NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Fort St. Vrain, Unit No. 1	0 5 0 0 0 2 6 7	1 OF 1 2

TITLE (4) Discovery Of Blockage In PCRV Penetration Pressurization Supply Lines

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 5	0 3	8 5	8 5	0 0 7	0 0	0 6	0 3	8 5	N/A	0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	20.402(b)	20.405(a)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(a)(1)	X 50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(a)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Jim Eggebroten, Technical Services Engineering Supervisor	AREA CODE 3 0 3 7 8 5 - 2 2 2 4

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
B	A B	B L O	G 0 6 3	Y		X	B D	P S P	G 0 6 3	Y	
X	I J	M I	X 9 9 9	Y							

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	XX NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

During surveillance testing, with the reactor shutdown and depressurized, several refueling penetrations on the top head of the Prestressed Concrete Reactor Vessel (PCRV) were discovered to have blockage in their pressurization supply lines. Pressurization of PCRV penetrations with purified helium is provided above 100 psia reactor pressure to ensure that any primary or secondary boundary leakage is purified helium, and to maintain continuous closure leakage/integrity monitoring. This function is required for each penetration by LCO's 4.2.7 and 4.2.9.

The experienced blockage is believed to have been caused by moisture induced corrosion of the carbon steel supply piping and penetration liner. Specifically the blockage is believed to have occurred due to local attack or debris accumulation at the 1/8 inch orifice in the penetration liner. Investigations are continuing to determine the extent and severity of system and penetration corrosion. Although the recent penetration moisture ingress, discovered following the June 23rd. transient (LER 84-008), is the likely instigator of this condition, the time of occurrence has not been determined.

This event is being reported as a condition which could have prevented the fulfillment of a safety function designed to control and monitor the release of radioactive primary coolant, as defined by 10 CFR 50.73(a)(2)(v).

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BACKGROUND:

The Fort St. Vrain reactor vessel primary coolant boundary consists of an essentially leak tight, continuous 3/4 inch thick carbon steel liner. The secondary boundary is composed of 15 ft. (nominally) of prestressed concrete except for the various equipment, instrument, and access penetrations. These penetrations have carbon steel liners varying between 1/2 to 2 inches in thickness, and are either welded directly to the primary liner or sealed by gasketed joints to maintain the continuity of the primary coolant boundary (Figure 1). The overall PCRV design has been evaluated to result in an exceedingly low probability of gross rupture or significant leakage throughout its design life.

The PCRV penetrations have designated primary and secondary closures (boundaries) designed in accordance with the ASME, Section III, Class A and B Codes, respectively. Their design pressure is 845 psig (Reference Pressure) which is greater than the highest credible accidental pressure (FSAR Section 14.5).

Overall monitoring of the primary coolant pressure boundary for significant leakage is provided by radiation monitors in the reactor building exhaust system. Additionally, the PCRV penetration interspaces are normally maintained pressurized slightly above primary coolant pressure with purified helium from the helium purification system. The penetration pressurization function ensures that any primary or secondary closure leakage is purified helium and any abnormal flow is monitored and alarmed by appropriate instrumentation.

EVENT DESCRIPTION:

On May 3, 1985, with the reactor shut down for refurbishment of control rod drive components, it was determined that several of the thirty-seven refueling penetration pressurization supply lines contained significant blockage. This condition was discovered during surveillance testing to check the primary and secondary closure leakage within the refueling penetrations following recent work on the control rod drive and orifice assemblies (LER 84-008). The identified blockage was subsequently cleared following pressurization testing and all thirty-seven penetration and pressurization supply lines were verified operable. Penetration pressurization is required during power operation in accordance with LCO 4.2.7 to ensure that penetration primary or secondary boundary leakage is purified helium, and also to provide for continuous leakage monitoring through flow monitoring limits in accordance with LCO 4.2.9.

ANALYSIS:

The integrity of the primary coolant boundary is maintained by the PCRV liner, which was designed for greater than the maximum credible pressure and originally tested to 1.15 times this pressure (970 psig). The PCRV concrete, along with the individual penetrations, form the independent secondary closures, which were also designed for 845 psig (RP) and analyzed not to exceed 90% of their material minimum yield strength at a differential pressure across the primary closure of 2.1 times RP.

