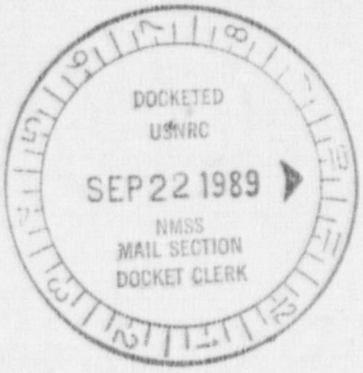
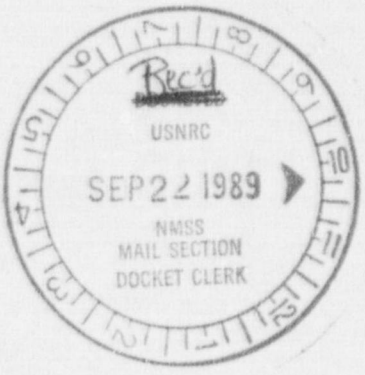
RETURN TO 396-35 P1-137

RE: 89140-N 40-8027

PDR | LPDR

SEQUOYAH FUELS CORPORATION





September 14, 1989

Certified Mail
Return Receipt Requested

Mr. Leland C. Rouse, Chief
Fuel Cycle Safety Branch
Division of Industrial and
Medical Nuclear Safety, NMSS
U.S. NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555

RE: License SUB-1010; Docket No. 40-8027
Revision to Part II, Chapter 16

Dear Mr. Rouse:

As enclosures to this letter, Sequoyah Fuels Corporation (SFC) is transmitting to you a revision to Part II, Chapter 16, of SFC's License SUB-1010. This submittal constitutes a major revision to Chapter 16 to update information and to incorporate information on the UF_6 Reduction Plant. All changes have been bar-marked in the left-hand margin for your convenience. Also enclosed is an update to the SUB-1010 Table of Contents.

Should you have any questions concerning any of these revisions, please contact Lee Lacey at (918) 489-3207.

Sincerely,

Lee R. Lacey for SPK

Scott P. Knight
Vice President
Administration

SPK:LRL:nv

Enclosures as stated

cc: R. E. Hall, URFO - Region IV
K. E. Asmussen, General Atomics
B. B. Lenz
File

1/1

DF04

Hwy 10 & I-40 P.O. Box 610 Gore, Oklahoma 74435 Telephone (918) 489 5511 Facsimile (918) 489 5620

Addt w/o 25960

DOCKET NO. 40-8027
CONTROL NO. 25960
DATE OF DOC. September 14, 1989
DATE RCVD. September 22, 1989
FCUF ✓ PDR ✓
FCAF LPDR ✓
I&E REF. ✓
SAFEGUARDS
FCTC OTHER
DATE 9/22/89 INITIAL SAC

DOCKET NO. 40-8027
CONTROL NO. 25960
DATE OF DOC. September 14, 1989
DATE RCVD. September 22, 1989
FCUF ✓ PDR ✓
FCAF LPDR ✓
I & E REF. ✓
SAFEGUARDS
FCTC OTHER
DATE 9/22/89 INITIAL SAC

TABLE OF CONTENTS PAGE

LIST OF TABLES

LIST OF TABLES (Cont'd.)

LIST OF FIGURES

LIST OF FIGURES (Cont'd.)

LIST OF DRAWINGS

LIST OF DRAWINGS (Cont'd.)

CHAPTER 16. PROCESS DESCRIPTION AND SAFETY ANALYSES

16.1 UF_6 Conversion Plant - Process Steps and Flowsheets

The process used for production of UF_6 at the Sequoyah Facility utilizes technology which has been proven by successful performance at various DOE facilities. The process employed at Sequoyah Facility follows the DOE approach involving preparation of pure uranium trioxide from ore concentrate and dry chemistry conversion to uranium hexafluoride. The uranium ore concentrate is purified by solvent extraction and converted to UF_6 by successive treatments with heat, hydrogen (H_2), hydrogen fluoride (HF), and fluorine (F_2).

The production method used at the Sequoyah Facility Conversion Plant involves (a) feed preparation, (b) dissolution of the ore concentrate in nitric acid, (c) purification of the uranium solution by solvent extraction, (d) thermal denitration of the uranyl nitrate to prepare uranium trioxide, (e) hydrogen reduction of the uranium trioxide to uranium dioxide, (f) conversion of the uranium dioxide to uranium tetrafluoride by reaction with anhydrous hydrogen fluoride, and (g) formation of uranium hexafluoride by contacting the uranium tetrafluoride with elemental fluorine.

Schematic diagrams of the production process are shown in Figures 16-1A through 16-1M. Individual flowsheets are presented at the end of the Chapter for each of the process steps in the following process description.

16.1.1 Receiving and Sampling (Dwg. No. 220-M-101)

Yellowcake is received at Sequoyah Facility in 55-gallon drums and stored on stacked pallets on an outside storage pad. The drums and lids are identified by number. Drums are removed from the storage pad and placed on the full drum receiving conveyor. Each drum is weighed and the weight and drum identification number is recorded on a printed ticket. The drum is then manually transferred to the full drum elevator feed conveyor.

The drum lid is manually removed and replaced with a temporary dust cover. The drum is then transferred on to the drum elevator, which raises the full drum to the dump floor level where the drum is transferred on to the full drum dumper storage conveyor. The temporary cover is removed and set aside to be replaced after the dumping operation. The drum is transferred to the feeding position for the drum dumper and the contents of the drum are removed.

The empty drum is then moved onto the elevator and lowered to the lower level where the drum is transferred onto the drum storage conveyor. The drum is cleaned with a vacuum hose and the lid is replaced. The drum is then transferred to the drum scale where it is weighed and recorded. Empty drums are then transferred to the outside drum storage pad.

FIGURE 16-1A

DRY URANIUM CONCENTRATE SAMPLING

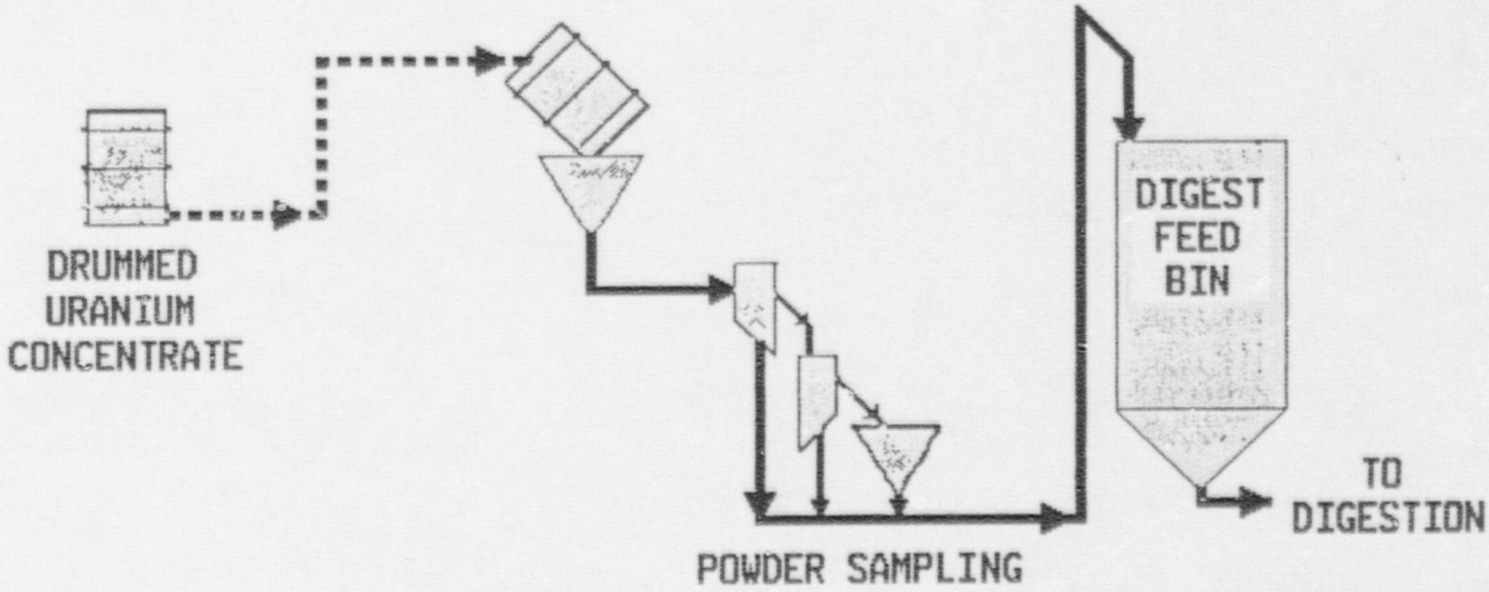


FIGURE 16-1B

URANIUM SLURRY RECEIVING & SAMPLING

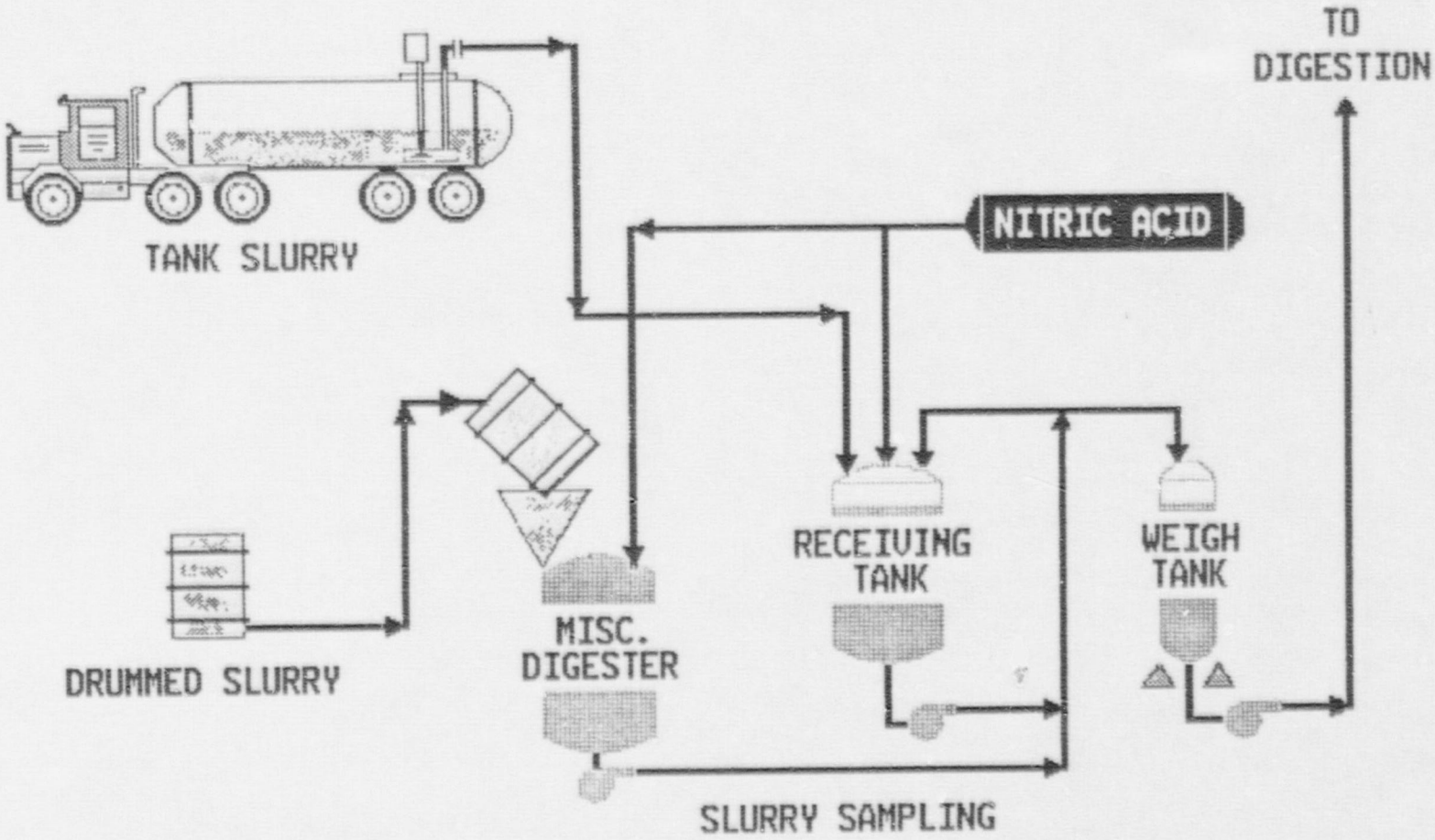


FIGURE 16-1C

DIGESTION

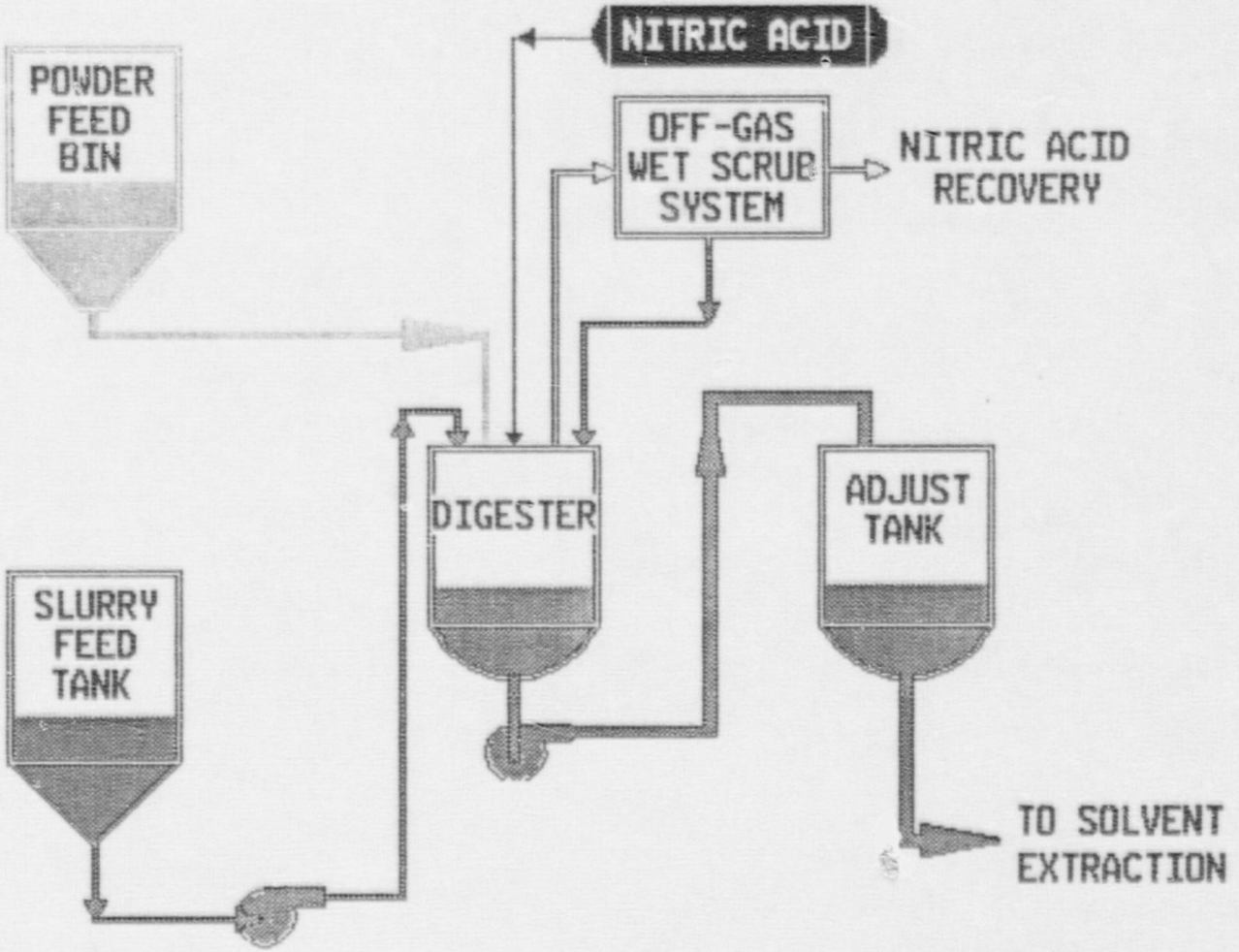


FIGURE 16-1D

SOLVENT EXTRACTION

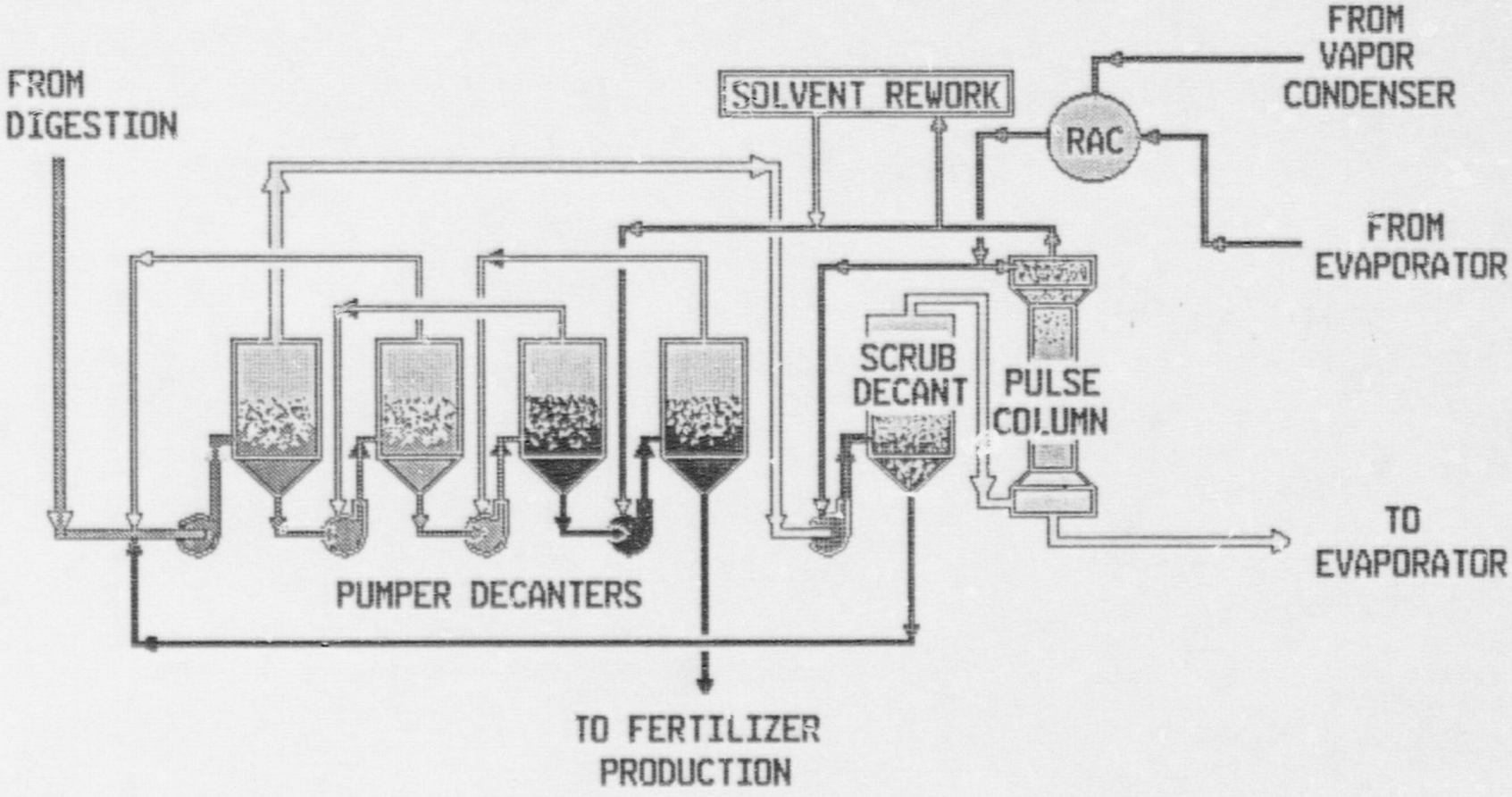


FIGURE 16-1E

FERTILIZER PRODUCTION

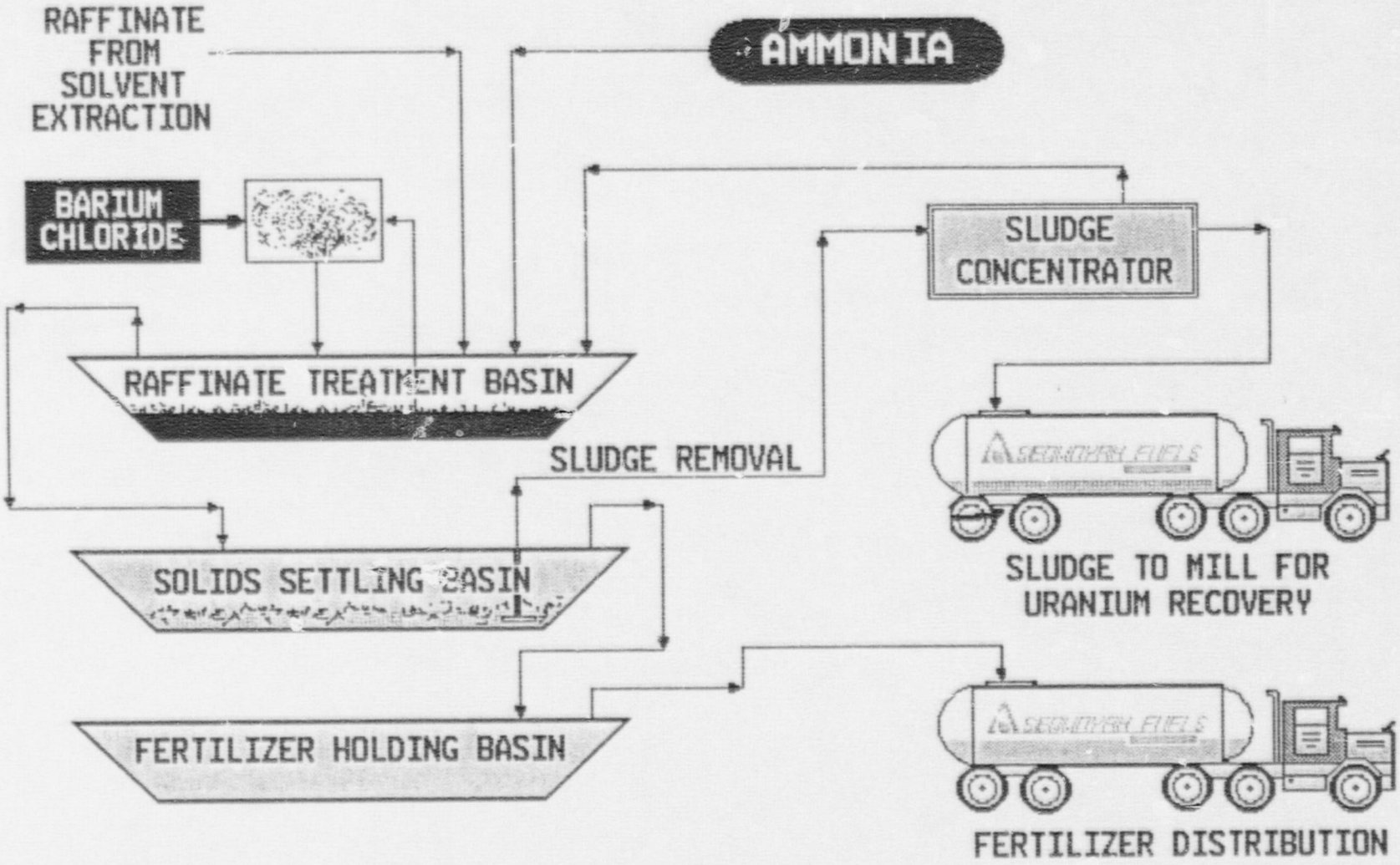


FIGURE 16-1F

CONCENTRATION

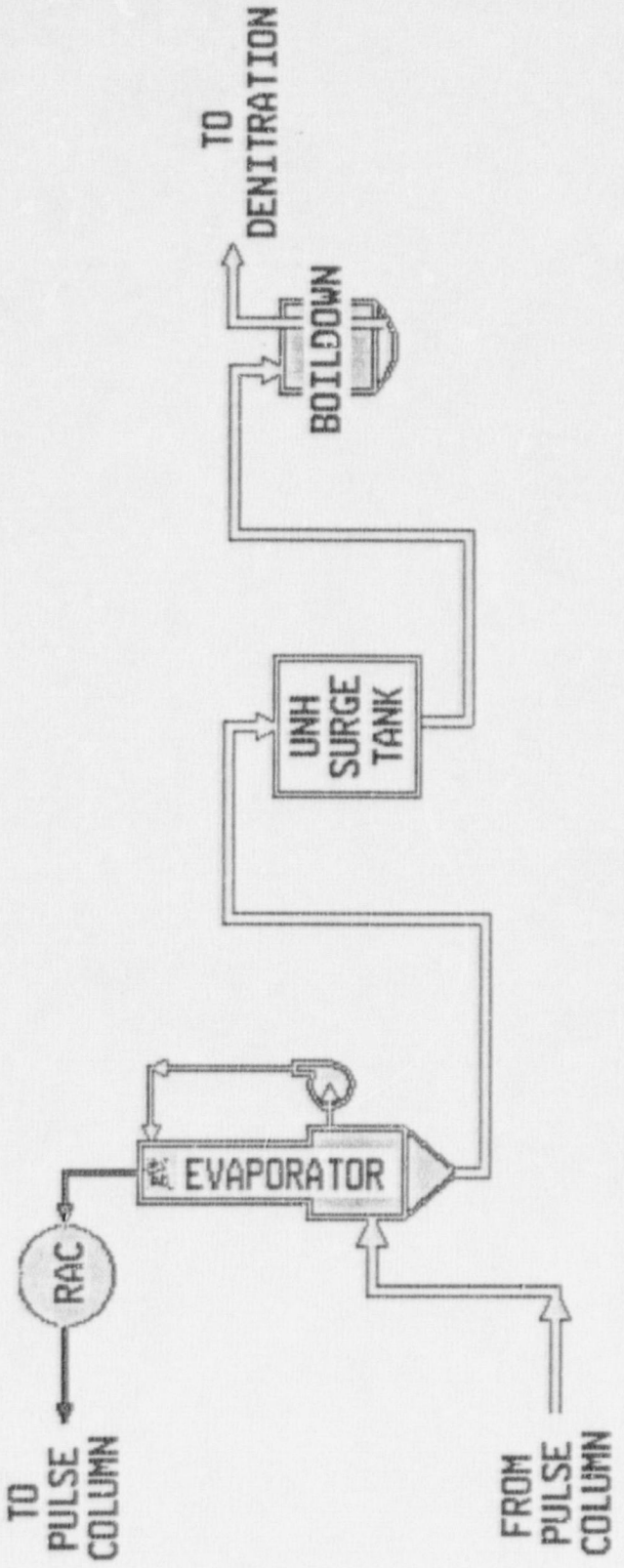


FIGURE 16-1G

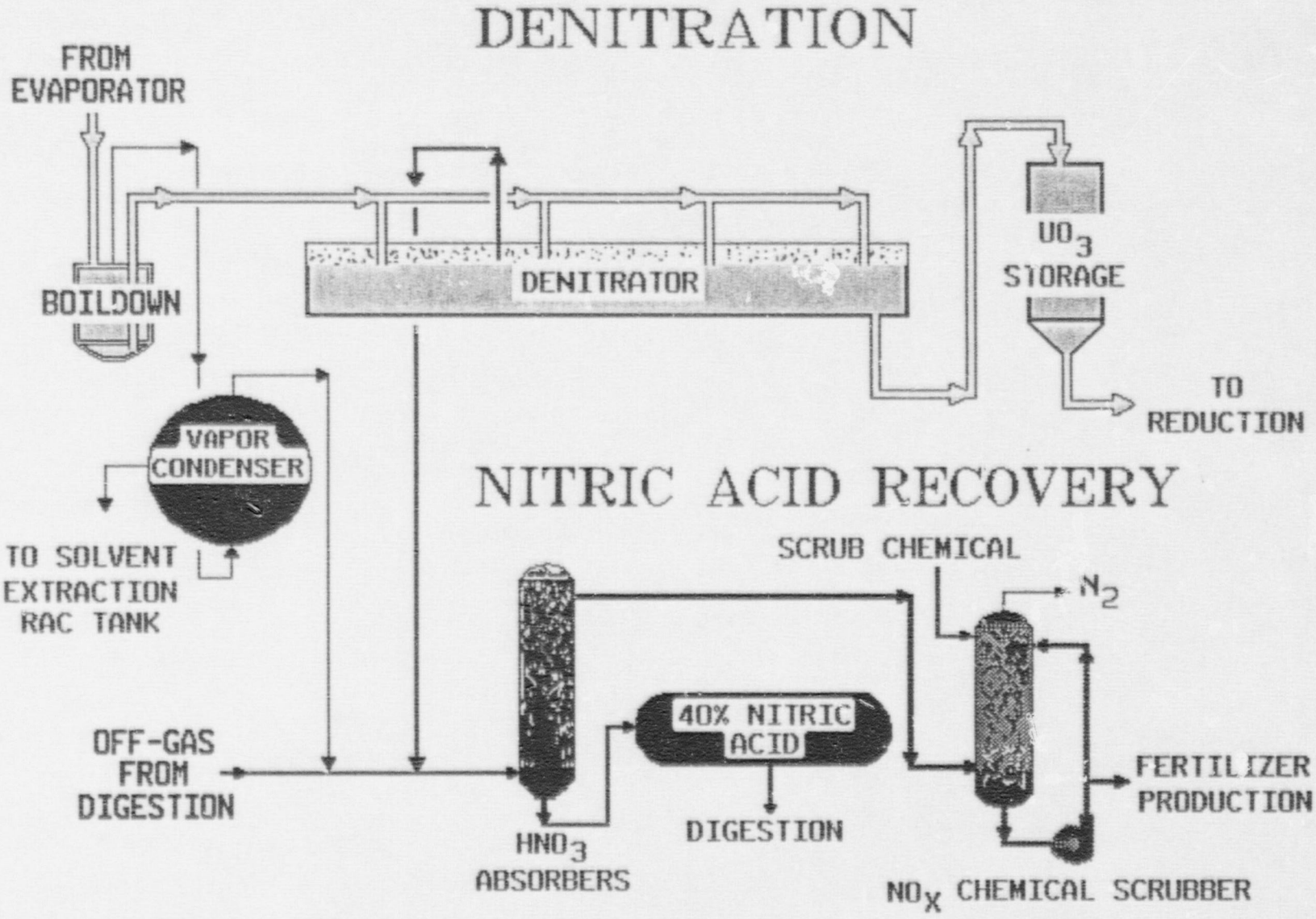

DENITRATION
FROM EVAPORATOR
BOILDOWN
DENITRATOR
UO_3 STORAGE
TO REDUCTION
VAPOR CONDENSER
TO SOLVENT EXTRACTION RAC TANK
NITRIC ACID RECOVERY
SCRUB CHEMICAL
N_2
OFF-GAS FROM DIGESTION
40% NITRIC ACID
FERTILIZER PRODUCTION
HNO_3 ABSORBERS
DIGESTION
NO_X CHEMICAL SCRUBBER

FIGURE 16-1H

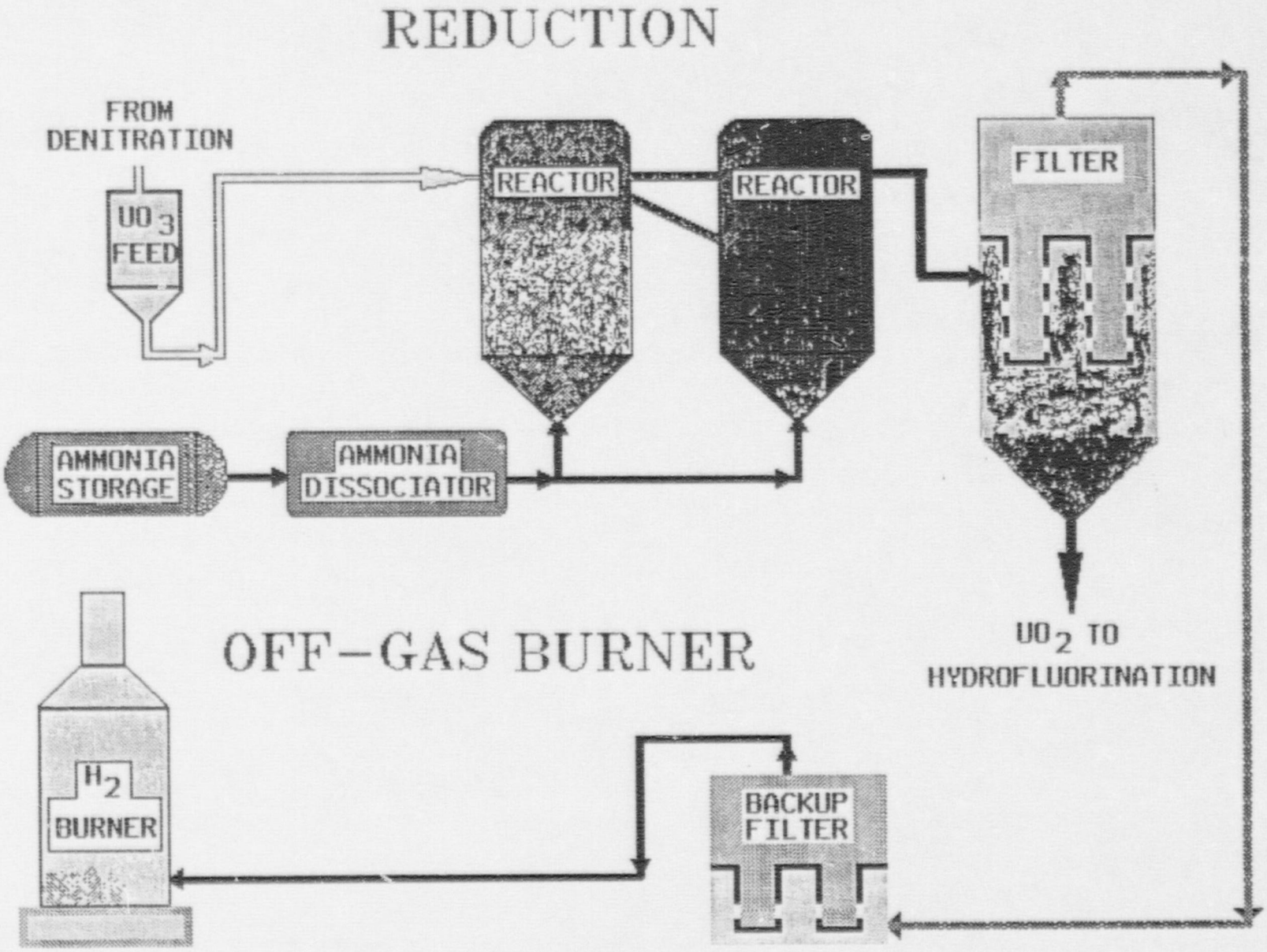

REDUCTION
FROM DENITRATION
UO_3 FEED
REACTOR
REACTOR
FILTER
AMMONIA STORAGE
AMMONIA DISSOCIATOR
UO_2 TO HYDROFLUORINATION
OFF-GAS BURNER
H_2 BURNER
BACKUP FILTER

FIGURE 16-11

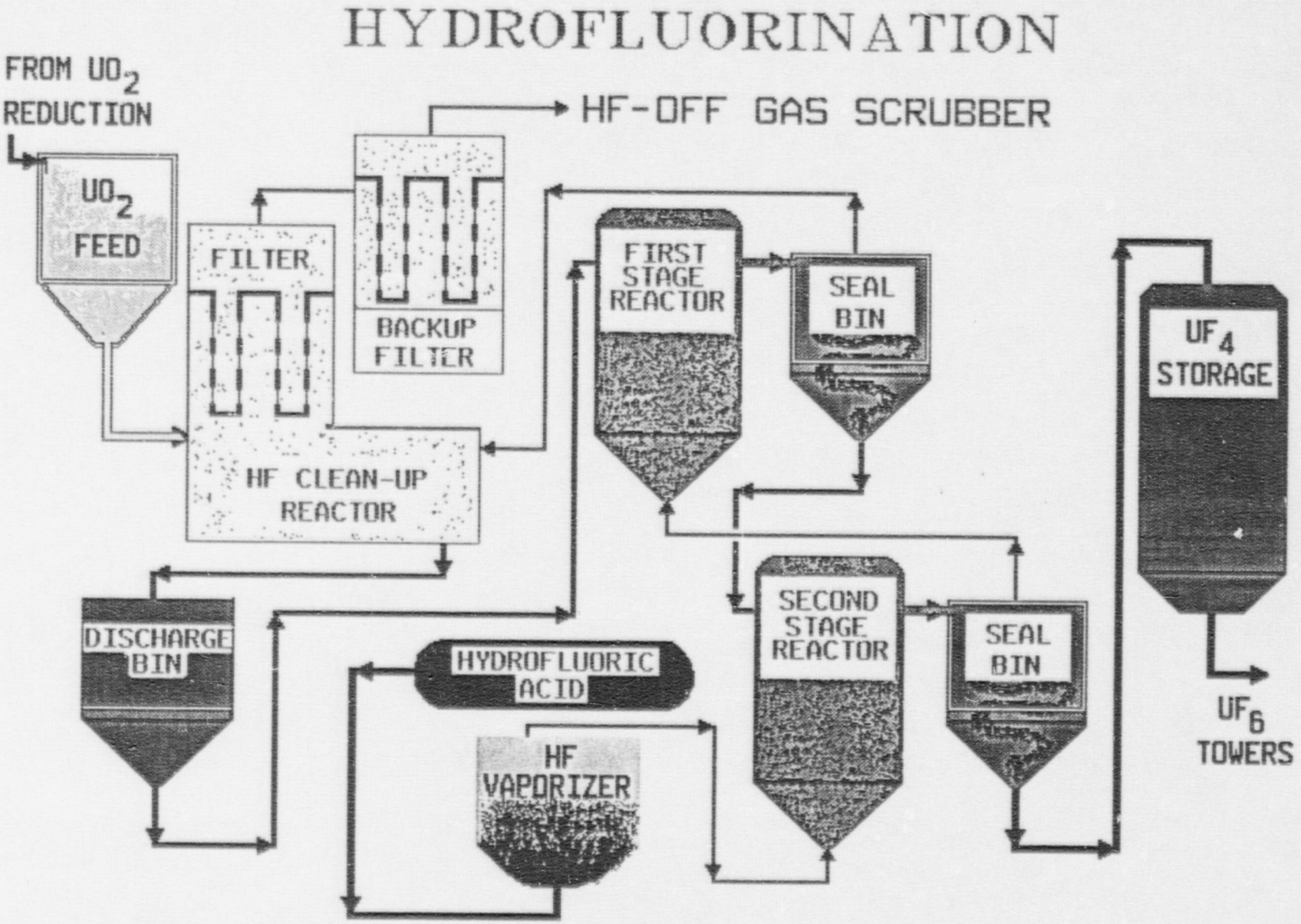

HYDROFLUORINATION
FROM UO_2 REDUCTION
HF-OFF GAS SCRUBBER
UO_2 FEED
FILTER
BACKUP FILTER
FIRST STAGE REACTOR
SEAL BIN
UF_4 STORAGE
HF CLEAN-UP REACTOR
DISCHARGE BIN
HYDROFLUORIC ACID
HF VAPORIZER
SECOND STAGE REACTOR
SEAL BIN
UF_6 TOWERS

