Florida
Power
CORPORATION
Crystal River Unit 3
Docket No. 50-302

August 30, 1996
3F0896-23

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555-0001

Subject: Licensee Event Report (LER) 95-028-01

Dear Sir:

Please find the enclosed Licensee Event Report (LER) 95-028-01 regarding inadequate Borated Water Storage Tank (BWST) vacuum breaker capacity. This supplemental report is submitted by Florida Power Corporation in accordance with 10 CFR 50.73. The changes reflected in this LER were made to incorporate the results of a failure analysis conducted to determine the root cause of blockage in the sensing line of the previously installed vacuum breakers. Additional corrective actions are also described.

Sincerely,

Larry C. Kelly for

P. M. Beard, Jr.
Senior Vice President
Nuclear Operations

PMB/TWC

Attachment

xc: Regional Administrator, Region II
Project Manager, NRR
Senior Resident Inspector

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NRC FORM 366 (5-92)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104

EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HOURS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON DC 20503.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
CRYSTAL RIVER UNIT 3 (CR-3)	0 5 0 0 0 3 0 2	1 OF 1 0

TITLE (4)

Operation Outside Design Basis Caused by Personnel Errors and Inadequate Documentation of Borated Water Storage Tank Vacuum Breaker Capacity

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)
									N/A	0 5 0 0 0
1 2	1 3	9 5	9 5	0 2 8	0 1	0 8	3 0	9 6	N/A	0 5 0 0 0

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (CHECK ONE OR MORE OF THE FOLLOWING) (11)					
POWER LEVEL (10)	1 0 0	20.402(b)		20.405(c)		50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)		50.36(c)(1)		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)	X	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
T. W. Catchpole, Sr. Nuclear Licensing Engineer	3 5 2 5 6 3 - 4 6 0 1

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
B	B P	V A C	A 4 1 5	Y							

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

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

ABSTRACT

On December 13, 1995, Florida Power Corporation's Crystal River Unit 3 (CR-3) was in MODE ONE (POWER OPERATION) operating at 100% Reactor Power and generating 882 megawatts. During preparation for a test of Borated Water Storage Tank (BWST) vacuum relief valve DHV-70, the sensing line which connects the body of the vacuum breaker with the pilot assembly was found to be blocked. DHV-70 is one of two vacuum breakers required to provide vacuum relief to the BWST. Further investigation revealed the existing vacuum breakers did not individually have adequate relief capacity for their intended safety purpose. This was determined to be a condition outside the design basis and was reported as such on December 15, 1995. A temporary screened rain-hood assembly was installed in place of DHV-70 to provide a vent path and assure operability of the BWST. Corrective actions included installation of replacement valves without a sensing line, revisions to design basis documents to formalize the required relief capacity, strengthening the basis for BWST vacuum breaker redundancy, and confirming that other installed and functioning vacuum breakers are not subject to the same failure mechanism. The root cause of the corroded sensing line was due to dislodged corrosion products drawn into the sensing line during normal operation of the valve.

EVENT DESCRIPTION

On December 13, 1995, