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GENERAL ELECTRIC

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

DOCUMENT NO.
HW-82382

DATE
June 8, 1964

COPY NO.
9

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HF OFFGAS SCRUBBER
ENGINEERING STUDY

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HF OFFGAS SCRUBBER ENGINEERING STUDY

A. INTRODUCTION

In order to accomplish the fluorination step of the 234-5 Building "Button Line" process and control the HF offgas, the fluorinator is operated under negative pressure generated by a water jet of marginal capacity which discharges from 5 to 12 GPM to the D-6 drain system, a retrievable plutonium stream. This installation presents a potential hazard because of the possibility of water backup in the event of check valve failure into the hot fluorinator which could result in a steam explosion. The jet water constitutes more than one half of the D-6 load, considerably diluting the waste stream and increasing, in the advent of recovery thru the new Waste Treatment Facility, the rework quantity. Some finesse is required in order to operate the fluorinator at a relatively uniform and consistent pressure. Because of the potential explosion hazard and other operating disadvantages, an engineering study of offgas systems was initiated with the intention of proposing an improved and safer system.

B. PURPOSE

The intent of this document is to report the results of an engineering study of the fluorinator HF offgas system located in glove boxes H-9A and HC-9B located on the 234-5 Building "Button Lines."

C. SUMMARY AND RECOMMENDATIONS

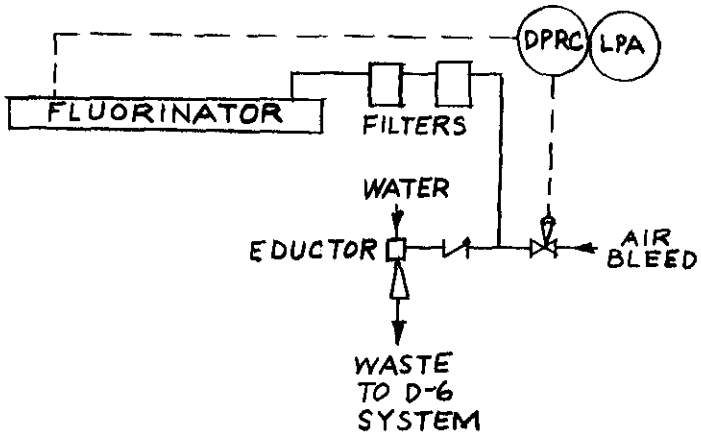
An engineering review of existing HF offgas systems and consultation with concerned personnel indicates that the jets should be removed from the glove boxes and the offgas lines routed to a caustic potash scrubber located in a separate glove box from the process glove box. An engineering-process flow diagram, attached, SK-2-19496, describes the scrubbing process and equipment. Attached drawing SK-2-19497 illustrates the scrubbing glove box arrangement for the RMC Button Line. Briefly, the installation would require a 3-inch diameter x 3 foot long disc and donut recirculation scrubber complete with a 6 inch diameter x 5 foot long glass pump tank, pump, condenser, vacuum blower, instrumentation, and piping services located within a stainless steel glove box about 4 feet wide x 2 feet deep x 14 feet high.

The recommended scrubber installation described above would eliminate the potential hazard associated with possible jet water backup into the fluorinator, be an easily controlled vacuum source, have increased capacity, and reduce the D-6 system volume by about 50 percent. Additional benefits would be derived from an improved vacuum control which would automatically maintain a uniform fluorinator pressure. A remotely-controlled, instrumented and interlocked facility would be furnished to provide a safe, reliable vacuum offgas treatment unit. A study stage project cost estimate for the complete installation indicates a total cost of $90,000 to $115,000.

D. DISCUSSION

Included in this section is a brief discussion and a simplified schematic of each HF offgas system reviewed. Alternatives #2 and #3 have been altered slightly in order to present them as they would be utilized for CPD processing rather than as designed for the Rocky Flats process.