FIGURE 16-1J

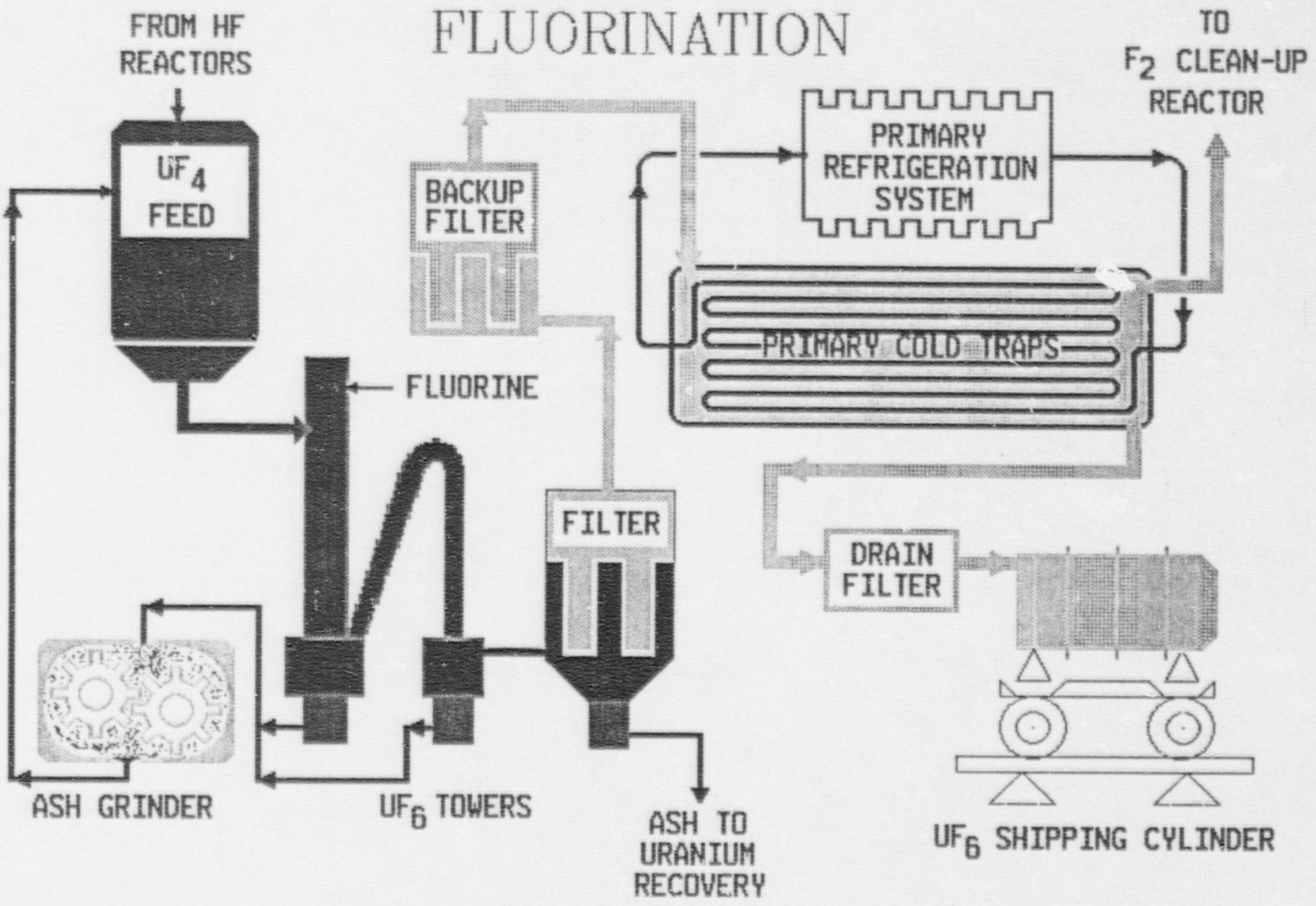

FLUORINATION
FROM HF REACTORS
UF_4 FEED
BACKUP FILTER
PRIMARY REFRIGERATION SYSTEM
TO F_2 CLEAN-UP REACTOR
PRIMARY COLD TRAPS
FLUORINE
FILTER
DRAIN FILTER
ASH GRINDER
UF_6 TOWERS
ASH TO URANIUM RECOVERY
UF_6 SHIPPING CYLINDER

FIGURE 16-1K

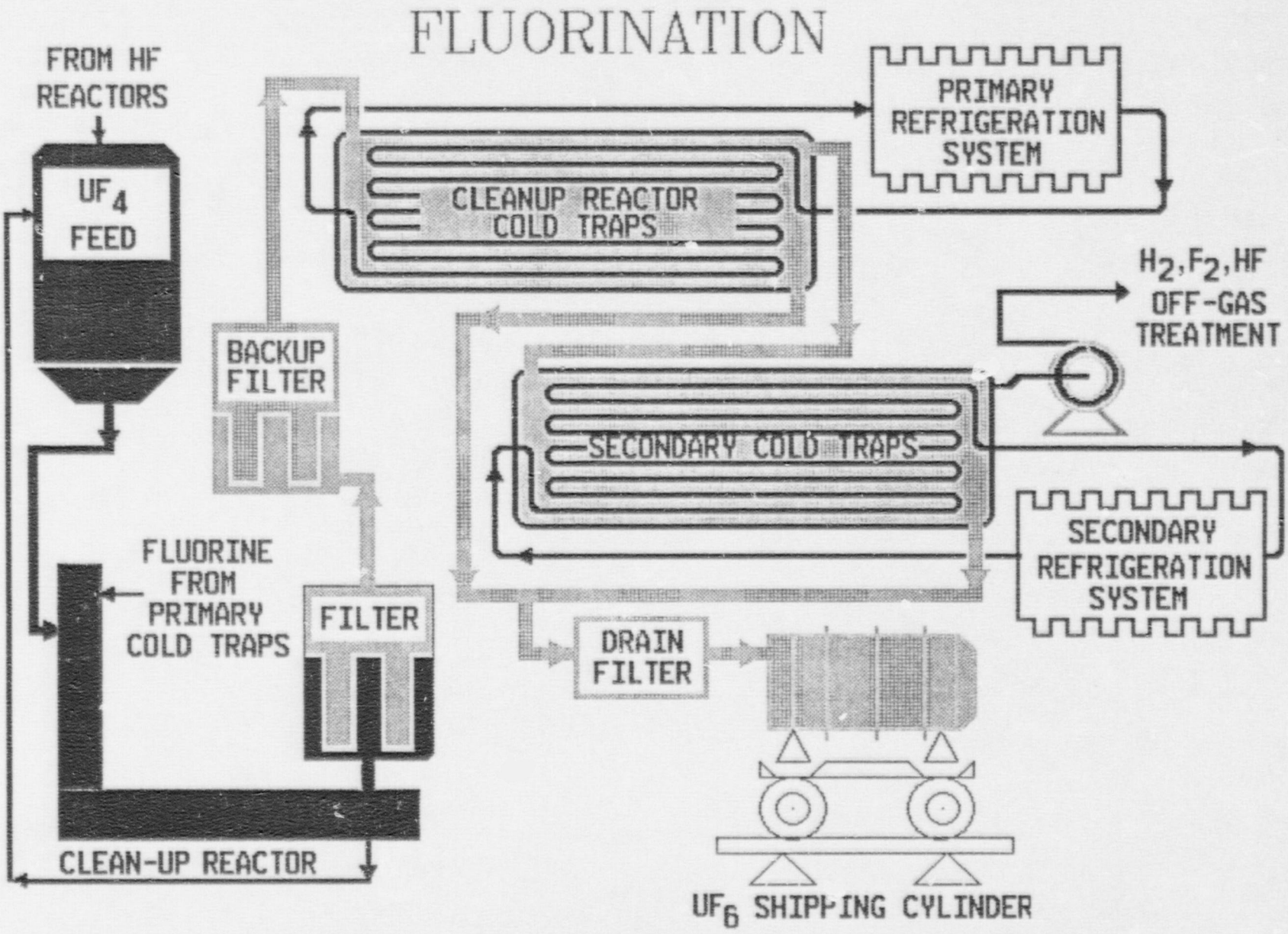

FLUORINATION
FROM HF REACTORS
UF_4 FEED
BACKUP FILTER
CLEANUP REACTOR COLD TRAPS
PRIMARY REFRIGERATION SYSTEM
H_2,F_2,HF OFF-GAS TREATMENT
SECONDARY COLD TRAPS
SECONDARY REFRIGERATION SYSTEM
FLUORINE FROM PRIMARY COLD TRAPS
FILTER
DRAIN FILTER
CLEAN-UP REACTOR
UF_6 SHIPPING CYLINDER

FIGURE 16-1L

H_2, F_2, HF, OFF-GAS TREATMENT

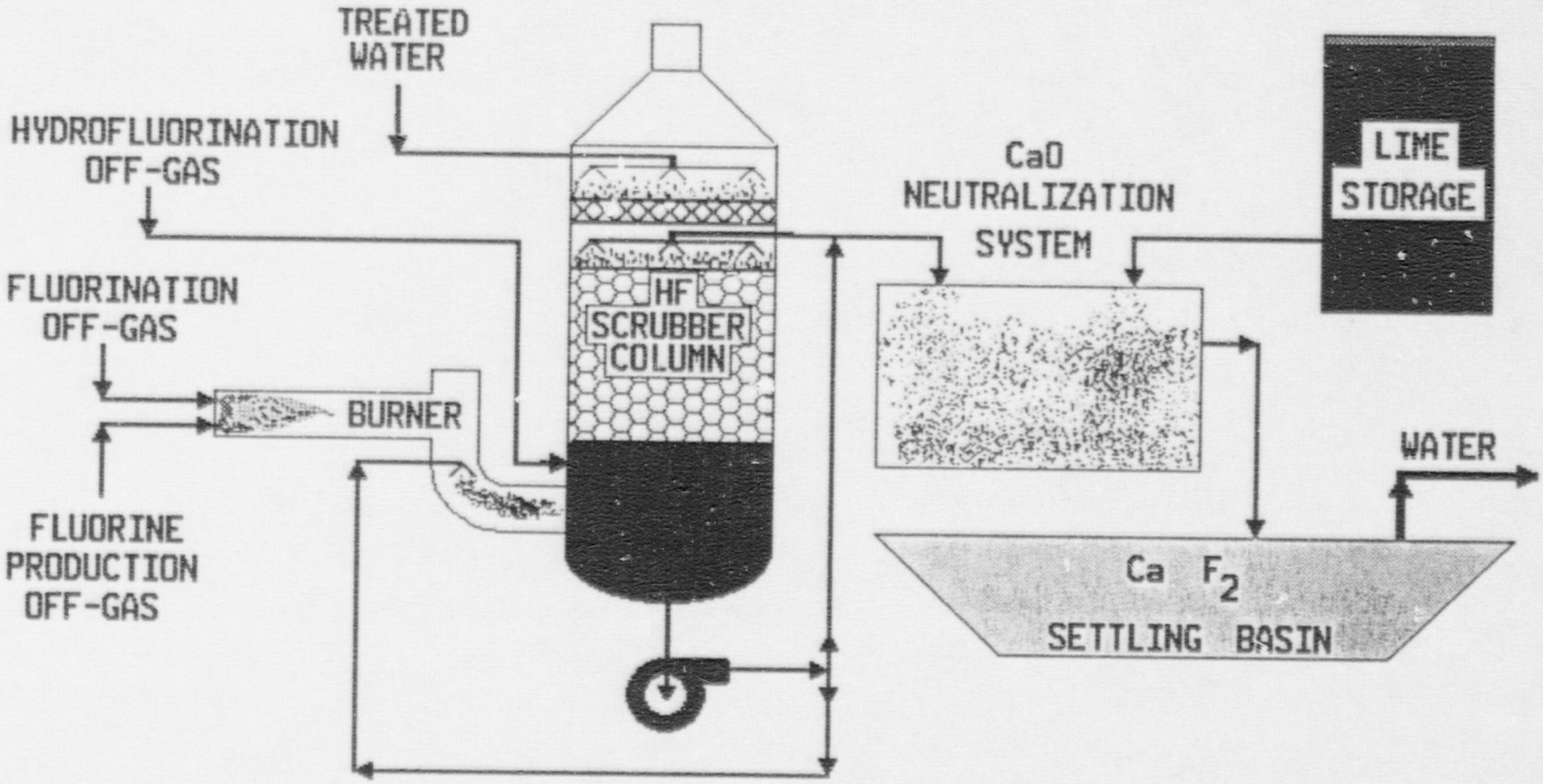
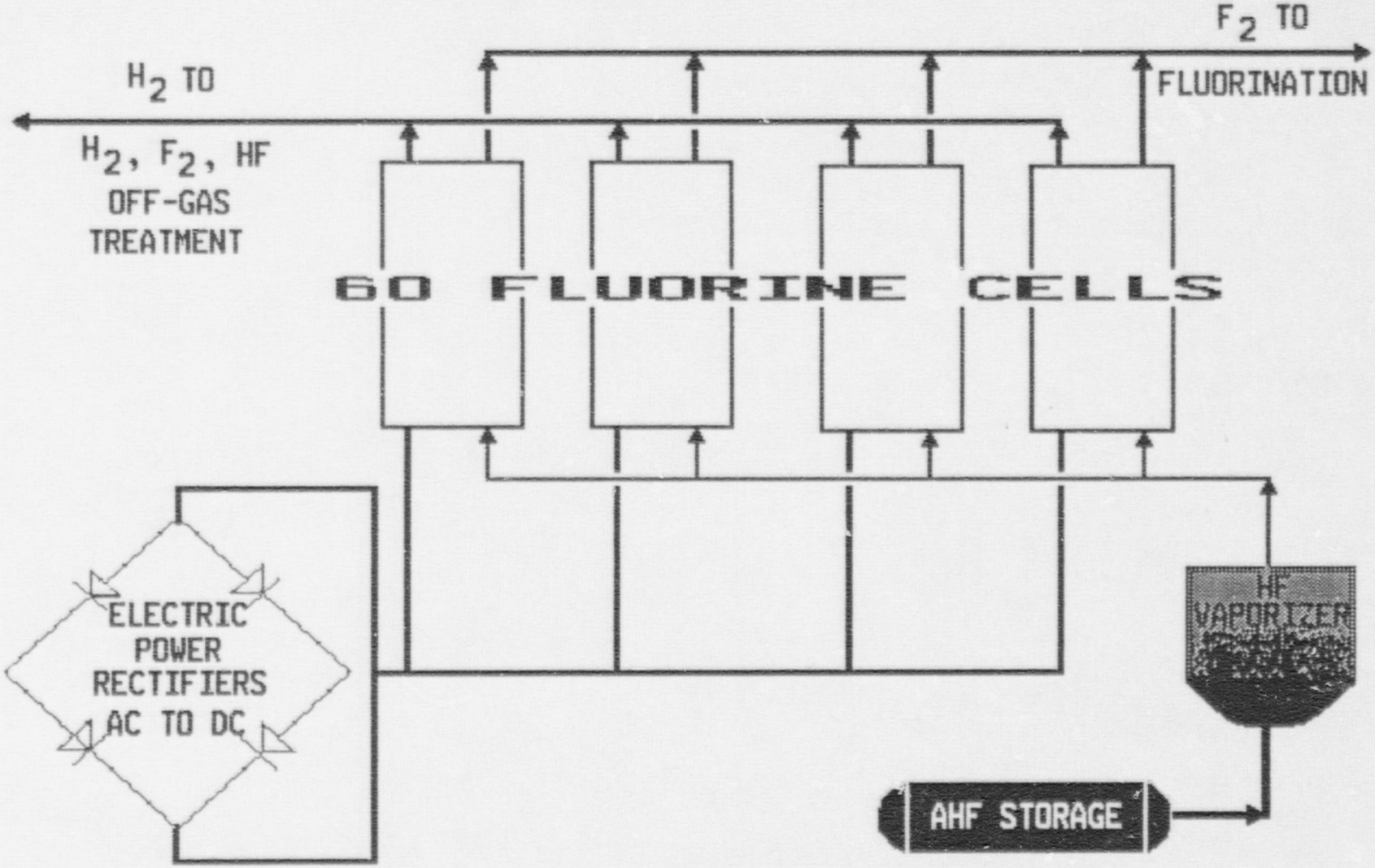


FIGURE 16-1M

FLUORINE PRODUCTION



Provisions have been made to allow for redrumming concentrate after it has been sampled. When concentrate is to be redrummed, the empty drums are stopped at the redrumming station. Concentrate is transferred from the bin into the empty drum. When the drum has been filled and covered with its lid, it is transferred to the redrum scale where it is weighed, then transferred to the outside drum storage pad.

The purpose of the sampling operation is to obtain a representative sample of each lot of yellowcake received. The chemical analyses performed on these samples constitute the basis for uranium accountability and for billing or payment of shippers for UF_6 conversion services or uranium purchased. After sampling, the concentrate will either be transferred to the digester feed bins or will be redrummed.

Yellowcake concentrate is discharged from drums by the drum dumper to the yellowcake receiving bin. The receiving bin is fitted with an agitator and vibrator and is capable of holding the contents of three 55-gallon drums. Concentrate is transferred from the bin to the primary first stage sampler by a vibrating trough feeder. The sampler is of the dust-tight falling-stream type, taking a continuous sample, and is designed to collect 10 percent of the material fed to the unit. The rejected material flows by gravity to the primary sample reject bin. The material collected by the first stage sampler is transferred to the primary second stage sampler by a vibrating trough feeder. The second stage sampler is also a falling-stream type unit which collects 10 percent of the feed as sample. The balance of the material fed to the unit is routed to the primary sample reject bin. The sample discharged from the second stage unit is routed to the yellowcake sample weigh bin. This primary sample is equivalent to about one percent of the material dumped from the drums. The primary sample is batched into the yellowcake sample collection bin.

The primary sample is then fed to the secondary sampling station where it is split down to about 20 lbs. This secondary sample is transferred to the sample prep room for the sample preparation operations necessary before chemical and physical properties of the material are determined. The rejects from the secondary sampler are collected in a 55-gallon drum. Drums of reject material are returned to the sampling plant.

Feed material is continuously withdrawn from the primary sample reject bin by the bucket elevator feed conveyor. This unit normally transfers feed material to the yellowcake bucket elevator. However, if so desired, sampled feed can be routed from the conveyor to the redrumming bin. The bucket elevator discharges into a split chute which is fitted with a flop gate. Material is diverted to either of the two digester feed bins, which are capable of storing one day's output of the receiving and sampling plant. The bins are mounted on load cells and the desired batch weight of material can be fed to a digester.

Unloading, Sampling and Digestion of Wet Yellowcake (Dwg.220-M-1003)

Wet yellowcake slurry delivered from a uranium mill will contain approximately 38% (wt.) of water. The slurry is transported in a stainless steel cargo tank meeting the appropriate DOT specification. A special yellowcake slurry receiving area is provided at the Sequoyah Facility. This area contains facilities and equipment for unloading the cargo tank, dissolving the slurry with nitric acid, and sampling the uranyl nitrate solution.

Tanks for receiving, weighing and sampling the uranium product are enclosed in a building which rests on a concrete curbed foundation with sufficient volume to contain liquid spillage from one full tank. The tanks have a total capacity of 21,000 gallons. The receiving and transfer pumps are contained in a small building with a curbed foundation that drains to the large curbed area in case of spillage in the pump house. The area where the cargo tank is parked is also curbed adequately to contain the entire tank volume.

The cargo tank arrives at the facility with blind flanges on all openings except the pressure relief device. The cargo tank is spotted at the unloading rack and the blinds removed. The material is re-slurried and transferred to the slurry prep tank where nitric acid is added. Some water may be added to the cargo tank to facilitate re-slurrying and unloading. The resulting uranyl nitrate solution is mixed, weighed, sampled and then transferred to a storage tank. The storage tank contents are subsequently transferred to Digestion as feed to Solvent Extraction.

Unloading, Sampling and Digestion of Uranium Concentrates in Solution and Slurry Forms

Slurry is normally received in 55 gallon containers. A sampling area for the slurry is located on the west end of the existing slurry receiving building. The slurry digestion and sampling area rests on a curbed foundation with sufficient volume to contain the contents of the digestion tank.

The full containers are placed on a roller conveyor. The lids are removed and the containers are emptied into the process feed hopper using a mechanical tipper. The slurry is then fed into the digester containing HNO_3, for yellowcake slurry, or HNO_3 and $Al(OH)_3$ pre-mixed, for slurries that may contain some fluoride. After digestion, the resulting solution is mixed, weighed and sampled. It may then be pumped to the storage tank or to process tankage for preparation as feed for the Solvent Extraction operation.

Uranium received in solution form is also normally received in 55 gallon containers and is unloaded the same way slurry is unloaded. Small pumps are used to transfer the solution from the containers to the slurry receiving tank where it is weighed and

sampled. It may then be pumped to process tankage for preparation as feed for Solvent Extraction.

16.1.2 Primary Digestion (Dwg. No. 230-M-101)

In Primary Digestion, sampled concentrate is reacted with preheated nitric acid in one of three digestion tanks to convert the uranium in the feed material, present in the form of oxides or diuranates, to uranyl nitrate solution. The reaction is accompanied by evolution of nitrogen oxides. The composition of the released gas is dependent on the type of uranium concentrate feed and the strength of the nitric acid used.

The digester off-gases are piped to a condenser to be cooled with dilute nitric acid. The cooled off-gases are discharged into a jet eductor where they are scrubbed. Condensed vapor, recovered process liquid and solids are retained in the scrubbing liquid and returned, by gravity, to the digester tanks. The scrubber off-gas is piped to the nitric acid absorber in the nitric acid recovery plant.

Recovered nitric acid is charged to the selected digester tank. Acid is pumped from a nitric acid storage tank located in the tank farm using a transfer pump. The acid quantity required is pre-set and metered by a flow meter located in the control room. The nitric acid inlet valve to each digester is actuated from the control room.

After acid flow is established to the digester tank, the tank agitator is started and the desired digestion temperature is set on a panel mounted indicating temperature controller. The controller operates two split range control valves, one in the steam line and the other in the cooling water line to the digester tank coils. The water and steam control valves are interlocked so that the steam valve is closed when the water valve is open and vice versa. The normal digestion temperature is within the range of 125° - 220°F. During the acid charging period, the acid is heated to the required digestion temperature using approximately 100 psig steam.

Dry concentrate feed for the digester is stored in the digester bins which are located in the sampling area. Material is transferred by screw-type conveyors which run to the top of the digester tanks and deliver concentrate to the tanks. Load cells are furnished for each digester feed bin and indicators provide the weight of material in each feed bin. The digester tanks are sized to provide at least 15% free board in the expected range of operating conditions. Liquid concentrate feed for digestion is stored in the hold tanks in the slurry receiving building. The slurry hold tank is on load cells and digest feed is transferred on a weight basis.

The reaction of the concentrate with nitric acid is exothermic and the desired digestion temperature will be automatically

maintained by the water valve on the inlet to the digester coils. When digestion is complete, the digested slurry is transferred to one of the adjustment tanks. Pumps and piping are configured so that the digest slurry can be pumped to the adjustment tanks or from digester to digester. The adjustment tanks provide additional hold-up in the system allowing for adjusting the final composition of the product and cooling the digester product to a temperature suitable for feeding to Solvent Extraction. Aluminum nitrate solution, phosphoric acid and other chemicals may be required to either improve uranium recovery in the Solvent Extraction process or to prevent the loss of uranium as precipitated insoluble uranium compounds. The digestion product will normally contain 400-500 g. U/l in 1M-1.6M HNO_3. Slurry from the miscellaneous batch digester will be blended with primary digestion product. The adjustment tank vent lines are connected to the vapor inlet line to the digester fumes jet scrubber for venting and scrubbing any off-gas evolved in the adjustment tanks, the same as the digesters.

Slurry is transferred to Solvent Extraction at approximately 50 gpm. The Solvent Extraction requirement varies from 5-25 gpm and the balance is recirculated to the adjustment tank which is providing feed for Solvent Extraction. The purpose of recirculating the slurry is to maintain line velocities high enough to prevent settling out of solids in the pipelines. Feed piping between Digestion and Solvent Extraction is designed for self-draining of the slurry to the slurry feed break tank.

16.1.3 Miscellaneous Digestion (Dwg. No. 230-M-101)

The Miscellaneous Batch Digester is used to recover uranium from materials that cannot be processed through normal handling routes. This includes ash from the exit filters of the fluorination reactors.

The dissolution of uranium materials in the Miscellaneous Digester with nitric acid is accompanied by evolution of nitrogen oxides. The composition of the evolved gas is dependent on the composition of the material being processed. The digester off-gases are cooled and scrubbed with dilute nitric acid, then scrubbed with dilute caustic soda solution to remove any HF before the gas is combined with the off-gas from the primary digesters and is piped to the nitric acid recovery plant. Condensed vapor, recovered process liquid and solids are retained in the scrubbing liquid and are returned to the digester tank.

If ash or fluoride-bearing material is to be processed, an aluminum nitrate solution is prepared using aluminum hydroxide and nitric acid. The tank agitator is started and the desired digestion temperature is set on a panel mounted indicating temperature controller. The Miscellaneous Digestion temperature control system is the same as on the primary digesters. The aluminum nitrate solution is heated to the required digestion temperature. The gas

evolved during the reaction is drawn to the digester fumes jet scrubber and is cooled and scrubbed with a recirculating stream of dilute nitric acid. When the digestion period is complete, the product will be batch blended with slurry from the primary digestion system. Leakage in the Miscellaneous Digester area is contained within a curbed area draining to a small sump. The contents of the sump can be transferred back to the Miscellaneous Digester.

16.1.4 Solvent Extraction (Dwg. No. 240-M-101)

Tributylphosphate (TBP), diluted with n-hexane, is used to extract uranium from the digester slurry. The system is designed for normal operation with high-uranium, low acid feed (digester slurry containing 280-600 g. U/l, in 1.0 - 1.6M HNO_3). The normal concentration of TBP in n-hexane is 30 vol. %. Pumper decanters are used for extraction of the feed slurry. Pumper decanters are a type of mixer-settler in which the two phases are mixed externally in a centrifugal pump and allowed to separate in a decanter.

The TBP-hexane extractant is normally fed to pumper-decanter No. 1, where aqueous raffinate is withdrawn. Slurry feed normally enters at pumper-decanter No. 6, where the organic extract is withdrawn. Provisions are available for introduction of feed slurry to a number of pumper-decanters. Recycled solvent from the top of each decanter is mixed in a pump with the aqueous phase from the bottom of the previous unit (or with the aqueous feed slurry) and the extract from the next unit. The pump discharge enters the decanters tangentially via an internal pipe and the mixed phases separate in the decanter.

The critical control feature in Solvent Extraction is the ratio of TBP flow to the total input U mass flow (including recycled U). Two conditions must be met by the control system:

a) Maintenance of solvent flow at an instantaneous level sufficient to minimize U loss to the raffinate treatment.

b) Maintenance of solvent uranium saturation at a level adequate to assure satisfactory separation of U from impurities.

Solvent flow is maintained at an adequate level to maintain uranium losses in the raffinate at an acceptable level by adjustment of the slurry feed rate with constant solvent flow. The U content of this stream is monitored by specific gravity and the aqueous feed rate is adjusted to maintain the desired U loading in the solvent flow. The separation of uranium from soluble impurities is improved by maintaining a high level of uranium saturation in the product end of the system. At the product end of the system a slight change in U concentration in the organic requires a substantial change in the U concentration of the aqueous phase in equilibrium with this organic stream. The organic phase is washed with approximately

0.01 M HNO_3 in a two-stage mixer-settler scrub system for removal of any dissolved and entrained impurities.

The washed organic (extract) is contacted with approximately 0.01 M HNO_3 in the re-extraction pulse column where the uranium is stripped from the organic phase and is transferred back to an aqueous solution. The column is operated with continuous aqueous phase and an organic/aqueous flow ratio of approximately 1.2/1, controlled by measurement of the density of the aqueous product. Stripped solvent from the column is processed in the solvent rework system, where it is purified and its composition can be adjusted to replace any hexane and TBP losses before it is fed back to the pumper decanters.

Aqueous product from the pulse column is washed with hexane in a two-stage decanter system to prevent any TBP from entering the subsequent evaporation stage. This is done to prevent explosions which can occur when degradation products of TBP are heated in contact with high concentrations of nitric acid or nitrates. The washed aqueous product from Solvent Extraction will normally contain 70-80 g. U/l. Raffinate from the pumper decanter section is washed with hexane for TBP removal and the organic phase is removed by decantation. The washed raffinate is routed to one of the settling basins of Clarifier A prior to treatment and disposal.

16.1.5 Solvent Rework (Dwg. No. 240-M-105)

The purpose of this system is to purify and make any necessary composition adjustments to stripped solvent from the re-extraction pulse column before it is recycled to the pumper-decanters. TBP hydrolysis products are considerably more soluble than TBP in aqueous solutions, and accumulation of these products in the solvent can prevent complete stripping of uranium from the solvent resulting in unacceptable uranium losses in the raffinate.

Residual uranium will be recovered by treatment with a sulfate solution. The hydrolysis products (DBP and MBP) are then removed as soluble sodium salts by scrubbing with a sodium hydroxide solution. Any uranium not removed in the sulfate scrub stage will be precipitated as sodium diuranate in the caustic treatment stage. After scrubbing with caustic solution, the purified solvent is separated from the scrub solution in a continuous centrifuge. The solvent is then adjusted as necessary by addition of hexane and/or TBP.

16.1.6 Evaporation (Dwg. No. 240-M-109)

The aqueous product from Solvent Extraction contains approximately 80 g. U/l and is concentrated to about 450 g. U/l in Evaporation. The incoming aqueous uranyl nitrate solution enters a feed tank which provides surge capacity for the evaporator system.

From the feed tank, the solution flows to a feed condensate heat exchanger where the evaporator feed is preheated and the recovered acidic condensate leaving the system is cooled.

Hot feed solution, about 200°F, from the feed/condensate heat exchanger flows into the evaporator sump where it mixes with concentrated uranyl nitrate. Concentrate is recirculated to a flood box located at the top of the evaporator/condenser assembly and down through distributors which generate a thin film on the inner surfaces of the condenser tubes. As the solution flows down the tubes, a small percent is evaporated as steam. This steam flows through a mist eliminator and then to a centrifugal compressor where it is compressed to approximately 7 psig to raise its temperature of condensation somewhat above the boiling point of the concentrated uranyl nitrate solution. The compressed steam then enters the shell side of the evaporator/condenser assembly, where it condenses on the outside of the tubes, causing more liquor to be evaporated on the inside. The condensate collects in the recovered acidic condensate tank and is then pumped back through the feed/condensate heat exchanger where it discharges at about 155°F.

Concentrated uranyl nitrate is discharged continuously from the recirculation system at its atmospheric boiling point, approximately 225°F, and flows through a steam traced line to the UNH surge tank. The evaporator operates at approximately atmospheric pressure, except for the shell side of the condenser, which operates at approximately 5-7 psig. A small vent from the recovered acidic condensate tank is provided to purge gases such as saturated steam and trace amounts of hexane from the system.

The evaporator UNH product has a freezing point of approximately -4°C and all outdoor product lines and vessels are steam traced and insulated. UNH is transferred to the boildown tanks by the UNH surge tank discharge pump. Level in the UNH surge tank is maintained by adjustment of the flow to the boildown tanks. A sulfate solution is fed to the UNH surge tank contents. The sulfate ions improve the reactivity of the uranium oxides in the downstream processes.

16.1.7 UNH Boildown (Dwg. No. 250-M-101)

The evaporator product (approximately 4 lb. U/gal.) is concentrated to a solution containing approximately 10 lb. U/gal. in three boildown tanks having a total capacity of about 225,000 lbs. of uranium. The evaporator UNH product contains free water that is removed in the boildown stage, which is operated at approximately atmospheric pressure. The steam heating coils in the boildown tanks are sized so that the contents can be brought to and maintained at a controlled concentration while evaporator product is fed to the tank. Overhead vapor is condensed in the water cooled UNH boildown condenser yielding a solution of approximately 0.01 M nitric acid, which is routed to the recovered acidic condensate tank in the

solvent extraction system and to the nitric acid recovery plant.

Vertical UNH pumps circulate boildown product through a recycle loop from which product is fed to the denitrators. Recirculation through the recycle loop provides mixing of the contents of the tanks. A pressure of up to 80 psig can be maintained in the recycle loop. The 10 lb. U/gal. material has a freezing point of about 140°F and lines handling this material are steam traced and insulated.

16.1.8 Denitration (Dwg. No. 260-M-101)

The molten UNH product from the boildown tanks is introduced into the denitrators via separate feed lines from the boildown system recycle loop. Each denitrator is fed via several feed points. Flow to each feed point is controlled by a valve actuated by the bed temperature at that feed point. When a feed point temperature drops below its set point, the feed control valve is actuated to decrease the quantity of UNH being fed at that point (and vice versa). The denitrators are operated with a bed temperature of approximately 525°F under a negative pressure.

The Denitration off-gases are scrubbed with nitric acid for removal of particulates. Approximately one-third of the nitrogen oxides and some water vapor, are also removed in the scrubbing operation, which cools the off-gases. The scrubbed off-gases are piped to the nitric acid recovery plant. The scrub fluid is recirculated to the scrubbers after being cooled in the water-cooled recycle cooler. Accumulation of recovered nitric acid in the scrub liquid system is routed to the nitric acid storage tank.

Uranium trioxide (UO_3) produced in the denitrators is a free-flowing material. The product is discharged from the denitrators by controlling powder flow through the seal leg. The product flows via the seal legs to the UO_3 conveyor and then into the UO_3 elevator, which discharges the product into the UO_3 surge bin or the storage bin. The surge bin provides a surge capacity and a steady feed to the UO_3 pulverizer. The UO_3 is transferred from the surge bin to the UO_3 pulverizer where it is ground to powder. The pulverizer discharges into the UO_3 storage bin.

The UO_3 surge and storage bins and the pulverizer are vented through the bin vent baghouse. UO_3 fines removed from the vented gases are blown back periodically into the storage bin. UO_3 product is withdrawn from the storage bin and transferred to the UO_3 feed bins in the Reduction system by the UO_3 feed bin conveyors.

16.1.9 Reduction (Dwg. No. 260-M-104)

There are two reduction reactor lines, each having two fluid-bed reactors. Pulverized UO_3 is reduced to uranium dioxide (UO_2) by

contacting the solids with cracked ammonia in fluid-bed reactors; cracked ammonia flow is in parallel with powder flow in series through the reactors. UO_3 powder from the denitration system is delivered to the UO_3 feed bin which is buffered with nitrogen to maintain a pressure in the bin above atmospheric pressure to prevent air infiltration. The UO_3 is withdrawn from the bin by the reduction reactor feed conveyor and is charged to the fluidized-bed 1st stage reduction reactor. Cracked ammonia (hydrogen and nitrogen) from the ammonia dissociators is introduced to the bottom of the 1st and 2nd stage reduction reactors. The reducing gas flow (divided between both stages) is greater than the stochiometric requirement for complete reduction.

The reaction is exothermic and the reaction temperature is maintained near 1100°F. Reactor cooling is accomplished by external air cooling coils around each reduction reactor. Reactor heating is accomplished with separate 50 KW, nitrogen purged, electrical furnaces for each reactor.

The reducing gas enters each reactor through an inlet at the bottom of the conical section of the reactors. The partially reacted powder from the first stage overflows into the second stage reactor where the reduction is completed. The use of two stages minimizes the possibility of incomplete reduction. The overflow in the 2nd stage reactor is positioned to maintain a powder bed at a pre-established level.

The gas and solids discharged from the 2nd stage reactor (at a temperature of approximately 1000°F) flow to the UO_2 filter bin where the solid product is filtered from the off-gas by porous stainless steel filter elements. The filters serve to remove UO_2 particles from the gas stream. The filters are periodically cleaned by being blown-back with nitrogen. Back flushing of the filter elements is regulated by a timer. Solids collected in the filter bin are discharged to the UO_2 elevator by the UO_2 filter bin discharge screw. The UO_2 elevator transfers the product to the HF recovery reactor system. The exit gas from the UO_2 filter bin is piped to the reduction reactor off-gas back-up filter. Final traces of product are recovered from the off-gas by filter elements identical to those in the UO_2 filter bin. The filtered off-gases (nitrogen, water vapor, hydrogen, and hydrogen sulfide) are piped to the reduction hydrogen burner for disposal.

Flow of cracked ammonia to each reactor is controlled from the control room. Fluidization is monitored by measurement of bed pressure drops. Total pressure measurement at the bottom of the reactor beds is provided. High pressure is normally indicative of a blockage in the off-gas and filter system. There are rapid but low amplitude fluctuations of the inlet pressure with normal fluidization. The powder bed temperatures are monitored by measuring internal temperature at several points. Reactor shell temperatures are also measured at several points. Both heating and cooling is controlled automatically using internal powder

temperature measurement.

Solids flow from the UO_3 storage bin to the UO_3 feed hopper is controlled between a high and low level in the UO_3 feed hopper. Flame failure in the reduction hydrogen burner results in shutting off dissociated ammonia flow from the dissociators. To maintain a positive seal in the UO_3 feed bin, low UO_3 level automatically stops the feed screw leading to the first stage reduction reactor. The rate of flow of solids to the first fluid bed is controlled from the control room. This rate of flow also determines the rate of flow through the subsequent Hydrofluorination stage since there is no large intermediate surge capacity. When cracked ammonia flow is stopped, the reactors are then purged with nitrogen to remove or dilute residual hydrogen.

16.1.10 Hydrofluorination (Dwg. No. 260-M-106)

There are two hydrofluorination reactor lines, each having two stirred bed uranium tetrafluoride (UF_4) conversion reactors and a horizontal-screw HF recovery reactor. UO_2 is converted to UF_4 by contacting the solids with anhydrous HF gas in the stirred fluid-bed reactors. The anhydrous HF gas enters the second stage reactor and flows counter-current to the solids.