In the incredible event of penetration primary closure failure, the penetrations are designed with limit stops to limit the ejection force on the secondary closures. In the incredible event of a refueling penetration primary and secondary closure simultaneous failure, overlapping hexagonal hold-down plates, bolted to the adjacent secondary closures, would prevent ejection of the control rod drive and orifice assembly and limit the primary coolant leakage area (FSAR Section 5.8). The worst case penetration failure involving an essentially instantaneous depressurization of the total primary coolant inventory in the PCRV through the lower access penetration has also been evaluated and would result in off-site doses at least an order of magnitude less than 10 CFR 100 limits (FSAR Section 14.11).

Specifically, the thirty-seven refueling penetrations in the top head of the PCRV provide access for removal and replacement of fuel and reflector elements. Typical penetration arrangement is shown in Figure 2 and pressurization line details shown in Figure 3.

The helium penetration pressurization system provides two safety functions: 1) it ensures that primary and secondary closure leakage is purified helium, and 2) provides continuous monitoring of primary and secondary boundary integrity or leakage. Five refueling penetrations were found to have significant blockage which would have degraded or possibly prevented interspace pressurization at normal operating pressures (710 psia nominally). Although the pressurization function has no direct affect on the integrity of the primary or secondary closures, nor on their bounding accident probabilities or consequences, non-pressurized penetrations could allow limited primary coolant leakage during normal operation. Primary and secondary leakage is allowable but limited through LCO 4.2.9, and seal leakage is regularly measured to be within acceptance criteria. Although allowable and possible with depressurized penetrations, leakage would still be detected by the primary monitoring system consisting of normal, backup, and emergency radiation monitors in the reactor building exhaust system. Primary and secondary closure leakage was verified within acceptable limits following the functional testing to clear the pressurization supply lines.

Non-pressurized penetrations could also disable the monitoring function. The monitoring function of the penetration pressurization system is used to ensure that a significant increase in closure leakage is sensed and alarmed so that corrective action may be taken if required. The piping supply to a failed closure is automatically isolated and an alarm initiated if the pressurization system gas flow exceeds 275 lbs./hr. To verify primary and secondary closure integrity, system leakage is determined once per quarter or following an unanticipated alarm s required by Technical Specification Surveillance requirement, SR 5.2.1/ a. Although this test does not individually check each penetration, significant system blockage would be detected. Again, there is no credible mechanism for causing significant primary closure leakage or failure.

Instantaneous failure of the primary closure under depressurized interspace conditions has been specifically evaluated concluding that the secondary closure would not fail at internal cavity pressures less than 1690 psi (FSAR Section 5.8).

In conclusion, the actual significance of the discovered condition was minimal, as no abnormal conditions were detected by the reactor building exhaust radiation monitors. Recurrence of this condition will be prevented by the installation of moisture monitors and knockout pots in the associated purified helium headers and pre-operational surveillance testing of individual penetration pressurization supply lines.

CAUSE:

The experienced penetration pressurization line blockage is believed due to moisture induced corrosion of the carbon steel components, concentrated specifically at the orifice formed by the 3/4 inch supply line and the 1/8 inch liner inlet pathway.

Moisture ingress into the penetration pressurization supply piping was discovered following the reactor shutdown on June 23, 1984 (LER 84-008). Investigations have determined that the "A" helium circulator penetration had become flooded as a result of a bearing water leak resulting in carryover to the penetration pressurization supply system. As all penetrations are pressurized by a common header, the potential exists to affect all penetrations. Subsequent investigations have determined that the existing penetration supply line moisture monitors had failed to detect this condition due to corroded terminals and wiring.