1. Existing HF Offgas System (H-9A & HC-9B)



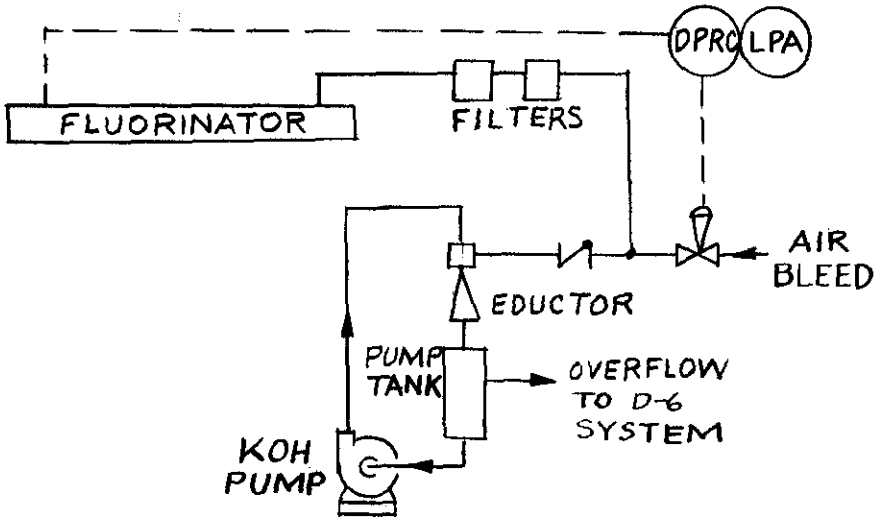
Eductor water supply is directly off the process water header and protection against water backup into the hot (400-500°C) fluorinator is contingent upon satisfactory performance of the specially constructed check valve in the offgas stream. Upon several occasions, water has been found in the secondary filter housing. This does not indicate positive evidence of check valve failure because the quantity found could have been from

condensables. Loss of fluorinator differential pressure for any reason, but specifically due to a water backup in the offgas stream would cause the bleed valve to close, thereby eliminating that avenue of water pressure relief. Full header pressure and flow through the one-inch water supply line would flood the filter cases and eventually flash to steam upon entry to the fluorinator proper. Depending upon the hydraulics of an upset system, existing low differential alarm may or may not provide an adequate advance notification for remedial action. A related potential criticality hazard exists due to the presence of a source of unlimited water supply to the glove box confines. Should a sudden rupture of the supply or exhaust line occur, which is credible due to the corrosiveness of the HF stream, an appreciable quantity of water will be introduced into the glove box. A sump probe alarm exists to detect and notify of a high liquid level condition; however, here again, timing would be very important. A further disadvantage of this system is due to the nature of a one-pass water stream which results in full discharge to the D-6 drain system. The eductor presently in use is a Penberthy 184A water jet exhauster which has a consumption of 5 to 12 gallons per minute. With one jet in service, its contribution to the normal D-6 flow rate exceeds 50 percent; occasionally two jets (one in each glove box, H-9A and HC-9B) are in service simultaneously, thereby, further increasing the load to the D-6 system.

Originally the system was designed with a special monel jet to handle the flow sheet offgas rate of 4.28 CFM @ 200°C. By experience, it was determined economically justifiable to substitute a brass 3/4 inch Penberthy 182A water jet exhauster for the more expensive monel jet. After limited operation, the 3/4 inch 182A was replaced with a 1-1/4 inch 184A of increased capacity. For maximum performance, the 184A requires a 1 inch pressure connection and 1-1/4 inch suction and discharge connections; consequently, maximum performance is not achieved due to utilization of the undersized original lines. Capacity is further affected because of the need to throttle the jet water supply to supplement the pressure control system. Inleakage has been a continuing and unpredictable problem causing, in part at least, the need for increased capacity. A separate program has been initiated to investigate this phase of the system. Limited capacity increases the filter brushing frequency required to reduce pressure drop in the system. Increased personnel exposure and decreased operating time are directly affected. Increased capacity is therefore a requirement of an improved replacement