UO_2 powder is withdrawn from the UO_2 seal bin in the reduction system and conveyed through the HF Recovery system to the first stage stirred fluid bed hydrofluorination reactor. The solids enter the first stage reactor at a point below the top of the fluid bed. The reactor is heated by an electric furnace and the desired reactor cooling is provided by the means of the HF reactor cooling air blower. The partially converted solids and outlet gases discharged from the 1st stage reactor at a temperature approaching 800°F flow to the intermediate seal bin where the solids are separated from the gases. The gases discharged from the intermediate seal bin are routed through the HF Recovery System, or back-up filter to the HF condenser subcooler.

The gases flow counter current to powder through the HF recovery system. Unreacted gases exit through the recovery reactor filter, the HF back-up filter, and the HF condenser subcoolers. The condensate from the coolers is piped to the fluoride/lime neutralization system. The non-condensible off-gases are piped to the HF scrubber for subsequent fluoride waste disposal. The solids from the recovery reactor are discharged into the UO_2 seal bin for feed to the 1st stage hydrofluorination reactor. The partially converted solids collected in the intermediate seal bin are conveyed to the 2nd stage hydrofluorination reactor.

Anhydrous HF gas, heated to approximately 1000°F in the AHF heater, is fed to the 2nd stage stirred fluid bed reactor at a pressure of approximately 25 psig. The gas enters each reactor through an inlet at the bottom of the conical section of the

reactors. The 2nd stage reactor is operated at temperature of about 900°F, maintained by an electric furnace and the HF reactor cooling air blower. The outlet gases from the 2nd stage reactor (at approximately 900°F and 10 psig pressure) carry the solids to the UF_4 seal bin where most of the solids separate from the gases. The gases and some entrained solids then flow directly to the bottom of the 1st stage reactor.

UF_4 collected in the seal bin is transferred to the UF_4 nitrogen lift by the UF_4 seal bin discharge conveyor. The nitrogen lift provides a purge stream to sweep out any HF vapor entrained with the solids to permit the use of carbon steel for the conveyor downstream of the purge conveyor. The N_2 purge stream is exhausted through a primary and backup filter. The filtered purge N_2 exhaust is piped, with non-condensables from the HF condenser subcooler, to the HF scrubber in the waste gas disposal system. The UF_4 product discharges from the nitrogen lift to the UF_4 feed bin conveyor which transfers it to the UF_4 storage bin in Primary Fluorination. On stoppage of HF flow, nitrogen can be manually purged through the reactors for the removal and/or dilution of residual HF vapor in the reactors.

16.1.11 Primary Fluorination (Dwg. No. 270-M-101)

Uranium tetrafluoride (UF_4) is converted to uranium hexafluoride (UF_6) by reaction with elemental fluorine in vertical tower reactors at a wall temperature of about 850°F. The gas and solids are introduced at the top of the reactors and conversion of UF_4 to UF_6 is essentially complete if an excess of fluorine is maintained and the UF_4 powder is well dispersed in the gas stream. The outlet gas stream from the reactors (containing UF_6, F_2, HF, O_2, N_2) is cooled and passed through porous monel filters for removal of entrained solids. The gases are passed to a primary cold trap where most of the UF_6 is removed by condensation as a solid. When the cold trap is loaded, it is taken off-stream and the UF_6 is melted, filtered and drained into shipping cylinders. The non-condensed gas from the cold trap is fed to the clean-up reactor in Secondary Fluorination where the excess fluorine is consumed by reaction with an excess of UF_4.

UF_4 powder is transferred by conveyor and bucket elevator from Hydrofluorination to the UF_4 storage bins. The UF_4 storage bin discharge conveyor transfers UF_4 from the bins to the UF_4 conveyor which elevates the powder to the storage bins or the UF_4 distribution conveyor. The distribution conveyor provides feed to the fluorination reactors and the clean-up reactor in Secondary Fluorination. UF_4 is delivered by gravity to small bins mounted over the F_2 reactor feed conveyors. UF_4 powder is charged to the reactors at the rate of about 650 lb./hour per reactor at a temperature of about 100°F. The solids enter the top of the reactors via powder dispersers. The gas stream is fed to the lower portion of the disperser.

The fluorination reactors are fitted with external cooling coils through which steam is passed to remove the heat evolved from the exothermic reaction and to maintain the reactor wall temperature at about 700°F. Some of the solids feed is collected as unreacted UF_4 and intermediate fluorides in the bottom of the reactors. This unreacted material is recycled to the UF_4 feed system.

The outlet gas stream from the reactors is cooled to about 300°F in the reactor transfer section. Any entrained solids are removed from the gases by cyclone separation followed by passage through porous monel filter elements in the F_2 reactor filters. The filters remove very fine particles from the gas stream and are periodically cleaned by being blown-back with nitrogen. The filter bodies used for storage of the retained solids are steam traced. Filter ash is returned to the miscellaneous digester for re-processing after approximately 6 months aging. The outlet gas streams from the individual reactor filters are combined and passed through the F_2 reactor back-up filters for removal of final traces of solids. These filter elements are identical to the reactor filters and are also steam traced. The filtered gas is passed through a refrigerated cold trap maintained at approximately 30°F where about 90% of the UF_6 in the gas is condensed as a solid. The non-condensed gas leaving the cold trap is vented through Secondary Fluorination.

Production of fluorine is regulated manually by the number of cells on-stream in the fluorine production area and by adjustment of the operating amperage. The total fluorine flow is distributed between the reactors on-stream. The UF_4 feed rate is adjusted manually.

16.1.12 Secondary Fluorination (Dwg. No. 270-M-105)

The gas stream exiting the primary cold traps (containing substantial quantities of fluorine and other non-condensable gases) is then contacted with an excess of UF_4 in the clean-up reactor. This clean-up reactor is a vertical tower (with powder dispenser) having a porous monel outlet gas filter. The solids removed by the filter are collected in a hopper and are recycled to the UF_4 storage bin in Primary Fluorination. The walls of the clean-up reactor are maintained at a temperature of about 700°F. The temperature is lowered to about 400°F in the cooling section. The outlet gases from the clean-up reactor filter (containing UF_6, F_2, HF, O_2, N_2) are passed through a porous monel back-up filter, a clean-up reactor cold trap, maintained near 30°F, and then through a low temperature secondary cold trap, maintained at a temperature near minus 65°F, where essentially all of the UF_6 is condensed as a solid. The gases discharged from the cold trap are transferred to the H_2-F_2 burner and HF scrubber in the waste gas disposal system through the off-gas blower.

UF_4 powder is transferred by the UF_4 distribution conveyor to the bin mounted over the clean-up reactor feed conveyor. UF_4 powder is fed to the clean-up reactor at near ambient temperature. The solids enter the top of the reactor through a powder disperser. The exit gas stream from the primary fluorination system, containing approximately 40 mol% of fluorine, is heated to about 700°F before it enters the lower portion of the powder disperser. The reactor is operated with an excess of UF_4 and the fluorine is consumed in converting the UF_4 to UF_6.

The clean-up reactor wall temperature is maintained by means of an electric furnace; the exothermic heat of reaction is absorbed by air or steam fed to external cooling units on the walls of the reactor. The solids and gases discharged from the reactor are cooled to about 400°F in the clean-up reactor cooling section. The unconverted solids and filter ash collected in the clean-up reactor discharge bin are transferred back to the UF_4 storage bin. The reactor outlet gases and entrained solids enter the steam-traced clean-up reactor filter. The porous monel filter elements are of the same type used in the Primary Fluorination filters, and are periodically cleaned by being blown back with nitrogen. Solids removed by the filter are also collected in the clean-up reactor discharge bin.

Controls for the clean-up reactor, filters and traps are similar to those used in Primary Fluorination. Fluorine concentration in the outlet gas stream from the cold traps is continuously monitored in the control room to maximize conversion efficiency. The UF_4 feed rate to the clean-up reactor is adjusted to minimize the fluorine content in the outlet gas stream. The pressure at the top of the reactor is maintained above atmospheric to reduce air inleakage by automatic regulation of the quantity of gas recycled around the off-gas blower.

16.1.13 Product Shipping (Dwg. No. 280-M-101)

UF_6 is collected as a solid in the cold traps. When a cold trap is loaded, the UF_6 is melted and drained by gravity through porous monel filters into evacuated 2-1/2-ton, 10-ton or 14-ton capacity shipping cylinders, where it slowly solidifies and cools to ambient temperature. The piping from the cold traps to the cylinders consists of a sloped, steam-traced transfer header. The transfer header and filter is connected to the cylinder valve through a copper tubing pigtail.

Two transfer headers and filling stations are in use. The headers are manifolded so that each filling station can handle UF_6 from either the primary or secondary cold traps. After filling, the cylinders are weighed and transferred to the cylinder storage area in the yard. The cylinders are cooled for a minimum of 5 days before shipment.

16.1.14 Fluorine Production (Dwgs. 400-M-101, 400-M-1301)

The purpose of this system is to generate the fluorine gas required for the conversion of UF_4 to UF_6. Fluorine is produced by electrolysis of anhydrous HF in a molten electrolyte. The electrolyte contains a mixture of potassium fluoride, lithium fluoride, and hydrofluoric acid. When a direct current is passed through the electrolyte, the HF is electrolytically reduced to hydrogen and fluorine. The by-product hydrogen gas also produced is not used in the process and is piped to the waste gas disposal system. To maintain the correct liquid level in the cell, HF is added to the cells to replace the HF decomposed and that lost by evaporation. Adjustment of HF concentration by addition or removal of electrolyte is sometimes required.

Direct current up to about 8000 amps can be supplied to the cells by rectifiers. The cells have an operating range with production rates up to a maximum of about 8000 amps and an average voltage drop of approximately 11 volts per cell. There are two cell rooms, each containing 30 cell production stations. Along with the 60 production stations, two depolarizing stations and four cell rework, testing and conditioning stations are provided. The cell bodies have cooling jackets and cooling tubes provided for temperature control. The anodes are made of carbon and the cathodes are made of steel. Hydrogen is produced at the cathode and fluorine is produced at the anode. The two gases are collected in separate compartments above the electrolyte surface. The gases are then removed through separate piping systems to surge tanks which dampen pressure fluctuations resulting from operation of the downstream equipment. The hydrogen from the hydrogen surge tank is piped directly to the hydrogen burner, where it is disposed of by oxidation. The fluorine gas is filtered and compressed to approximately 4 psig. At this point the fluorine gas contains some HF. The fluorine gas is then piped to the fluorination reactors.

A temperature control system is furnished to maintain the electrolyte temperature. Tempered water is supplied to the cells by tempered water pumps. The heat picked up by the tempered water is removed in the F_2 cell heat exchangers. A steam heater has been furnished to heat the water for start-up. Electrolyte level in the cells is maintained within about one-half inch of the desired level by manual adjustment of the HF feed flow. The electrolyte also provides a seal between the H_2 and F_2 compartments of the cell, making it essential to maintain the proper level in the cell.

As a certain amount of electrolyte mist is carried from the solution, the HF concentration will tend to vary for a given electrolyte level. For this reason, chemical analysis of electrolyte samples is used in conjunction with level control and electrolyte addition and removal to maintain the desired HF concentration in the electrolyte.

16.1.15 Nitric Acid Recovery and Off-Gas Treatment (Dwg. 600-M-101)

There are four (4) process systems which evolve HNO_3 vapor, and nitrogen-oxides (NO_x): Primary Digestion, Miscellaneous Digestion, Slurry Processing, and Denitration. To prevent these gases from being discharged as air pollutants, NO_x emission control systems are used to remove these gases from the exhaust stream. Where possible, the equipment is designed to recover the nitrates as a reusable dilute nitric acid. The evolved gases from some process systems are initially discharged into a jet eductor where they are scrubbed. The scrubber off-gas is piped to the nitric acid absorber where dilute nitric acid is recovered. The absorber off-gases are scrubbed again and the stream is passed through a 3 stage chemical scrub system. This system breaks down the remaining nitrogen-dioxide to nitrogen. The waste chemicals discharged from the chemical scrub system are sent to one of the raffinate clarifier basins.

The jet eductor scrubber on the digestion gas evolving system cools the gases so nitric acid condensation will occur and provides a wetted surface for condensation and absorption. The initial scrub system on the miscellaneous digest system also includes a caustic solution recirculation loop with direct gas contact to remove any carry over HF vapor-mist from the evolved gases. There is a varying amount of air inleakage from each of the process systems, which with time will oxidize NO to NO_2 which can be absorbed into liquid solution. The length of piping from the initial scrub system provides some time for oxidation.

The nitric acid recovery system provides a multi-stage liquid-gas contact column where the available NO_2 is absorbed from the gas stream to form a dilute HNO_3. The 2nd stage scrubber systems are called nitric acid absorbers. The motive force for the process gases through the initial scrubbing and nitric acid absorbers is provided by two steam ejector systems. The ejector systems include a gas cooler to condense out the steam used and cool the gas back down to approximately 120°F for the final emission control system. An air bleed control valve at the inlet to each ejector controls the amount of vacuum that is provided on each of the process systems. This provides an O_2 source to allow oxidation of the remaining NO in the off-gas stream into NO_2 gas.

The final emission control system consists of a contact scrubber and a chemical scrubber. Additional air is mixed with the total remaining process off-gas to cool it and provide an excess of O_2 to convert all remaining NO to NO_2 gas. The contact scrubber column has a packed bed, which provides a large wetted surface area for gas contact, and maximizes the absorption of the NO_2 from the gas stream. The excess liquid which accumulates here is used as make-up liquid for the initial scrubbing of the denitration evolved gases. After the contact scrub, the off-gas stream is passed through a chemical scrub system. This system has 3 stages of packed bed columns in which a chemical solution is recirculated to contact the

gas stream and strip out the remaining NO_2 gas to below 100 ppm in the stack discharge. The used chemical solution is pumped to the raffinate clarifier basins. The motive force for the off-gas through the final emission control system is provided by an exhaust blower which moves the discharge gases out the stack.

16.2 Safety Analysis of Each Step

The Sequoyah Facility processes only source material therefore there is no need to provide nuclear safety analyses of each process step.

16.3 UF_6 Conversion Plant - Safety Features of Each Step

Each step is reviewed in the following sections from a health physics and industrial safety standpoint with emphasis on safety of the employees, the public and protection of the environment.

16.3.1 Receiving and Sampling

The yellowcake receiving and sampling area consists of drum handling and power conveying equipment. The equipment was manufactured to handle 1500-pound drums with the actual average drum weight being around 800 pounds. The system is semi-automatic with extensive use of micro-switches, photo electric switches, powered conveyors and mechanisms to accomplish the required functions of weighing, drum dumping, powder sampling, and either re-drumming or conveying to storage. Dust collection points are located throughout the area where potential for yellowcake leakage from the system exists. There are no liquid chemical hazards in this area and the only potential for fire hazards would be the electrical wiring which was installed according to existing National and State codes. As a result of the sound design, construction and operation of this system it is not considered to present a hazard to the public or to the environment.

The wet yellowcake slurry receiving operation is basically a chemical dissolution of yellowcake in nitric acid. All equipment in contact with acid is properly constructed of stainless steel. Operating procedures prescribe safety equipment to be used in the area for personnel protection. Ventilation is provided to prevent acid fumes from reaching the atmosphere. All tanks containing uranium solutions or acids are properly constructed with retention curbing to retain possible spillage. The tankage is equipped with level control instrumentation to prevent overfilling. Safety relief valves are installed on closed tanks. This system is not considered hazardous to the public or the environment.

16.3.2 Primary Digestion

Digestion is a simple batch process involving the dissolution of concentrate in heated nitric acid. The system was designed and built for operation from the control room with safety interlocks provided to prevent mis-operation. Materials of construction have been properly selected for the specific service atmosphere, i.e., carbon steel for powder storage bins and stainless steel for nitric acid service. Automatic temperature control is provided for the dissolving cycle and to minimize dissolution excursions. Several safety features minimize chemical hazards, i.e., agitator motors are interlocked so steam valves cannot open until the agitator is running, uranium solution handling pumps have dual mechanical seals, and air operated valves will fail closed on power failure. In the rare possibility of a tank or line rupture, curbing is provided that will contain the contents of one tank full of liquid. Ventilation is installed and operated at a slight negative pressure to transport the nitrate off-gases to the acid recovery system.

Although this operation involves hot acid and evolution of noxious fumes, adequate safety measures are incorporated to protect the public and the environment.

16.3.3 Miscellaneous Digestion

Miscellaneous Digestion is a batch operation similar to Primary Digestion and has been designed, constructed, and operated with the same safety consideration given to Primary Digestion. No additional hazards are expected to occur and it is reasonable to assume similar protection is provided for the public and the environment.

16.3.4 Solvent Extraction and 16.3.5 Solvent Rework

The major safety concern of these operations is the flammability of the hexane used in the process. The Solvent Extraction and Solvent Rework operations are housed in a building of non-combustible construction located over 100 feet west of the Main Process and Administration Building. Solvent Extraction is located in the south half of the building and Solvent Rework is located in the north half. The building is considered a hazardous area and all electrical equipment is explosion-proof to Class I, Group D, Division I.

A foam and water fire protection piping network is installed in this building. Heat sensing devices, rated at 325°F, are located throughout Solvent Extraction. When the foam system is actuated by these devices, foam discharge nozzles will provide foam water coverage of approximately 0.16 gpm per sq. ft. of floor area. Actuation of the system will be signalled by a major alarm in the control room and by emergency air horn signal devices located within the plant boundaries. The foam spraying system will be shut-down

manually at the discretion of the operating staff. The pulse column, located outdoors, is also protected by the foam and fire water system.

All pumps and agitators are started and stopped from the control room. The "Key" valves in the system are remote-operated from the control room thus allowing, under normal conditions, for operation of the process from the control room. The majority of the manual valves are furnished either for maintenance purposes or to provide flexibility in operating the system (e.g., by-passing of a pumper decanter, several slurry feed points to pumper decanters); these manually operated valves require very infrequent operation after the system has been started-up.

All vessels containing solvent are fitted with rupture discs; pumps have been selected which cannot over pressure the tanks. Discharge piping from the rupture discs is connected to an emergency vent header which is fitted with a relief stack to atmosphere above the roof of the building, and a drain to the floor sump. The pulse column is fitted with a separate emergency relief stack. The pulse column outside of the building is located inside a curbed area that is large enough to hold the entire contents of the column.

Operating procedures require that the building be kept well ventilated. No open flames, welding, smoking or vehicles are allowed within 100 ft. of the building. Protective clothing is required when handling solvent. A protective nitrogen blanket is maintained in the underground hexane tank, the normal vent header and the centrifuge gear box. Although the area is considered hazardous, it is designed, constructed and operated in such a manner that the public and the environment are protected from any hazards.

16.3.6 Evaporation and 16.3.7 UNH Boildown

The evaporation and boildown operations concentrate the pure uranyl nitrate for feed to the denitrators. All components in contact with nitrates are stainless steel. Normal operating procedures list the safety precautions necessary for proper operation to prevent injury from hot nitrates. Temperatures, pressure, and tank levels are monitored and indicated in the control room with alarms for abnormal conditions. The areas where spillage could occur are curbed to hold contents of the tankage in case of tank failure. All electrical equipment in the evaporator curbed area is explosion proof to Class I, Group D, Division I.

The major hazards of this operation are based on the possibility of inadvertent introduction of organics into the nitrate. The evaporator is located outside the building due to this potential hazard. Thermal conditions are limited to those indicated to be safe in AEC document DP-25. Operating procedures require routine visual checks for the presence of organic and temperatures are controlled well below the potential problem temperature of 260°F and

above. All tankage is equipped with rupture discs to prevent excessive pressure build up. Excessive pressures in the evaporator will automatically vent, and feed to the evaporator will be stopped until the cause of overpressure is corrected. Evaporation and Boildown have a potential for explosion if organics reach the systems, but they are instrumented and controlled sufficiently to minimize the hazard.

There are no undue risks involved in this system that could pose a hazard to the public or the environment.

16.3.8 Denitration

Denitration consists of high temperature decomposition of uranyl nitrate to UO_3 with evolution of nitrogen oxides and water vapor. Powder conveying and storage is also included. This system is normally operated from the control room. Safety precautions necessary for operating personnel in the area are described in operating procedures.

The denitrators and associated piping are constructed of stainless steel for protection from nitrate corrosion. Process equipment is instrumented as necessary for automatic control or alarm indication where critical. The denitrators are operated under a slight negative pressure to prevent nitrogen oxides from entering the work environment. The nitric acid recovery system, which provides a negative pressure, is connected to the denitrators with minimum valving to prevent accidental shut off of motive force for the off-gases. Loss of vacuum to Denitration requires immediate stoppage of UNH feed. Spot ventilation is provided for areas of high potential fuming.

This system is designed, constructed, and operated in such a manner that protection is provided for the public and the environment.

16.3.9 Reduction

The reduction of UO_3 to UO_2 is accomplished in electric heated, forced air cooled, fluid bed type reactors using cracked ammonia as the reducing gas. The equipment is constructed of stainless steel, the type being dependent on temperature service. Appropriate controls are provided for operation of the system from the control room. Nitrogen purging is provided to prevent accumulation of H_2-air mixtures approaching an explosive level. Positive seals are provided for the powder feed and product removal conveyors. The system off-gases are filtered and then burned in the reduction hydrogen burner prior to release to the atmosphere. Failure of the hydrogen burner will automatically shut down flow of cracked ammonia. Purging of the system is accomplished by manual valving of nitrogen into the system. The precautions necessary for safety of

operators in the area are described in the operating procedures for the system.

This system is considered safe for operation and does not provide undue risk or hazard to the public or the environment.

16.3.10 Hydrofluorination

Hydrofluorination involves contacting UO_2 powder with hot anhydrous HF vapor in stirred fluid-bed reactors to produce UF_4. Materials of construction have been properly selected to minimize corrosion (i.e., reactors and agitators are inconel and monel, filters are carbon). Instrumentation is provided to permit operation of equipment from the control room. Interlocks and N_2 gas purges are provided to prevent HF contact with the atmosphere and unprotected equipment. The flow of AHF is remotely controlled from the control room and is designed to fail safe on power failure; AHF flow is replaced by nitrogen flow. The solids feed and take off points are provided with powder seals.

The reaction of AHF with UO_2 is strongly exothermic and temperatures are closely controlled by use of an electric furnace in conjunction with forced cooling air on fins welded to the reactor shell. Thermocouples are strategically located for full bed temperature control. Off-gases are filtered, condensed, and scrubbed prior to release to the main plant stack. The lines are kept heated to prevent undue corrosion from HF condensation.

Operating procedures are used that include requirements for eye protection, gloves, and respirator use at proper times. Procedures require leak checks after maintenance and routine shift surveillance of equipment operation and condition. The procedure also calls for special precautions to avoid skin contact with HF.

This process step is designed and operated in a manner which precludes exposure of the public and the environment to undue risks.

16.3.11 Primary Fluorination and 16.3.12 Secondary Fluorination

The Fluorination processes involve the exothermic reaction of fluorine gas with UF_4 solids to produce a gaseous UF_6 product. All equipment in contact with fluorine or HF is constructed of materials compatible with fluorine and HF. Powder seals are provided to prevent F2 loss through the feed system. Other than off-gas piping to the scrubbers, the entire system is totally contained. All UF_6 transport lines are kept heated. The system is fully instrumented for operation from the control room.

The reactors are maintained near atmospheric pressure by the clean-up reactor and off-gas blowers. An in-line analyzer is used to monitor fluorine concentration out of the system, thus providing

a monitor to maximize productivity and minimize losses.

The major chemical hazard in the system, fluorine, is controlled by a safety shut-down (Q) circuit that will stop the generation of fluorine and thus the generation of UF_6 when abnormal conditions are present. The safety precautions to be observed by operating personnel are included in the operating procedures.

This system operates with reactive chemicals and is sufficiently designed, constructed and operated to mitigate any possible risks to the operators, the public, or the environment.

16.3.13 Product Shipping

This system consists of the transfer of UF_6 from the primary and secondary cold traps to 2-1/2-ton, 10-ton and 14-ton capacity shipping cylinders, weighing the cylinders and movement to storage. The 10-ton and 14-ton capacity shipping cylinders are fabricated from 5/8" thick Type A-515 carbon steel and fitted with carbon steel support skirts. Product temperatures in the transfer header are monitored by a temperature scan system. All other instrumentation is located locally.

The major hazard in the operation is the possibility of UF_6 leakage. Operating procedures requiring line purging and cylinder evacuation are strictly observed to mitigate this possibility. An emergency procedure describes the precautions necessary to respond to UF_6 leaks.

16.3.14 Fluorine Production

Fluorine Production involves a variety of potential problem areas, each presenting its own safety considerations. Each potential problem area and measures taken for safety assurance are summarized below:

1. Hydrofluoric Acid (HF) - HF is the basic feed component for the electrolytic production of fluorine. As the HF is electrically decomposed and the hydrogen and fluorine is produced, the HF must be replenished. For optimum production, the electrolyte mixture is operated with an HF concentration near 40% by weight. The HF is replenished by bubbling vaporized HF into the electrolyte where it is absorbed. Because the HF is so corrosive, the cells are made from monel. To assure continued safe operation, as the cell internals are being rebuilt, the cell body and tempered water tubes, wall thicknesses are checked to determine if excessive corrosion has taken place. If any areas show excessive corrosion or other unacceptable damage, they are repaired or replaced.

2. Hydrogen - Hydrogen is produced at the cell cathode by the electrolytic reduction of the HF in the electrolyte. The hydrogen is collected above the electrolyte in a separate compartment from the fluorine and removed through a separate piping system. The two gas compartments are kept separate by a liquid seal of electrolyte. Because of the chemical properties of the two gases, they cannot be allowed to mix. To achieve this, the level of electrolyte in the cells is checked twice a shift. To assure safe operation an electrical interlock system is provided and is discussed in the "Q" circuit section below.

3. Fluorine - Fluorine is produced at the cell anode. General hazards and control are the same as mentioned in the hydrogen section.

   The extremely reactive nature of elemental fluorine requires additional safeguards against contact with organic carbon materials. To prevent such contact, maintenance and operator training is provided to assure cleanliness of equipment and a degreasing procedure is enforced for all equipment prior to use in the Fluorine Production area.

4. Electrical Hazards - High amperage direct current is required to provide the "motive force" for the electrolytic decomposition of HF to hydrogen and fluorine. A typical cell operates at about 6,000 amperes and 10 volts. Overhead bus-work provides electricity to the cells. The high current involved produces a large amount of heat, which must be dissipated by the bus-work, therefore the bus-work is uninsulated. The bus-work from the rectifiers to the cell room is enclosed in such a manner to inhibit accidental contact and electrical shock. Each cell has its own cut-off switches to allow the electricity to be turned off for maintenance.

5. General Comments - Assigned operators are instructed on the safe operations of the Fluorine Production area. In the normal course of maintenance to the cells, small amounts of fluorine and hydrogen are released. These small releases are removed from the area via the building ventilation system.

   Nitrogen purges are provided to all cells and piping in Fluorine Production. Before any vessels or lines are opened for repair work, they are purged with nitrogen to remove fluorine and hydrogen. Also, before the cells are brought on line after the piping system has been opened to the atmosphere, the lines are once again purged. This is to remove oxygen which could react with the hydrogen.

The large current and voltage across the cells produce a large amount of heat. The heat is removed by pumping temperature controlled water through the jacket on the cell bodies and through internal water pipes. This system is a closed loop, with the cell tempered water being recycled through heat exchangers and the water being reused.

6. "Q" Circuit and Other Instrument Safety Devices - The greatest concern in Fluorine Production is the possible mixing of hydrogen, and/or fluorine, and/or air on a large scale. This could come about by the cells grossly pressuring up, forcing electrolyte into the piping systems, disrupting the liquid electrolyte seals in the cells, and allowing the gases to mix, producing a fire or an explosion. The purpose of the "Q" circuit is to assure that pressurization cannot occur.

   The "Q" Circuit measures:

   1. Pressure in the fluorine surge tank.
   2. Pressure in the hydrogen surge tank.
   3. Pressure differential between the two surge tanks.

   The "Q" Circuit checks and alarms for:

   1. High pressure in the fluorine surge tank. Major Alarm (control room)

   2. High pressure in the hydrogen surge tank. Major Alarm (control room)

   3. High pressure differential between the two surge tanks. Major Alarm (control room)

   4. Low pressure in the hydrogen surge tank. Major Alarm (control room)

   The rectifiers providing the current for fluorine production automatically shut down when the "Q" circuit alarms due to one or more of the above conditions. The fluorine flow to the fluorination section of the plant is automatically shut off and the emergency relief vent to the atmosphere is opened. The "Q" circuit can also be activated manually by the control room operator or by the operator in the Fluorine Production area.

   Each cell has a thermocouple and circuit to monitor the temperature of the electrolyte. The cell temperature video monitor is located in the control room. Each cell also has a pressure sensing circuit on the hydrogen side and the fluorine side. These circuits activate an alarm in the control room if any individual cell pressures up and is outside of the operating parameters. The operator is then

notified and the problem resolved. The operating voltage of each cell is also recorded and monitored both locally and in the control room. The normal operating voltage is in a range of 8 to 12 volts. If a cell is not operating in this range, it is normally removed from production and rebuilt.

Although there are several potential safety problem areas in the fluorine production system, the design, construction and operation of the system mitigates the possibility of danger to the operating personnel, the public, or the environment.

16.3.15 Nitric Acid Recovery And Off-Gas Treatment

This system is in itself a safety device. It prevents the evolution of noxious fumes into the atmosphere from Primary Digestion, Miscellaneous Digestion, and Denitration. This system is designed, constructed, and operated in such a manner that protection is provided for facility personnel, the public, and the environment.

The system provides a slight negative pressure at all points it services. It collects noxious fumes and scrubs them out before discharging the off-gas to the environment. The major portion of the system is located outside the Main Process Building and is controlled and monitored from the control room. The final HNO_3 recovery stage and the chemical scrub system both have the electrical controls and monitoring instrumentation located with the system, but are controlled from the control room.

The tankage is equipped with level control devices to prevent over filling. The chemical scrub system is equipped with pH control instrumentation to prevent the formation of any toxic gases. Automatic temperature controls are provided to maximize noxious fume removal and prevent freezing. In the event of a possible system leak, each major scrub unit is located inside a curbed area to contain any loss of recirculation liquid.

The systems are designed and built for operation with safety interlocks provided to prevent mis-operation. The materials of construction have been properly selected for the specific service atmosphere. This system is not considered hazardous to the public or the environment.

16.4 UF_6 Reduction Plant - Process Steps and Flowsheets

The process descriptions discussed in this section pertain to both natural and depleted uranium hexafluoride (UF_6) and natural and depleted uranium tetrafluoride (UF_4), therefore the words natural and depleted are not used throughout the various process steps.

The process chemically reacts UF_6 with disassociated ammonia (DA) and produces UF_4 and anhydrous hydrofluoric acid (AHF). The

UF_4 product is packaged in 55-gallon drums. The recovered AHF is condensed to a liquid and used in the UF_6 Conversion Plant. Drawing 800-M-1401 shows the stream compositions, temperatures, pressures, and flow rates.

The processing equipment is housed in a steel frame metal building with approximately 7,000 square feet of ground floor area. There are four upper level working platforms in a 1,600 square foot chemical reactor bay area which is approximately 60 feet high. Utility and reagent supplies for this plant are furnished from the UF_6 Conversion Plant and are described in Chapter 10.0 of this license.

16.4.1 Uranium Hexafluoride Supply

The UF_6 is supplied in 10-ton and 14-ton thin-walled and thick-walled steel cylinders from the Department of Energy (DOE). After emptying, the cylinders are returned to the DOE for refilling. (UF_6 vaporizing is described in 16.4.4.)

16.4.2 Dissociated Ammonia Supply

Ammonia is thermally dissociated in one of the existing ammonia dissociators located at the UF_6 Conversion Plant. The DA (a mixture of nitrogen and hydrogen gases) is piped to the UF_6 Reduction Plant. The ammonia is about 99.9 percent decomposed to nitrogen and hydrogen.

16.4.3 Molecular Sieve

The DA is passed through a molecular sieve to remove any residual ammonia. If allowed to remain with the dissociated ammonia, the residual ammonia would react with UF_6 and produce an ammonium fluoride-uranium fluoride complex -- an unwanted by-product. The molecular sieve consists of parallel vertical cylindrical tubes filled with a zeolite adsorbent having a strong affinity for ammonia. The DA flows through the adsorbent in one tube and exits that tube essentially free of ammonia. When the adsorbent in one tube is to be regenerated, the flow of DA is diverted through the alternate tube. The zeolite adsorbent is regenerated by heating with electric heaters and purging with nitrogen. This causes the adsorbed ammonia to be vaporized from the adsorbent and carried away by the nitrogen purge gas.

16.4.4 UF_6 Vaporizing

UF_6 is received as a solid in 10-ton or 14-ton UF_6 cylinders. Autoclaves are used to heat UF_6 cylinders and vaporize the UF_6 for introduction into the processing system. The autoclaves will

completely contain the contents of a cylinder when heated, so that any leakage of UF_6 from a cylinder, a cylinder valve, or the copper "pigtail" attached to the valve, will not escape to the room or to the environment. The autoclaves are horizontal steel cylindrical pressure vessels, 6 feet in diameter by 21 feet long, with design pressure of 200 psig and design temperature of 250°F. They are designed, constructed, tested, and code stamped according to requirements of Section VIII, ASME Code. The autoclaves are opened by retraction of the cylindrical portion with its attached head using a hydraulic system.

A pressure relief line is attached to the fixed head of the autoclave and vented out the roof via a rupture disc and a pressure relief valve with a pressure switch between the rupture disc and the relief valve. A separate pressure measuring device monitors autoclave pressure continually and if pressure exceeds a pre-set limit, initiates automatic shut down of the autoclave, initiates an alarm and causes the reason for the alarm to be displayed. If a pressure in excess of 200 psig occurs in the autoclave, a rupture disc and a pressure relief valve open to reduce autoclave pressure. When the pressure drops below 200 psig, the relief valve closes.

Using a 20-ton jib crane or fork truck outdoors at the south end of the building, a cylinder is placed on a cylinder transfer cart on rails. The cart is moved on the tracks and positioned on the cylinder scale inside the building. The gross and tare weights (of UF_6) are established for the cylinder and an electronic system calculates the net weight. This information is printed on a weigh ticket locally, and the Distributed Control System (DCS) prints the weights on a weigh ticket in the control room. The operator independently compares this weigh ticket with the DOE shipping document, which includes serial number, gross weight, tare weight, and net weight, and verifies that the cylinder does not contain more than the maximum allowable weight of UF_6.

The cylinder is transferred to one of the autoclaves, using a 20-ton bridge crane. The autoclave area is designed so cylinders can be transferred at a minimum height above the floor. The maximum lifting heights will be those required for removing and placing the cylinders in the cradles on the scale cart and in the autoclaves. After the cylinder is in position in the autoclave, the UF_6 discharge piping ("pigtail") is connected to the cylinder discharge valve and leak tested with approximately 80 psia nitrogen. The cylinder valve is opened and the pressure in the pigtail falls to less than atmospheric, since the cylinder is under a negative pressure. The extension handle from the motorized valve closer is then connected to the cylinder discharge valve. The motorized valve closer is designed only to close the valve, not to open it. All piping and instrument connections to the autoclave are on the autoclave fixed head. The hydraulic system is used to close and lock the retractable cylindrical portion of the autoclave to the fixed head. The UF_6 cylinder handling operations described above are done under local manual control. Subsequent operations in this

area (except for any UF_6 sampling) are monitored and controlled from the control room through the Distributed Control System (DCS).

After the autoclave is closed and locked, the control room operator uses the DCS to open the block valve in the steam line to the autoclave and sets the pressure controller for approximately 3 psig saturated steam, corresponding to about 220°F (if steam temperature exceeds approximately 235°F, a block valve on the steam line closes automatically). Under these conditions, the UF_6 cylinder heats to about 220°F at which point the UF_6 is liquid at a vapor pressure of about 75 to 80 psia. The UF_6 cylinder is ready to feed UF_6 vapor to the chemical reactor system.

In the preceding sequence of operations, the pressure in the pigtail is monitored and recorded in the DCS. If the DCS has not recorded a 70 psia pressure in the pigtail, indicating a pressure test of the pigtail, followed by a fall in pressure to below atmospheric, indicating the cylinder discharge valve has been opened and is not plugged, then the control room operator is not able to turn on the steam to the autoclave. This feature precludes heating a cylinder with a closed or plugged cylinder valve. After the steam has been turned on, failure of the pigtail pressure to rise to the proper operating pressure in a reasonable period of time causes the DCS to shut off the steam, sounds an alarm in the control room, and displays the cause of the alarm. This feature also precludes heating a cylinder with a closed or blocked cylinder valve.

Any leakage of UF_6 from a cylinder being heated within an autoclave would react with the steam condensate and steam vapor within the autoclave. This reaction would produce hydrofluoric acid (HF) and uranyl fluoride (UO_2F_2), and generate additional heat which, if contained in a fixed volume, would cause an increase in pressure. In order to contain these materials within the autoclave, the autoclave systems include remotely operated containment valves on all pipe connections to the autoclave except the pressure relief line. Also, the remotely operated motorized UF_6 cylinder valve can be closed to stop leakage from the cylinder valve stem and pigtail. All these valves are operated via the DCS.

In order to minimize the amount of chemical reaction which can take place in the event of a UF_6 leak, the amount of water as steam and condensate which can be retained in the autoclave is minimized. The amount of water retained in the autoclave, if completely reacted with UF_6, would produce a maximum pressure in the autoclave less than the 200 psig design pressure of the autoclave and pressure relief valve.

The HF and UO_2F_2 generated by the reaction of UF_6 with water are both soluble in water and the presence of small amounts would increase the electrical conductivity of the condensate. Condensate conductivity is continually monitored.

Parameters on the autoclave systems which are monitored by the DCS are:

1. Autoclave pressure
2. DUF_6 pressure in the pigtail
3. Condensate level in the autoclave drain nozzles (Redundant)
4. Conductivity of the autoclave condensate (Redundant)
5. Conductivity of the steam sample condensate
6. Temperature of the autoclave
7. Pressure switches between the rupture discs and the pressure relief valves on the autoclaves

Automatic responses by the DCS to abnormal parameter readings are as follows:

1. If the autoclave pressure exceeds approximately 10 psig, the steam supply valve and the UF_6 supply valve close automatically, alarms initiate and causes for the alarms are displayed in the control room. The steam and UF_6 valves provide containment.

2. A continued pressure rise in the autoclave to approximately 15 psig causes automatic closure of the steam sample containment valve, the condensate discharge containment valve and the UF_6 cylinder valve, initiates an alarm in the control room, and displays the causes of the alarm.

3. Indication of a high level of water in the autoclave condensate drain nozzle by either of the level probes in the nozzle closes the steam supply valve, initiates an alarm in the control room and displays the alarm cause.