The cause of the leak in the bearing water supply piping has been identified as due to a bolt failure on the circulator inlet flange within the penetration (Figures 4 and 5). The bolt failure was analyzed by GA Technologies and determined due to a manufacturing defect in the bolt material.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

Investigations to determine the duration of supply line blockage are not conclusive at this time, however, the recent moisture ingress is believed to be the major contributor. Individual refueling penetration seal leakage is tested regularly following any maintenance involving disturbance of the primary closure seal. Region 18, which was one of the most significantly blocked penetrations, was refueled in February of 1984 and it's primary seal verified acceptable through penetration pressurization supply testing. Therefore, it appears that the blockage occurred some time following reactor startup in May of 1984. Moisture breakthrough from the helium purification train is also a postulated source of ingress during prolonged periods of PCRV moisture removal (Figure 6).

CORRECTIVE ACTIONS:

All refueling penetration pressurization supply lines were cleared of blockage and proven operational through subsequent testing.

Individual refueling penetration pressurization capability will be reverified following the continuing helium purification system modifications and testing prior to plant startup.

Future moisture ingress of the penetration pressurization supply lines will be detected and alarmed with newly installed moisture monitoring equipment and knock-out pots in associated helium supply headers (see P-85032, dated January 30, 1985).

The extent and location of pressurization supply line corrosion will be specifically investigated and further corrective action taken if necessary. Futher corrective action is not anticipated, since further moisture ingress would be detected and significant contamination corrected if necessary.

The penetration pressurization supply lines for all related PCRV penetrations will be verified operational as part of the continuing investigations.

There are two reports relative to this event, LER 84-008 and LER 84-012.

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TEXT *(If more space is required, use additional NRC Form 366A's)* (17)