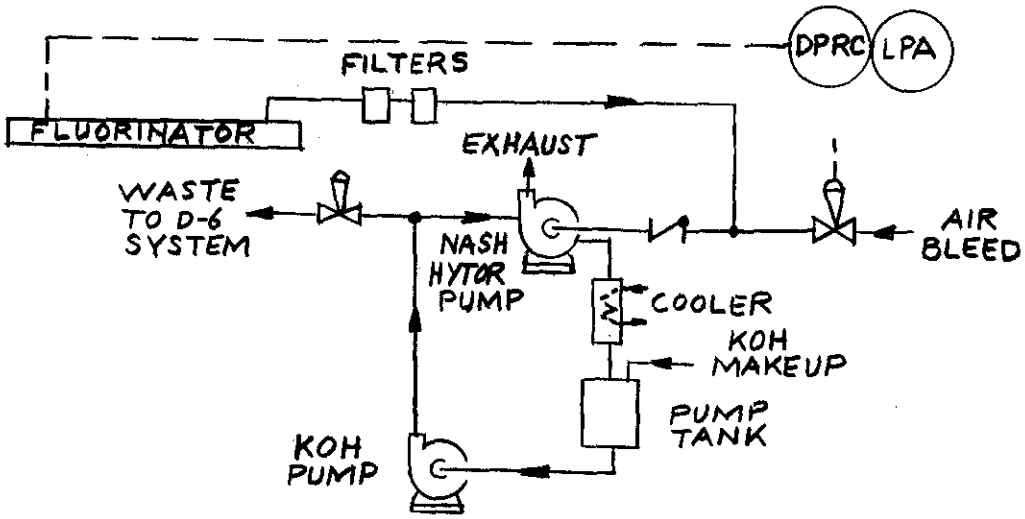
offgas system. The limit has been reached by increasing jet size. The present jet system presents potential explosion and criticality hazards, unduly loads the D-6 system, is difficult to control, possesses limited capacity and adversely affects operating efficiency. A new replacement system is required. Following is a discussion of four alternative systems, each possessing some merit. The last, #4, is recommended for installation as it most nearly fulfills all of the criteria.

2. Alternative #1, Recirculation Educator HF Offgas System



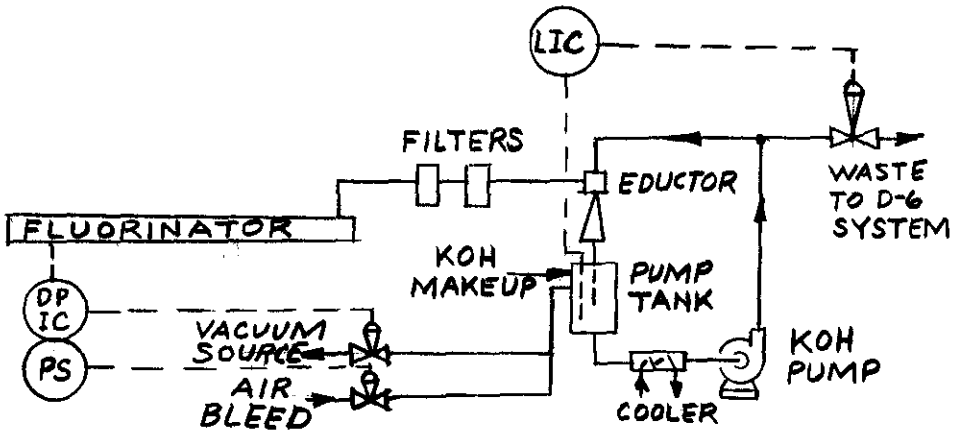
The refinements incorporated in this proposed system are the recirculation pump which would reduce the total flow of the D-6 system by about 50 percent and limit the total amount of water which could enter the glove box due to a pressurized line leak to the quantity contained within the pump tank. There would be no improvement for the water backup hazard in the event that the eductor discharge should become obstructed.