4. Indication of high conductivity in the autoclave condensate closes the steam supply valve, initiates an alarm in the control room and displays the alarm cause.

5. If the UF_6 pressure in the pigtail increases from its normal preset parameter, the steam supply valve closes, an alarm will initiate in the control room and the alarm cause is displayed.

In addition to the above automatic responses, interruption of power results in closing the four containment valves on the autoclave.

After the UF_6 cylinder is emptied, both the UF_6 feed valve at the autoclave and the autoclave steam supply valve are closed. The pigtail is purged with nitrogen back into the UF_6 cylinder several times. As the cylinder cools, any residual UF_6 vapor condenses and the pressure in the cylinder drops below atmospheric pressure. The cylinder valve is closed using the remote operated motorized closer, the autoclave is opened, and the pigtail and extension handle on the cylinder valve is disconnected from the empty cylinder.

The empty UF_6 cylinder is removed from the autoclave using the bridge crane and placed on the cylinder weight cart on the cylinder scale. The same procedure is used for weighing the cylinder out as was used for weighing the cylinder in, except for the comparison with the D.O.E. shipping information and checking for overfilling.

The condensate from each autoclave is combined and collected in a condensate receiver and pumped alternately to one of the condensate holding tanks. Each holding tank is sized to hold about 24 hours of condensate production. When one tank is full, condensate flow is shifted to the empty tank and the full tank is agitated and sampled. The sample is analyzed for uranium and fluoride content. If uranium and fluoride are not present, the condensate is drained to the calcium fluoride settling and storage basin #2. If uranium and fluoride are present, the condensate is treated with lime as it enters the above mentioned settling basin. Discharge from the settling basin is pumped to the existing fluoride clarifier basins and subsequently to the Combination Stream (Outfall 001). Since uranium or fluoride is not expected in this condensate stream, the amount of calcium fluoride sludge waste from the plant will not be increased.

16.4.5 UF_4 Chemical Reactor

The chemical reactor consists of a small cyclonic type of UF_6-H_2 mixer mounted on the top of the reaction chamber. The reaction chamber consists of a vertical conical-shaped tube. The reaction chamber is tapered, and the bottom is welded to a cooling screw conveyor.

The chemical reaction chamber is enclosed in four clam shell vertical cylindrical 45 KW electric heaters. Each heater output is independently controlled using temperature sensors attached to the outside shell of the reactor tube. Room air is compressed by blower and introduced between each heater section and the reactor tube for cooling as required. Pneumatic vibrators are used to shake UF_4 off the reactor walls.

The UF_6 vapor is superheated from about 220°F as it leaves the autoclave to 350° by use of electric heat tapes on the UF_6 piping headers. The setpoint temperature is controlled by the DCS. The DA may be pre-heated up to 1300°F by means of an electric heater located between the flow controller and the reactor mix head. The DCS is used to control the temperature of the DA at the desired setpoint. Heat sensors are used to detect possible DA leaks and interlocks automatically shut off the DA flow upon the detection of a sudden rise in temperature.

The UF_6 flow rate from the UF_6 cylinders is regulated by a flow controller. The DA flow rate is regulated by another controller and is approximately 1.2 times the theoretical quantity required for complete chemical reaction. The two streams enter the cyclonic

mixer and discharge into the top of the chemical reactor tube where the reaction takes place.

The temperature of the reactor is controlled at about 1,200°F at the top and about 850°F at the bottom, using the electric heaters and cooling air as required. The majority of the reaction occurs at the top of the reactor. The UF_4 formed is a powdery solid. The UF_4 and the remaining gaseous reaction products pass from the bottom of the reactor to the cooling screw conveyor.

16.4.6 Cooling Screw Conveyor

The cooling screw conveyor is mounted horizontally under the reactor. The conveyor is provided with cooling water by the cooling jacket attached to the outside of the shell. The single shaft penetration on the drive end of the conveyor is sealed with a stuffing box which is purged with nitrogen gas to prevent release of UF_4 powder, H_2, or HF. The stuffing box is enclosed in a hood under negative pressure so that any release due to an upset is captured and filtered through a high efficiency baghouse. (This same design feature is used on all rotating stuffing box shaft seals on equipment under pressure in which radioactive or hazardous chemicals are contained.)

The powder is cooled to about 300°F and conveyed to a chute between the cooling screw and product transfer screw. A bed of UF_4 powder (seal leg) is maintained in the chute to prevent downward flow of gases with the powder. The off-gases are cooled to about 300°F and exit from the top of the discharge end of the conveyor.

16.4.7 UF_4 Product Handling and Packaging

The UF_4 product discharges from the cooling screw, through a level controlled chute, into the product transfer screw and is conveyed to a bucket elevator which elevates the product and drops it through a screen to the blending system feed screw, which conveys the UF_4 to one of two identical product storage bins. The other bin, normally containing a full load of UF_4 from a previous cycle, is isolated from the solids feeding system. Compressed nitrogen is pulsed into a blending cone on the bottom of the off-line bin to fluidize the UF_4 powder, homogenizing the bin contents. Each bin alternates between receiving UF_4 as produced and blending stored UF_4. Each product storage bin may also be fed from a refeed system which dumps powder from individual drums into the boot section of the bucket elevator.

After the powder in the off-line bin has been thoroughly blended, UF_4 is discharged through a screw conveyor and through the packaging system into 55-gallon product drums which are filled to a net weight of approximately 1,400 pounds. The product is added to the drum through a ventilated hood resting on the drum. The hood,

drum, and scale are contained in a drumming station enclosure. Room air is drawn into the enclosure through any openings in the enclosure to prevent escape of dust to the room. The air leaving the hood and enclosure is filtered through a high efficiency baghouse which discharges to the atmosphere from a stack above the building.

16.4.8 Off-Gas Treatment

The off-gases from the cooling screw conveyor pass through a combination cyclone-filter where entrained dust is removed. The entrained dust drops into a chute forming a seal leg just above a rotary valve which discharges to the discharge end of the cooling screw conveyor, thus combining the dust with the main product stream. The estimated efficiency of the combination cyclone-filter assembly is about 99.97 percent. The off-gases then pass through a backup filter where any small amount of remaining dust is removed. The collected dust drops into a small dust can below the filter. This dust is removed from the collection can via the vacuum cleaning system. Two chemical traps in series are provided downstream of the filters to adsorb any traces of unreacted UF_6 in the off-gas stream. The traps contain beds of granular activated carbon.

16.4.9 HF Recovery, H_2 Burning, and HF Scrubbing

After off-gas treatment, the gases pass through the partial HF condenser and are cooled to approximately minus 10°F. About two-thirds of the contained HF is condensed to a liquid and drained to one of the two AHF rundown tanks. The partial HF condenser is the shell and tube type, with approximately minus 15°F refrigerant on the shell side. The remaining approximately minus 10°F off-gas stream then passes through a final shell and tube HF condenser and is cooled to approximately minus 95°F. Most of the remaining HF is condensed to a liquid and drained to one of the AHF rundown tanks.

The approximately minus 95°F off-gases are then piped to the UF_6 Conversion Plant, fed into its own H_2 burner to burn excess H_2, and then through the existing waste gas HF scrubber to remove any HF remaining. The amount of H_2 and total gases feeding to this existing scrubber adds only a few percent to the load. recovered anhydrous HF in the AHF rundown tanks is sampled and analyzed for purity before being transferred to the UF_6 Conversion Plant AHF storage tanks. The refrigeration system that provides coolant to the HF condensers for heat removal uses cooling tower water from the UF_6 Conversion Plant.

16.4.10 Vacuum Cleaning System

Two separate piping and dust collecting units are provided. One unit, the Process Vacuum System, is used for cleaning product

quality UF_4 powder from equipment in preparation for maintenance work. The second unit, the Waste Vacuum System, is for all other uses. Each of the two dust collecting units are combination cyclone filters with polyester felt filter fabric. The clean air streams from both dust collectors are combined and flow to a centrifugal vacuum compressor which discharges through the high efficiency dust collector on the plant dust collection system. The solids collected in the dust collecting units are discharged to drums for either recycle or disposal.

16.4.11 Dust Collection System (Dwg. No. 800-M-6503)

The dust collection system consists of a baghouse with bag filters of high efficiency medium, a dust collection fan and a rotary air lock on the baghouse which discharges the collected UF_4 dust to the drumming station via a screw conveyor, a ductwork system to the various dust control points, and a duct to route the discharged air to an exhaust stack. Dust control points include the product drumming station hood, the product drumming station enclosure, refeed system, refeed system enclosure, and the hoods around stuffing boxes and mechanical seals.

16.4.12 Breathing Air System

Breathing air for use with full face masks is Grade D quality and is piped to each level of the process area.

16.4.13 Air Monitoring System

The air monitoring system is equivalent to that used in the UF_6 Conversion Plant. Filter heads are provided in all areas of the plant as appropriate, with these heads being piped to a vacuum compressor which discharges to the atmosphere.

16.4.14 Water Supply

Process cooling water (CWS) is provided by a pipeline from the existing water cooling tower system to the UF_6 Reduction Building and returned by pipeline to the cooling tower. This water is used for cooling water on the cooling screw, cooling water on refrigeration units, and cooling water on the air compressor.

Potable water is piped from the main building to the toilet, wash basin, drinking fountain, and the safety showers.

16.4.15 Waste Solids

Waste solids are discussed in the Comprehensive Solid Waste Management Plan which is incorporated by reference into this license.

16.4.16 Off-Gases

Process off-gases have previously been described under 16.4.6, 16.4.8 and 16.4.9. Before release, these gases are cycloned, double filtered, passed through chemical traps to remove traces of UF_6, cooled to condense HF, burned to destroy hydrogen, and scrubbed to remove HF.

16.4.17 Power Failure

In the event of a power failure, the DCS automatically shuts off the flow of UF_6 and DA to the reactor and closes the four containment valves. The burner and scrubber continue to operate on the main plant emergency power system in the event of a general power failure. The nitrogen supply system requires no power and continues to operate in the event of a general power failure.

16.4.18 Process Controls

The UF_6 Reduction process is operated by a chemical operator from the control room in the UF_6 Conversion Plant using a Distributed Control System (DCS). The DCS is a microprocessor based system with integrated analog and digital control including electric motor and remotely operated valve control as well as sequential controls on automatic shutdown systems. The control room is equipped with redundant operators' interface consoles with viewing screens which allow the operator to set control points on operating parameters, operate remotely operable valves, motors, and other devices, monitor operating parameters and variables, receive alarm signals, and read the reason for alarms on the screens.

In the electric room at the UF_6 Reduction Building, besides the regular power supply and motor control centers, there are redundant multifunctional controllers and several hundred input-output (I/O) devices, which interface with the instrumentation at the process equipment and with the control room consoles. The entire DCS is powered by an uninterruptible power supply. In case of power failure, all electric motors turn off and all electrically actuated valves and other control devices position themselves to the fail safe position.

16.4.19 Process Streams Descriptions and Activities

Quantities of materials in each process stream are shown on the process flow sheet, Drawing 800-M-1401. Table I is presented as an aid in visualizing each stream's physical nature and activity.

16.4.20 Refeed System

Provisions are made to allow recycle of off-specification product by a refeed system. A 55-gallon drum is positioned on the lifting platform of a drum dumper via roller conveyors. After removal of the drum locking ring and lid, the dumper lowers and secures to the drum top a conical pouring spout equipped with a butterfly discharge valve.

The dumper raises and inverts the drum and secures it by pressure against a feed spout on a rotary star valve feeder which feeds to the discharge end of the product transfer screw, which in turn discharges to the feed boot of the bucket elevator. After opening the butterfly valve and starting the star valve feeder, the contents of the drum are fed into the main stream product line.

The above system is enclosed in a containment housing. Dust is controlled by the use of proximity hoods within the enclosure which are ventilated and under negative pressure relative to the building pressure. All ventilation air is discharged through the main dust collection system.

16.4.21 Screen Oversize System

The screen oversize material discharges from the product through a chute into a 55-gallon drum. Past experience has proven the oversize material to be a very small amount, therefore the level in the drum is monitored by the operator and the drum changed accordingly.

16.5 UF_6 Reduction Plant - Safety Analysis of Each Step

There are no fissile materials involved; thus there is no need to discuss criticality safety. The system consists of well known standard unit processes and unit operations--in full conformance with applicable federal and local laws, codes, and regulations. Additional safety analysis of each step beyond that already described is not required.

TABLE I

ESTIMATED PROCESS STREAM ACTIVITIES

UF_6 REDUCTION PLANT

SEQUOYAH FUELS CORPORATION SEQUOYAH FACILITY

Stream Name	Physical Nature	Activity uCi/g	Activity uCi/ml
Dissociated Ammonia	Gas (Nitrogen & Hydrogen)	Nil	Nil
UF_6 to Premixer	Gas (UF_6)	3.22×10^{-1}	6.2×10^{-3}
Reactor Feed (1200°F)	Gas (UF_6, N_2, H_2)	3.10×10^{-1}	7.0×10^{-4}
Reactor Discharge	Gas with entrained UF_4 HF	3.10×10^{-1}	9.0×10^{-4}
UF_4 Product Streams	Solid Powder	3.61×10^{-1}	1.11
Off-Gas from Sintered Filters	Gas (trace of UF_4, HF)	8.0×10^{-7}	7.8×10^{-10}
Off-Gases to HF Recovery	Gases with HF	8.0×10^{-7}	6.4×10^{-10}
Recovered Anhydrous HF	Liquid	1.4×10^{-9}	1.5×10^{-9}
Off-Gases to Burner & Scrubber	Gas	5.5×10^{-8}	5.4×10^{-11}
Spent Cooling Water (CWSD)	Water	Nil	Nil
Stream Condensate to Out Fall	Hot Water	Nil	Nil
Autoclave Condensate to Out Fall	Water	Nil	Nil
Dust Collector Discharge	Air	5.4×10^{-8}	5.4×10^{-11}

Reference is made to Drawing 800-M-1401, "Depleted UF_4 Flow Sheet." The above listed activities are calculated for the expected nitrogen purges of 15 pounds per hour.

16.5.1 Special Provisions

Provisions have been made to achieve the objective of preventing exposures to radiation or chemicals. The safety features installed in the processing equipment provide for a safe working environment.

1. Removal of UF_4 from the reactor off-gases by cycloning, double filtration through sintered metal filters, filtration and adsorption (for UF_6), burning of the excess hydrogen, and finally water scrubbing before release to the main plant stack.

2. Vacuum cleaning systems to remove UF_4 powder spills to clean out equipment before inspection and maintenance.

3. A pressurized nitrogen (or air where there is no H_2 in the equipment) seal system on mechanical seals and stuffing boxes on equipment under pressure containing UF_4, HF or H_2.

4. Equipment has been used in the processing system with proven capability and reliability and of such construction as to be closed and leak tight.

5. All piping and equipment through which DA flows is initially purged with nitrogen to displace air. This procedure is followed before a re-start whenever equipment is replaced or opened for any reason which could allow air to enter the system.

6. Unless one of the roof ventilators in the high bay area is operating, the DA supply valve will not open by virtue of an electrical interlock. This will insure considerable dilution air to dilute any hydrogen leakage to below the explosive limit of 4 volume percent hydrogen in air.
7. There are a number of strategically placed hydrogen detectors in the building. Detection of one volume percent hydrogen will signal an alarm in the control room, and detection of 2 volume percent will automatically shut off the flow of dissociated ammonia and UF_6 and open the nitrogen purge valve to the chemical reactor. Heat-sensors at the DA pre-heater and piping to the reactor will also shut off the flow of DA if sudden rise in temperature is detected.

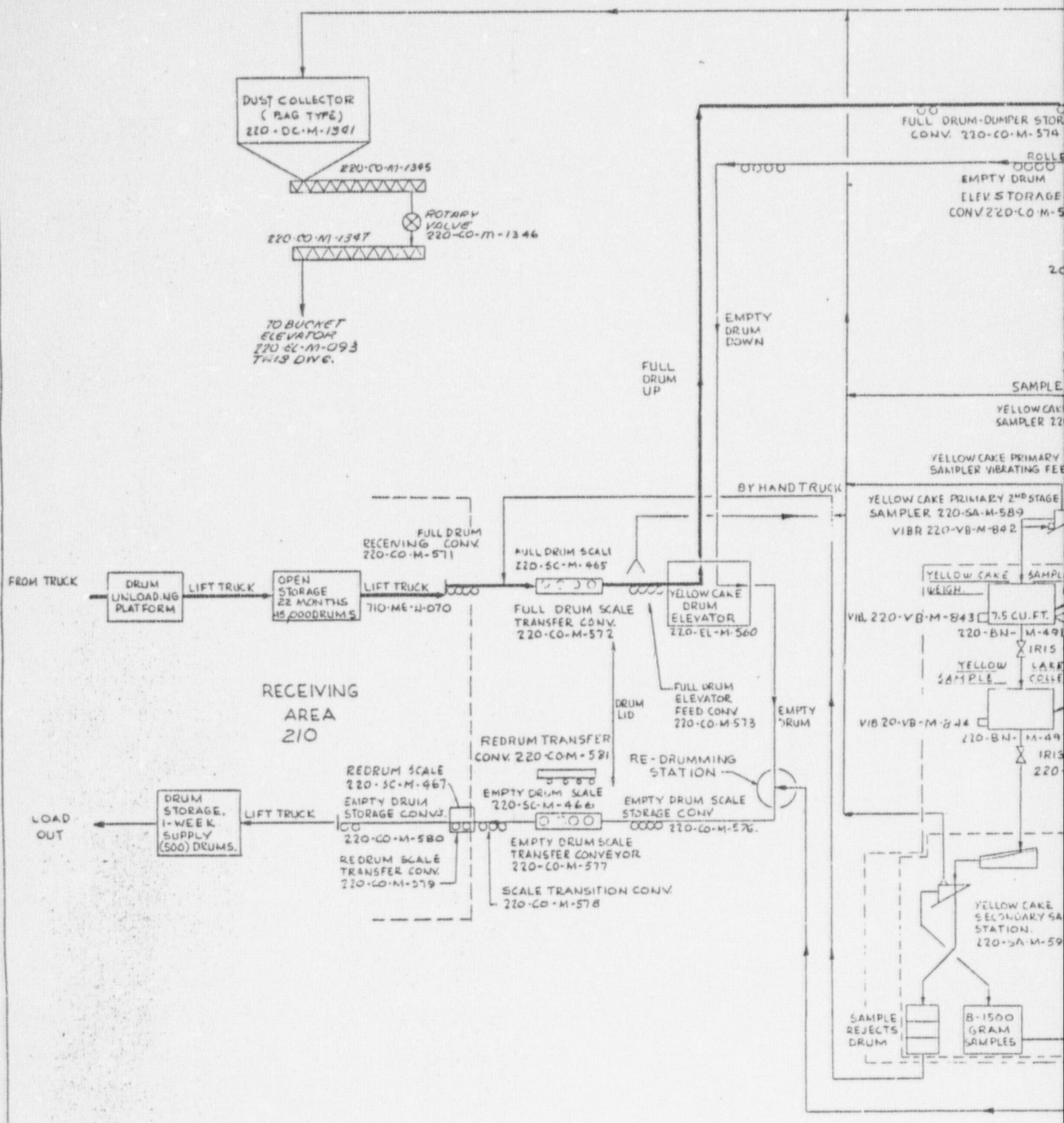
8. There is a powder seal in the chute between the cooling screw and product transfer screw. The seal prevents hydrogen flow downward along with the UF_4 powder. The seal is equipped with level detectors. The higher level controls the level of seal by controlling the rate of removal of powder from the bottom of the seal. The lower detector alarms in the control room and indicates a safe shutdown of the reactor through an interlock programmed into the DCS if the powder level drops below a pre-set level.

9. Because a failure of the chemical reactor wall could allow HF and H_2 (and possibly UF_6) to escape and enter the cooling air between the reactor wall and chemical reactor furnaces, an HF detector is installed in the cooling air exhaust from the reactor. The instrument will alarm at 4 ppm HF with corrective action to be taken as appropriate. In addition, there are temperature sensors in each of the cooling air discharge ducts before the ducts are combined for venting. An abnormal increase in the temperature due to hydrogen burning will cause an alarm in the control room.

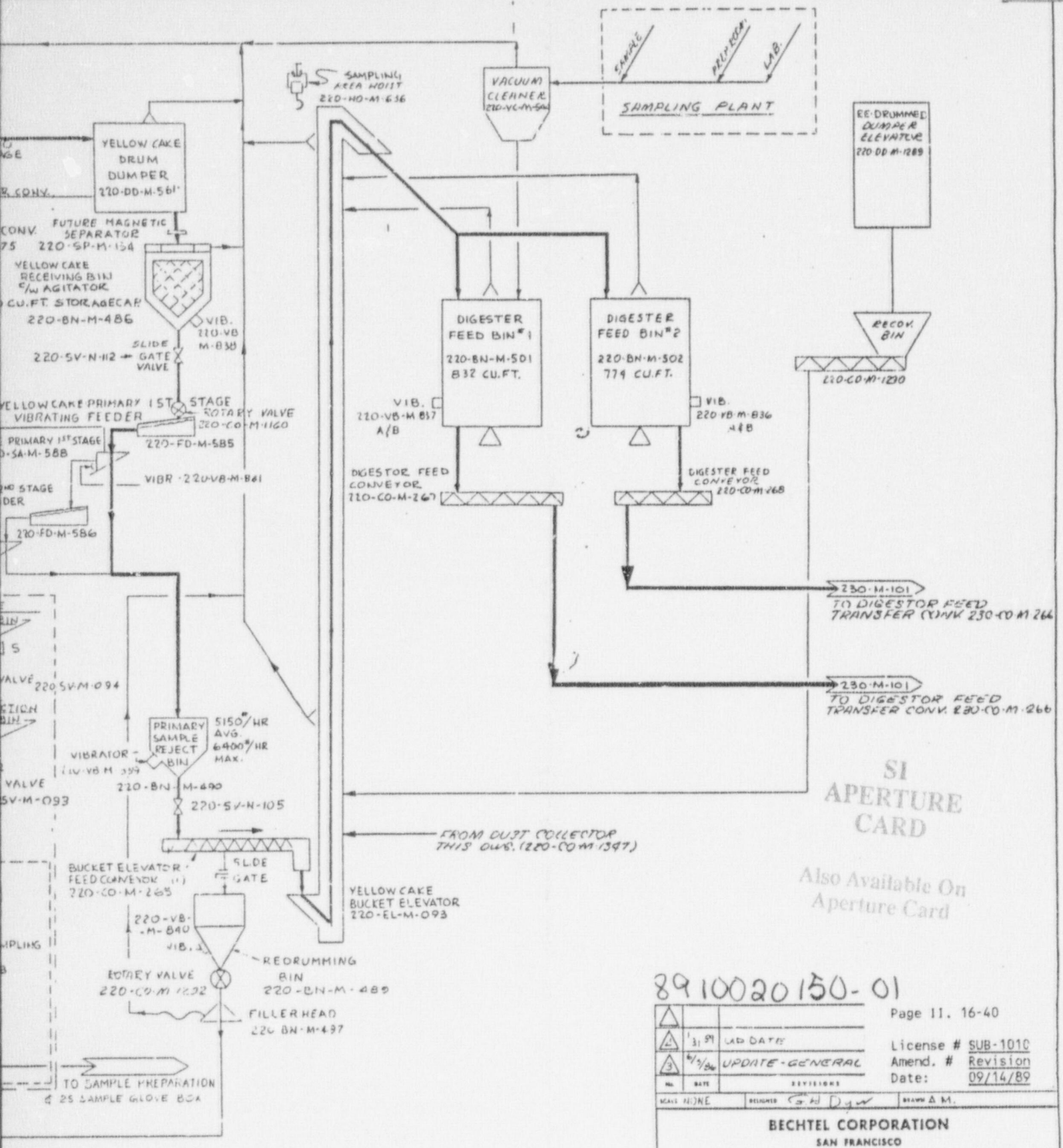
10. There are HF detectors inside the building near equipment containing HF. Detection of HF by any of the detectors will alarm in the control room.

11. Each pipe carrying UF_6 gas from an autoclave to the UF_6 Feed Surge Tank is monitored for UF_6 leaks by ionization type leak detectors. Indication of a leak by any of the smoke detector stations alarms in the control room through the DCS and appropriate action taken.

12. The building air and exhaust from the dust collector are monitored for radioactive material in conformance with the requirements set forth in Chapter 3.0 of this license.


DUST COLLECTOR
(BAG TYPE)
220-DC-M-1391
220-CO-M-1395
ROTARY VALVE
220-CO-M-1346
220-CO-M-1397
TO BUCKET ELEVATOR
220-EC-M-093
TWIN DIVE.
FULL DRUM-DUMPER STOR
CONV. 220-CO-M-574
EMPTY DRUM
ELEV. STORAGE
CONV 220-CO-M-5
EMPTY DRUM DOWN
FULL DRUM UP
SAMPLE
YELLOW CAKE
SAMPLER 22
YELLOW CAKE PRIMARY
SAMPLER VIBRATING FE
BY HAND TRUCK
YELLOW CAKE PRIMARY 2ND STAGE
SAMPLER 220-SA-M-589
VIBR 220-VB-M-842
FULL DRUM RECEIVING CONV. 220-CO-M-571
FULL DRUM SCALE 220-SC-M-465
FROM TRUCK
DRUM UNLOADING PLATFORM
LIFT TRUCK
OPEN STORAGE 22 MONTHS 45,000 DRUMS
LIFT TRUCK
710-ME-N-070
FULL DRUM SCALE TRANSFER CONV. 220-CO-M-572
YELLOW CAKE DRUM ELEVATOR 220-EL-M-560
YELLOW CAKE
WEIGH
VIB 220-VB-M-843
7.5 CU.FT.
220-BN-
M-49
IRIS
YELLOW
SAMPLE
CAKE
COLLE
FULL DRUM ELEVATOR FEED CONV 220-CO-M-573
DRUM LID
EMPTY DRUM
VIB 20-VB-M-844
220-BN-
M-49
IRIS
220-
RECEIVING AREA 210
REDRUM TRANSFER CONV. 220-CO-M-581
RE-DRUMMING STATION
REDRUM SCALE 220-SC-M-467
EMPTY DRUM SCALE 220-SC-M-466
EMPTY DRUM SCALE STORAGE CONV 220-CO-M-576.
LOAD OUT
DRUM STORAGE, 1-WEEK SUPPLY (500) DRUMS.
LIFT TRUCK
EMPTY DRUM STORAGE CONV. 220-CO-M-580
REDRUM SCALE TRANSFER CONV. 220-CO-M-579
EMPTY DRUM SCALE TRANSFER CONVEYOR 220-CO-M-577
SCALE TRANSITION CONV. 220-CO-M-578
YELLOW CAKE SECONDARY SA STATION. 220-SA-M-59
SAMPLE REJECTS DRUM
8-1500 GRAM SAMPLES

SIZE D



8910020150-01

Page 11. 16-40

NO.	DATE	REVISIONS
2	1/31/89	LAD DATE
3	6/1/89	UPDATE - GENERAL

License # SUB-1010
Amend. # Revision
Date: 09/14/89

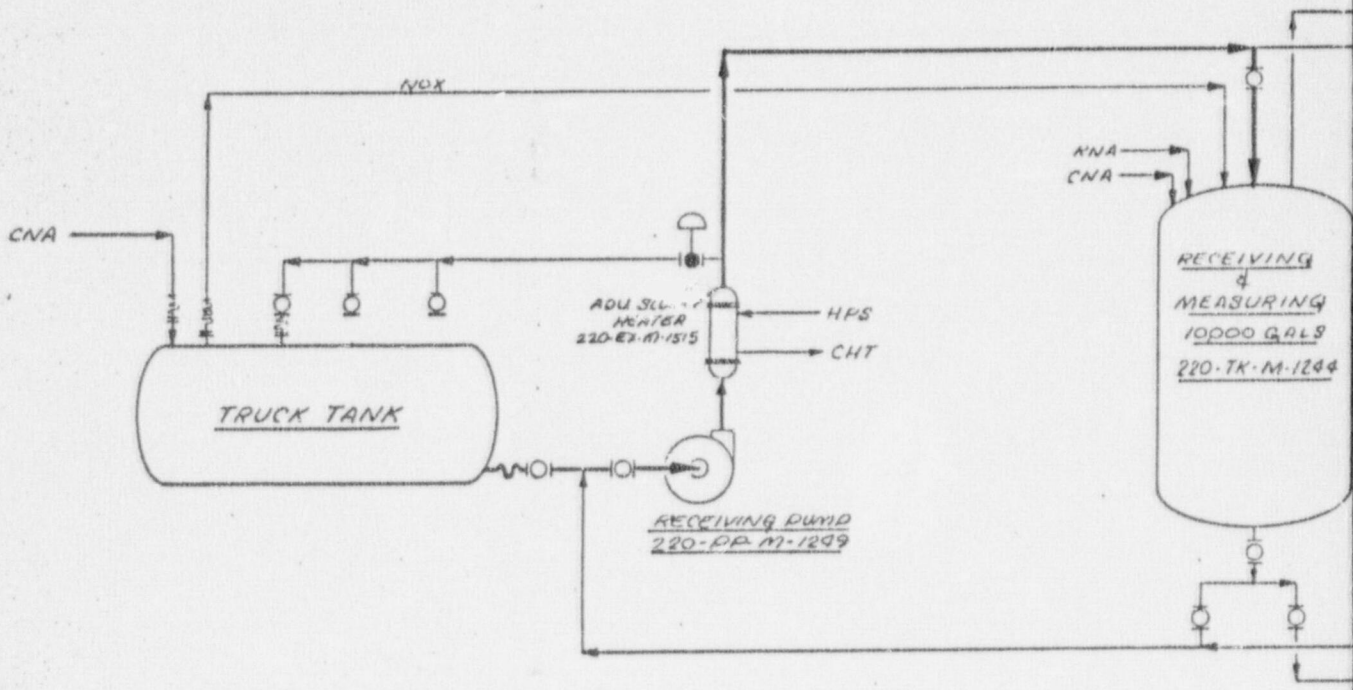
MASS NONE | DESIGNED [illegible] | DRAWN A.M.

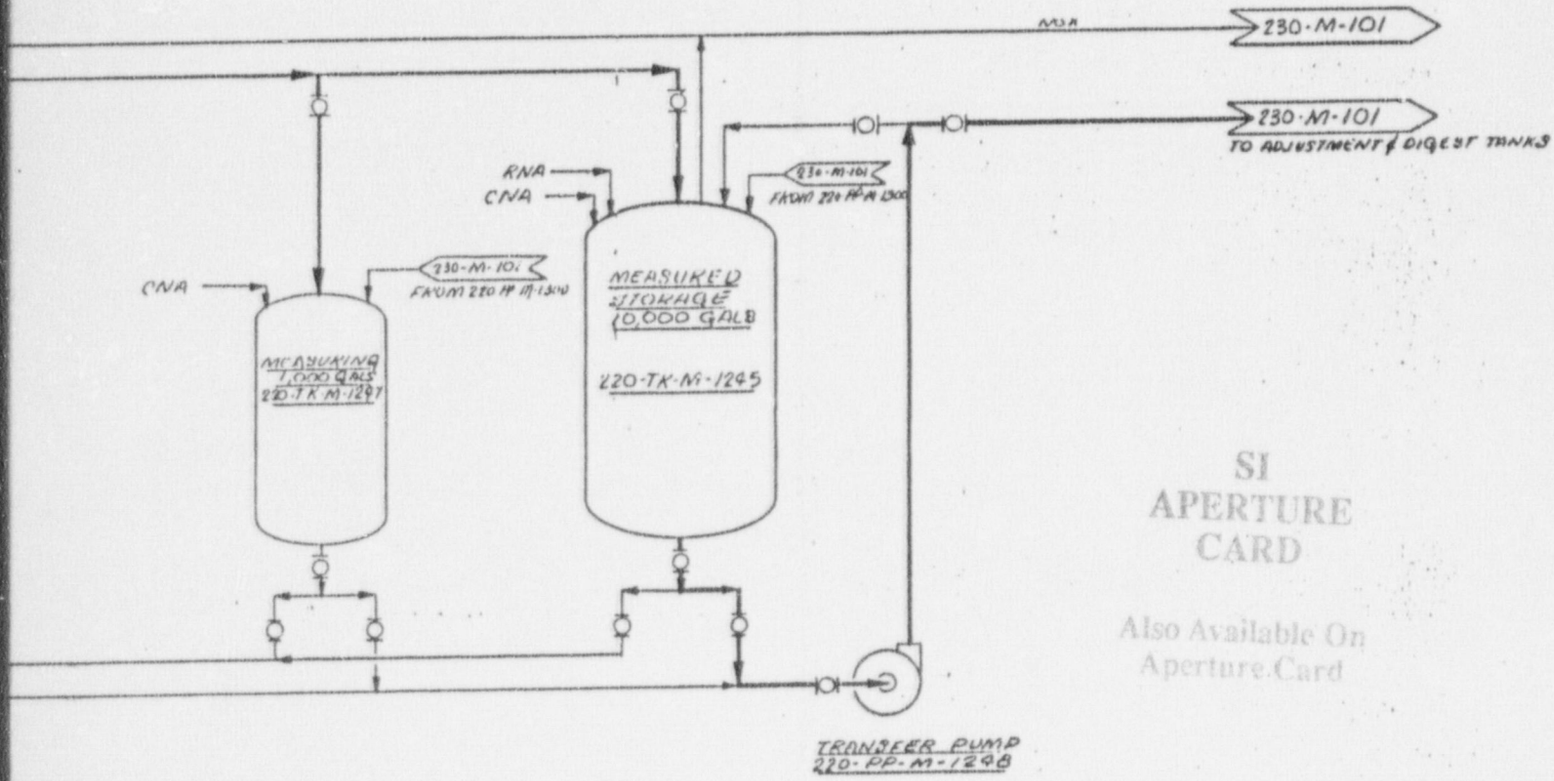
BECHTEL CORPORATION
SAN FRANCISCO

KERR-McGEE CORPORATION
SEQUOYAH FACILITY

RECEIVING & SAMPLING AREA FLOW SHEET

JOB No.	DRAWING No.	REV
6752	220-M-101	4


NOX
CNA
CNA
CNA
ADJ. SLL. - I
HEATER
220-EJ-M-1515
HPS
CHT
TRUCK TANK
RECEIVING PUMP
220-PP-M-1249
RECEIVING
&
MEASURING
10000 GALS
220-TK-M-1244



License # SUB-1010
Amend. # Revision
Date: 09/14/89

8910020150-02

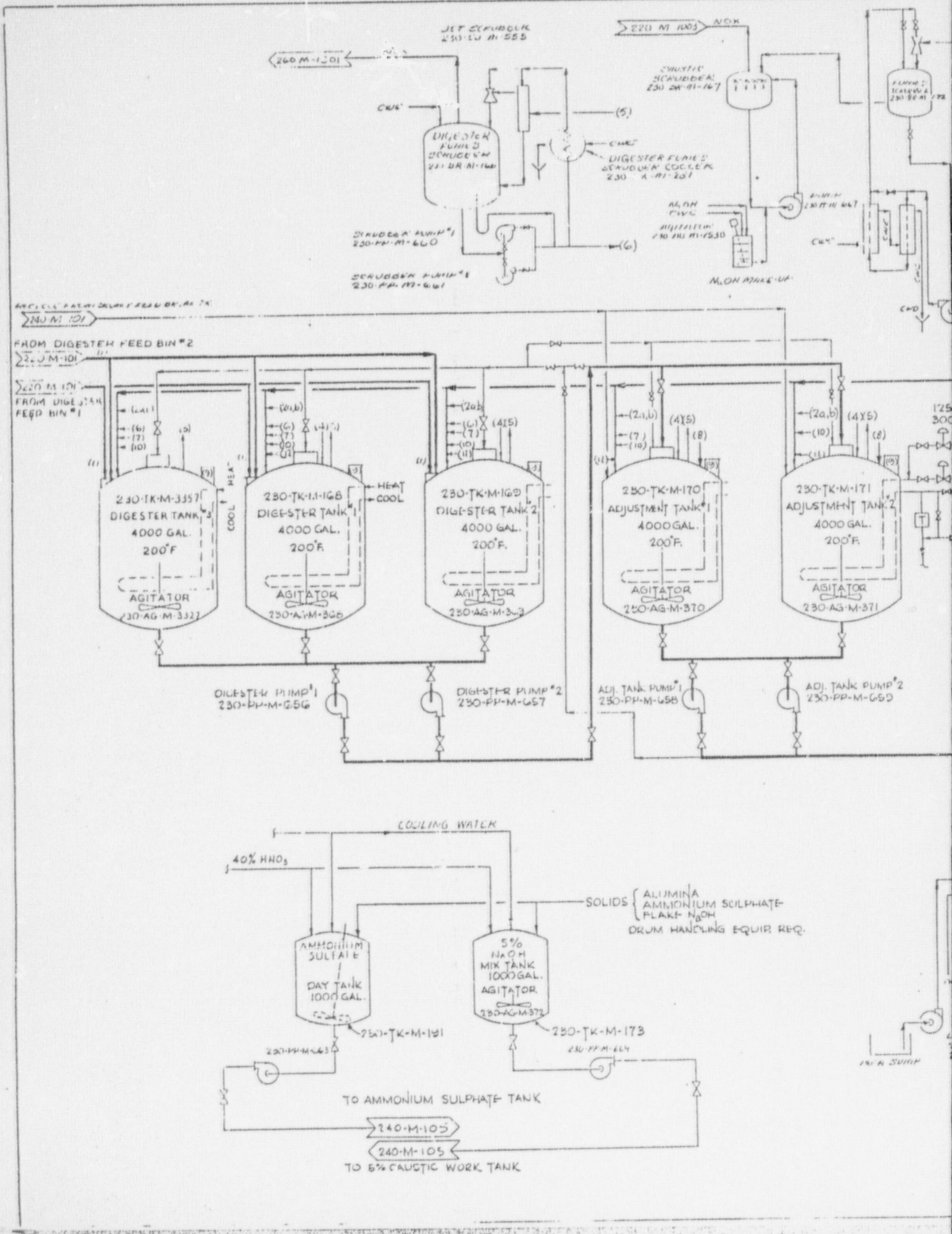
REV. NO.	DESCRIPTION	BY	DATE	APPR.

BEQUOYAH FUELS CORPORATION
BEQUOYAH FACILITY, GORE, OKLA.
KERR-MCGEE CORPORATION, OKLAHOMA CITY, OKLA.

DRAWN HAMPTON 6/13/86
APPROVED S.A. Mayes 6/16/86

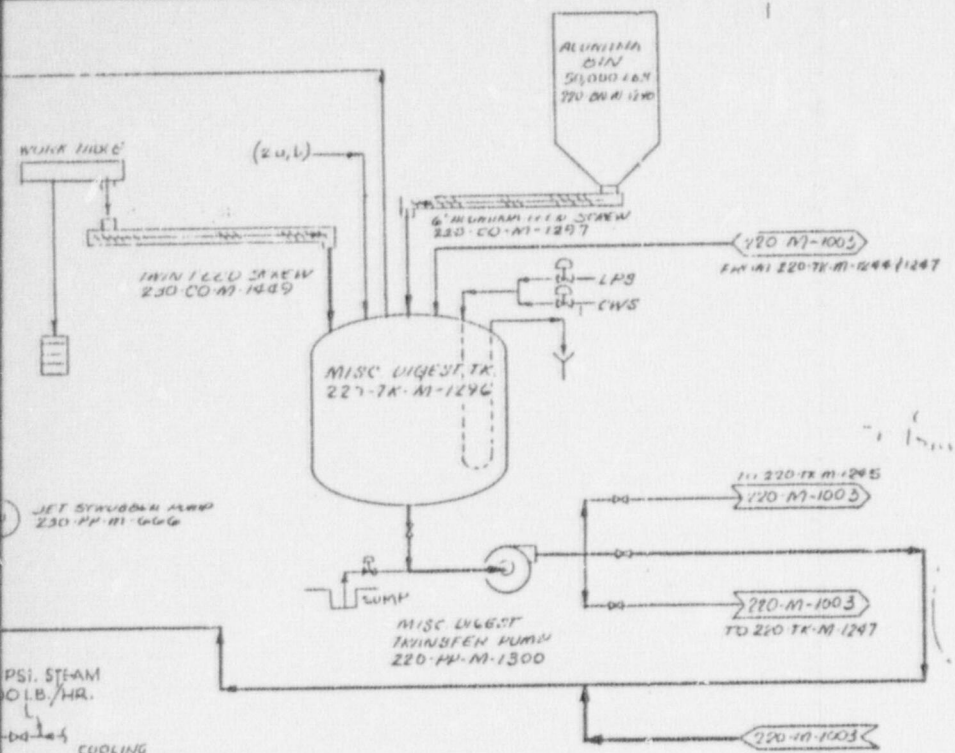
SLURRY FEED RECEIVING & MEASURING FLOWSHEET

SCALE NONE
DRAWING NUMBER 220-M-1003



JET SCRUBBER
260-M-1201
DIGESTER FUMES SCRUBBER
(5)
CWS
DIGESTER FUMES SCRUBBER COOLER
(6)
SCRUBBER PUMP #1 230-PP-M-660
SCRUBBER PUMP #2 230-PP-M-661
220 M 1003
NOX
CAUSTIC SCRUBBER 230-SR-M-167
NaOH
CWS
NaOH MAKE-UP
240 M 101
FROM DIGESTER FEED BIN #2
220 M 101
FROM DIGESTER FEED BIN #1
230-TK-M-3357
DIGESTER TANK #3
4000 GAL.
200°F
AGITATOR
COOL
HEAT
230-TK-M-168
DIGESTER TANK #1
4000 GAL.
200°F.
AGITATOR
230-AG-M-368
HEAT
COOL
230-TK-M-169
DIGESTER TANK #2
4000 GAL.
200°F.
AGITATOR
230-TK-M-170
ADJUSTMENT TANK #1
4000 GAL.
200°F.
AGITATOR
230-AG-M-370
230-TK-M-171
ADJUSTMENT TANK #2
4000 GAL.
200°F.
AGITATOR
230-AG-M-371
DIGESTER PUMP #1 230-PP-M-656
DIGESTER PUMP #2 230-PP-M-657
ADJ. TANK PUMP #1 230-PP-M-658
ADJ. TANK PUMP #2 230-PP-M-659
COOLING WATER
40% HNO3
SOLIDS
ALUMINA
AMMONIUM SULPHATE
FLAKE NaOH
DRUM HANDLING EQUIP. REQ.
AMMONIUM SULFATE DAY TANK 1000 GAL.
230-TK-M-181
5% NaOH MIX TANK 1000 GAL. AGITATOR
230-AG-M-372
230-TK-M-173
TO AMMONIUM SULPHATE TANK
240-M-105
240-M-105
TO 5% CAUSTIC WORK TANK

SIZE D



PRIMARY DIGESTION
BATCH TRANSFER DATA

ITEM	RATE	FREQUENCY
(1) YELLOW CAKE FEED	6000-8000 LB/HR.	2 HR./BATCH 2 BATCHES/DAY/TANK
(2) 40% HNO_3	175 GPM, 70°F, 1.2 C.P.	15 MIN./BATCH
60% HNO_3	0-100 GPM, 70°F, 1.2 C.P.	NON-SCHEDULED
(3) COOLING WATER	0-100 GPM, 70°F, 1.0 C.P.	" "
(4) SPECIAL FEED ADDNS.	0-25 GPM, 100-200°F, 6.7 C.P.	" "
(5) VENT TO SCRUBBER	500 ACFM FR. DIGESTERS 100 ACFM FR. ADJ. TANKS	2 HR./BATCH " "
(6) SCRUBBER TO HNO_3 RECOVERY	500 ACFM	" "
(7) SUMP PUMP	25 GPM, 70°F, SP.G. 1.0/50 C.P.	NON-SCHEDULED
(8) SUMP TANK PUMP	25 GPM, 70°F, SP.G. 1.0/50 C.P.	" "
(9) MAIN SLURRY PUMPS	60 GPM, 200°F, SP.G. 1.5/50 C.P.	2 BATCHES/DAY

PRELIMINARY

MISC. DIGESTION
BATCH TRANSFER DATA

(1) SOLIDS FEED	550 LB. UF_4/HR.	2 HR/BATCH
(2) 40% HNO_3	0-50 GPM, 70°F.	30 MIN/BATCH
(3) COOLING WATER	0-50 GPM, 70°F.	NON-SCHEDULED
(4) SPECIAL FEED ADDNS.	0-25 GPM, 200°F.	" "
(5) VENT TO HNO_3 RECOVERY CLEAN-UP		2 HR./BATCH
(11) MISC. DIGESTER PUMP	0-50 GPM, 200°F, SP.G. 1.5/50 C.P.	

PRELIM.

STEAM HEATING (125 PSIG)

DIGESTER TANKS #1, #2 & #3 — 1×10^6 BTU/HR. EACH, 45 MIN./BATCH, TWO BATCHES/DAY, NOT SIMULTANEOUS.

ADJUSTMENT TANKS #1 & #2 — 25,000 BTU/HR. CONT. HEAT LOSS ALLOW.

MISC. BATCH DIGESTER — 1×10^6 BTU/HR., 1 HR/BATCH, 1 BATCH/DAY NOT SIMULTANEOUS W/DIGESTER TANKS #1 & 2

SPECIAL FEED ADDNS. MIX TANK — 1×10^6 BTU/HR., 1 HR/BATCH, 1 BATCH/DAY NOT SIMULTANEOUS WITH OTHER DIGESTION STEAM LOADS

WATER COOLING (ONCE-THROUGH)

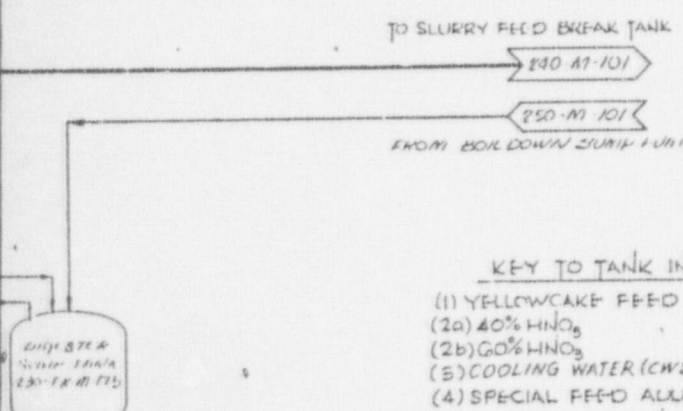
DIGESTER TANKS #1, #2 & #3 — 700,000 BTU/HR. EACH FOR 2 HR/BATCH, TWO BATCHES/DAY, NOT SIMULTANEOUS (70 GPM EACH). BALANCE OF DAY DROPS TO 70,000 BTU/HR, CONT. EXCEPT DURING BRIEF CLEANING & HEATING CYCLE

ADJUSTMENT TANKS #1 & 2 — 70,000 BTU/HR. EACH, CONT. (SEE NOTE #1) 7 GPM EACH.

MISC. BATCH DIGESTER — 70,000 BTU/HR., CONT. EXCEPT DURING BRIEF CLEANING & HEATING CYCLE 7 GPM.

NOTE (1) ADJUSTMENT TANK HEATING & COOLING COILS MUST BE DESIGNED TO ACCOMMODATE FULL 700,000 BTU/HR. COOLING WHEN LATER USED AS CONTINUOUS DIGESTER SYSTEM.

NOTE (2) TOP ENTRY OF STEAM COILS, AND THEIR COMMON USAGE AS WATER COOLING COILS, WILL REQUIRE A SPECIAL TRAP OR TRAP SYSTEM DESIGN TO ASSURE A CAPABILITY OF FLUSHING CONDENSATE FROM COILS THROUGH VERTICAL EXIT LEG.



KEY TO TANK INLET LINES & FITTINGS

(1) YELLOWCAKE FEED
(2a) 40% HNO_3
(2b) 60% HNO_3
(3) COOLING WATER (CWS) TO COILS ONLY
(4) SPECIAL FEED ADDITIONS:
ALUMINUM NITRATE
CAUSTIC
PHOSPHORIC ACID
IRON SOLUTION
(5) VENT TO SCRUBBER
(6) SCRUB RETURN
(7) SUMP RETURN
(8) URANYL NITRATE RECYCLE (FROM EVAP & BOILDOWN)
(9) MANHOLE
(10) COOLING WATER EMERGENCY
(11) MISC. BATCH DIGESTION & SLURRY FEED
(12) PLANT SERVICE WATER

NOTE (3) DATA ON THIS FLOWSHEET HAS NOT BEEN UPDATED FOR THE 10,000 TU/YR RATE

NO.	DATE	REVISIONS	
			Page II. 16-42
			License # SUB-1010
2	6/14	UPDATE - GENERAL	Amend. # Revision
			Date: 09/14/89

SCALE NONE | DESIGNED G.N.Dyer | DRAWN TONY B.

BECHTEL
SAN FRANCISCO

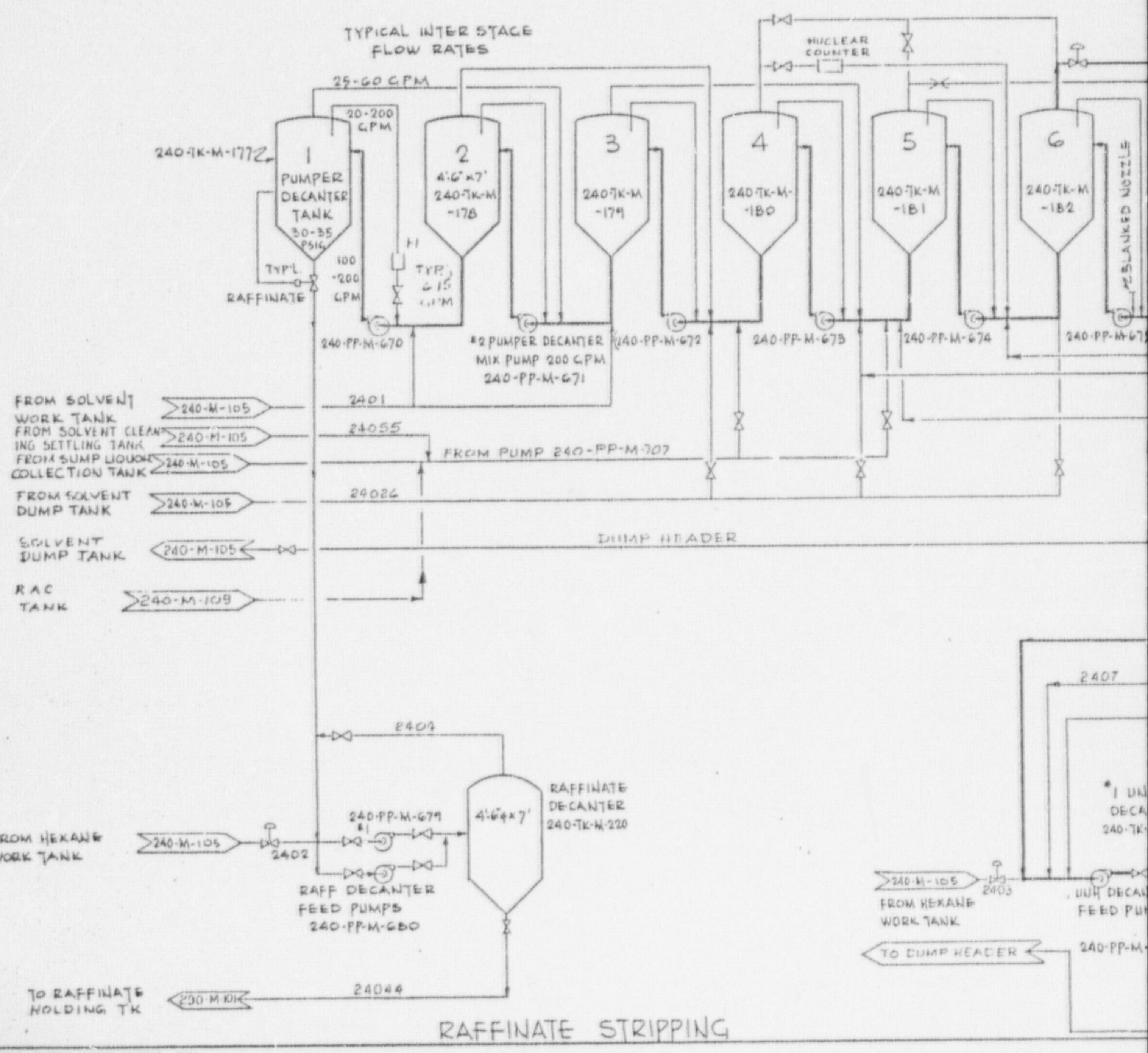
KERR-McGEE CORPORATION
SEQUOYAH FACILITY

DIGESTION
FLOW SHEET

BECHTEL | JOB No. 6752 | DRAWING No. 230-M-101 | REV. 5

STREAM No.	2401	2402	2403	2404	2405	2406	2407	2408	24021	24022	24023	24031	24032	24
TITLE	SOLVENT FR'M PREP. TANK	HEX FR'M WORK T. TO RAFF STRIP	HEX FR'M WORK T. TO UNH STRIP			RAFFINATE DECANTER HOLDUP	UNH DECANTER RECYCLE	SOLVENT TO TREATM.	FROM DIGESTER	SCRUB WATER	STRIP WATER	TO MIX SETTLER	SCRUB WATER RECYCLE	AQUE SCR
WEIGHT LBS/MIN	246.5	5.6	3.8			1170	1147	244.5	110.6	31.7	274.6	305.1	31.8	4
VOLUME GPM (60°F)	38.4	1.0	.7			200	100	38.1	NET 6.6 TOTAL 50	3.8	32.9	39.9	3.8	4
SPECIFIC GRAVITY	0.80	.65	.65			0.70	0.75	0.74	1.54	1.0	1.0	0.92	1.0	1.
COMPOSITION LBS/MIN.														
UN							47.5	TR.	47.5			56.8	TR.	
HNO_3 (MOLAR/LB./MIN)							.17	TR.	1/4.5	0.01/0.2	0.01/0.17	2.9	TR.	
H_2O							274.4		58.6	31.7	274.4		31.7	31
M+N														
TBP	93.2					120	0.3	92.5				92.8		
HEXANE	153.3	5.6	3.8			1050	825	151.95				152.5		
OPERATING TEMP °F	77-95	77-95	77-95			77-95	77-140	77-140	77-95	77-140	122-140	77-95	77-140	77-
VISCOSITY CENTIPOISE 20°C < 30°C	.61 (35°C)	.347	.347			.5	1.5	.61 (35°C)	6	1.0	1.0	.81	~1.0	~

NOTE: FLOW AND HEAT BALANCE DATA FOR 5,000 TONS PER YEAR CAPACITY.
MULTIPLY ALL NUMBERS BY 1.57 FOR 10,000 TONS PER YEAR CAPACITY.
TANK SIZES INDICATED ARE ADEQUATE FOR 10,000 TONS PER YEAR C



RAFFINATE STRIPPING

SIZE D

	24034 FROM MIX SETTLER	24035 TO #1 UNH DECANTER	24036 TO #2 UNH DECANTER	24037 TO EVAPORATOR	24041 TO RAFF. DECANTER	24044 TO RAFF. HOLD-UP	24038 RECYCLE TO SCRUB
.9	292.9	322.9	322.9	321.9	96.1	96.0	
.2	39.5	34.2	34.2	34.0	11.4	11.4	
26	0.89	1.13	1.13	1.13	1.01	1.01	
3	47.5	47.5	47.5	47.5			
.9	0	.17	.17	.17	76/4.5	4.5	
7		274.4	274.4	274.2	90.3	90.3	
					TR.	TR.	
	92.8	.3			.45		
	152.5	.55	.8		.8	1.2	
40	77-140	77-140	77-140	77-140	77-95	77-95	
.2	~.81	1.5 (25°C)	1.5	1.5	2	2	

ALTERNATE ROUTING MAY CARRY UP TO 10% OF 24035

SEE SOLVENT REWORK FLOWSHEET (240-M-105) FOR NUMBERED CONNECTN NOT GIVEN IN THIS BLOCK.

APACITY.

240-M-101 TO ADJUSTMENT TK

24021

240-M-101 FROM ADJUSTMENT TANKS

24022

240-M-109 RECOVERED ACIDIC CONDENSATE TANK

24031

GRAVITY FLOW 24023

240-M-105 TO SOLVENT COOLER

AGITATOR 240-AG-M-399

240-TK-M-174

SLURRY FD. BREAK TANK 300 GAL

EXTRACT SCRUB TK. NO 1 4'-6"x7' 240-TK-M-222

EXTRACT SCRUB TK NO 2 4'-6"x7' 240-TK-M-223

24036

24023

LPS

HPS

PULSE GEN

PULSE GEN

RE-EXTRACTION COL. PULSE GENERATOR 240-PC-M-061

RE-EXTRACTION COL. PULSE GENERATOR 240-PC-M-3650

#1

#2

EXTRACT SCRUB TANK MIX PUMPS 240-PP-M-741

240-PP-M-742

24032

24038

RE-EXTRACTION PULSE COL. 240-PC-M-759

RE-EXTRACTION PULSE COL. 240-PC-M-3627

SLURRY FEED BREAK TK DISCHARGE PUMP 240-PP-M-676

AQUEOUS SCRUB 24033

240-PP-M-740 WASH

RE-EXTRACTION NO. 1

RE-EXTRACTION NO. 2

24035

240-M-105 TO HEXANE HEAD TK

½" BLEED RETURN

6'-6"ϕ x 8'-0" 2000 GAL

24036

#2 UNH DECANTER 240-TK-M-186

6'x 6' ϕ x 8'-0" 2000 GAL

GRAVITY FLOW

24037

240-M-109 CONTINUOUS CONCENTRATION EVAPORATOR

UNH STRIPPING

8910020150-04

Page II. 16-43

No.	DATE	REVISIONS	DESIGNED
3	2/14	UP DATE GENERAL	G. H. Dyer

License # SUB-1010
Amend. # Revision
Date: 09/14/89

BECHTEL
SAN FRANCISCO

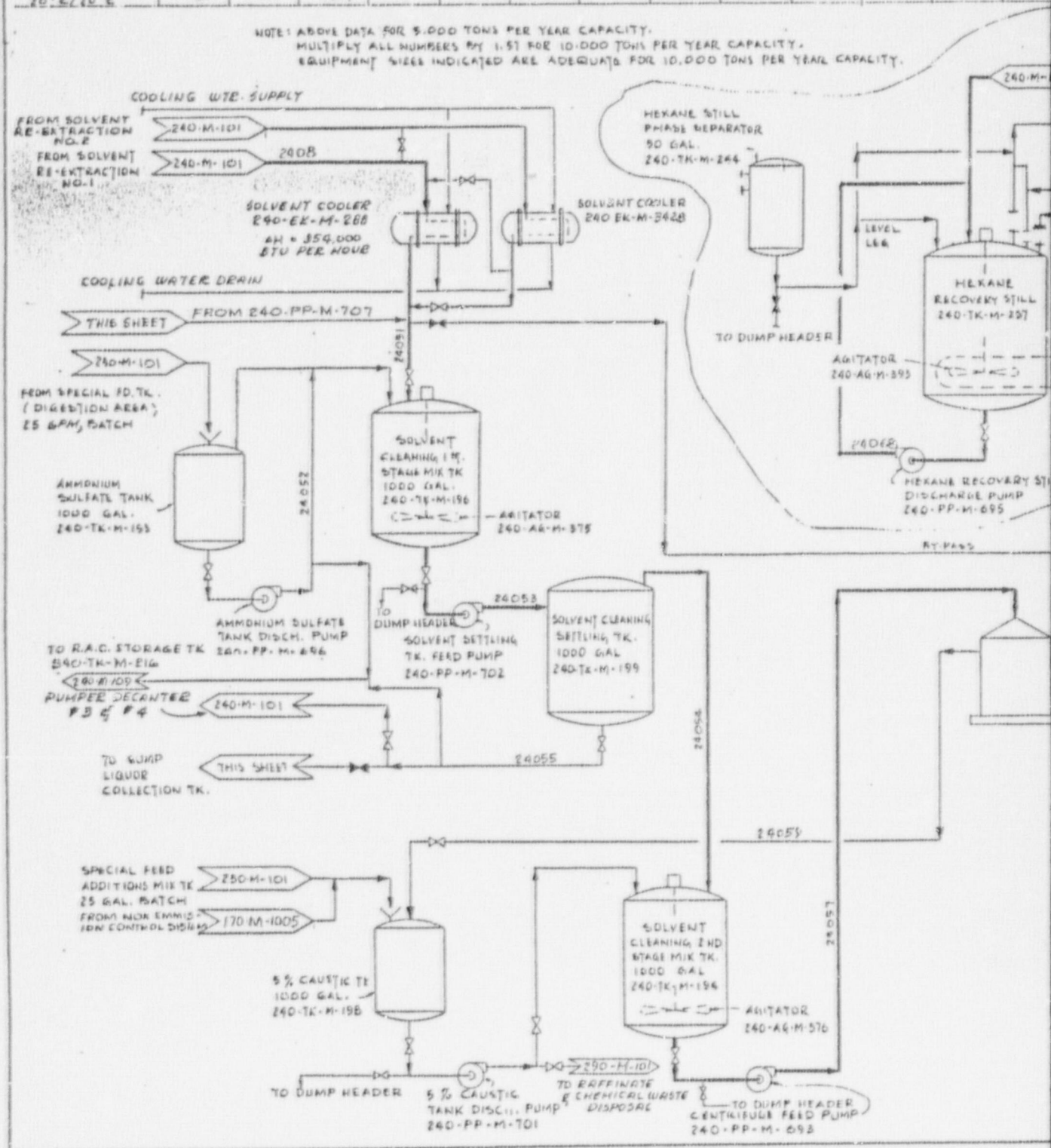
KERR-McGEE CORPORATION
SEQUOYAH FACILITY

SOLVENT EXTRACTION FLOWSHEET

JOB NO.	DRAWING NO.	REV.
6752	240-M-101	3

STREAM NO	2401	2402	2403	2404	2405			24051	24052	24053	24054	24055	
TITLE	SOLVENT TO EXTRACTION	MISC. FROM MISC. TK. TO RAFF. DEC.	MISC. FROM MISC. TK. TO UNH. DEC.	RAFF. DEC. TO STILL	UNH. DEC. TO STILL			TO SOLVENT CLEANING	$(NH_4)_2SO_4$ SOLVENT TO MIX TK.	TO SETTLING TANK	ORGANIC FROM SETTLING TK.	INORGANIC FROM SETTL. TK.	
WEIGHT LBS/MIN.	246.5	5.8	3.8	5.9	3.8			246.5	15.2	261.7	246.9	15.2	
VOLUME GPM AT 60°F	38.4	1.0	.7	1.0	.7			38.4	1.6	39.0	38.4	1.6	
SPECIFIC GRAVITY	.80	.65	.55	.70	.65			.80	1.16	.81	.80	1.14	
HEXANE LBS/MIN.	155.3	3.8	3.8	5.5	3.57			155.3		156.8	155.3		
TBP LBS/MIN	93.2			.45	.3			93.2		93.2	93.2		
WATER LBS/MIN.									11.4	11.4		11.4	
$(NH_4)_2SO_4$ LBS/MIN									3.8	3.8		3.8	
$NaOH$ LBS/MIN													
UN LBS/MIN				TR	TR			TR	TR			TR	
MnO_2 LBS/MIN								TR	TR			TR	
OPERATING TEMP °F	77-95	77-95	77-95	77-95	140			100	77-95	~95	95	95	
VISCOSITY CENTIPOISES 20°C/20°C	.61	.649	.367	.38	.35			.61	1.98	~.8	.61	1.98	

NOTE: ABOVE DATA FOR 5,000 TONS PER YEAR CAPACITY.
MULTIPLY ALL NUMBERS BY 1.57 FOR 10,000 TONS PER YEAR CAPACITY.
EQUIPMENT SIZES INDICATED ARE ADEQUATE FOR 10,000 TONS PER YEAR CAPACITY.



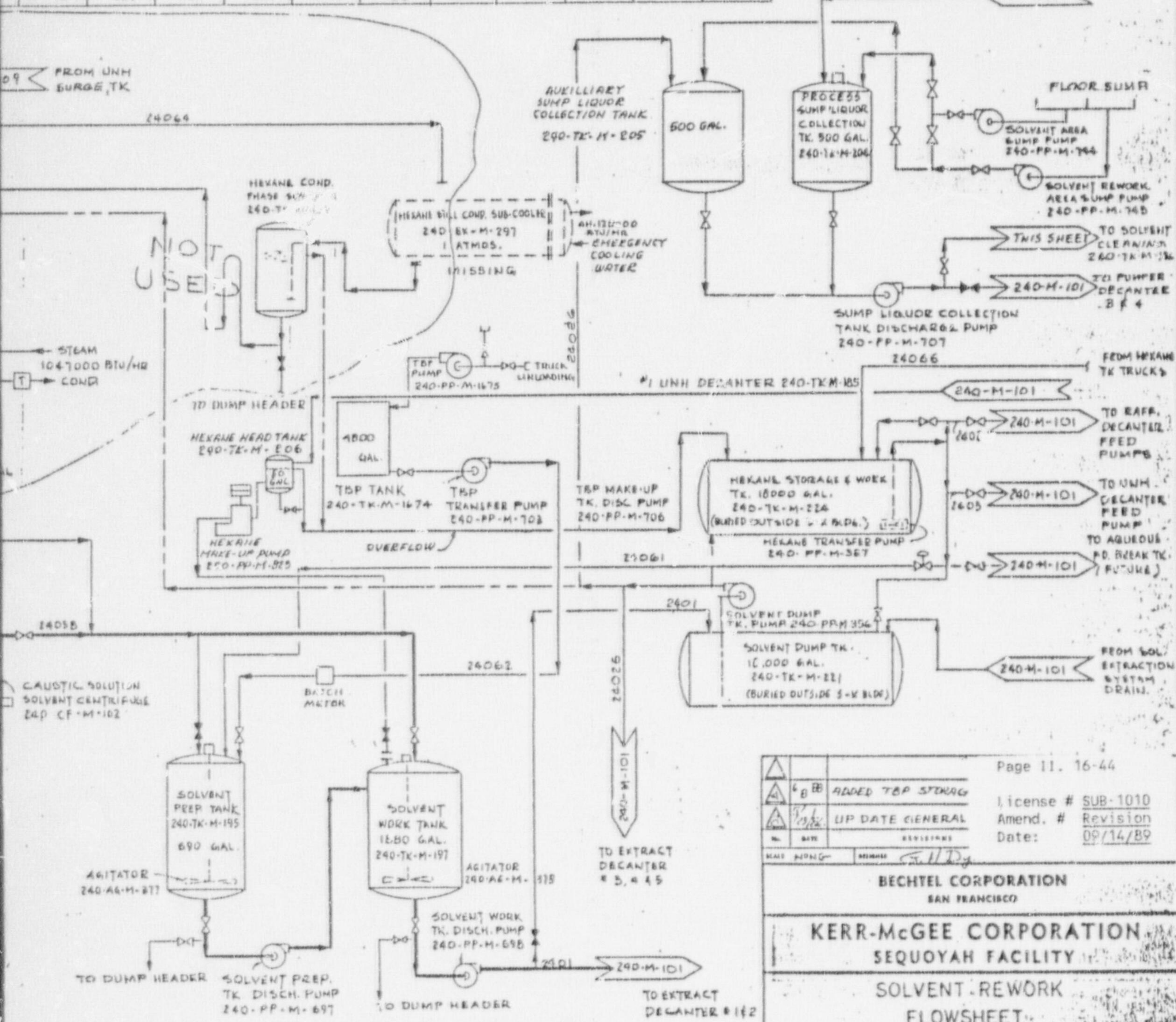
SIZE D

	24057	24058	24059	24061	24062	24063	24064	24065	24066	24067	24068
	TO CENTRIFUGE	ORGANIC FROM CENTRIFUGE	INORGANIC FROM CENTRIFUGE	HEXANE MAKE-UP	TBP MAKE-UP	WET STILL UNDER-FLOW	STILL TO CONDENSING	TO HEXANE WORK TANK	FROM HEX. TANK TRUCKS	FROM TBP DRUMS	STILL RECYCLE
	240.6	245.8	14.8	.5	.23	2.10	7.7	7.7	550	82	83
	40.0	38.4	1.7	0.08	0.08 AVG W/BATCH TRANS	.35	1.34	1.34	100	10	10
	.785	.80	1.04	.65	.97	.81	.69	.65	.65	.98	~1.0
	153.4	152.8	.5	.5		.4	7.7	7.7	550	82	22
	93.2	93.0	.23		.23	.7					11
	15.5		15.5			TR	TR.				30
									BATCH TRANSFER	BATCH TRANSFER	
	.8		.8								
						TR					TR
	~90	90	90	77-95	77-95	160	160	100	80	80	160
	~.76	.61	1.30	.847	3.74	.65	.35	.35	.35	3.74	~1

NOTE
SPACE TO BE LEFT FOR FUTURE PRECIPITATION WITH NH_3 (100 FT²) AND FUTURE CALCINING

SI APERTURE CARD

Also Available On Aperture Card



SOLVENT CLEANING SETTLING TANK
THIS SHEET
FROM UNH SURGE TK
24064
AUXILLIARY SUMP LIQUOR COLLECTION TANK
240-TK-M-205
500 GAL.
PROCESS SUMP LIQUOR COLLECTION TK. 500 GAL. 240-TK-M-206
FLOOR SUMP
SOLVENT AREA SUMP PUMP 240-PP-M-744
SOLVENT REWORK AREA SUMP PUMP 240-PP-M-745
HEXANE COND. PHASE SEPARATOR
HEXANE STILL COND. SUB-COOLER
240-EX-M-297
1 ATMOS.
EMERGENCY COOLING WATER
MISSING
NOT USED
THIS SHEET
TO SOLVENT CLEANING
240-M-101
TO PUMPER DECANTER
SUMP LIQUOR COLLECTION TANK DISCHARGE PUMP
240-PP-M-707
STEAM
1047000 BTU/HR
COND
TBP PUMP
240-PP-M-1675
TRUCK UNLOADING
24066
FROM HEXANE TK TRUCKS
#1 UNH DECANTER 240-TK-M-185
TO DUMP HEADER
240-M-101
HEXANE HEAD TANK
240-TK-M-206
4800 GAL.
TBP TANK
240-TK-M-1674
TBP TRANSFER PUMP
240-PP-M-703
TBP MAKE-UP TK. DISC PUMP
240-PP-M-706
HEXANE STORAGE & WORK TK. 18000 GAL.
240-TK-M-224
(BURIED OUTSIDE S-K BLDG.)
HEXANE TRANSFER PUMP
TO RAFF. DECANTER FEED PUMPS
TO UNH DECANTER FEED PUMP
TO AQUEOUS PD. BREAK TK. (FUTURE)
HEXANE MAKE-UP PUMP
OVERFLOW
24061
24058
2401
SOLVENT DUMP TK. PUMP 240-PP-M-354
SOLVENT DUMP TK. 10,000 GAL.
240-TK-M-221
(BURIED OUTSIDE S-K BLDG)
FROM SOL. EXTRACTION SYSTEM DRAIN.
CAUSTIC SOLUTION
SOLVENT CENTRIFUGE
240 CF-M-102
BATCH METER
24062
24026
SOLVENT PREP TANK
240-TK-M-195
690 GAL.
SOLVENT WORK TANK
1880 GAL.
240-TK-M-197
AGITATOR
240-AG-M-377
AGITATOR
240-AG-M-378
TO EXTRACT DECANTER #3, 4 & 5
SOLVENT WORK TK. DISCH. PUMP
240-PP-M-698
2401
240-M-101
TO DUMP HEADER
SOLVENT PREP. TK. DISCH. PUMP
240-PP-M-697
TO DUMP HEADER
TO EXTRACT DECANTER #1 & 2

No.	DATE	REVISIONS
4	6 88	ADDED TBP STORAG
		UP DATE GENERAL

SCALE NONE

Page 11. 16-44

License # SUB-1010
Amend. # Revision
Date: 09/14/89

BECHTEL CORPORATION
SAN FRANCISCO

KERR-McGEE CORPORATION
SEQUOYAH FACILITY

SOLVENT REWORK FLOWSHEET

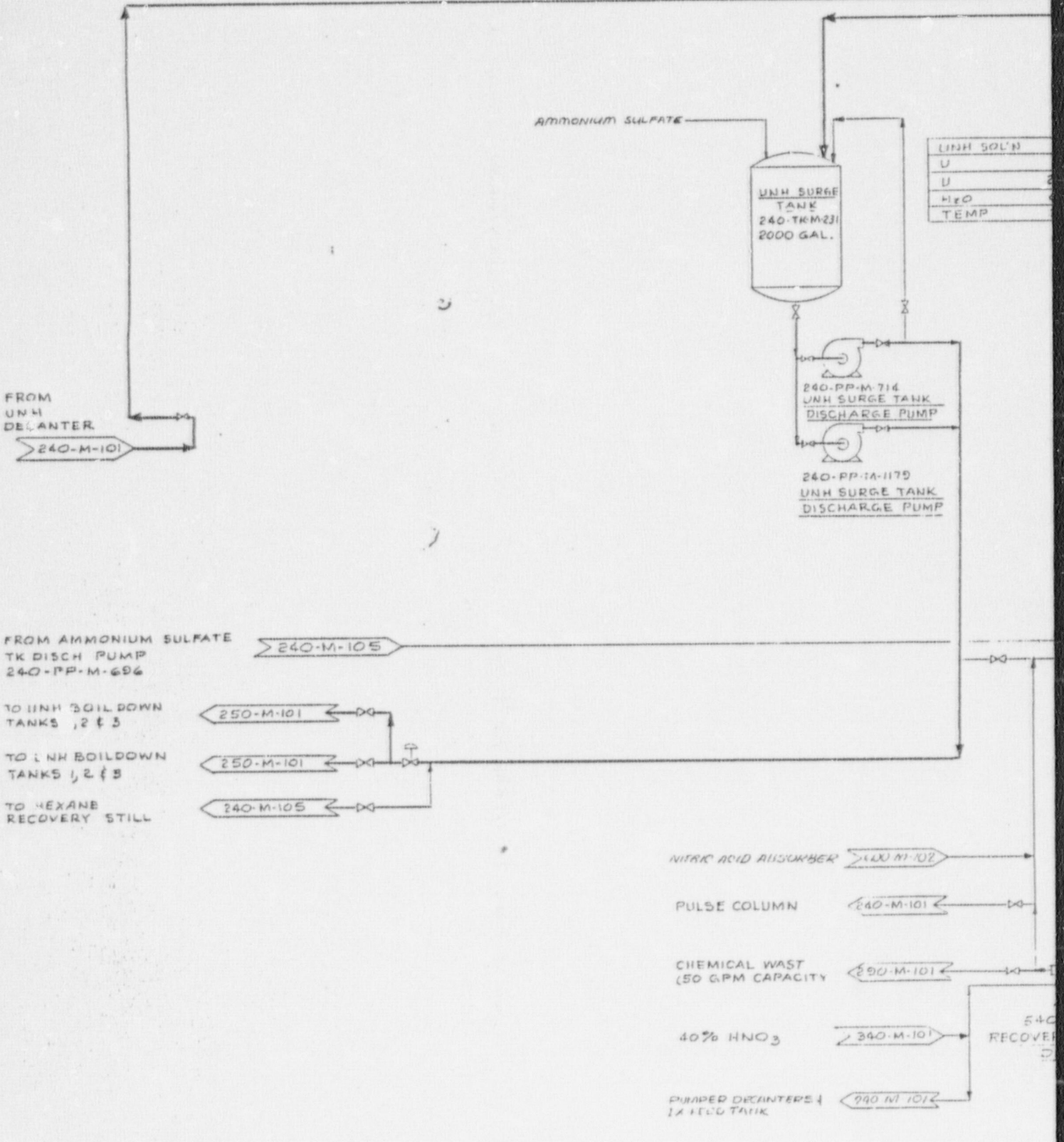
BECHTEL

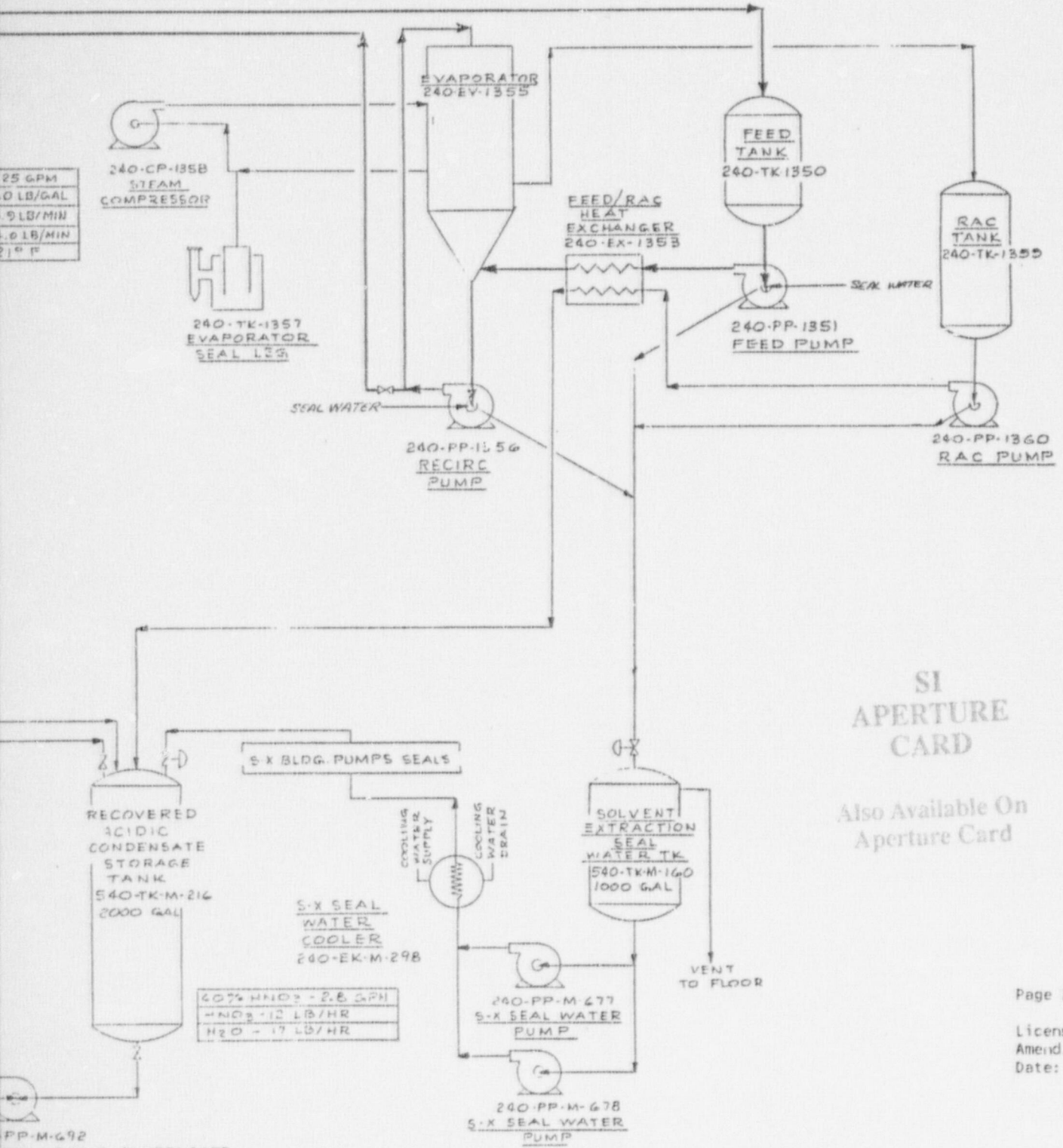
JOB No. 6752

DRAWING No. 240-M-105

REV. 4

8910020150-05


AMMONIUM SULFATE
UNH SURGE TANK 240-TKM-231 2000 GAL.
UNH SOL'N
U
U
H2O
TEMP
240-PP-M-716 UNH SURGE TANK DISCHARGE PUMP
240-PP-M-1179 UNH SURGE TANK DISCHARGE PUMP
FROM UNH DECANTER
240-M-101
FROM AMMONIUM SULFATE TK DISCH PUMP 240-PP-M-696
240-M-105
TO UNH BOILDOWN TANKS 1, 2 & 3
250-M-101
TO UNH BOILDOWN TANKS 1, 2 & 3
250-M-101
TO HEXANE RECOVERY STILL
240-M-105
NITRIC ACID ABSORBER
240-M-102
PULSE COLUMN
240-M-101
CHEMICAL WAST (50 GPM CAPACITY
240-M-101
40% HNO3
240-M-101
PUMPED DECANTERS 1A FEED TANK
240-M-101



License # SUB-1010
Amend. # Revision
Date: 09/14/89

8910020150-06

REV. NO.	DESCRIPTION	BY	DATE	APPR.
4	RE-DRAWN AS BUILT	S AM	3/3/86	JJN
5	REVISION EVAPORATOR	K.S	7-11-8	

SEQUOYAH FUELS CORPORATION

SEQUOYAH FACILITY
GORE, OKLA.

