NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

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) CORE SUPPORT FLOOR VENT SYSTEM PARTIALLY ISOLATED DURING REACTOR SHUTDOWN

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 7	0 6	8 8	8 8	0 1 1	0 0	0 8	0 5	8 8	N/A	0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): N

POWER LEVEL (10): 0 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
20.405(a)(1)(i)	50.36(c)(1)	X 50.73(a)(2)(v)	73.71(c)
20.405(a)(1)(ii)	50.36(c)(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 (AREA CODE)
Mark Joseph, Technical Services Supervisor	3 0 3 6 2 0 - 1 2 0 3

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
X	A 1 2	I S V	V 0 8 5	Y					

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO	EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR

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

On the morning of July 6, 1988, following reactor shutdown and depressurization in preparation for helium circulator maintenance, Operations Department personnel discovered that core support floor (CSF) vent valve, V-111063, was not full open as it should have been. Further investigation identified that the valve stem of V-111063 had become separated from the disc.

The CSF vent system provides an escape path for primary coolant that enters the CSF through a breach in the CSF steel casing. Venting this gas during reactor depressurization prevents CSF internal pressure from exceeding primary coolant pressure by more than 210 psi. If the CSF vent system is isolated during rapid PCRV depressurization, excessive differential pressure could develop across the CSF and result in deformation of the CSF casing sidewall and top head.

Failure of a set screw in V-111063, caused by overloading the valve handwheel due to a buildup of corrosion on the valve internals, allowed the valve stem to rotate within the valve body and eventually unthread itself from the valve disc.

V-111063 will be repaired/replaced and returned to service prior to reactor startup. Additional corrective actions will include installation of pressure indicating instrumentation upstream of V-111063, and establishment of administrative controls on manual valve operation in the CSF vent system.

BACKGROUND:

The reactor core [AC]* is supported by the core support floor (CSF) [AC]*, an insulated and water cooled composite concrete and steel structure (see Figure 1). The space inside the CSF is vented and drained to maintain the pressure in the floor at 100 psig or less. The vent and drain cavities were formed during the concreting of the CSF and are interconnected by tubes permanently cast in the concrete and routed through the floor, down the core support columns and to the radioactive gas waste system [WE]* (see Figures 2 and 3). The CSF vent system provides protection against overpressurization of the floor in the event of a CSF liner leak, which could result in high differential pressure between the floor and the primary coolant system during a Design Basis Accident DBA-2 ("Rapid Depressurization/Blowdown").

The concrete CSF and steel liner are maintained within specified temperature limits by a system of cooling tubes welded to the concrete side of the steel liner. In 1972, four CSF cooling tubes were identified as leaking. A technique to seal the leaking tubes with epoxy resin was developed and used successfully in 1973. In 1982, Fort St. Vrain experienced a primary coolant leak through the CSF liner, and also detected another CSF cooling tube leak which appeared to be in close proximity to the liner leak, thus allowing communication of primary coolant to the liner cooling system. The CSF liner leak seals at power levels above approximately 30% as PCRV pressure and core outlet temperature increase, but reopens during startup or shutdown operations (e.g., following a reactor scram from power levels above 30%).

The concern with overpressurizing the CSF is that if CSF internal pressure were to greatly exceed the pressure of the surrounding primary coolant, the resultant forces could potentially cause deformation of the CSF liner, resulting in either disarray of the core or blockage of the primary coolant flow path between the CSF liner and the PCRV liner. Analyses show that deformation of the CSF liner will not cause a safety concern if the pressure within the CSF does not exceed primary coolant pressure by more than 210 psi.

EVENT DESCRIPTION:

On July 5, 1988, the reactor was being shutdown from approximately 80% power in preparation for a scheduled three month outage to perform work on the helium circulators [AB]*. It was expected that as reactor power was reduced below approximately 28% with a corresponding decrease in PCRV pressure and core outlet temperature, the CSF liner breach would open and gas would begin to flow through the CSF vent to the radioactive gas waste system.

* Energy Industry Identification System (EIIS) Codes

At approximately 2200 hours on July 5, 1988, with the reactor at 20% power and decreasing, all four circulators operating at 3800 RPM on steam turbine drive, 382 psia PCRV pressure, and 1036°F average core outlet temperature, the CSF liner breach opened as indicated by flow recorded on FR-6375 through the CSF vent to the radioactive gas waste system. The flow rate through the vent, however, was significantly less than flow rates normally observed during reactor shutdown and depressurization operations. However, since the CSF pressure indicator controller, PIC-6364, was operating normally at the setpoint of 60 psig, this low flow rate through the CSF vent piping was not considered to be a problem. At 2255 hours on July 5, 1988, Operators began venting the Loop I PCRV liner cooling system surge tank (T-4601) to the gas waste vacuum tank (T-6301). Surge tank venting is normal procedure during reactor depressurization to release gas that enters the liner cooling water system through leaking CSF cooling water tubes. Upon venting the PCRV liner cooling system surge tank, CSF vent flow gradually decreased towards zero as indicated by flow recorder FR-6375, suggesting that the path of least resistance for CSF gas was into the PCRV liner cooling system via leaking CSF cooling water tubes in the CSF, to the Loop I PCRV liner cooling system surge tank, and finally to the gas waste vacuum tank. It is believed that this venting of the liner cooling system relieved any significant primary coolant pressure that may have developed in the CSF following the time the breach opened at approximately 2200 hours (see Figure 4).

Due to abnormal conditions, the Reactor Side Equipment Operator was directed to check the CSF vent system flow path. At 0800 hours on July 6, 1988, with the reactor shutdown, "A" and "D" circulators operating at 3300 RPM on steam turbine drive, "B" and "C" circulators self-turbining, 169 psia PCRV pressure, and 220°F average core outlet temperature, the Reactor Side Equipment Operator identified that manual isolation valve V-111063 (see Figures 3 and 5) was not fully open, as determined by operating the valve and observing an increase in both vent flow rate and gas waste vacuum tank pressure. It was later determined that the condition of V-111063 alone could have prevented fulfillment of the CSF vent system safety function needed to mitigate the consequences of DBA-2. Four hour notification was made on July 6, 1988, in accordance with 10CFR50.72(b)(2)(iii)(D).

CAUSE DESCRIPTION:

Manual isolation valve V-111063 failed in a mid-position that resulted in partial isolation of the CSF vent system. The failed valve is a 3/4" Velan globe valve which is installed in a horizontal position and is located such that a reach rod is required to operate the valve from a distance. V-111063 is enclosed, and the valve handwheel and stem are not visible to a person operating the valve. Radiography of the valve indicated that the stem had unthreaded from the valve disc (i.e., failure of the valve operator), and thus, as the valve handwheel was operated, the disc did not move in and out of the valve seat but remained stationary in a nearly closed position. The as-found condition of the valve was such that, as the valve was operated in the open direction, the stem unthreaded from the disc. This as-found condition could have caused the disc to actually lower onto the seat, rather than rising off of the seat when the valve was operated in the open direction.

V-111063 has a keyed collar and set screw assembly in the valve operator that is designed to prevent rotation of the valve stem as the valve is operated (see Figure 5). It is known that Operators have had to use a "cheater bar" to operate V-111063 in the recent past. Since the set screw is not actually recessed into the collar assembly, use of a cheater bar to operate the valve caused the set screw to fail and allow rotation of the entire collar assembly and valve stem, which in turn caused the stem to unthread from the valve disc. Upon valve disassembly, a significant amount of corrosion products were found in the area of the bellows and the valve disc/seat. It is postulated that corrosion caused the internals of the valve operator to seize up and led to the use of a cheater bar.

Operation of the CSF vent system with V-111063 partially closed was a result of an undetected passive failure of the damaged valve caused by overloading the valve handwheel. The vent system is not designed to withstand a single passive failure. It is designed to withstand a single active failure. The only applicable active components are pressure valve PV-6364 and block valve HV-1195, both of which are designed to fail open on loss of control signal or pneumatic/electric supply.

Since normal flows were observed through the CSF vent system during the most recent reactor startup in late May, it is concluded that V-111063 was fully open at that time. As reactor power was raised above approximately 30% during startup, the CSF liner breach sealed and CSF vent flow stopped. This occurred on May 27, 1988. The valve therefore appears to have failed sometime between May 27 and July 5, 1988. Although there is no positive evidence that V-111063 was operated between May 27 and July 5, it is postulated that the valve was operated in the open direction (e.g., during verification of valve line-up to ensure that the CSF was unisolated), causing the stem to unthread from the disc and lowering the disc onto the seat rather than opening the valve as intended.