3. Alternative #2, Vacuum Pump HF Offgas System



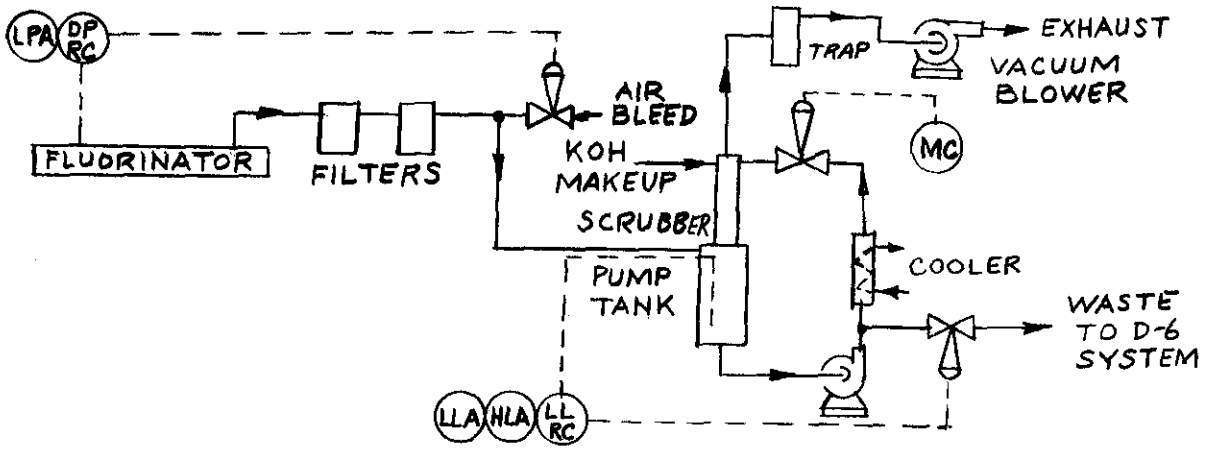
This pump system is basically similar to Alternative #1, in that the eductor is replaced with a Nash Hytor vacuum pump. Both types of systems are basically difficult to control at low fluorinator vacuums. The eductor system control can be eased somewhat by an additional control on the pump discharge pressure to the jet. The water backup hazard is comparable for both systems as is the quantity of discharge to the D-6 system. The pump system was tried at Rocky Flats and abandoned in favor of the scrubber system, described in Alternative #3.

4. Alternative #3, HF Offgas Jet Scrubber System



An eductor is used in this Rocky Flats system as a jet scrubber, the vacuum and pressure control being furnished on the tie-in to the house vacuum system. The hazard associated with a water backup to the fluorinator is still present. Waste to the D-6 system is appreciably reduced as is the quantity of water which would be available to flood the glove box.

5. Alternative #4, HF Offgas Scrubber System



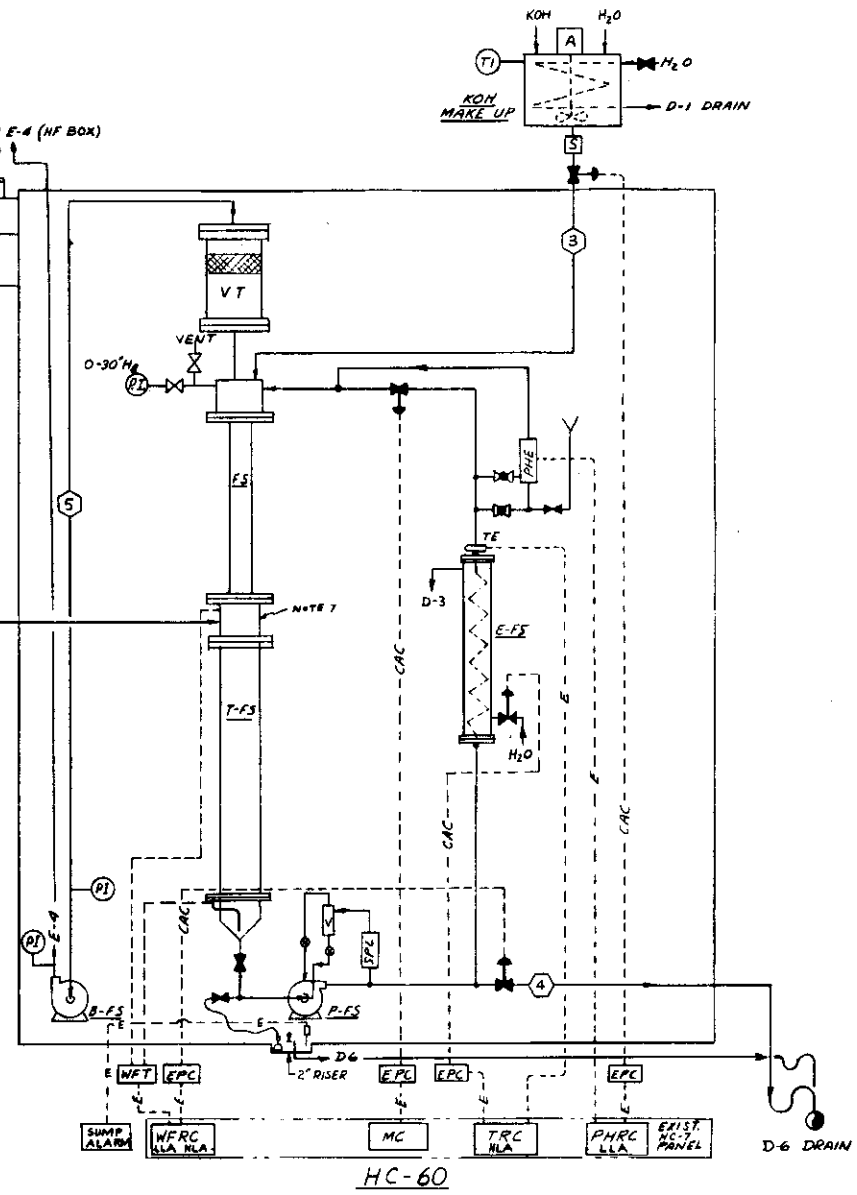
After review of the existing HF offgas system and Alternatives #1 thru #3, this system was developed to provide a safe, easily controlled and reliable means for handling the fluorinator off-gas stream. The potential hazard associated with jet water backup into the fluorinator is eliminated, the pump tank is instrumented for level control and alarm and the glass side wall affords visible confirmation that the controls are operating. Additional electrical interlocks will be installed to back up the instrumented level control, such as automatically stopping the pump upon high or low alarm. Other interlocks will be installed to provide a completely safe system. Since the scrubber would be located in a separate glove box, reference attached drawings SK-2-19496 and SK-2-19497, there would be no water available for flooding the process glove box. The waste stream to the D-6 system would be reduced to a minimum, determined automatically by pH instrumentation. The D-6 normal flow rate would thereby be reduced by about 50 percent. This proposed system eliminates all of the disadvantages of the existing system as well as those of alternatives #1 thru #3 and is recommended for replacement of