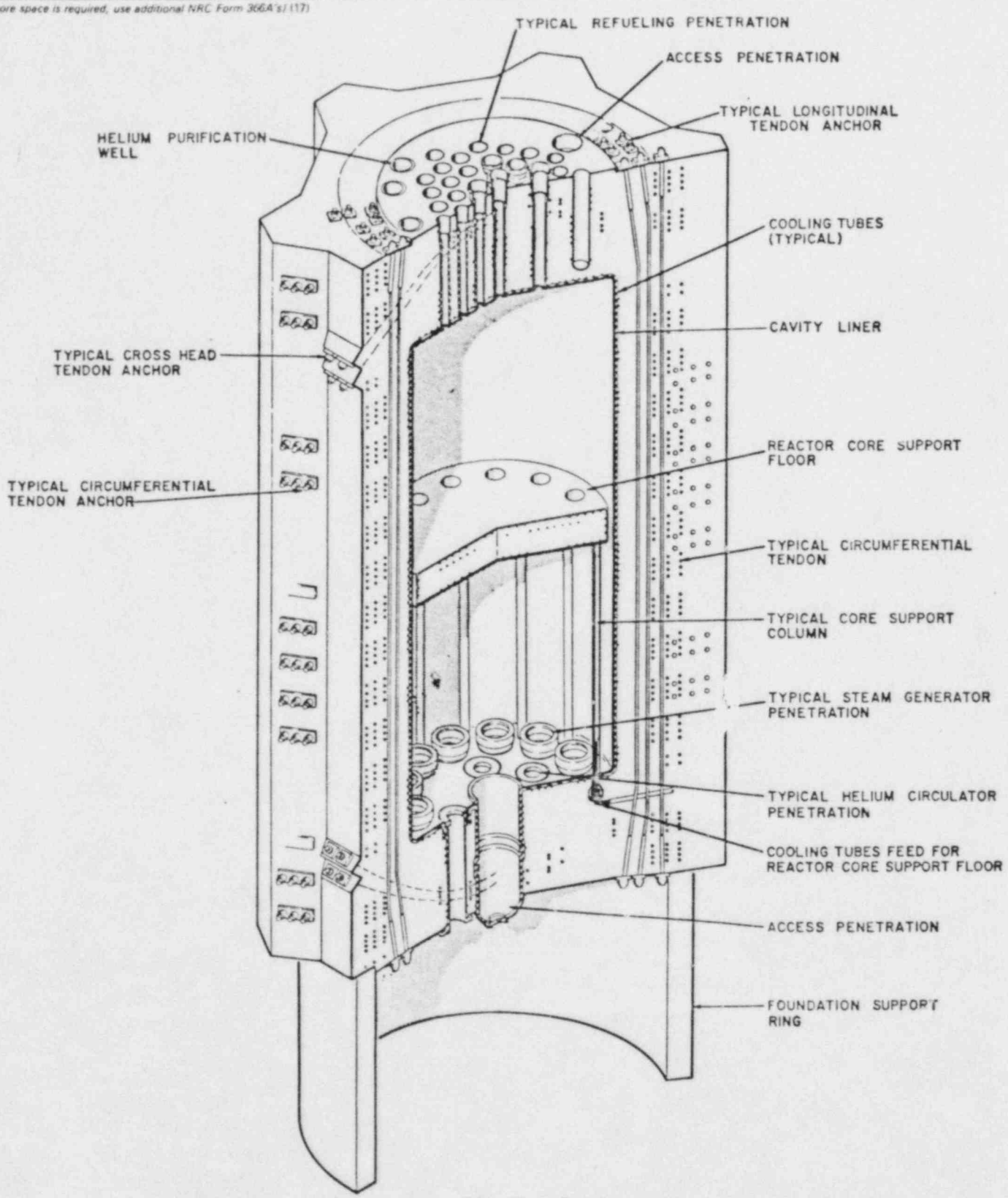

Figure 1

PCRV General Configuration

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FIGURE 2
REFUELING PENETRATION DETAIL