V-111063 was operated most likely to isolate the CSF knockout pot for draining (see Figure 3). However, during a review of the Reactor Side Equipment Operator round sheets (which record CSF knockout pot water level on a shiftly basis) and narrative logs for the time period from May 27 through July 5, 1988, no entries were found that indicated the CSF knockout pot had been drained during that time period. The Reactor Side Equipment Operators could not specifically recall having operated V-111063 for any reason during that time, and therefore, exactly when V-111063 became nearly closed is unknown.

SAFETY ANALYSIS:

The as-found condition of manual isolation valve V-111063 was determined to be such that it could have prevented proper venting of the CSF as the liner breach opened during plant shutdown on July 5, 1988. This report is therefore being submitted in accordance with 10CFR50.73(a)(2)(v)(D), as a condition that could have prevented fulfillment of the safety function of a system needed to mitigate the consequences of an accident.

A recent safety evaluation, submitted to the NRC via PSC letter P-88098, analyzes depressurization of the PCRV with the CSF vent line isolated during a permanent loss of forced circulation (LOFC) event (Design Basis Accident DBA-1). The analysis assumes that the internal pressure of the CSF is 100 psig when the CSF vent line isolation valves are shut immediately prior to the start of depressurization, and that depressurization is completed in approximately 7 hours. The following is taken directly from P-88098:

"It is not deemed possible that CSF pressure could exceed PCRV pressure by greater than 210 psi, at any time during the course of the 7 hour depressurization. PCRV pressure decreases from 617 psia to about 200 psia in the first 2.4 hours of the depressurization, and from 200 psia to 17 psia in the next 4.6 hours. Early in the depressurization with the CSF under external pressure and primary coolant leaking into the CSF, the CSF liner would be under compression and the liner leak would tend to close. Conversely, later in the depressurization with the CSF under internal pressure and primary coolant leaking out of the CSF, the CSF liner would be under tension and the liner leak would tend to open. Assuming helium leakage into the CSF were large enough to permit the CSF internal pressure to increase to above 227 psia within the first 2.4 hours, leakage out of the CSF and back into the PCRV cavity would occur with less resistance, and at a sufficient rate such that CSF pressure would never exceed PCRV pressure by greater than 210 psi during the PCRV depressurization."

During the event of July 5, 1988, the CSF was not completely isolated since V-111063 was not completely shut and initially allowed some flow of gas through the CSF vent system. Additional venting of the pressure in the CSF cavity occurred through the leaking CSF liner cooling tubes once the PCRV liner cooling system surge tank was vented to the gas waste vacuum tank. Also, the PCRV was depressurized at a much slower rate of depressurization than that assumed in the case of DBA-1, as shown in Figure 4. This slower rate of depressurization allowed more time for the CSF internal pressure to equalize with PCRV pressure as the PCRV was depressurized. The consequences of the event which occurred on July 5, 1988, are thus enveloped by the consequences of the DBA-1 analysis included in P-88098, and it is therefore concluded that at no time during this event did CSF internal pressure exceed PCRV pressure by greater than 210 psi.

Based on the above, this event posed no threat to the health and safety of the public. No previous events involving partial isolation of the CSF vent system have been reported.

CORRECTIVE ACTIONS:

Valve V-111063 will be repaired or replaced with a different valve type prior to startup. The possibility of using a diaphragm-seal valve as opposed to the existing bellows-seal valve is still being investigated. This type of valve would be less susceptible to the type of failure involved in this event, which is believed to be due to the buildup of corrosion products on the valve internals. If the option of using a diaphragm-seal valve is eliminated, Velan (the manufacturer of the existing V-111063) has recommended a repair that would prevent rotation of the keyed collar assembly should the set screw again fail.

Valve V-111063 will be sealed open and added to the Sealed and Critical Valve Check List (SR-OP-12-W). Valves on this check list are verified to be sealed in the proper position on a weekly basis. As an additional measure of assurance, the remaining manual valves in the CSF vent system will also be sealed open and added to the Sealed and Critical Valve Check List (V-11726, V-111062, V-6380, V-6381, V-6382, V-63100, and V-63202, as shown on Figure 3). This corrective action will ensure administrative control of the manual valves in the CSF vent system, and will be completed prior to startup. (Note that it was not deemed necessary to seal open the 24 individual vent column isolation valves, V-11711 through V-11722 and V-11735 through V-11746, in the CSF itself, as several of these valves would have to be mispositioned before an effect on CSF vent flow would be experienced.)