the installed jet systems. Study drawings SK-2-19496 and SK-2-19497, attached, were prepared for the presently operated fluorinator glove box HC-9B in order to obtain a cost estimate. The estimated cost for the complete installation by CPFF forces is $90,000 to $115,000.

R. A. Ciccarelli

ACKNOWLEDGEMENT:

The author thanks D. E. Braden for his efforts for conceiving and preparing the process flow diagram, and without whose cooperation this report would not have been possible.



HC-60

LEGEND

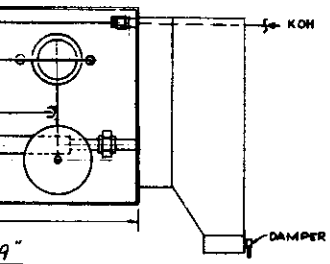
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
EPC	ELECTRICAL-PNEUMATIC CONVERTER
DPRC	DIFFERENTIAL PRESSURE RECORDER CONTROLLER
MC	MANUAL CONTROLLER
TRC	TEMPERATURE RECORDER CONTROLLER
PHE	PH ELEMENT
PHRC	PH RECORDER CONTROLLER
TE	TEMPERATURE ELEMENT
TT	TEMPERATURE TRANSMITTER
	DIAPHRAGM OPERATED VALVE
	MANUAL BALL VALVE
	MANUAL GLOBE VALVE
	HYDROCLONE (H-2-29701, PT.8)
SPL	IN-LINE SAMPLER (H-2-29698)
5	SEAL POT
----	EXISTING EQUIPMENT
	SIGHT FLOW INDICATOR
PI	PRESSURE INDICATOR