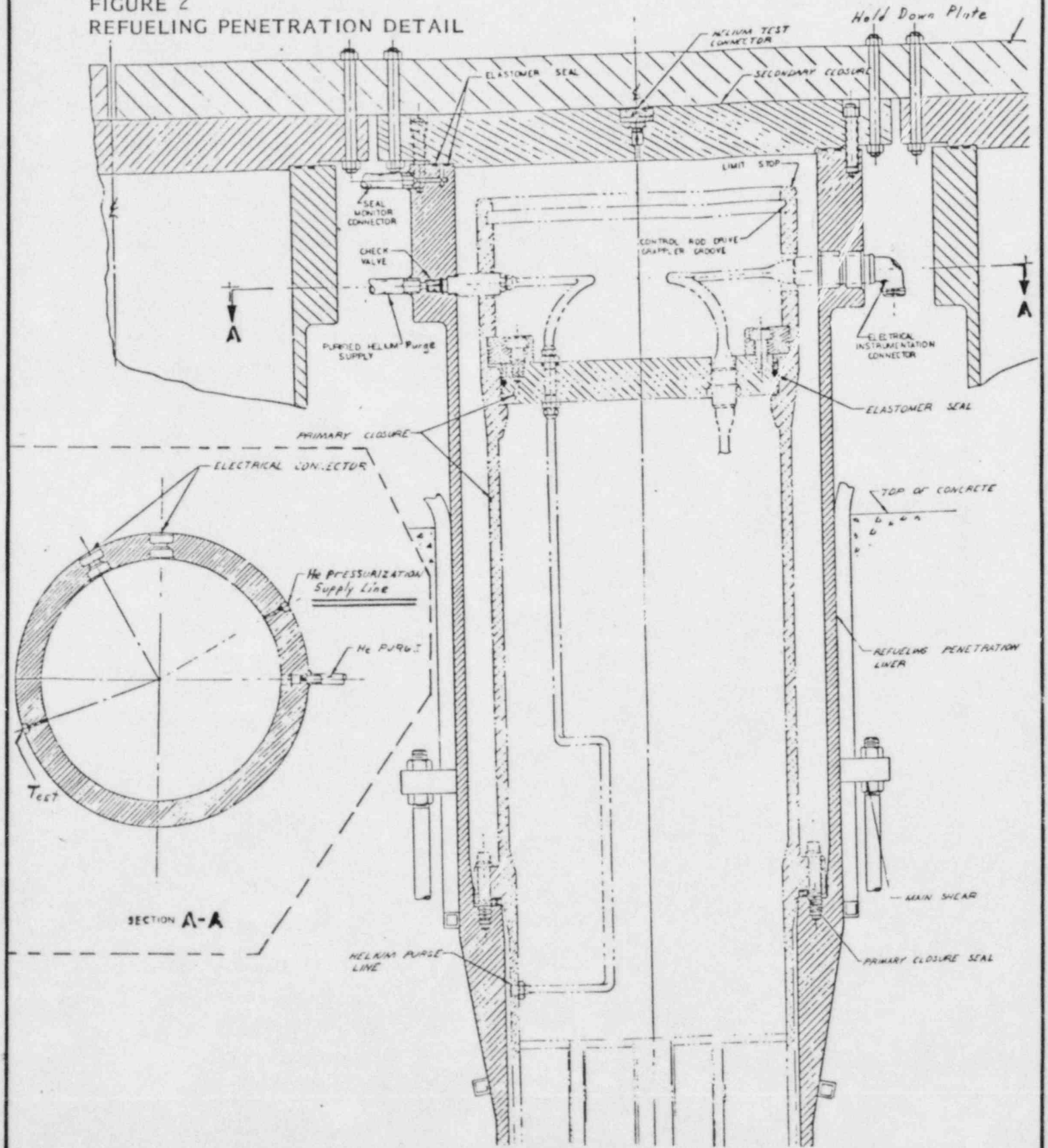

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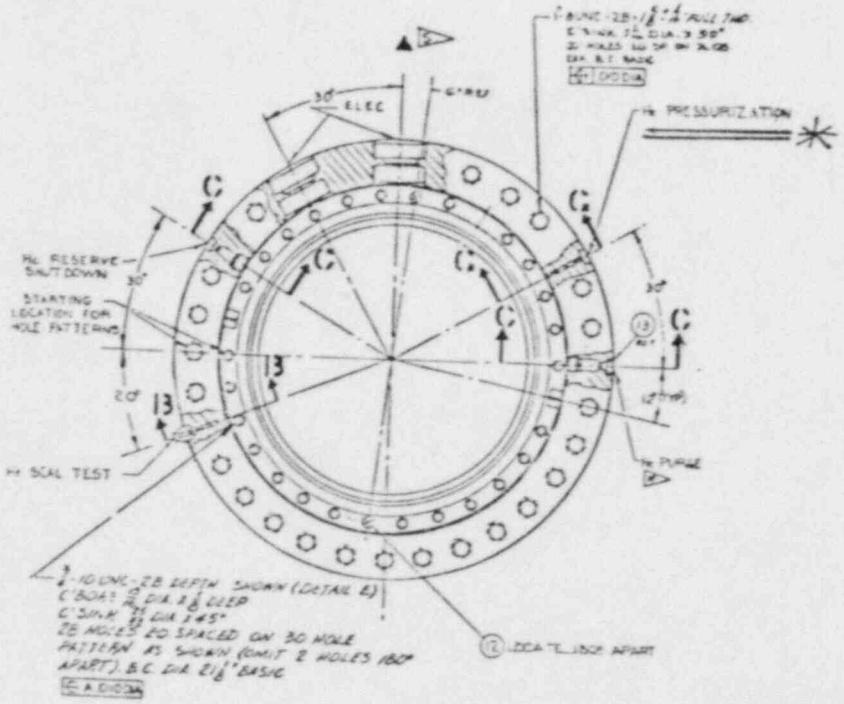
FIGURE 3