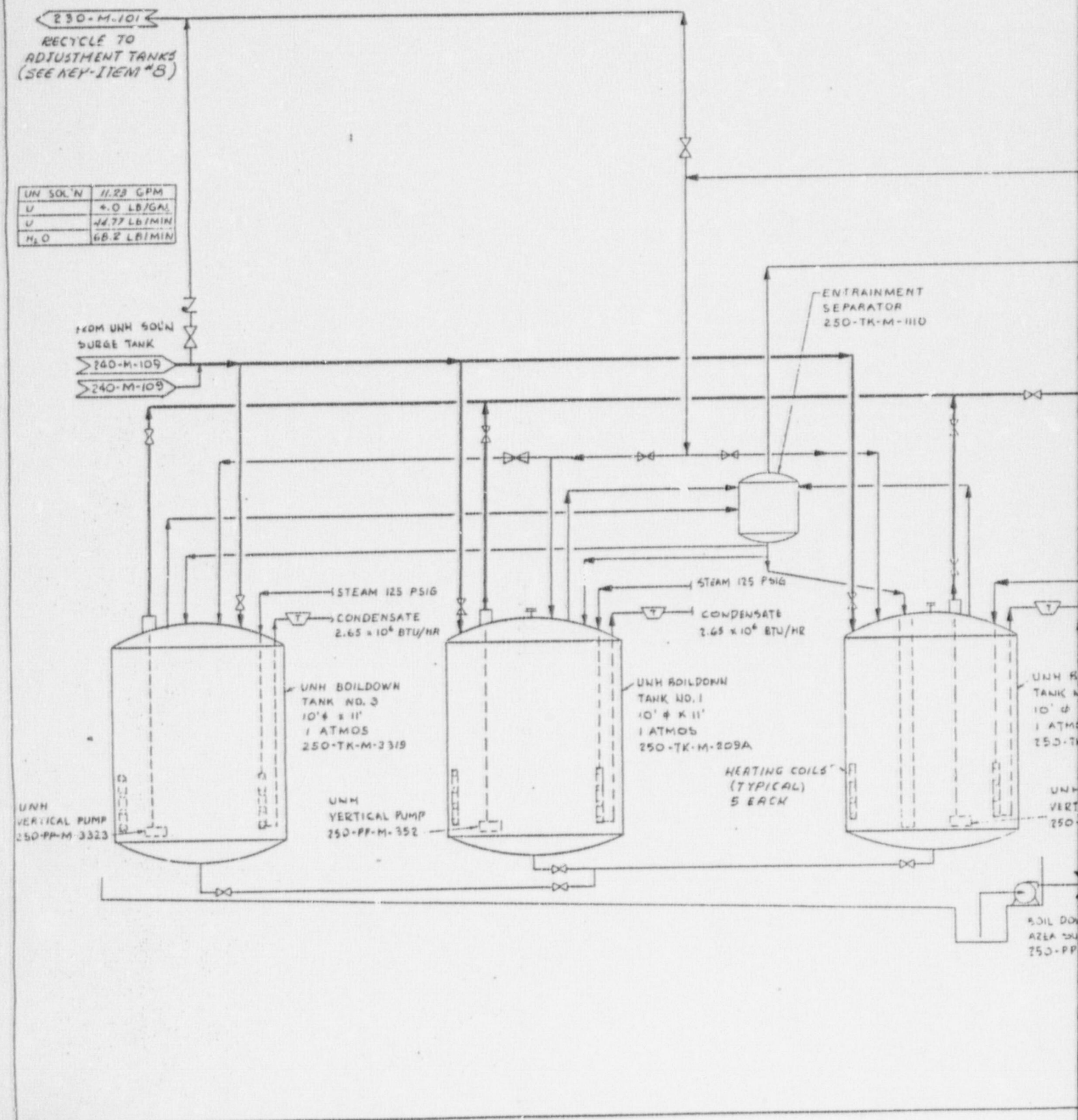
KERR McGEE CORPORATION
OKLAHOMA CITY, OKLA.

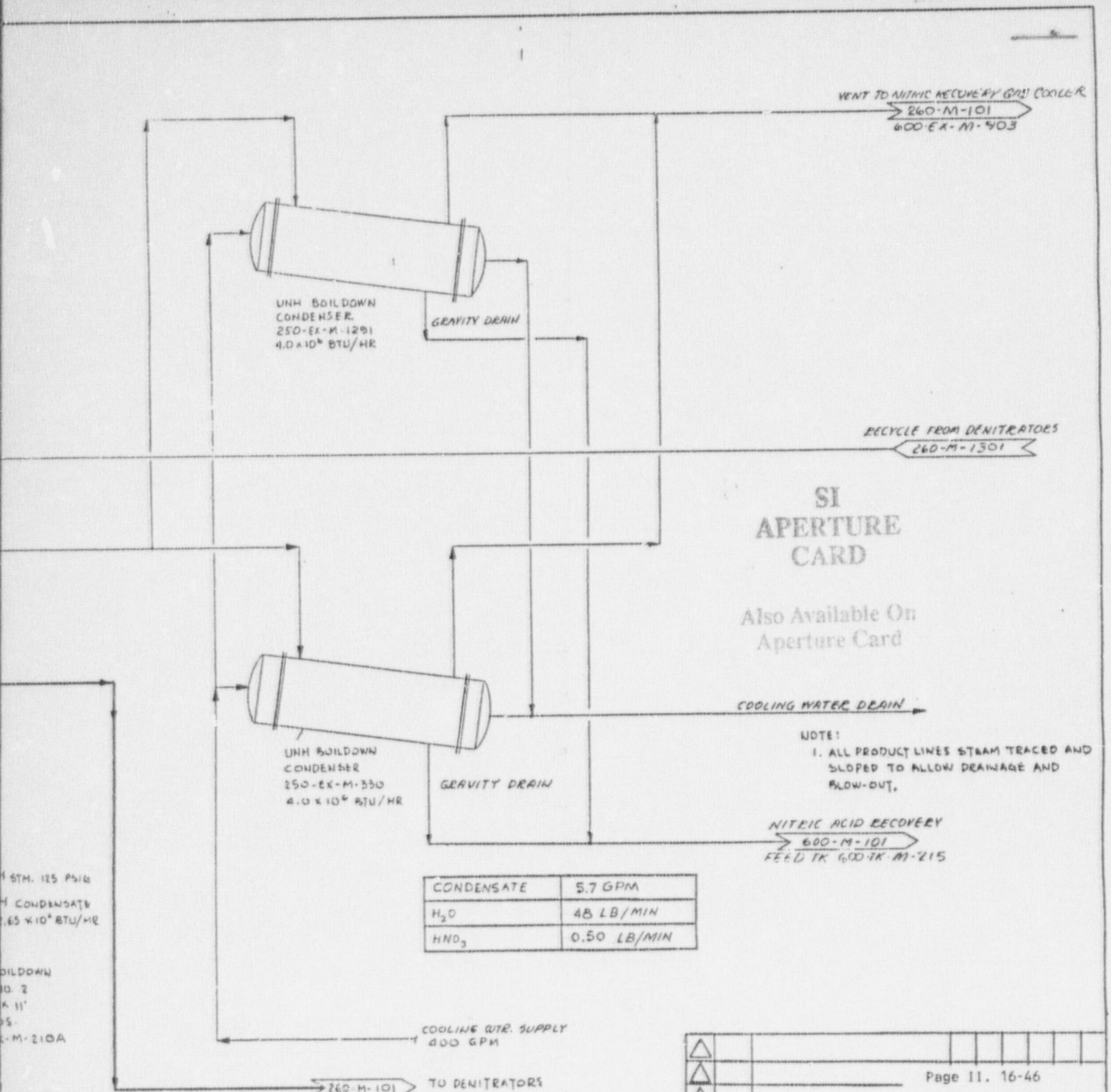
DRAWN VAM DATE 4/3/86
APPROVED L.W.M 6-5-86

EVAPORATION
FLOW SHEET

SCALE NONE

240-M-109


250-M-101
RECYCLE TO ADJUSTMENT TANKS (SEE KEY-ITEM #8)
UN SOL'N 11.23 GPM
U 4.0 LB/GAL
U 44.77 LB/MIN
H2O 68.2 LB/MIN
FROM UNH SOL'N SURGE TANK
240-M-109
240-M-109
ENTRAINMENT SEPARATOR 250-TK-M-1110
STEAM 125 PSIG
CONDENSATE 2.65 x 10^6 BTU/HR
STEAM 125 PSIG
CONDENSATE 2.65 x 10^6 BTU/HR
UNH BOILDOWN TANK NO. 3 10'ϕ x 11' 1 ATMOS 250-TK-M-3319
UNH BOILDOWN TANK NO. 1 10' ϕ x 11' 1 ATMOS 250-TK-M-209A
HEATING COILS (TYPICAL) 5 EACH
UNH VERTICAL PUMP 250-PP-M-3323
UNH VERTICAL PUMP 250-PP-M-352



NOTE:
1. ALL PRODUCT LINES STEAM TRACED AND SLOPED TO ALLOW DRAINAGE AND BLOW-OUT.

CONDENSATE	5.7 GPM
H_2O	48 LB/MIN
HNO_3	0.50 LB/MIN

NET FORWARD FLOW	
UNH	4.4 GPM
U	10.0 LBS/GAL
FREEZING PT.	140 °F
TEMP.	250 °F
TOTAL FLOW	100 GPM
LOOP PRES.	60 PSIG
SP G	2.5
VISCOSITY	3-5 CENTIPOISE

Page 11. 16-46

License # SUB-1010
Amend. # Revision
Date: 09/14/89

No.	DATE	REVISIONS
4	6/23/86	UPDATE GENERAL

DESIGNED G. W. Dyer

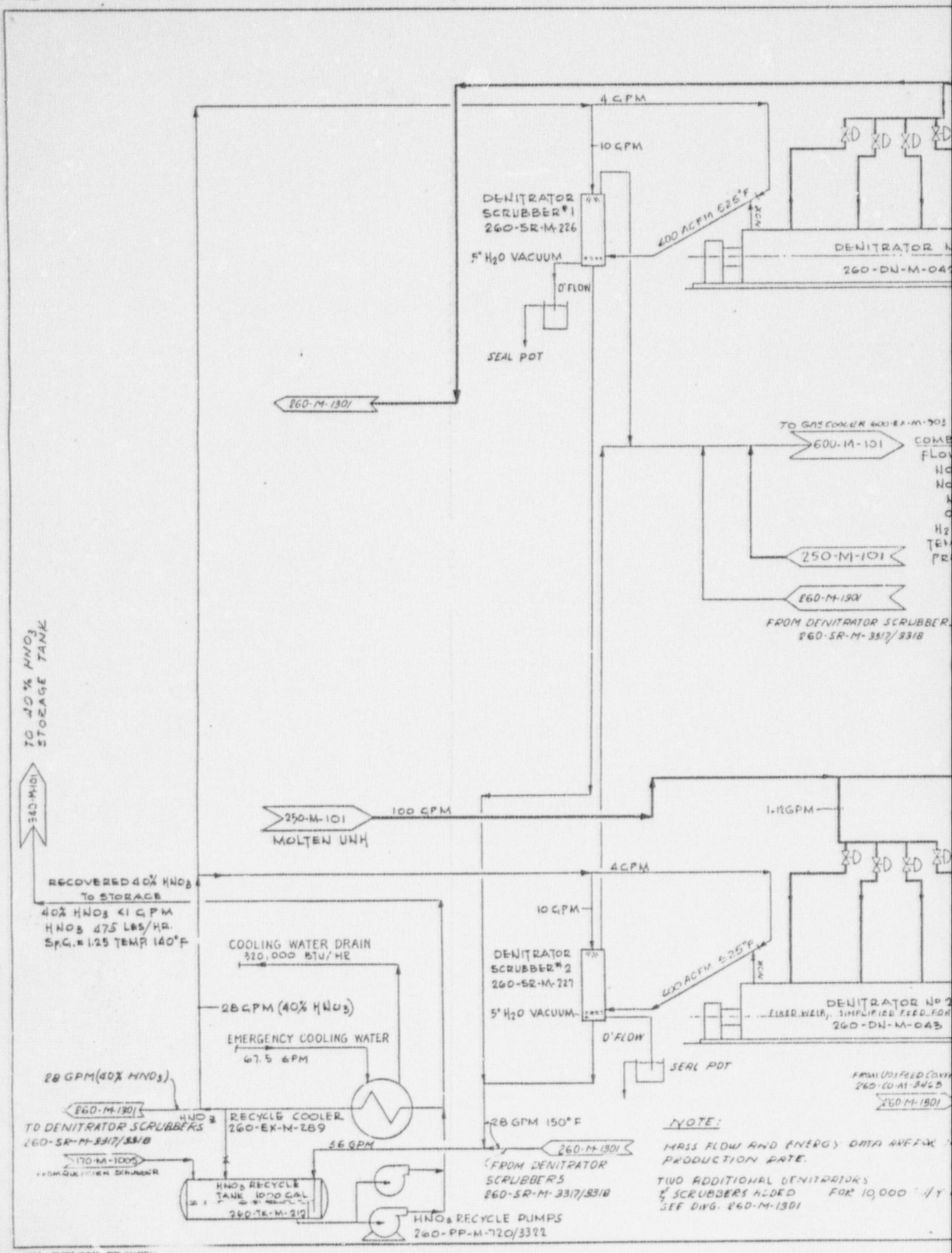
BECHTEL
SAN FRANCISCO

KERR-McGEE CORPORATION
SEQUOYAH FACILITY

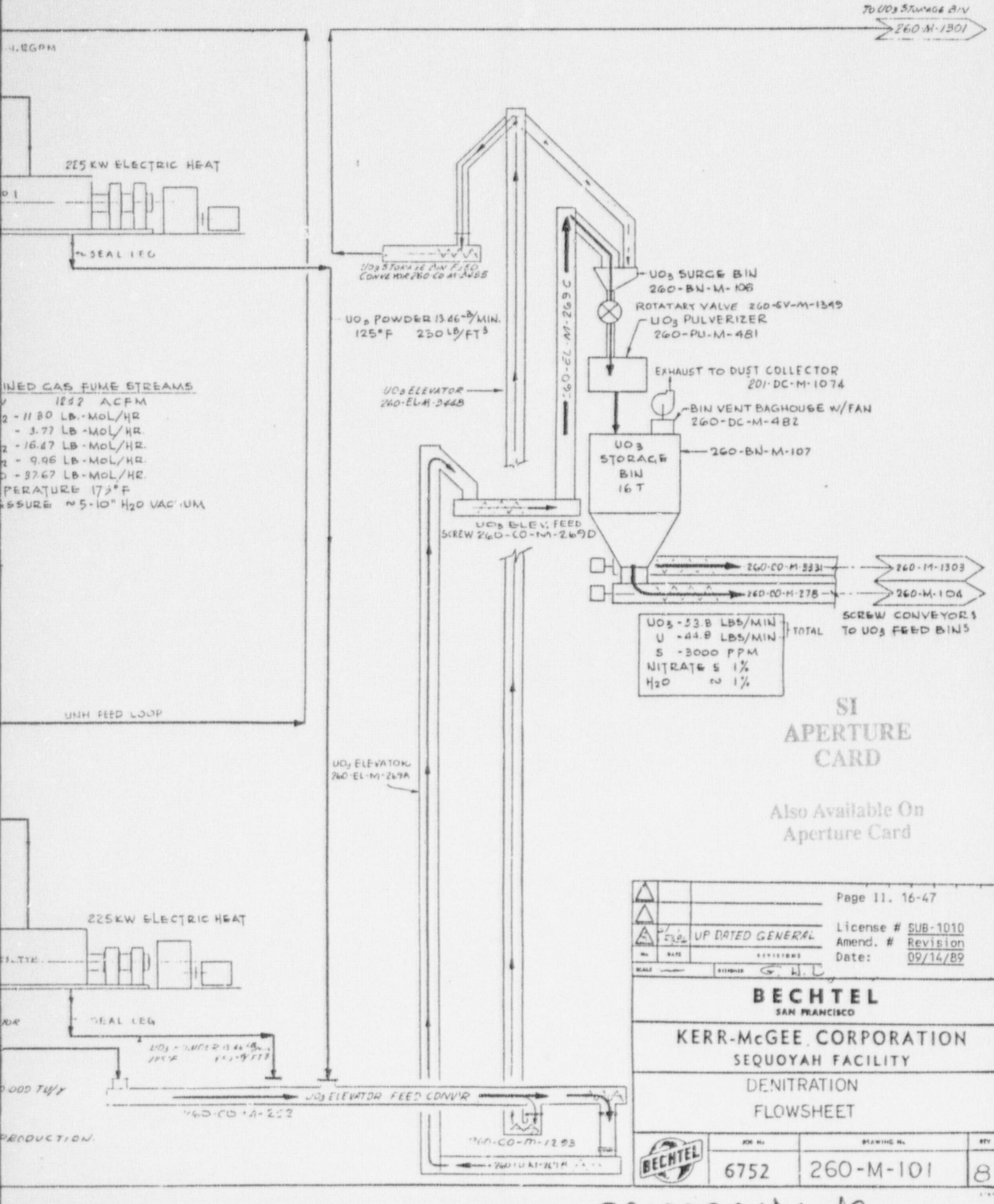
UNH BOILDOWN
FLOW-SHEET

JOB No.	DRAWING No.	REV.
6752	250-M-101	6

8910020150-07


4 GPM
10 GPM
DENITRATOR SCRUBBER #1
260-SR-M-226
400 ACFM 226°F
5" H2O VACUUM
O'FLOW
SEAL POT
260-M-1301
DENITRATOR N
260-DN-M-04
TO GAS COOLER 600-EX-M-303
600-M-101
250-M-101
260-M-1901
FROM DENITRATOR SCRUBBER
260-SR-M-3317/3318
TO 40% HNO3 STORAGE TANK
343-M-101
250-M-101
100 GPM
MOLTEN UNH
1.1 GPM
4 GPM
RECOVERED 40% HNO3 To STORAGE
40% HNO3 41 GPM
HNO3 47.5 LBS/HR.
Sp.G. = 1.25 TEMP 140°F
10 GPM
COOLING WATER DRAIN
320,000 BTU/HR
28 GPM (40% HNO3)
EMERGENCY COOLING WATER
67.5 GPM
DENITRATOR SCRUBBER #2
260-SR-M-227
400 ACFM 225°F
5" H2O VACUUM
O'FLOW
SEAL POT
DENITRATOR NO 2
FIBER WEB, SIMPLIFIED FEED FOR
260-DN-M-043
FROM UO3 FEED CONV
260-CO-M-3403
260-M-1801
28 GPM (40% HNO3)
260-M-1301
HNO3
TO DENITRATOR SCRUBBERS
260-SR-M-3317/3318
RECYCLE COOLER
260-EX-M-289
28 GPM 150°F
56 GPM
260-M-1301
(FROM DENITRATOR SCRUBBERS
260-SR-M-3317/3318
170-M-1009
FROM QUENCHER SCRUBBER
HNO3 RECYCLE TANK 1010 GAL
260-TK-M-319
HNO3 RECYCLE PUMPS
260-PP-M-720/3322
NOTE:
MASS FLOW AND ENERGY DATA ARE FOR
PRODUCTION RATE.
TWO ADDITIONAL DENITRATORS
& SCRUBBERS ADDED FOR 10,000 #/H
SEE DWG. 260-M-1301

SIZE D



Page 11. 16-47

License # SUB-1010
Amend. # Revision
Date: 09/14/89

UP DATED GENERAL

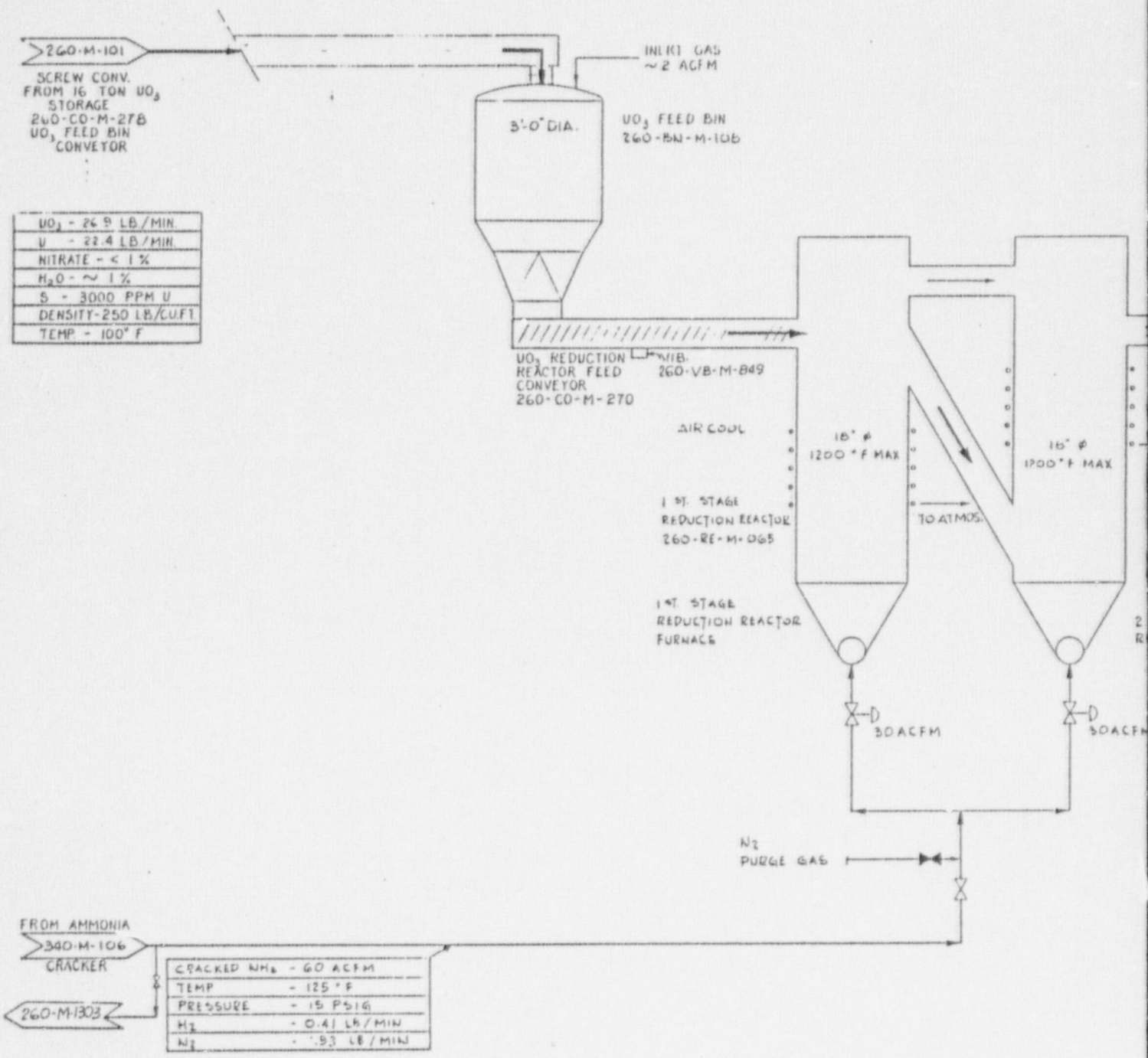
BECHTEL
SAN FRANCISCO

KERR-McGEE CORPORATION
SEQUOYAH FACILITY

DENITRATION
FLOWSHEET

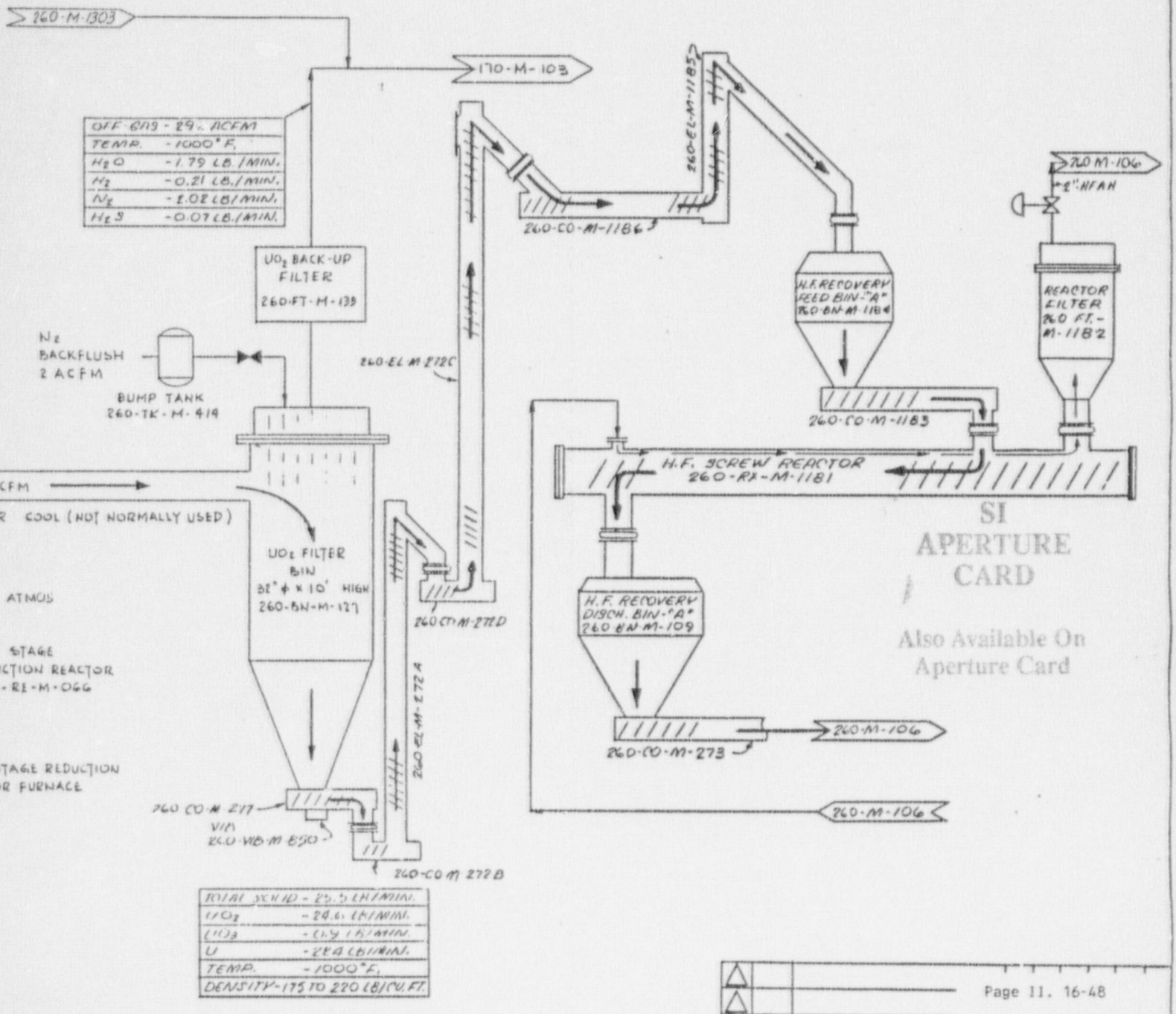
JOB No.	DRAWING No.	REV.
6752	260-M-101	8

8910020150-08


260-M-101
SCREW CONV. FROM 16 TON UO_3 STORAGE 260-CO-M-278 UO_3 FEED BIN CONVEYOR
INERT GAS ~2 ACFM
3'-0" DIA.
UO_3 FEED BIN 260-BN-M-108
UO_3 - 26.9 LB/MIN.
U - 22.4 LB/MIN.
NITRATE - < 1%
H_2O - ~ 1%
S - 3000 PPM U
DENSITY-250 LB/CU.FT.
TEMP. - 100° F
UO_3 REDUCTION REACTOR FEED CONVEYOR 260-CO-M-270
VIB. 260-VB-M-849
AIR COOL
18" ϕ 1200 °F MAX
16" ϕ 1200 °F MAX
1 ST. STAGE REDUCTION REACTOR 260-RE-M-065
10 ATMOS.
1 ST. STAGE REDUCTION REACTOR FURNACE
30ACFM
30ACFM
N_2 PURGE GAS
FROM AMMONIA 340-M-106 CRACKER
260-M-1303
CRACKED NH_3 - 60 ACFM
TEMP - 125 °F
PRESSURE - 15 PSIG
H_2 - 0.41 LB/MIN
N_2 - .93 LB/MIN

SIZE D

NOTE:
1. ONE ADDITIONAL LINE ADDED FOR 10,000 TU/YR.
2. PRODUCTION RATE DATA SHOWN IS FOR 5000 TONS PER YEAR NORMAL RATE OF EACH REDUCTION LINE, RATHER THAN CAPACITY WHICH IS IN EXCESS OF 20 TONS/DAY.



NO.	DATE	REVISIONS
5	8/27/86	UPDATE - GENERAL

Page 11. 16-48
License # SUB-1010
Amend. # Revision
Date: 09/14/89

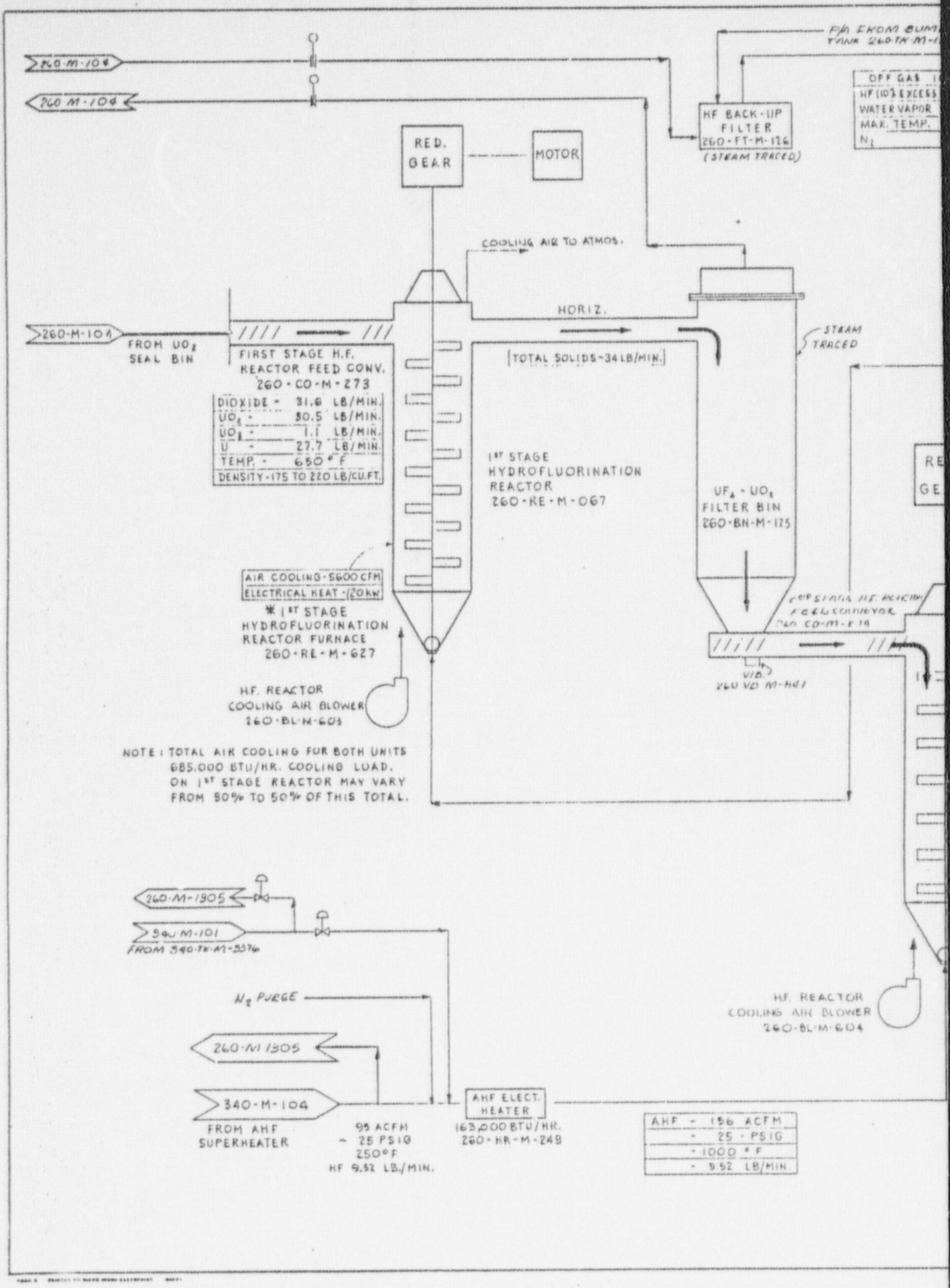
SCALE NONE | DESIGNED G.H. Dyer

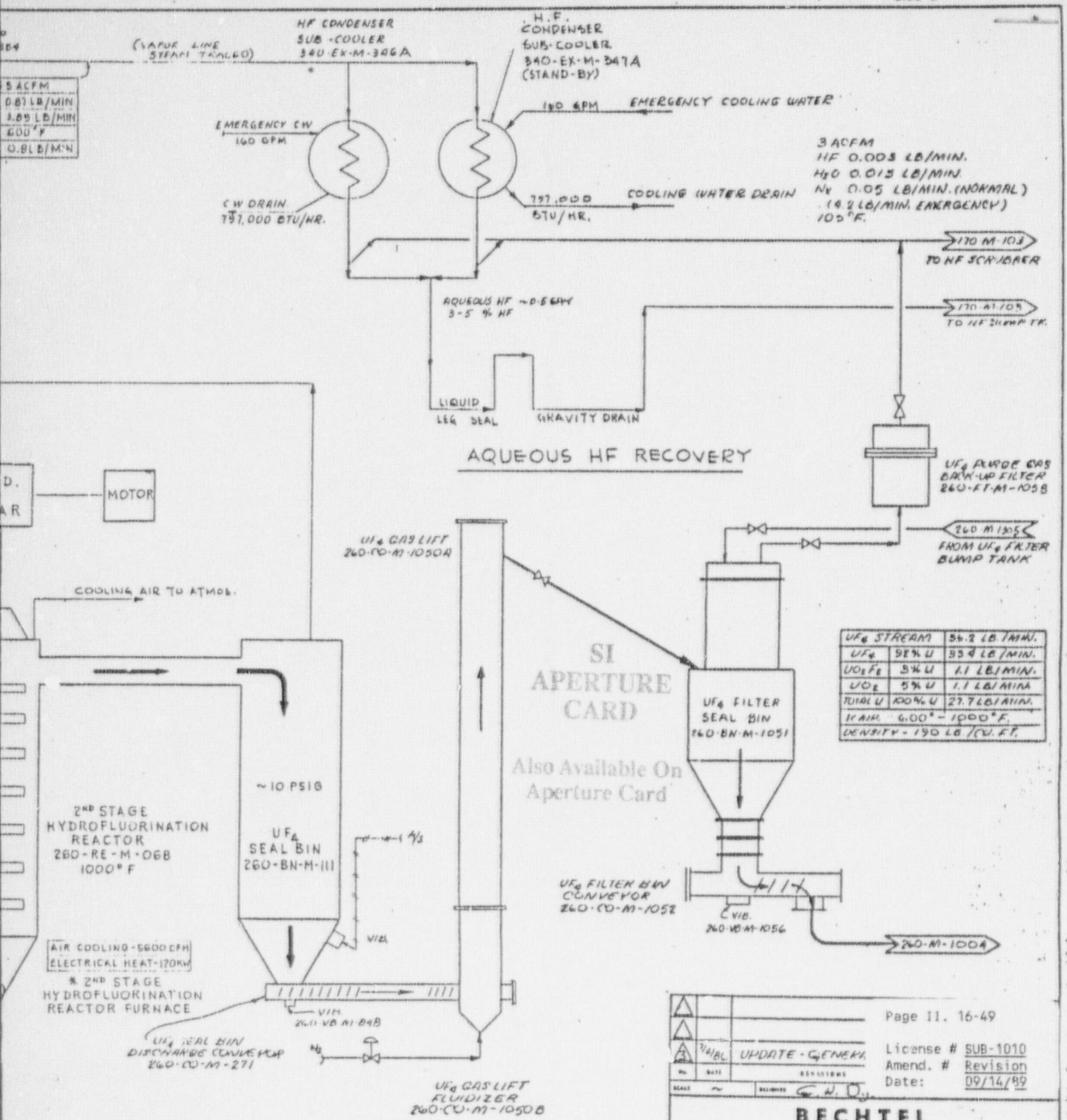
BECHTEL
SAN FRANCISCO

KERR-McGEE CORPORATION
SEQUOYAH FACILITY

REDUCTION
FLOW SHEET

JOB NO.	DRAWING NO.	REV.
6752	260-M-104	5


260-M-104
260-M-104
HF BACK-UP FILTER
260-FT-M-126
(STEAM TRACED)
RED. GEAR
MOTOR
COOLING AIR TO ATMOS.
HORIZ.
260-M-101
FROM UO_2 SEAL BIN
FIRST STAGE H.F. REACTOR FEED CONV.
260-CO-M-273
DIOXIDE - 31.6 LB/MIN.
UO_2 - 80.5 LB/MIN.
UO_3 - 1.1 LB/MIN.
U - 27.7 LB/MIN.
TEMP. - 650° F
DENSITY-175 TO 220 LB/CU.FT.
TOTAL SOLIDS-34 LB/MIN.
STEAM TRACED
1ST STAGE HYDROFLUORINATION REACTOR
260-RE-M-067
UF_4 - UO_2 FILTER BIN
260-BN-M-125
AIR COOLING-5600 CFM
ELECTRICAL HEAT-120KW
* 1ST STAGE HYDROFLUORINATION REACTOR FURNACE
260-RE-M-627
H.F. REACTOR COOLING AIR BLOWER
260-BL-M-603
NOTE: TOTAL AIR COOLING FOR BOTH UNITS 685,000 BTU/HR. COOLING LOAD. ON 1ST STAGE REACTOR MAY VARY FROM 90% TO 50% OF THIS TOTAL.
260-M-1305
340-M-101
FROM 340-TK-M-3376
N_2 PURGE
260-M-1305
340-M-104
FROM AHF SUPERHEATER
95 ACFM
~ 25 PSIG
250°F
HF 9.52 LB./MIN.
AHF ELECT. HEATER
163,000 BTU/HR.
260-HR-M-249
AHF - 156 ACFM
- 25 PSIG
- 1000 °F
- 9.52 LB/MIN.
H.F. REACTOR COOLING AIR BLOWER
260-BL-M-604



NOTES:

1. 1 ADDITIONAL LINE REQUIRED FOR 10,000 TU/Y PRODUCTION. RATE SHOWN IS FOR 20 TONS U PER DAY CAPACITY OF HYDROFLUORINATION LINE RATHER THAN THE NORMAL RATE OF 16.4 TONS U PER DAY.
2. HF RECOVERY EQUIPMENT DESIGN TO INCLUDE A MINIMUM MARGIN OF 100%.