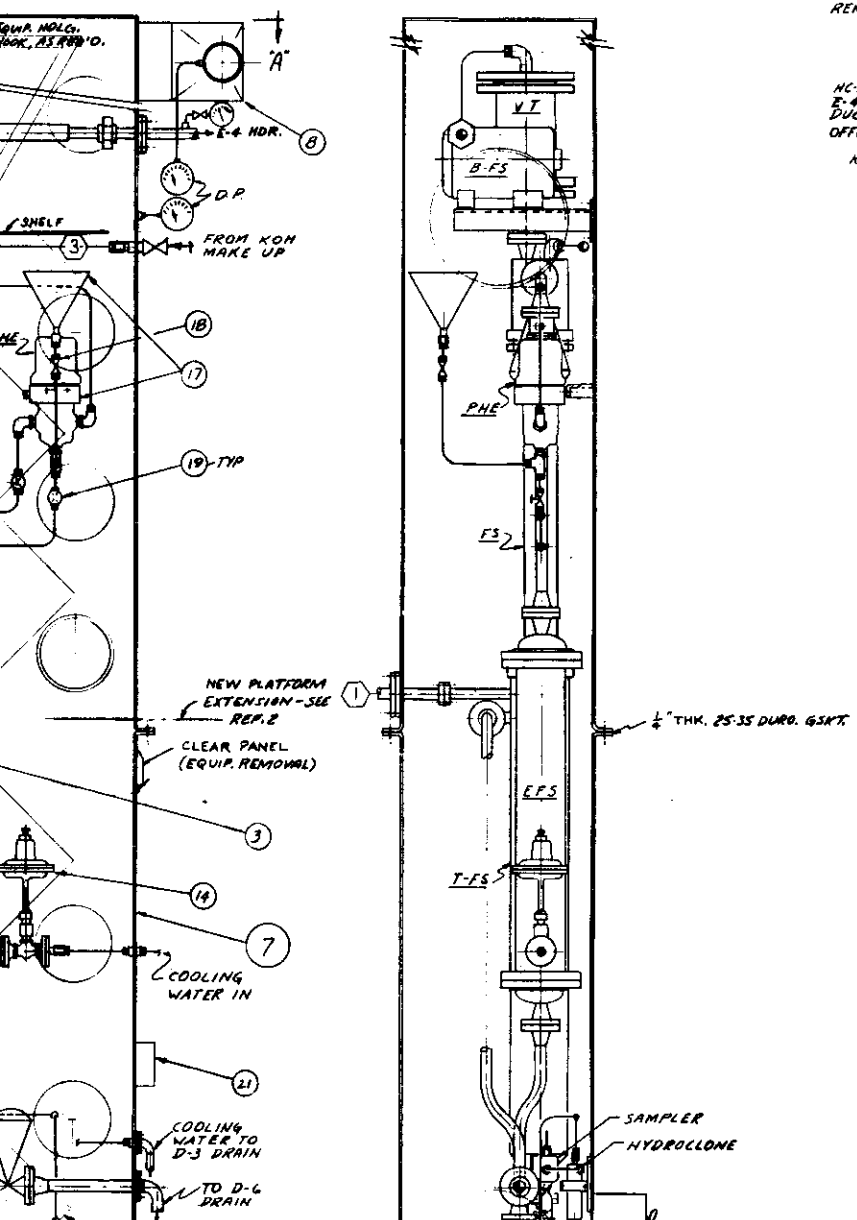
GENERAL NOTES

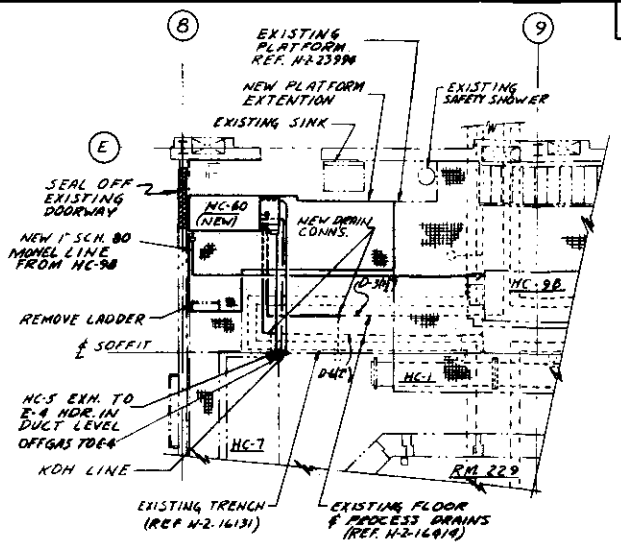
1. THE FS SCRUBBER SHALL BE A 3 FOOT LENGTH OF 3 INCH PYREX "DOUBLE-TOUGH" PIPE, CONTAINING THREE 2 INCH DIAMETER DISK-DONUT SECTIONS ON 4 INCH SPACING, WITH TYPE 304-L STAINLESS STEEL FLANGES.
2. ⚠1 THE T-FS PUMP TANK SHALL BE A 5 FOOT LENGTH OF 6 INCH PYREX "DOUBLE-TOUGH" PIPE WITH A FLANGED TOP FITTING AND A CONICAL BOTTOM SECTION OF 6" SCH. 40 304L S.S.T. PIPE.
3. THE E-FS HEAT EXCHANGER SHALL BE THE EXISTING SPARE G-62 VESSEL (H-2-19404), MODIFIED AS REQUIRED.
4. THE VT VENT TRAP SHALL BE SIMILAR TO PART 11 ON H-2-19423.
5. THE P-FS RECIRCULATING PUMP SHALL BE A MODEL GA-1K CHEMPUMP WITH SAMPLER AND HYDROCLONE.
6. THE B-FS BLOWER SHALL HAVE A CAPACITY OF 15 SCFM AIR AT 15 INCH H_g VACUUM.
7. THE INLET FLUORINATOR OFFGAS PIPING SHALL BE 1 INCH SCHEDULE 80 MONEL PIPE WITH FLANGED FITTINGS AND ELECTRICAL HEAT TRACING (FS SPOOL NOT TO BE TRACED).
8. THE RECIRCULATED LIQUID AND SCRUBBER OFFGAS PIPING SHALL BE 1 INCH SCHEDULE 40 TYPE 304-L STAINLESS STEEL PIPE WITH FLANGED FITTINGS.
9. ALL OTHER PROCESS PIPING INSIDE GLOVE BOX SHALL BE TYPE 304-L STAINLESS STEEL TUBING (0.049-INCH MIN. WALL THICKNESS).
10. THE KOH MAKE-UP TANK SHALL BE A 300-GALLON (250 GALLONS WORKING VOLUME) TANK OF TYPE 304-L STAINLESS STEEL CONSTRUCTION WITH AN AGITATOR AND COOLING COIL.

