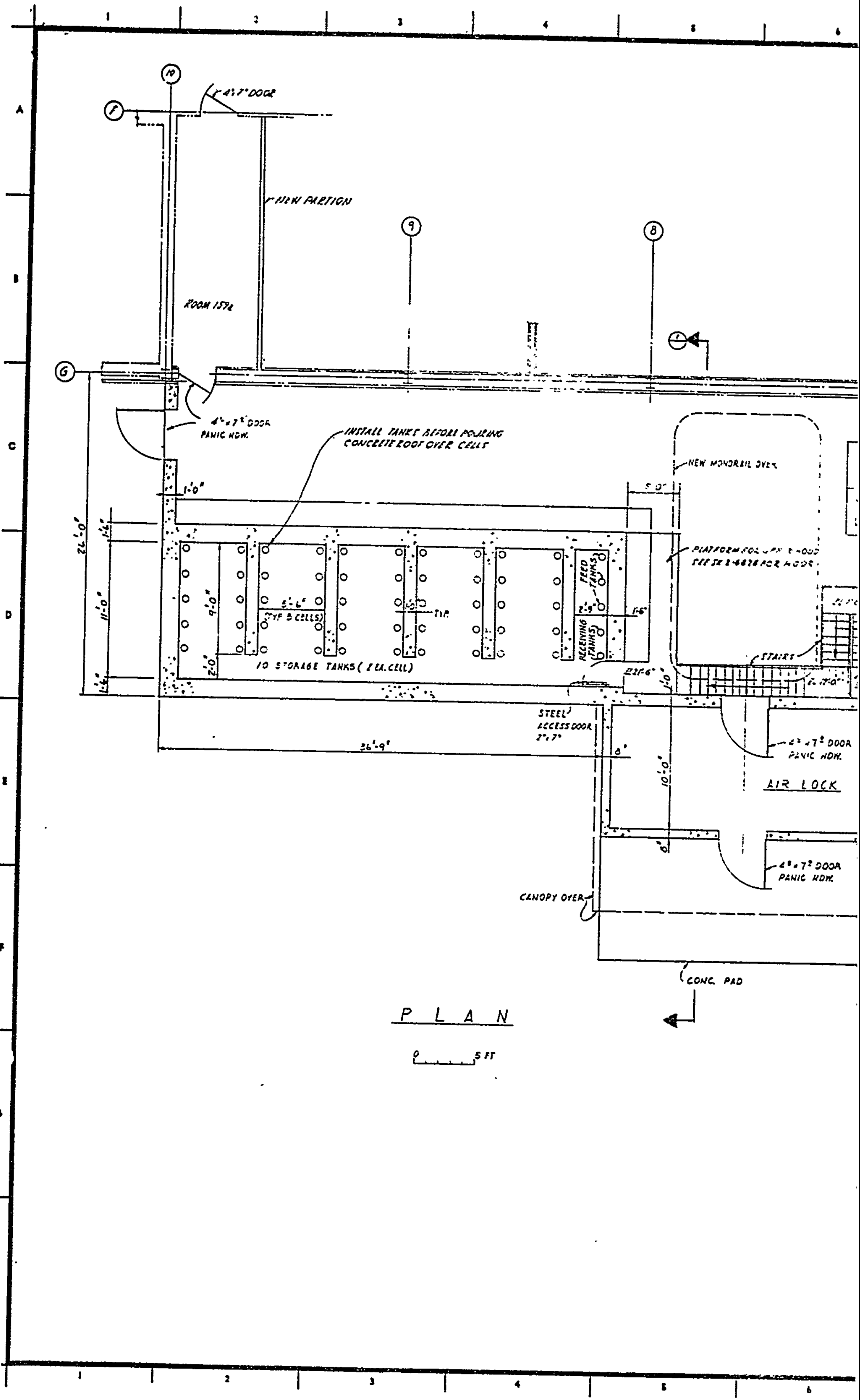
U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC

VENTILATION FLOW DIAGRAM

METAL CONTROL FACILITY

BLDG. NO. 234-5 | INDEX NO. 7001-01

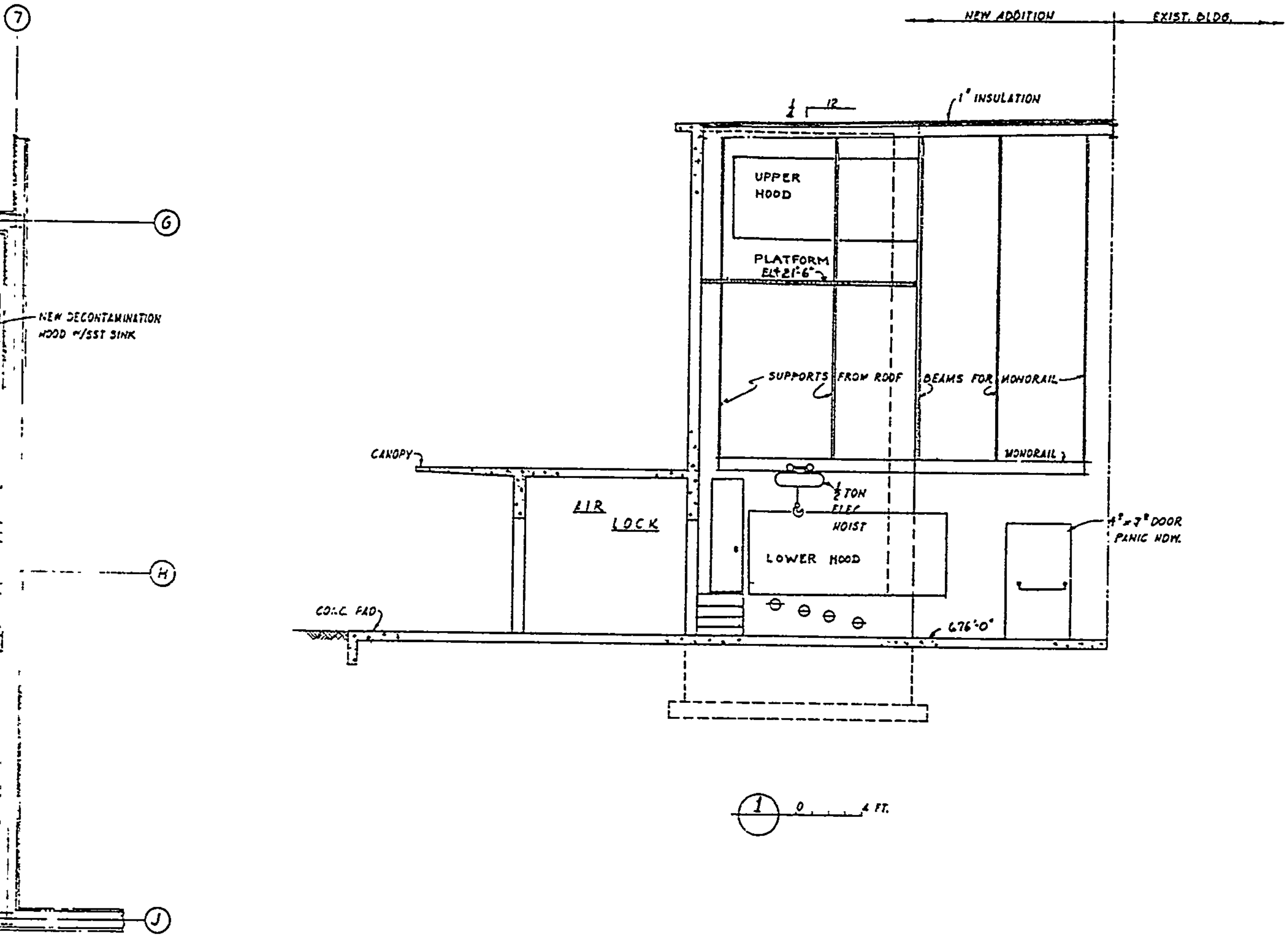
DWG. NO. SK-2-6830



4'x7' DOOR
NEW PARTION
ROOM 157B
4'x7' DOOR
PANIC HDW.
INSTALL TANKS BEFORE POURING
CONCRETE ROOF OVER CELLS
NEW MONORAIL OVER
1'-0"
5'-0"
26'-0"
11'-0"
9'-0"
2'-0"
5'-6" (TYP 5 CELLS)
TYP.
FEED TANKS
RECEIVING TANKS
1'-6"
PLATFORM FOR URN & HOOD
STAIRS
10 STORAGE TANKS (2 EA. CELL)
STEEL ACCESS DOOR 2'x7'
36'-9"
4'x7' DOOR
PANIC HDW.
AIR LOCK
10'-0"
4'x7' DOOR
PANIC HDW.
CANOPY OVER
CONC. PAD

P L A N

0 5 FT



SK-2-6834 / 0

U. S. ATOMIC ENERGY COMMISSION
HANFORD ATOMIC PRODUCTS OPERATION
GENERAL ELECTRIC

ARCHITECTURAL
METAL CONTROL
FACILITY ADDITION

SCALE SHOWN
R. J. HINES
CGC-944 12467
234-5 0800
NONE
SK-2-6834