To provide a means of identifying inadvertent isolation of the CSF vent in a timely manner, pressure indicating instrumentation will be added upstream of V-111063 (see Figure 3). This location will indicate as nearly as possible the pressure in the CSF itself. This corrective action will be completed prior to startup.

Figure 1.

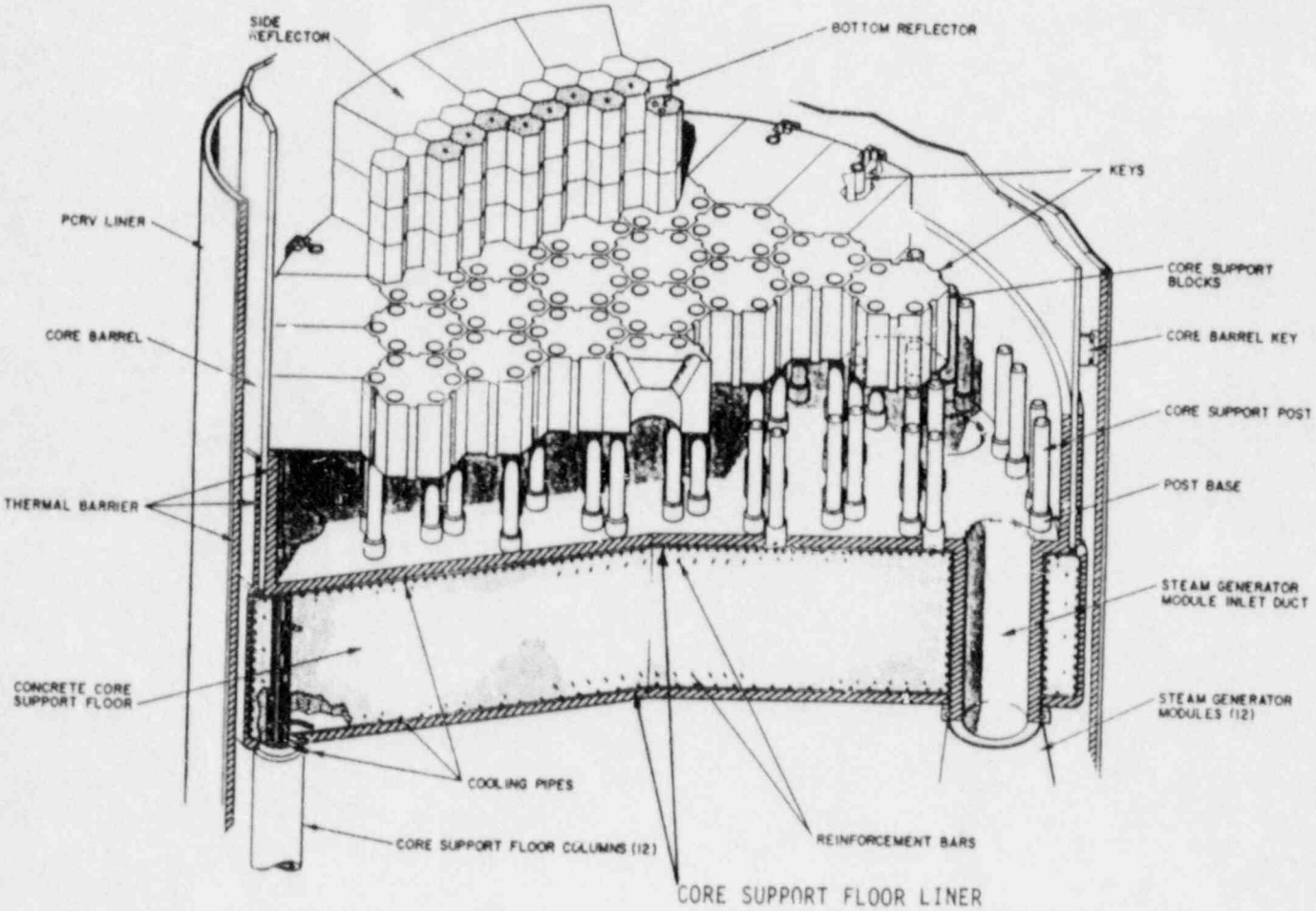

SIDE REFLECTOR
BOTTOM REFLECTOR
KEYS
PCRV LINER
CORE SUPPORT BLOCKS
CORE BARREL
CORE BARREL KEY
CORE SUPPORT POST
THERMAL BARRIER
POST BASE
STEAM GENERATOR MODULE INLET DUCT
CONCRETE CORE SUPPORT FLOOR
STEAM GENERATOR MODULES (12)
COOLING PIPES
CORE SUPPORT FLOOR COLUMNS (12)
REINFORCEMENT BARS
CORE SUPPORT FLOOR LINER