3	3/18/81	UPDATE - GENERAL
NO.	DATE	REVISIONS

License # SUB-1010
Amend. # Revision
Date: 09/14/89

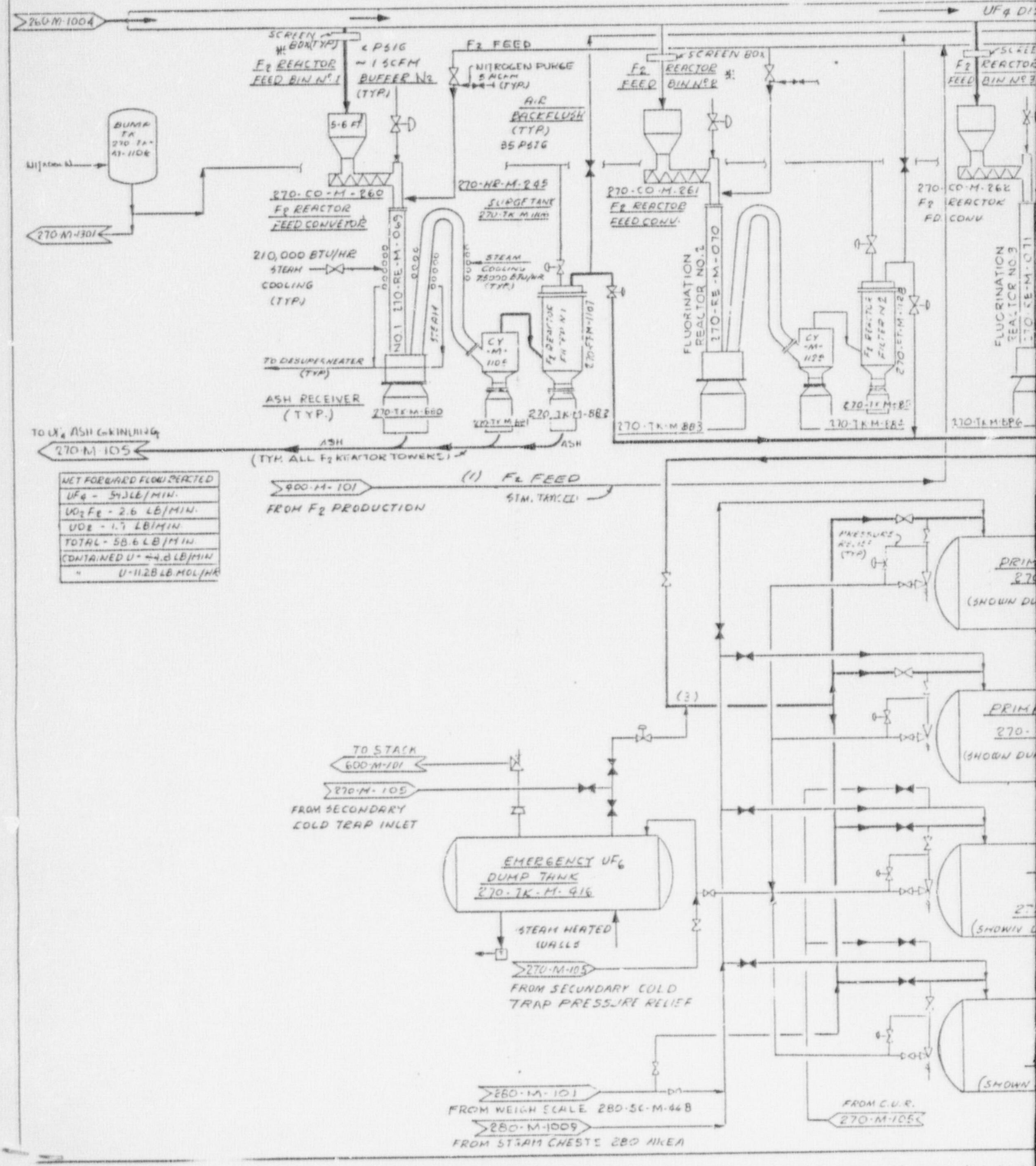
BECHTEL
SAN FRANCISCO

KERR-McGEE CORPORATION
SEQUOYAH FACILITY

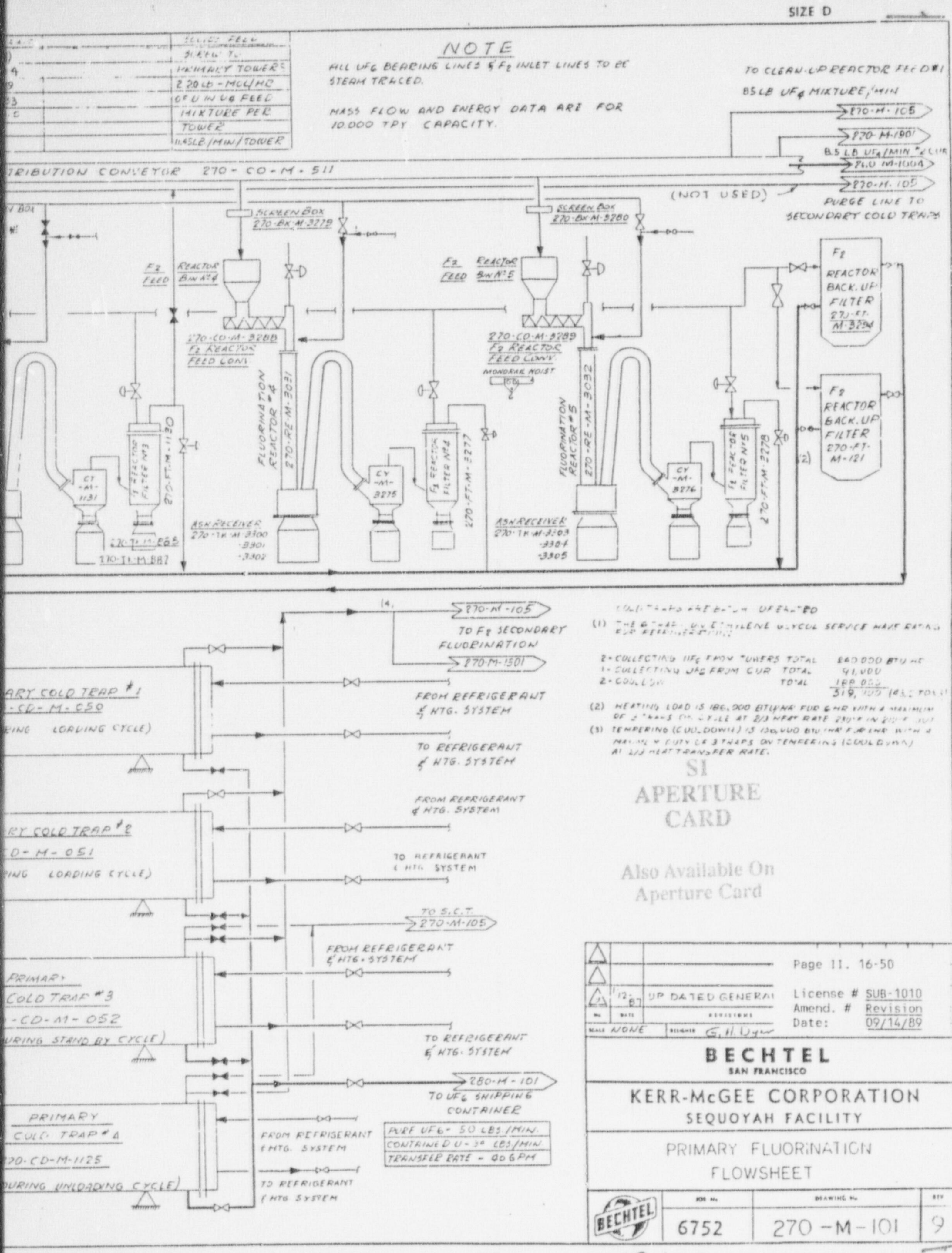
HYDROFLUORINATION FLOWSHEET

JOB NO.	DRAWING NO.	REV.
6752	260-M-106	3

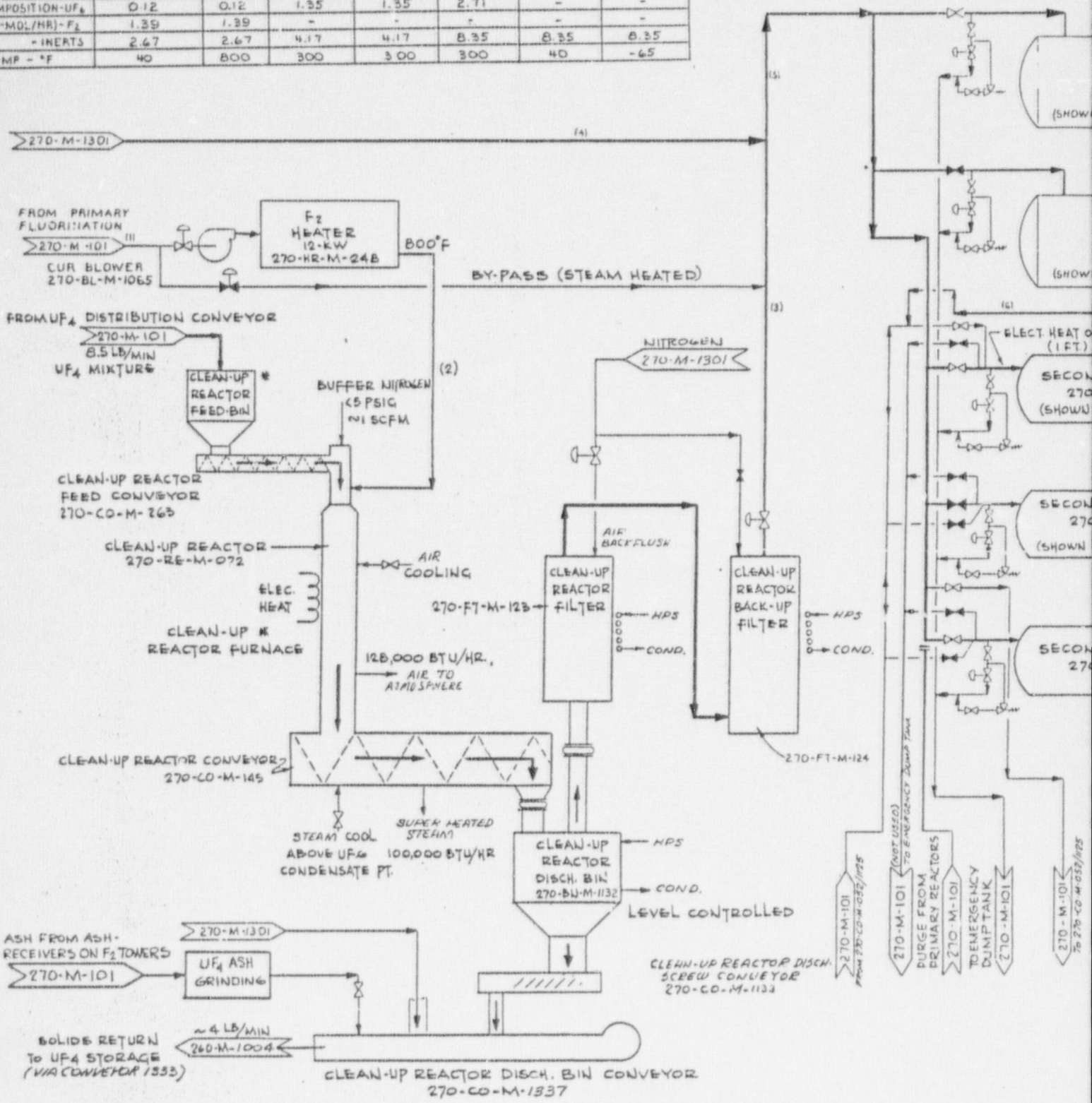
STREAM	F_2 FEED	TOWER INLET	TOWERS [illegible]	COLD TRAP FEED	[illegible]
NUMBER	(1)		(2)	(3)	(
COMPOSITION - UF_6	-		8.82	8.82	0.
(LB MOL/HR) - F_2	12.75		2.79	2.79	2.
- INERTS	.67		1.42	5.33	5
TEMP. °F	100		250	250	4



NET FORWARD FLOW REACTED
UF_4 - 54.3 LB/MIN.
UO_2F_2 - 2.6 LB/MIN.
UO_2 - 1.7 LB/MIN.
TOTAL - 58.6 LB/MIN.
CONTAINED U - 44.8 LB/MIN
" U - 11.28 LB. MOL/HR


SIZE D
NOTE
ALL UF6 BEARING LINES & F2 INLET LINES TO BE STEAM TRACED.
MASS FLOW AND ENERGY DATA ARE FOR 10.000 TPY CAPACITY.
SOLIDS FEED
PRIMARY TOWERS
MIXTURE PER TOWER
11.45LB/MIN/TOWER
TO CLEAN-UP REACTOR FEED #1
85LB UF4 MIXTURE,/MIN
270-M-105
270-M-1301
(NOT USED)
PURGE LINE TO SECONDARY COLD TRAPS
RIBUTION CONVEYOR 270-CO-M-511
SCREEN BOX 270-BX-M-3279
SCREEN BOX 270-BX-M-3280
F2 FEED
REACTOR BIN No 4
REACTOR BIN No 5
270-CO-M-3288
F2 REACTOR FEED CONV
270-CO-M-3289
F2 REACTOR FEED CONV.
MONORAIL HOIST
FLUORINATION REACTOR #4 270-RE-M-3031
FLUORINATION REACTOR #5 270-RE-M-3032
F2 REACTOR BACK-UP FILTER 270-FT-M-3294
F2 REACTOR BACK-UP FILTER 270-FT-M-121
CY-M-1131
CY-M-3275
CY-M-3276
270-FT-M-1130
270-FT-M-3277
270-FT-M-3278
ASH RECEIVER 270-TK-M-3300 -3301 -3302
ASH RECEIVER 270-TK-M-3303 -3304 -3305
270-TK-M-887
TO F2 SECONDARY FLUORINATION
FROM REFRIGERANT & HTG. SYSTEM
TO REFRIGERANT & HTG. SYSTEM
ARY COLD TRAP #1
-CD-M-050
LOADING CYCLE)
RY COLD TRAP #2
CD-M-051
LOADING CYCLE)
TO S.C.T.
PRIMARY COLD TRAP #3
-CD-M-052
DURING STAND BY CYCLE)
PRIMARY COLD TRAP #4
270-CD-M-1125
DURING UNLOADING CYCLE)
280-M-101
TO UF6 SHIPPING CONTAINER
PURE UF6 - 50 LBS/MIN.
TRANSFER RATE - 40 GPM
(2) HEATING LOAD IS 186,000 BTU/HR
(3) TEMPERING (COOLDOWN)
SI APERTURE CARD
Also Available On Aperture Card
UP DATED GENERAL
SCALE NONE
Page II. 16-50
License # SUB-1010
Amend. # Revision
Date: 09/14/89
BECHTEL
SAN FRANCISCO
KERR-McGEE CORPORATION
SEQUOYAH FACILITY
PRIMARY FLUORINATION FLOWSHEET
6752
270-M-101
9
8910020150-11

STREAM	FROM PRIMARY FLUORINATION	REACTOR INLET	FROM #1 CUR	FROM #2 CUR	CUR COLD TRAP FEED	CUR TRAP EXIT	SEC. TRAP EXIT
NUMBER	(1)	(2)	(3)	(4)	(5)	(6)	(7)
COMPOSITION-UF_6	0.12	0.12	1.35	1.35	2.71	-	-
(LB-MOL/HR)-F_2	1.39	1.39	-	-	-	-	-
- INERTS	2.67	2.67	4.17	4.17	8.35	8.35	8.35
TEMP - °F	40	800	300	300	300	40	-65



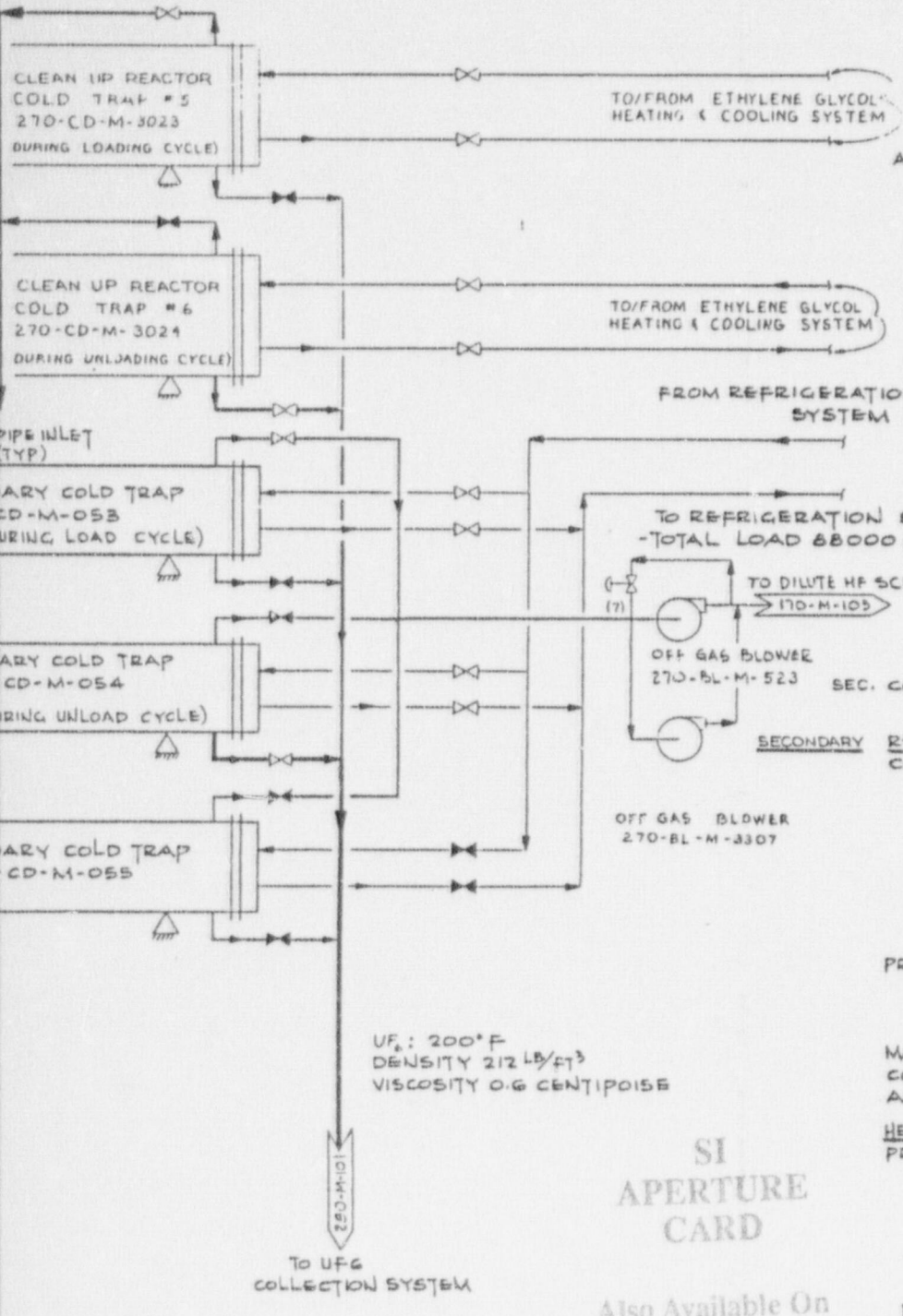
SIZE D

CVB COLD TRAP REFRIGERATION SYSTEM:

CLEANUP REACTOR COLD TRAPS ARE BATCH OPERATED. ONE ON LINE AT A TIME. SECOND BATCH UNLOADING.

UF_6 COLLECTION - 91,000 BTU/HR

FOR COOLDOWN AND MELTDOWN LOADS SEE DWG Nº 270-M-101.



ALL UF_6 BEARING LINES TO BE STEAM TRACED

ONE SECONDARY COLD TRAP-REFRIGERATION UNIT REQUIRED
270-RF-M-402 270-PP-M-794/795

ONE SECONDARY COLD TRAP - TEMPERING HEAT EXCHANGER REQ.
270-EX-M-290

SEC. COLD TRAPS ARE BATCH OPERATED, ONE AT A TIME - ONE ON LINE & ONE UNLOADING.

SECONDARY REFRIGERATION SYSTEM:

COOL DOWN - STEP 1 - BY RECIRCULATION OF TEMPERED FREON BRINE IN INTERNAL COILS. 55,000 BTU/HR. FOR 1 HOUR.

- STEP 2 - BY RECIRCULATION OF FREON BRINE IN INTERNAL TUBES (-75°F ON SHELL SIDE) 53,000 BTU/HR FOR 1 HOUR

PRODUCT TRAPPING -

- STEP 3 - SAME AS STEP 2 50,000 BTU/HR DURING - LOADING PERIOD.

MAXIMUM LOAD ON REFRIGERATION WHEN - CONDUCTING STEP 2 IN ONE TRAP & STEP 3 IN - ANOTHER, 103,000 BTU/HR (8.6 TONS REFRIGERATION)

HEATING & COOLING SYSTEM

PRODUCT MELTDOWN: STEP 4 - BY RECIRCULATION - OF TEMPERED BRINE, THEN FREON VAPOR - SEE P&ID 270-M-1013

- STEP 1 - SEE ABOVE

SIMULTANEOUS HEATING & COOLING CAPABILITY REQD.

NOTE:
SECONDARY REFRIGERATION HEATING, AND COOLING SYSTEM DATA HAS NOT BEEN UPDATED FOR THE 10,000 TU/YR

No.	DATE	REVISIONS	DESIGNED
6	8/86	UPDATE - GENERAL	G. H. Dyer

Page II. 16-51

License # SUB-1010
Amend. # Revision
Date: 09/14/89

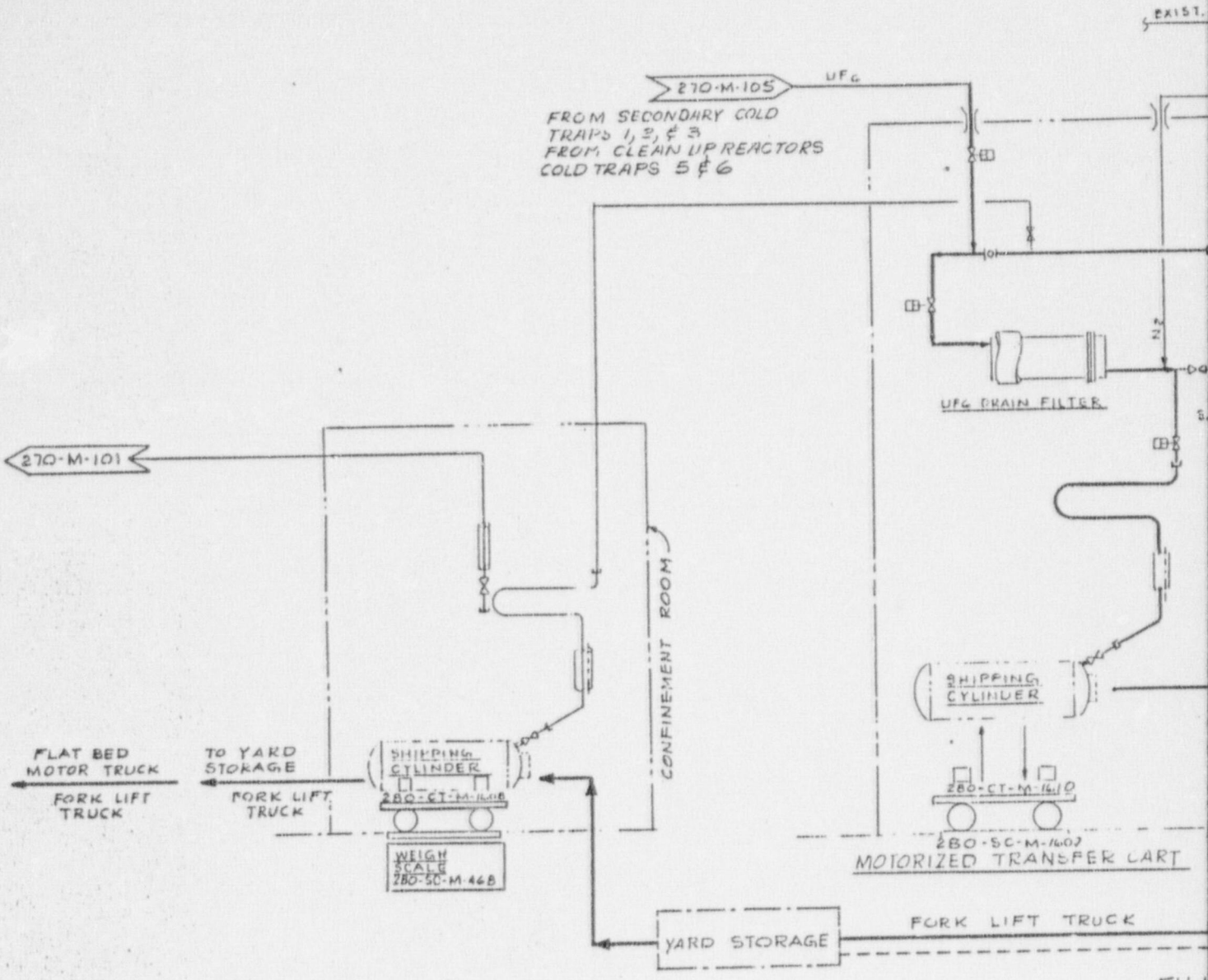
BECHTEL
SAN FRANCISCO

KERR-McGEE CORPORATION
SEQUOYAH FACILITY

SECONDARY FLUORINATION FLOWSHEET

JOB No.	DRAWING No.	REV.
6752	270-M-105	6

8910020150-12

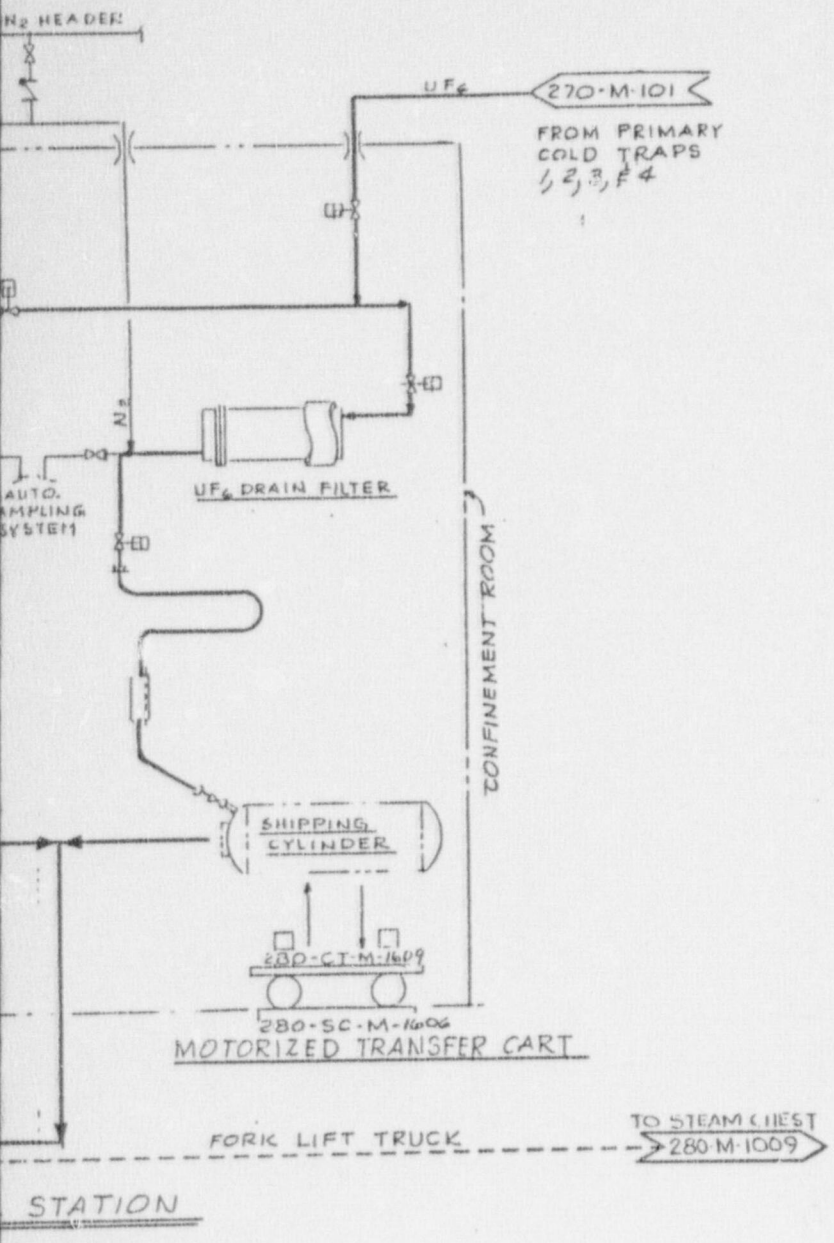

EXIST.
270-M-105
UF6
FROM SECONDARY COLD TRAPS 1, 2, & 3
FROM CLEAN UP REACTORS COLD TRAPS 5 & 6
UF6 DRAIN FILTER
N2
270-M-101
CONFINEMENT ROOM
SHIPPING CYLINDER
2BO-CT-M-1610
2BO-SC-M-1607
MOTORIZED TRANSFER CART
FLAT BED MOTOR TRUCK
FORK LIFT TRUCK
TO YARD STORAGE
FORK LIFT TRUCK
SHIPPING CYLINDER
2BO-CT-M-1611B
WEIGH SCALE
2BO-SC-M-468
YARD STORAGE
FORK LIFT TRUCK
ACCOUNTABILITY
WEIGH STATION

SIZE D

NOTE:

ALL TRANSFER LINES STEAM TRACED AND SLOPED FOR GRAVITY FLOW.

EQUIPMENT SHOWN IS FOR 5,000 TO 10,000 T/Y CAPACITY.



NO.	DATE	REVISIONS
1	12-87	UP DATED GENERAL

Page II. 16-52

License # SUB-1010
Amend. # Revision
Date: 09/14/89

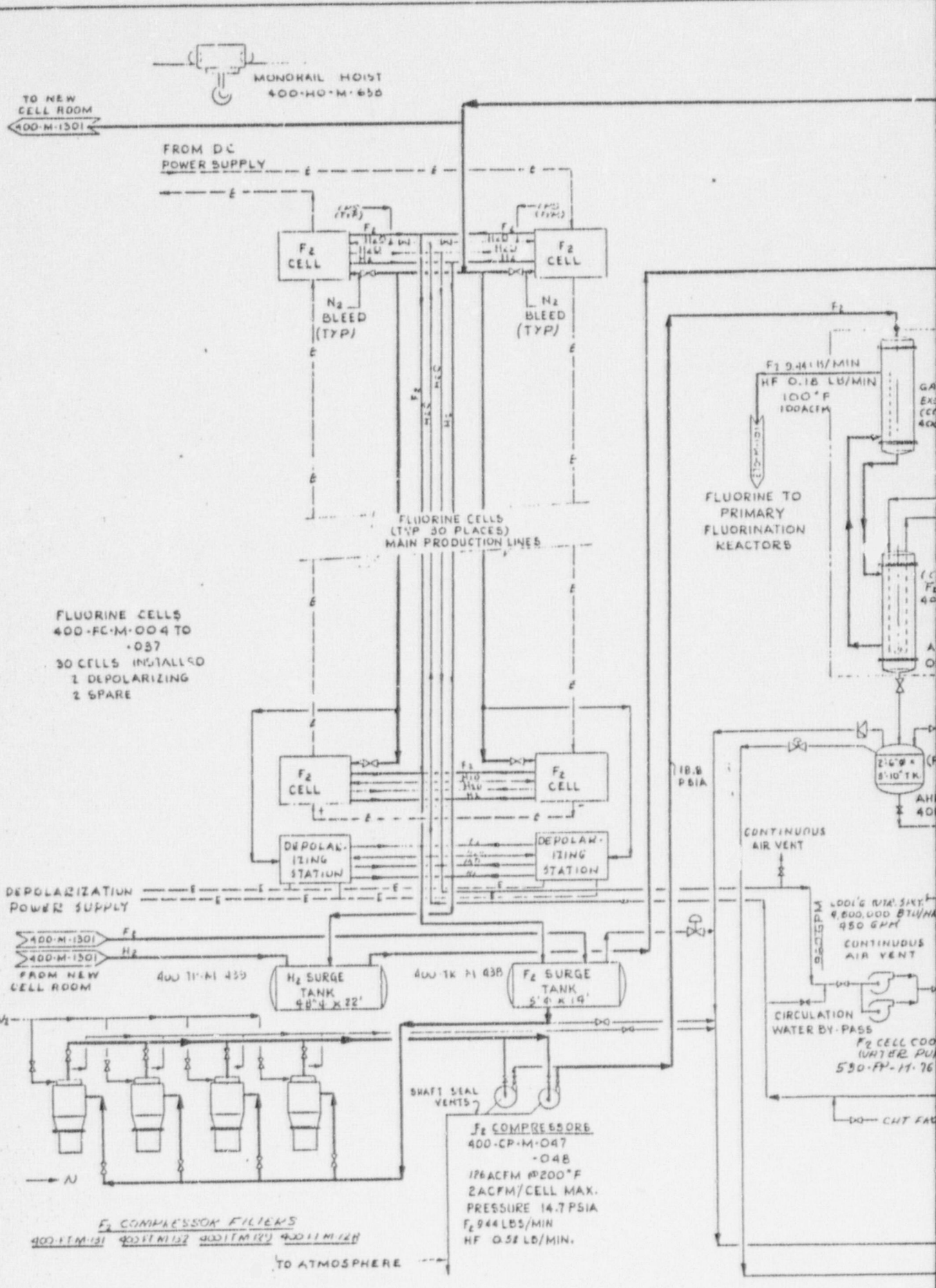
SCALE NONE DESIGNED G.N. Dyer

BECHTEL
SAN FRANCISCO

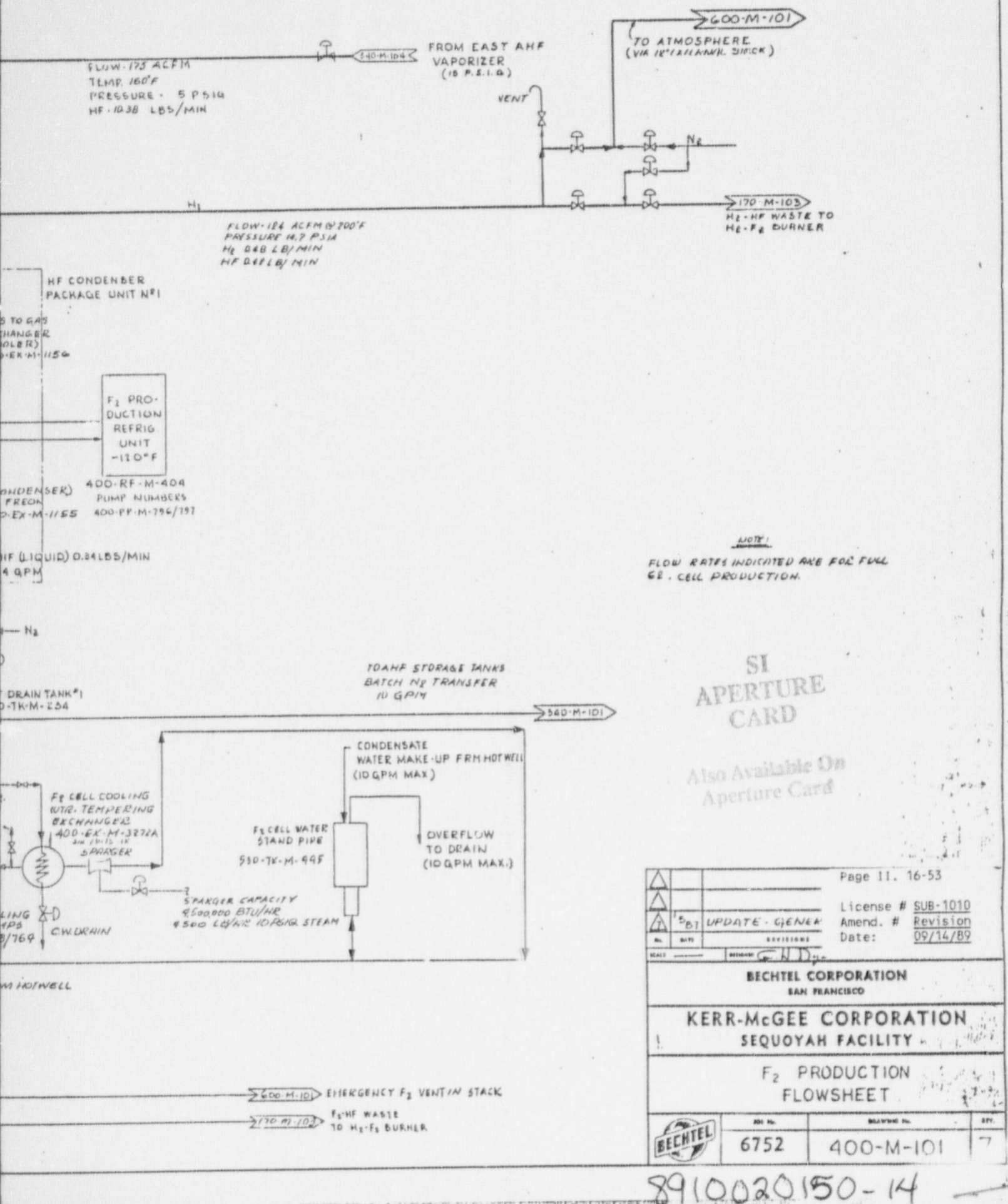
KERR-McGEE CORPORATION
SEQUOYAH FACILITY

PRODUCT SHIPPING
FLOWSHEET

JOB No.	DRAWING No.	REV.
6752	280-M-101	4


MONORAIL HOIST
400-HO-M-650
TO NEW CELL ROOM
400-M-1301
FROM DC POWER SUPPLY
F2 CELL
F2 CELL
N2 BLEED (TYP)
N2 BLEED (TYP)
FLUORINE CELLS (TYP 30 PLACES) MAIN PRODUCTION LINES
FLUORINE CELLS
400-FC-M-004 TO -037
30 CELLS INSTALLED
1 DEPOLARIZING
2 SPARE
F2 CELL
F2 CELL
DEPOLARIZING STATION
DEPOLARIZING STATION
DEPOLARIZATION POWER SUPPLY
400-M-1301
400-M-1301
FROM NEW CELL ROOM
400 TK M 438
H2 SURGE TANK 48'-4" X 22'
400 TK M 438
F2 SURGE TANK 5'-0" X 19'
N2
F2 COMPRESSOR FILTERS
400-FTM-131 400-FTM-132 400-FTM-134 400-FTM-135
SHAFT SEAL VENTS
F2 COMPRESSORS
400-CP-M-047
-048
176 ACFM @ 200°F
2ACFM/CELL MAX.
PRESSURE 14.7 PSIA
F2 944 LBS/MIN
HF 0.58 LB/MIN.
TO ATMOSPHERE
F2
F2 9.44 LB/MIN
HF 0.18 LB/MIN
100°F
1000ACFM
FLUORINE TO PRIMARY FLUORINATION REACTORS
18.8 PSIA
CONTINUOUS AIR VENT
CONTINUOUS AIR VENT
CIRCULATION WATER BY-PASS

SIZE D



NOTE 1
FLOW RATES INDICATED ARE FOR FULL GE. CELL PRODUCTION.