PRESSURIZATION SUPPLY LINE DETAIL



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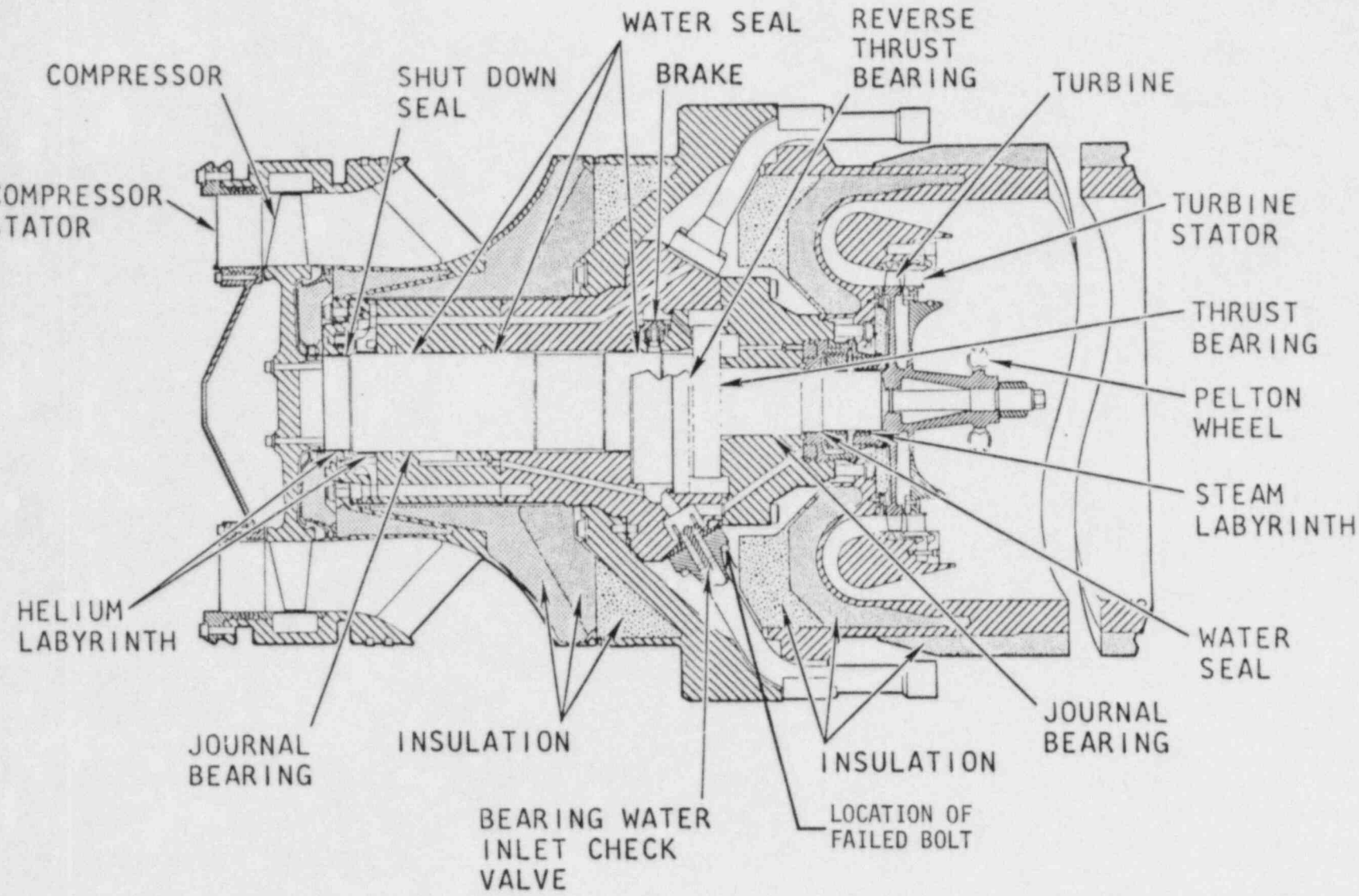