FSW	FSG
4	5
LIQUID	GAS
1.32	—

SK-2-19496 SHEET 7/- REV. 1







FLOOR PLAN

SCALE 1/4" = 1 FT.

QTY.	PT. NO.	DESCRIPTION
	1	FS SCRUBBER - SEE NOTE 1, SK-2-19496
	2	T-FS PUMP TANK - SEE NOTE 2, SK-2-19496
	3	E-FS HEAT EXCH. - SEE NOTE 3, SK-2-19496
	4	VT VENT TRAP - SEE NOTE 4, SK-2-19496
	5	PSF RECIRC. PUMP - SEE NOTE 5, SK-2-19496
	6	BFS BLOWER - SEE NOTE 6, SK-2-19496
	7	HC-5 GLOVE BOX (2 SECTION, FLG'D.)
	8	EXH. FILTER ASSY. (NON-GLASS HF FILTER) REF. H-2-31345
	9	2-50 CFM ABSOLUTE FILTERS (8×8×6)
	10	~~CATCH TANK 6" SCH 40 PIPE × 1'-0" LG, 304 L S.ST. W/ASCEND PIPE GUARD & SUCTION LINE~~
	11	GLOVE BOX SUPPORT C.STL.
	12	1" MANUAL OPR. BALL VALVE, FLG'D.
	13	1" DIAPH. OPR VALVE
	14	1/2" DIAPH. OPR VALVE, FLG'D.
	15	GUARD - (SST. SCREEN)
	16	SIGHT INDICATOR - 1/8 FPT, SST., ERNST ROTATING WHEEL FIG. E-575300
	17	Pt ELECTRODE CHAMBER & FUNNEL
	18	3/8" KONC. FITTED BALL VALVE
	19	3/8" KONC FITTED GATE VALVE (POWELL #1832K)
	20	SUCTION HEAD REF H-2-24290 PT. 55, SH. 2
	21	SPHINCTER SEAL, 1 QT. SIZE (REF. H-2-35981/2
	22	SPHINCTER SEAL, SAL'R. BOTTLE SIZE
	23	3" SAMPLE BOTTLE SEAL-OUT PORT
	24	1/2" DIAPH. OPR. VALVE. - KONC. FITTED

GENERAL NOTES

1. FOR PIPING SIZES & MAT'LS. SEE GEN. NOTES, DWG H-2-19496
2. GLOVE BOX TO INCLUDE TUBE LIGHTING IN PLASTIC WELLS, APPROX. 6 - 30W FIXTURES 'DAY-RAY DRV30-GK3
3. ⬡ DENOTES STREAM NO. FOR FLOW INFO. SEE REF. 1
4. VENTILATION BASIS: 100 CFM OF ROOM AIR.

SK-2-19497 SHEET 2 REV 1