Figure 2.

CSF Internal Vent Design

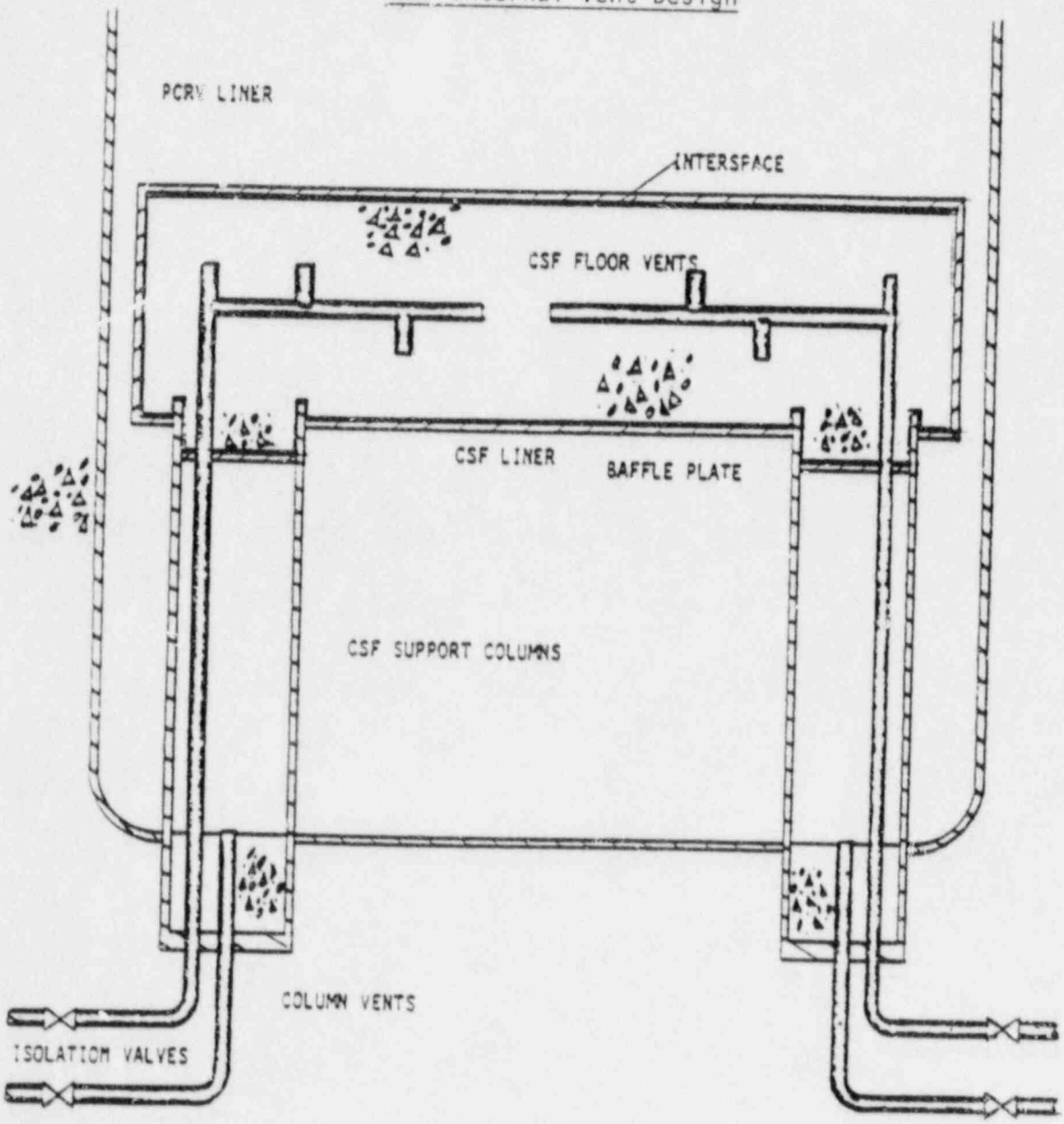
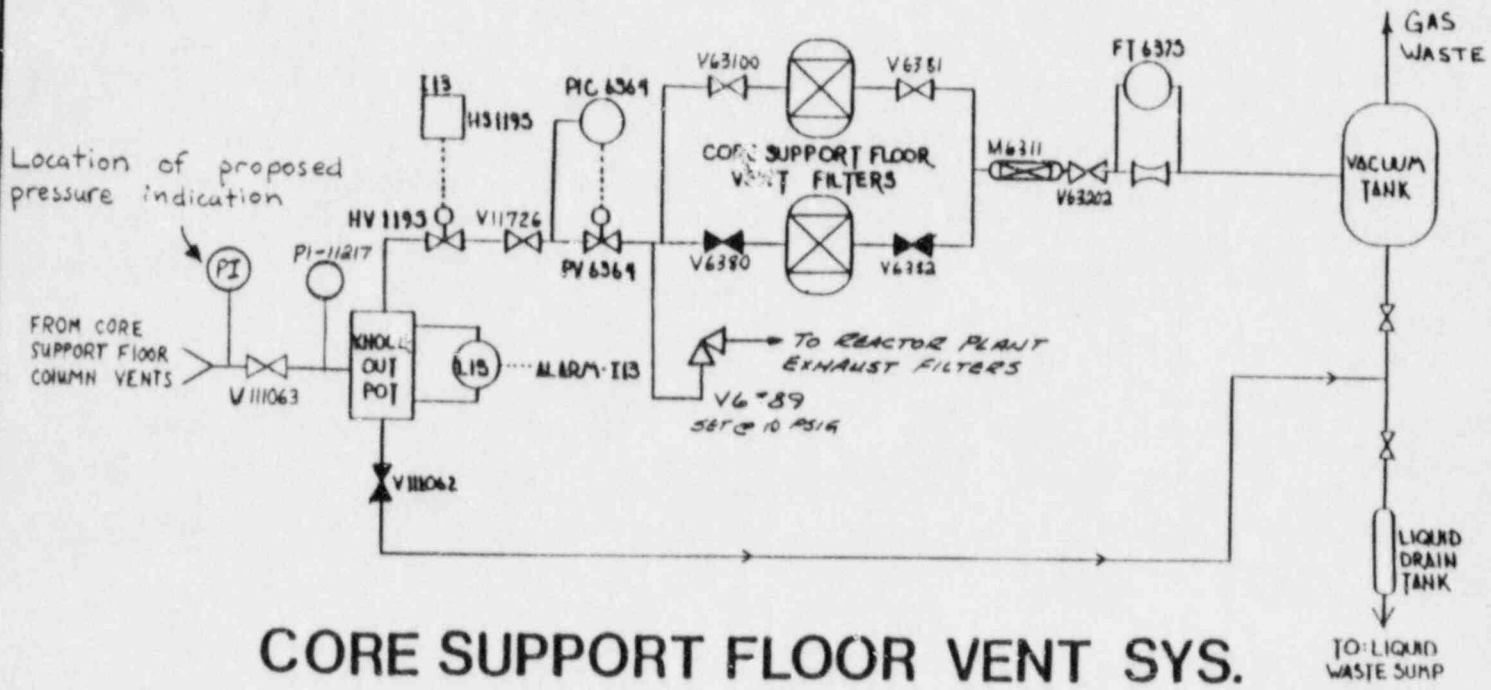