Figure 4 Helium Circulator Assembly

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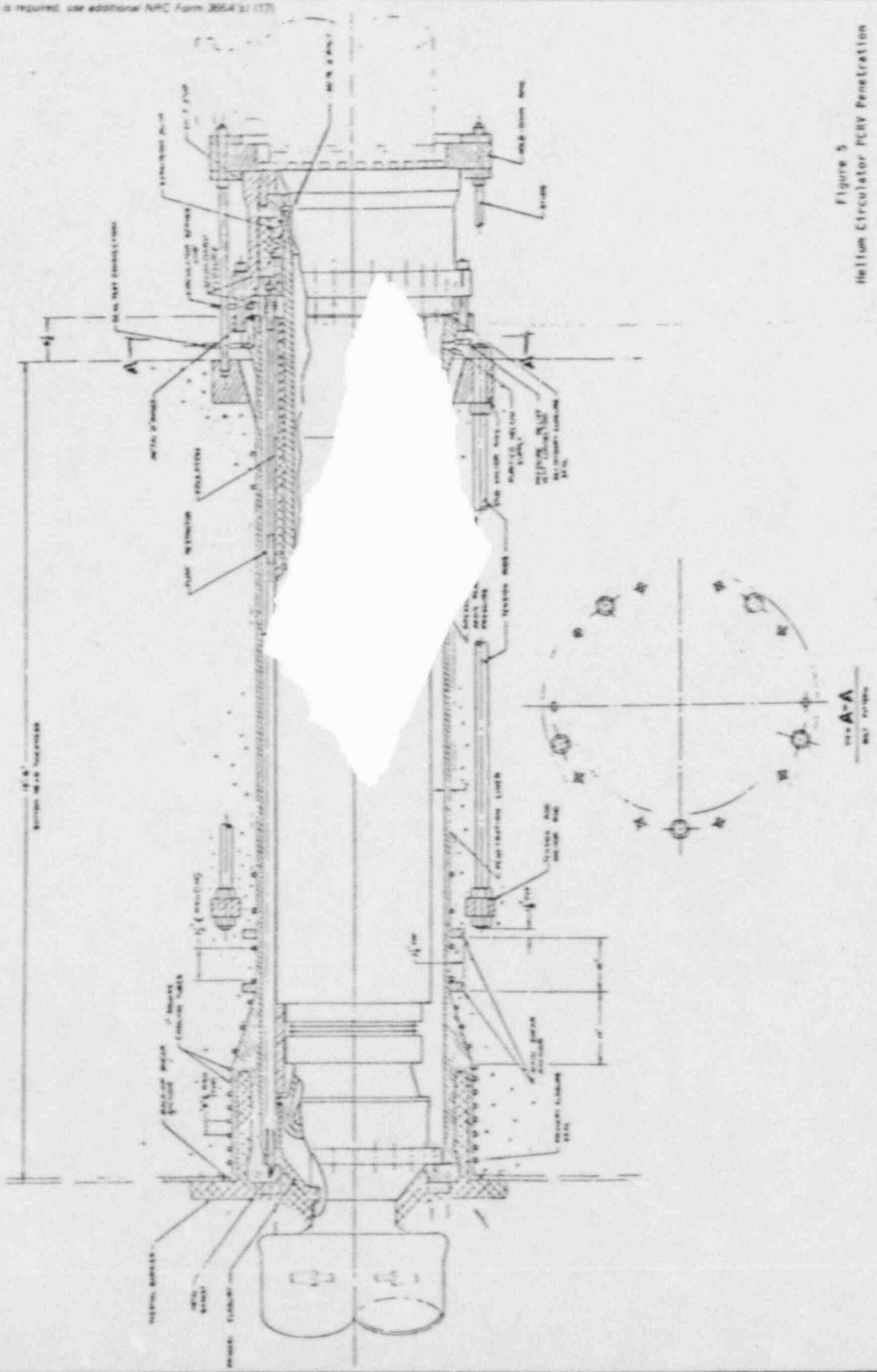