Page II. 16-53

License # SUB-1010
Amend. # Revision
Date: 09/14/89

No.	DATE	REVISIONS
5	B.T.	UPDATE - GENERA

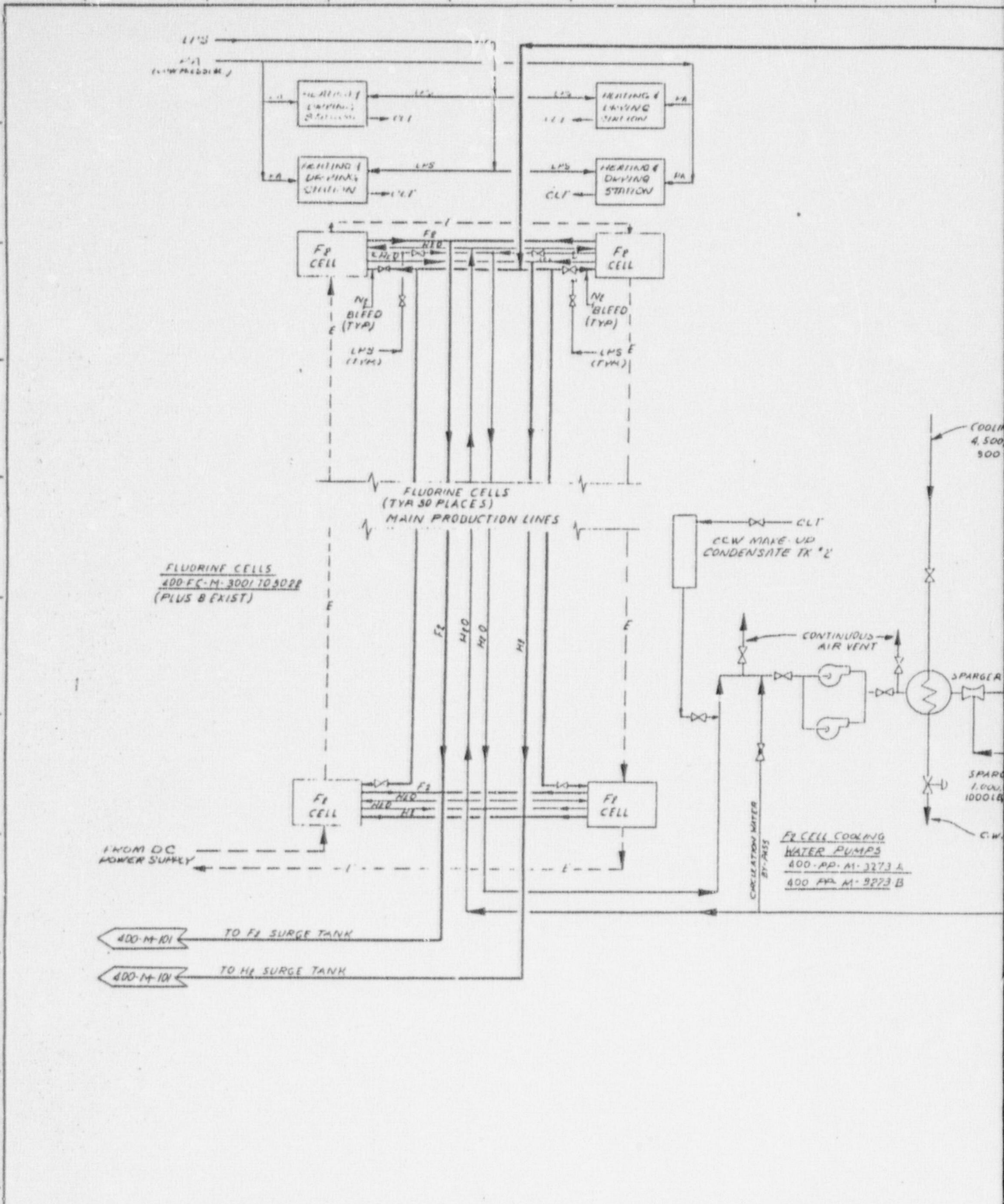
SCALE: —— DESIGNED: [illegible]

BECHTEL CORPORATION
SAN FRANCISCO

KERR-McGEE CORPORATION
SEQUOYAH FACILITY

F_2 PRODUCTION FLOWSHEET

BECHTEL	JOB No.	DRAWING No.	REV.
	6752	400-M-101	7

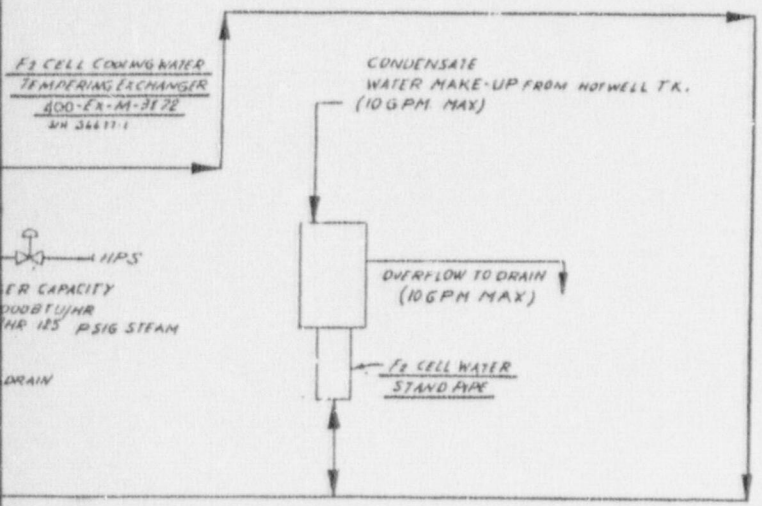


NO	REVISIONS	DATE	BY	CHK	APP'D	NO	REFERENCE DRAWINGS
1	UPDATE SCHEMATIC REV.	[illegible]	[illegible]	[illegible]		400-M-101	EXIST. F2 PRODUCTION FLOWSHEET

400-M-101 FROM LAST VARIANCE

FLOW - 87.5 ACFM.
TEMP. - 160°F
PRESSURE - 5 PSIG
ΔP - 5.19 LBS/MIN.

16 WATER SUPPLY
000 BTU/HR.
G.P.M.



Page 11. 16 54

License # SUB-1010
Amend. # Revision
Date: 09/14/82

8910020150-15

PRINT RECORD		ENG RECORD			DRAWING STATUS	
DATE		DRAWN	T.V.	7.8.74	ISSUED	DATE
FOM		CHECKED	K.B.	7.9.74	PRELIMINARY	
REVISED		MECH. CK.			FOR COMMENTS AND/OR APPROVAL	7.11.74
CUSTOMER		STRUCT. CK.			APPROVED FOR CONSTRUCTION	7.30.74
INTRA CO.		ELECT. CK.			REVISED & APPROVED FOR CONSTRUCTION	
		PIPING CK.	[illegible]	7-9-74		
		INSTR. CK.				
		CIVIL CK.				

Plot approved for construction unless signed and dated. Destroys all prints bearing earlier date and/or revision number.

KERR-McGEE NUCLEAR CORPORATION
SEQUOYAH FACILITY

F_2 PRODUCTION PLANT
NO. 2 CELL ROOM
PIPING
PROCESS FLOWSHEET

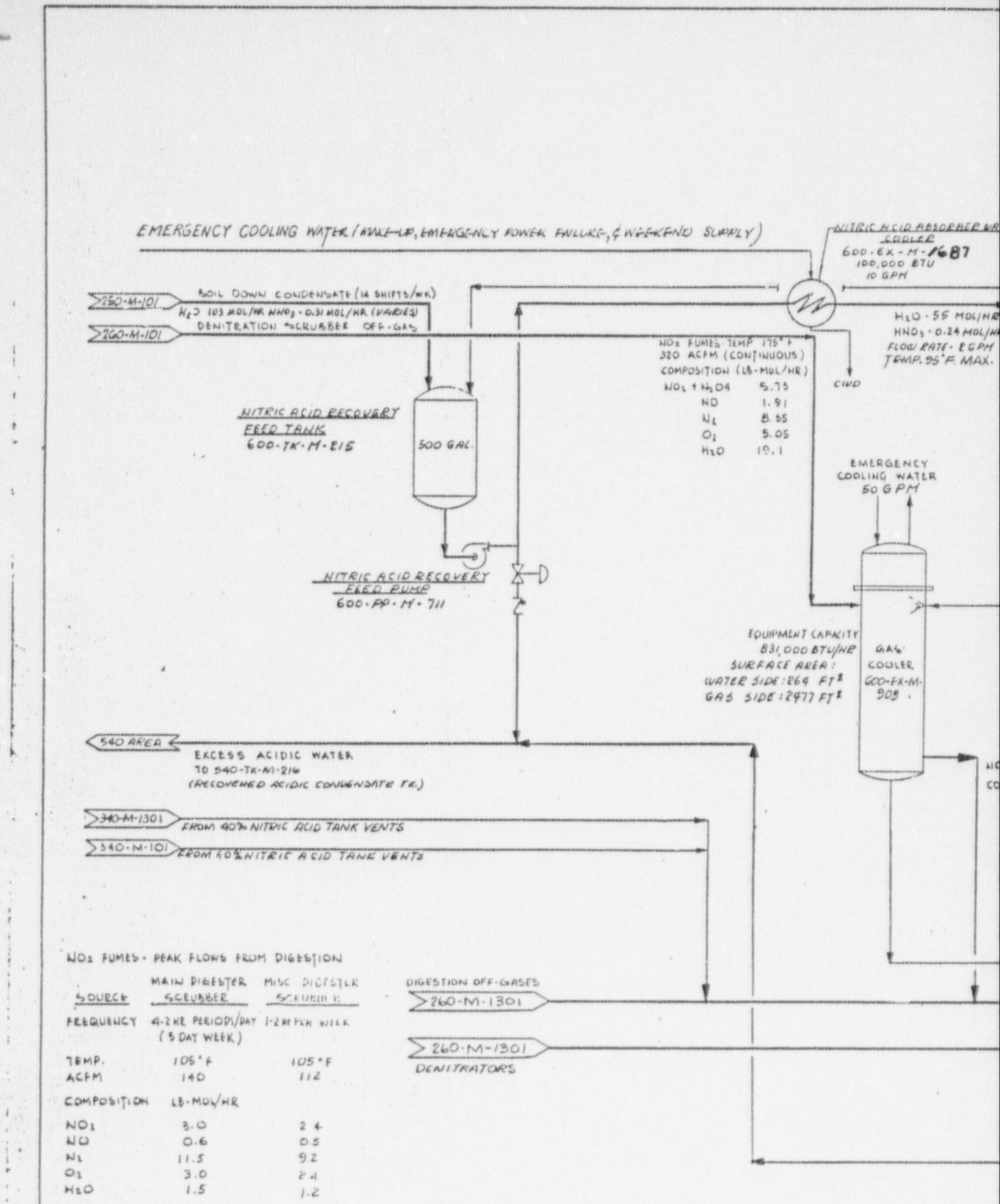
SCALE —

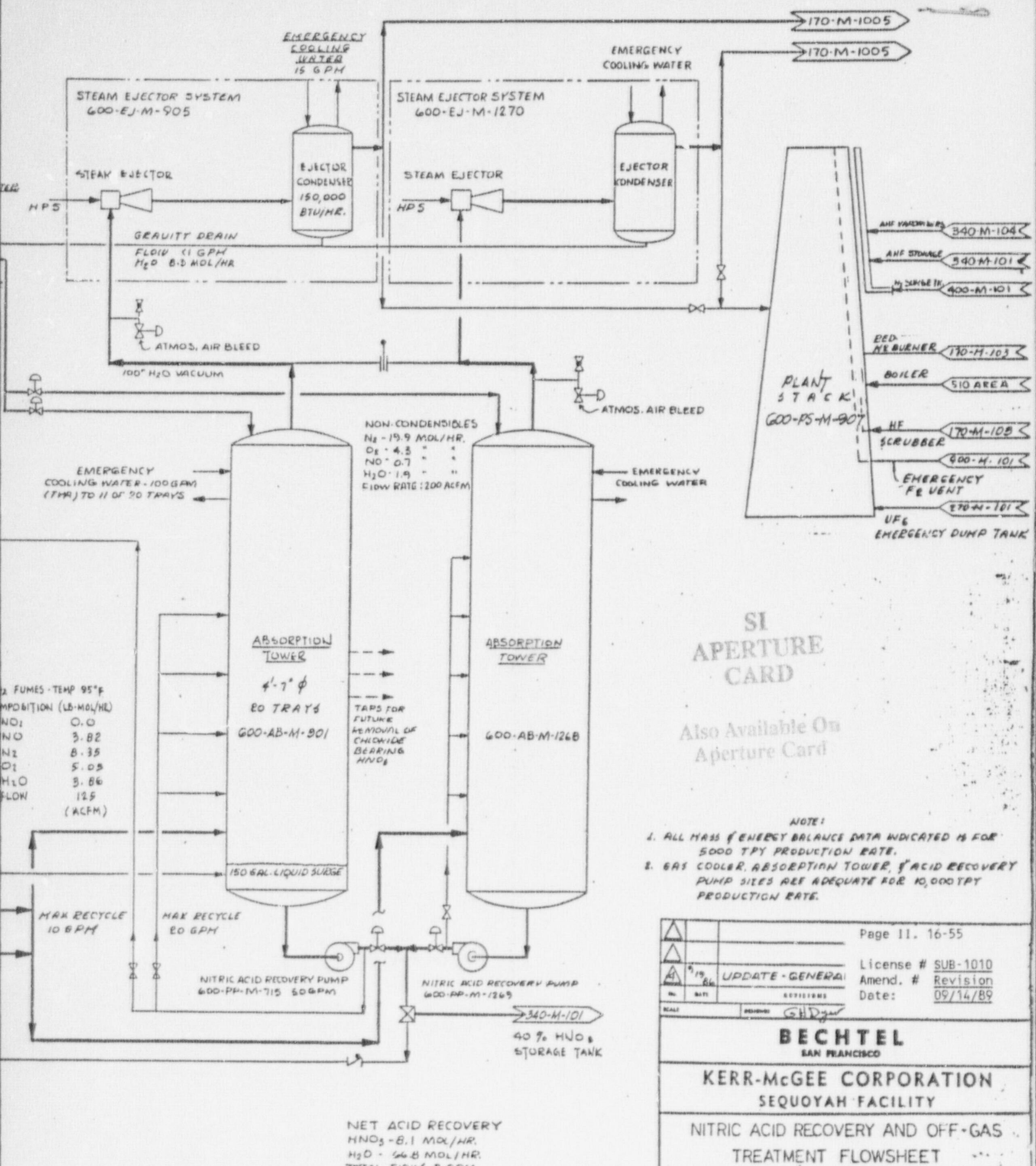
Stearns-Roger

DRWG NO. C-15000

APPROVED BY [illegible]
DATE 7.25.74
FOR K-M NUCLEAR CORP.

DWG NO. 400-M-1301


EMERGENCY COOLING WATER (MAKE-UP, EMERGENCY POWER FAILURE, & WEEKEND SUPPLY)
NITRIC ACID ABSORBER NO. 2 COOLER
600-EX-M-1687
100,000 BTU
10 GPM
250-M-101
260-M-101
BOIL DOWN CONDENSATE (16 SHIFTS/WK.)
H2O 103 MOL/HR HNO3 0.31 MOL/HR (VARIES)
DENITRATION SCRUBBER OFF-GAS
H2O 55 MOL/HR
HNO3 0.24 MOL/HR
FLOW RATE 8 GPM
TEMP. 95°F. MAX.
CWD
NOx FUMES TEMP 175° F
320 ACFM (CONTINUOUS)
COMPOSITION (LB-MOL/HR)
NO2 + N2O4 5.75
NO 1.91
N2 8.55
O2 5.05
H2O 19.1
NITRIC ACID RECOVERY FEED TANK
600-TK-M-215
500 GAL.
NITRIC ACID RECOVERY FEED PUMP
600-PP-M-711
EMERGENCY COOLING WATER
50 GPM
EQUIPMENT CAPACITY
831,000 BTU/HR
SURFACE AREA:
WATER SIDE: 864 FT2
GAS SIDE: 2977 FT2
GAS COOLER
600-EX-M-903
540 AREA
EXCESS ACIDIC WATER
TO 540-TK-M-216
(RECOVERED ACIDIC CONDENSATE TK.)
340-M-1301
FROM 60% NITRIC ACID TANK VENTS
340-M-101
FROM 60% NITRIC ACID TANK VENTS
NOx FUMES - PEAK FLOWS FROM DIGESTION
SOURCE
MAIN DIGESTER SCRUBBER
MISC. DIGESTER SCRUBBER
FREQUENCY
4-2 HR PERIODS/DAY (5 DAY WEEK)
1-2 HR PER WEEK
TEMP.
105°F
105°F
ACFM
140
112
COMPOSITION
LB-MOL/HR
NO2
3.0
2.4
NO
0.6
0.5
N2
11.5
9.2
O2
3.0
2.4
H2O
1.5
1.2
DIGESTION OFF-GASES
260-M-1301
260-M-1301
DENITRATORS



SI APERTURE CARD

Also Available On Aperture Card

NOTE:

1. ALL MASS & ENERGY BALANCE DATA INDICATED IS FOR 5000 TPY PRODUCTION RATE.
2. GAS COOLER, ABSORPTION TOWER, & ACID RECOVERY PUMP SIZES ARE ADEQUATE FOR 10,000 TPY PRODUCTION RATE.

Page II. 16-55

License # SUB-1010
Amend. # Revision
Date: 09/14/89

4 | 9/19/86 | UPDATE - GENERAL

REVISIONS

G.H. Dyer

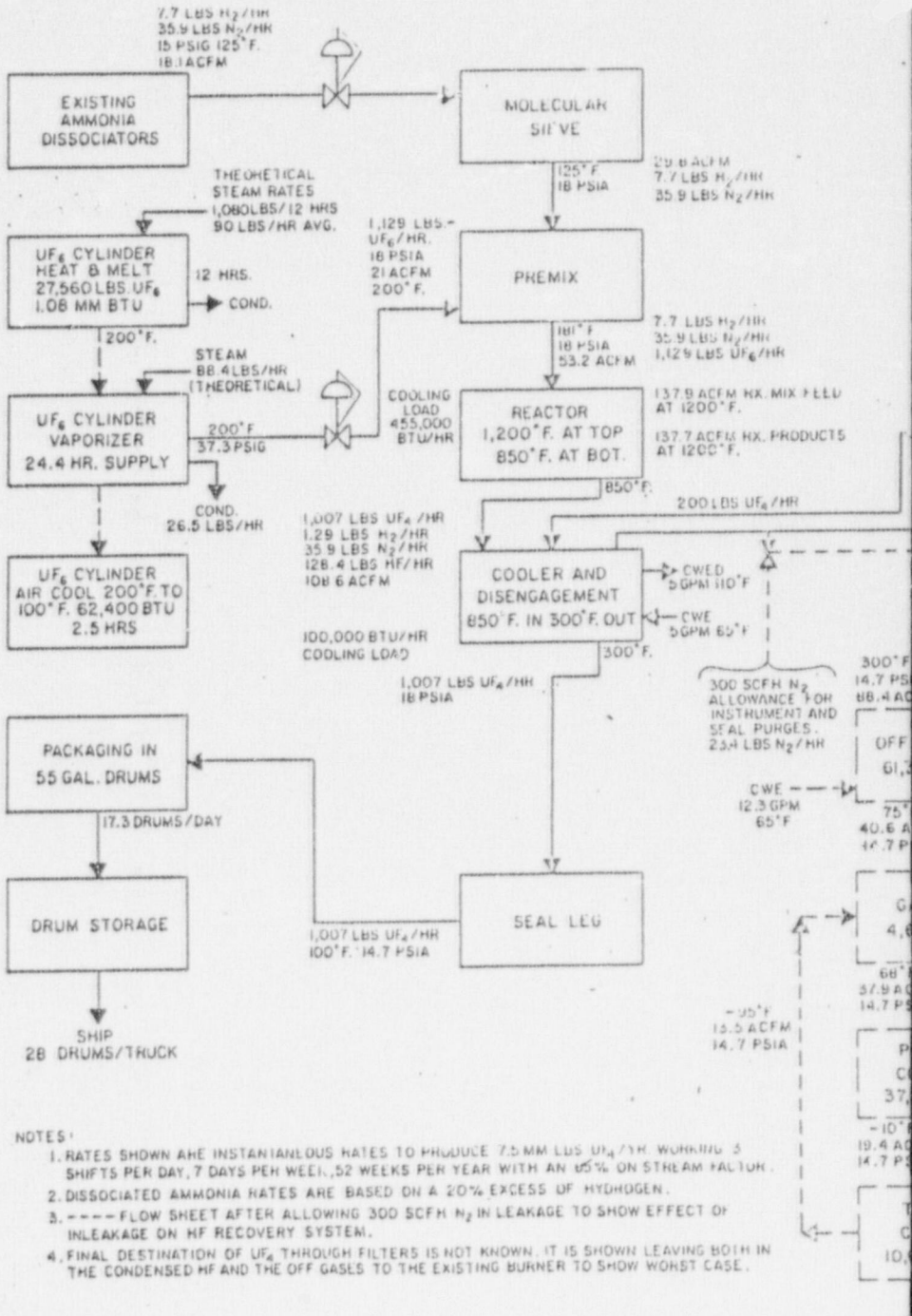
BECHTEL
SAN FRANCISCO

KERR-McGEE CORPORATION
SEQUOYAH FACILITY

NITRIC ACID RECOVERY AND OFF-GAS TREATMENT FLOWSHEET

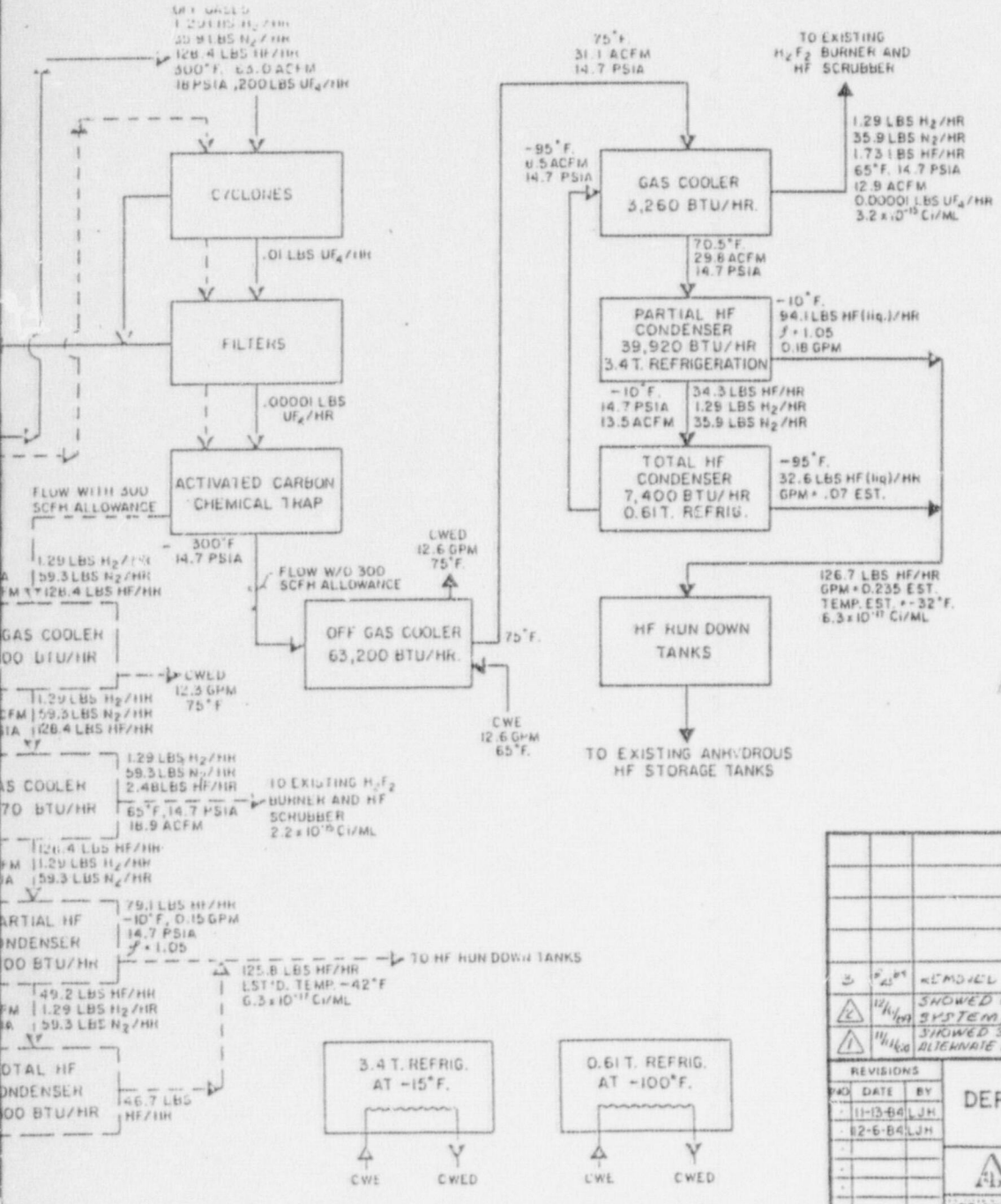
JOB NO.	DRAWING NO.	REV
6752	600-M-101	4

8910020150-16



NOTES:

1. RATES SHOWN ARE INSTANTANEOUS RATES TO PRODUCE 7.5 MM LBS UF_4/YR. WORKING 3 SHIFTS PER DAY, 7 DAYS PER WEEK, 52 WEEKS PER YEAR WITH AN 85% ON STREAM FACTOR.
2. DISSOCIATED AMMONIA RATES ARE BASED ON A 20% EXCESS OF HYDROGEN.
3. ---- FLOW SHEET AFTER ALLOWING 300 SCFH N_2 IN LEAKAGE TO SHOW EFFECT OF INLEAKAGE ON HF RECOVERY SYSTEM.
4. FINAL DESTINATION OF UF_4 THROUGH FILTERS IS NOT KNOWN. IT IS SHOWN LEAVING BOTH IN THE CONDENSED HF AND THE OFF GASES TO THE EXISTING BURNER TO SHOW WORST CASE.



Page 11. 16-56

License # SUB-1010
Amend. # Revision
Date: 09/14/89

3	5/25/89	REMOVED PULVERIZER	KJS
2	12/1/89	SHOWED 0.00001 LBS UF_4/HR LEAVING SYSTEM, SEE NOTE, ITEM 4	LJH
1	11/16/89	SHOWED 300 CFH N_2 ALLOWANCE WITH ALTERNATE FLOW SHEET USING THIS ALLOWANCE	LJH

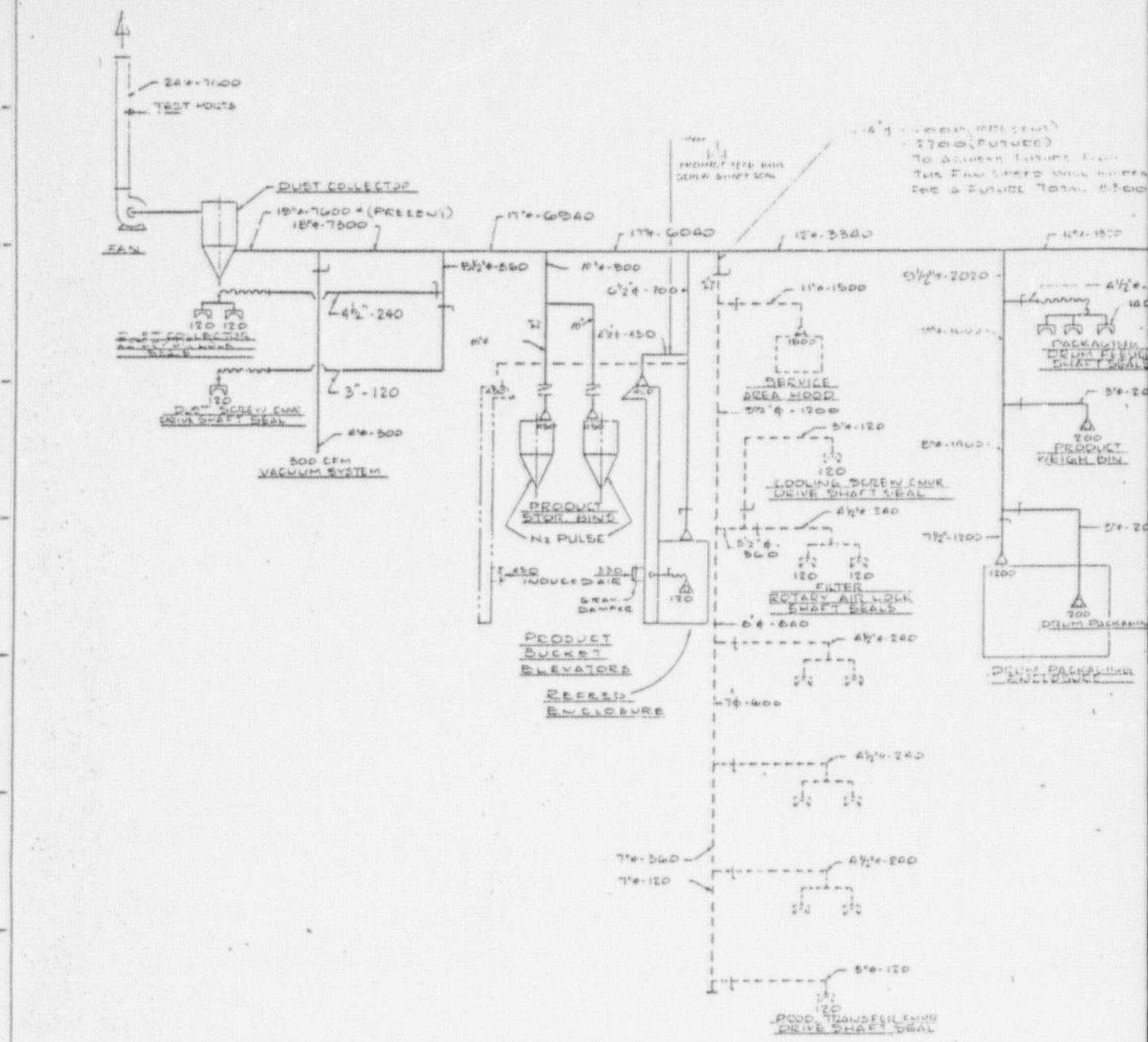
REVISIONS		
NO	DATE	BY
1	11-13-84	LJH
2	12-6-84	LJH

DEPLETED UF_4 FLOW SHEET

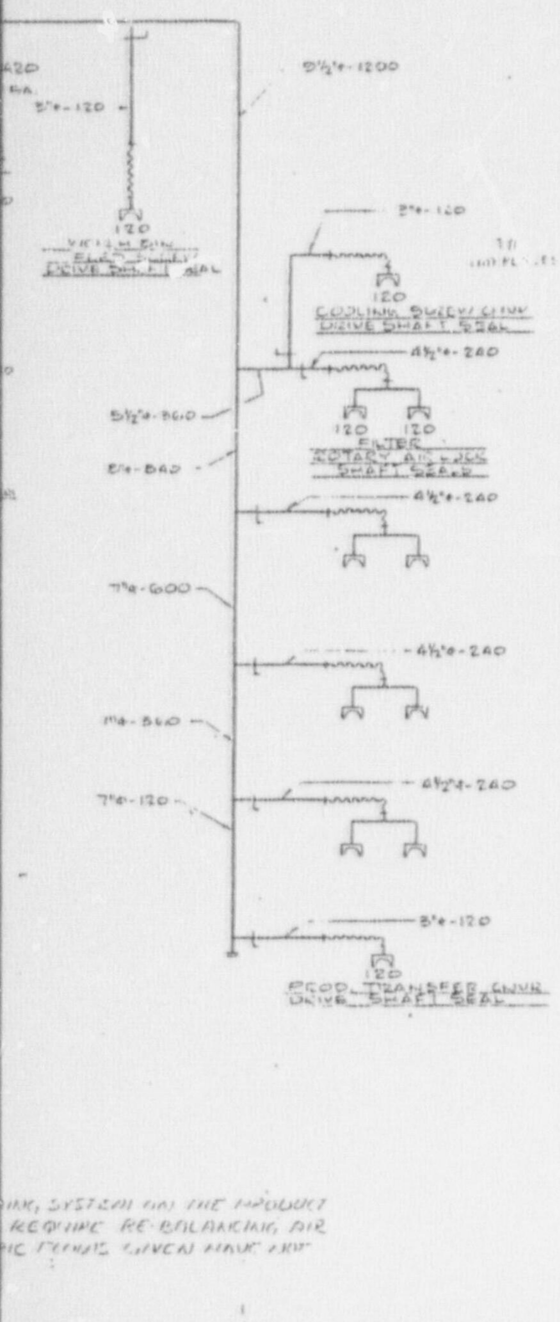
SEQUOYAH FUELS CORPORATION

ART ROBERTSON	9-12-84	SEQUOYAH FACILITY	
LARRY HAMPTON	9-24-84	NONE	
		22 x 34	
		800-M-1401	3

89100020150-17



NO	REVISIONS	DATE	BY	CHD	APPD	MR	REFERENCE DRAWINGS
1	REMOVED CBS EQUIPMENT	12/8	RJ				
2	BLEED ENCLOSURE VENTILATION CFMS ADDED	3/16	MW	JWS			
3	ADD FLEXIBLE HOSE ISSUE FOR CONSTRUCTION	7/16	SD	NEW			
4	REVISE DRUM FEEDER - ISSUED 6.F.C.	11-17-21	SN	FY			



REFERENCE DRAWINGS

M-6504	DUST COLLECTION - PLANS
M-6505	DUST COLLECTION - SECTIONS
M-6506	DUST COLLECTION - DETAILS
M-3518	REFEED ENCLOSURE VENTILATION DETAILS.

Page II. 16-57

License # SUB-1010
Amend. # Revision
Date: 09/14/89

SEQUOYAH FUELS CORPORATION

MECHANICAL
DUST COLLECTION
FLOW DIAGRAM

DEPLETED UF_4 PROJECT

CONFIDENTIAL

SCALE: NONE

Stearns Catalytic

ORDER NO: C28086

DRAWING NO: 800-M-6503

8910020150-18