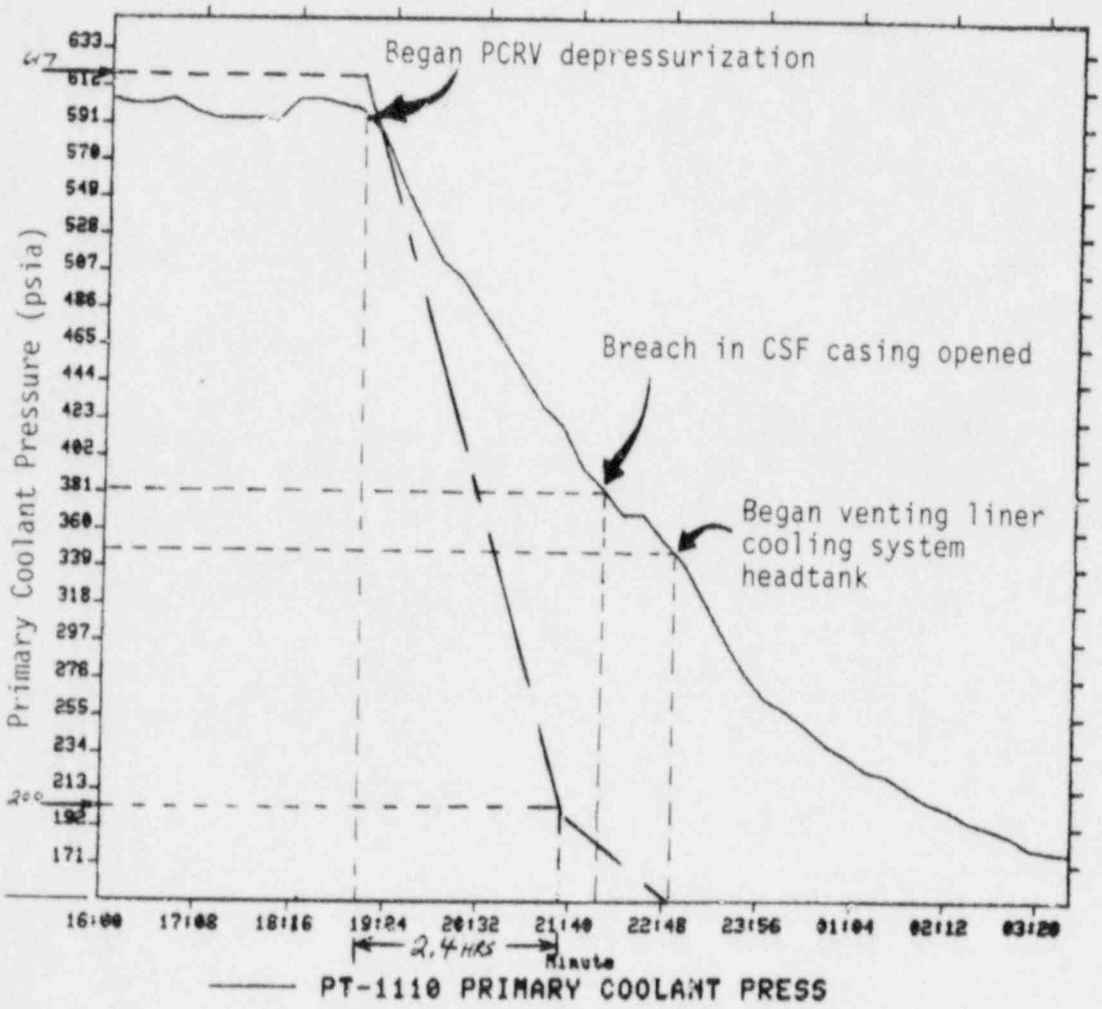