Figure 5
Helium Circulator PCRV Penetration

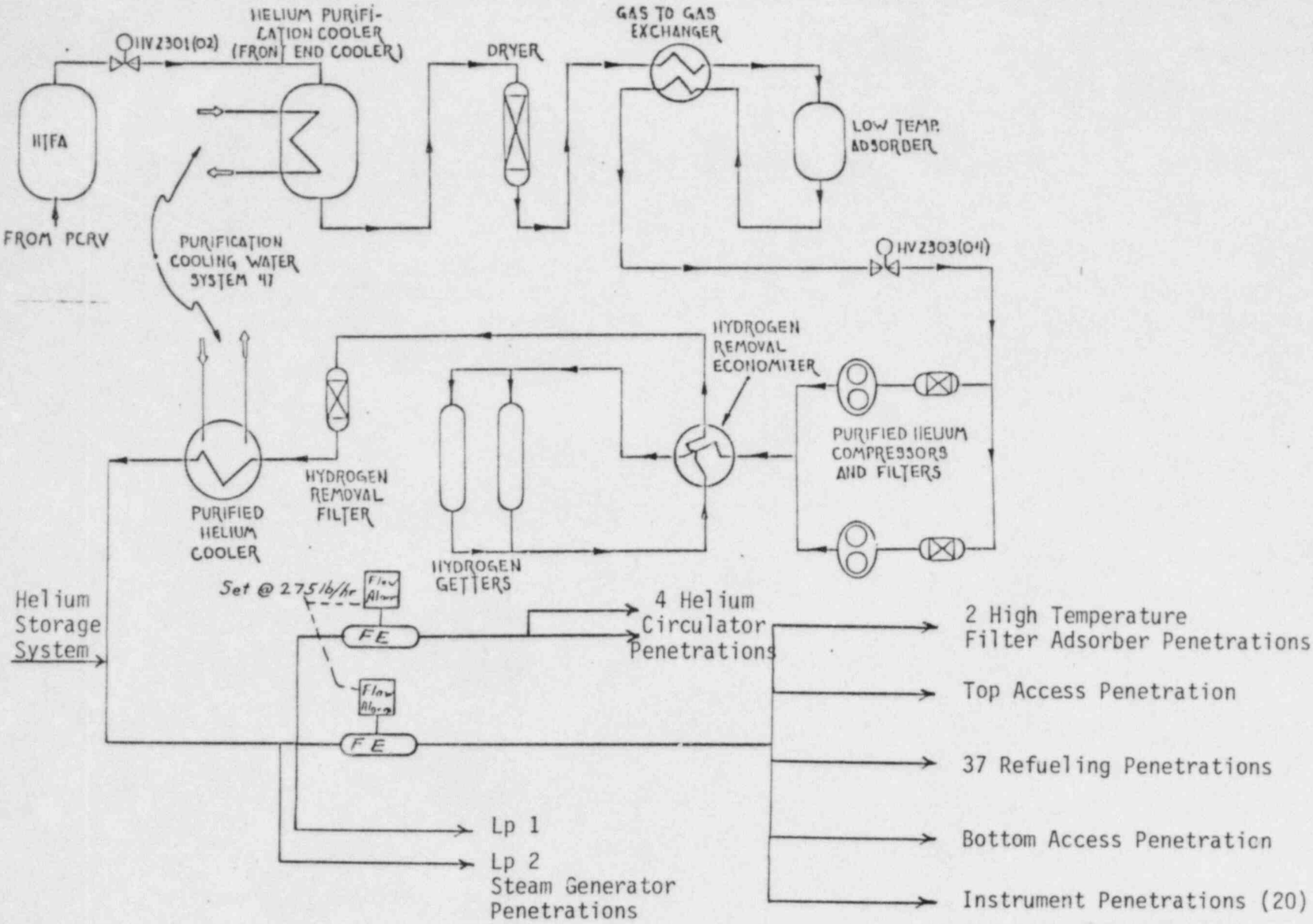

FIGURE 6

SYSTEM 23

Helium Purification Train

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June 3, 1985
Fort St. Vrain
Unit No. 1
P-85188

Regional Administrator
Region IV
U. S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

Attn: Mr. E. H. Johnson

Docket No. 50-267

SUBJECT: Licensee Event Report
85-007, Final Report

REFERENCE: Facility Operating
License No. DPR-34

Dear Mr. Johnson:

Enclosed please find a copy of Licensee Event Report No. 50-267/85-007, Final, submitted per the requirements of 10 CFR 50.73(a)(2)(v).

Sincerely,

J. W. Gahm
Manager, Nuclear Production

Enclosure

cc: Director, MIPC

JWG/djm

85-440

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IE-22

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