Figure 3.



CORE SUPPORT FLOOR VENT SYS.

Figure 4.



Assumed depressurization rate during DBA-1

Data represents the PCRV pressure during depressurization on July 5 and 6, 1988.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
	0 5 0 0 0 2 6 7	8 8	— 0 1 1	— 0 0	1 1 OF 1 2

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

Figure 5

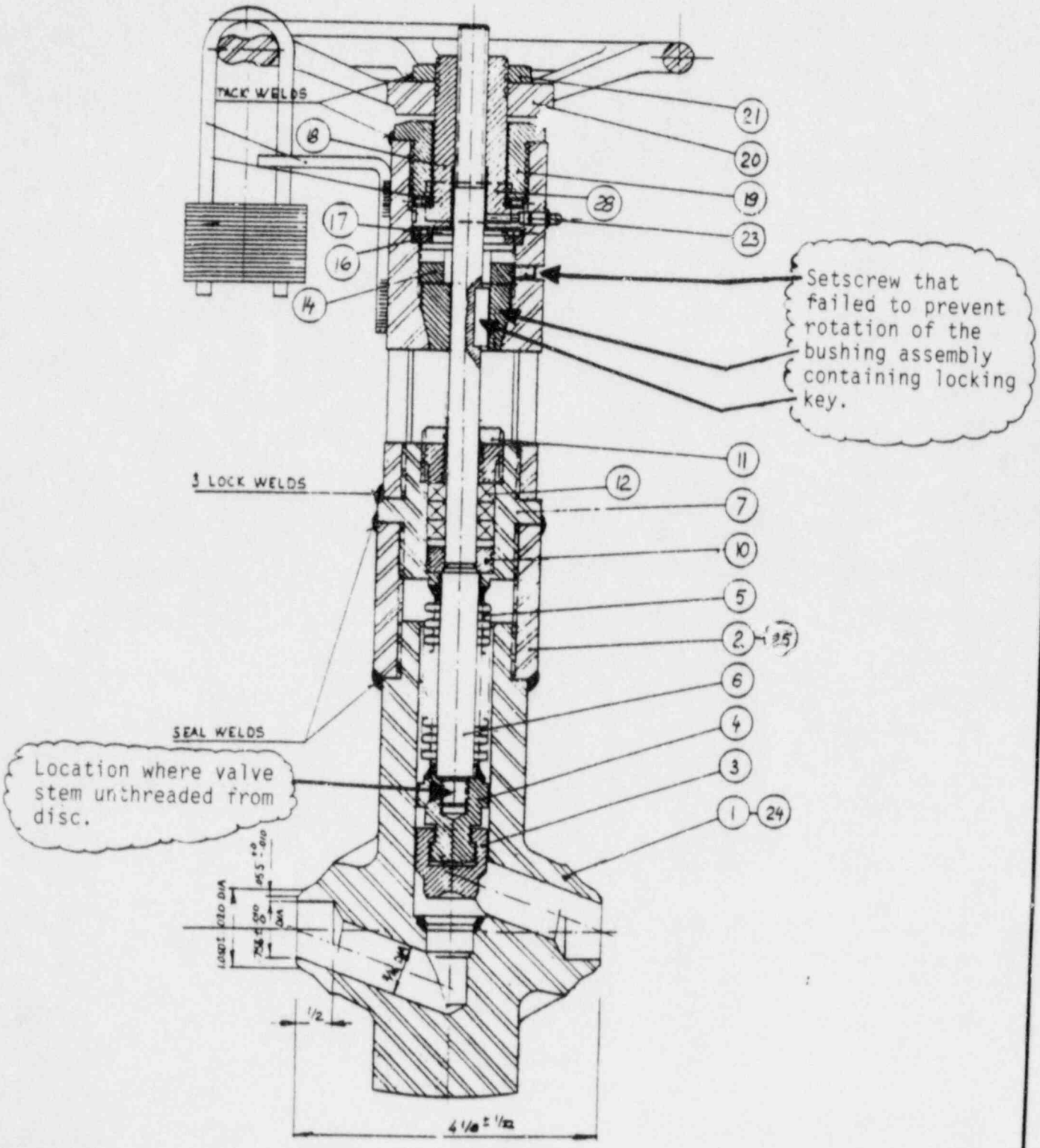


Diagram of V-111063

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Fort St. Vrain, Unit No. 1	0 5 0 0 0 2 6 7	8 8	— 0 1 1	— 0 0	1 2 OF 1 2

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

Jeff Castor
Technical Services Engineer

J.M Gramling
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Chuck Fuller by Jennie Evans
C. H. Fuller
Manager, Nuclear Production

Public Service™

Public Service
Company of Colorado

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August 5, 1988
Fort St. Vrain
Unit No. 1
P-88290

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Docket No. 50-267

SUBJECT: Licensee Event Report 88-011-00, Final Report

REFERENCE: Facility Operating License No. DPR-34

Gentlemen:

Enclosed, please find a copy of Licensee Event Report No. 50-267/88-011-00, Final, submitted per the requirements of 10 CFR 50.73(a)(2)(v)(D).

If you have any questions, please contact Mr. M. H. Holmes at (303) 480-6960.

Sincerely,

Chuck Fuller by
Dennis Swan

C. H. Fuller
Manager, Nuclear Production

Enclosure

cc: Regional Administrator, Region IV
ATTN: Mr. T. F. Westerman, Chief
Projects Section B

Mr. R. E. Farrell
Senior Resident Inspector, FSV

CHF/djm

IE22
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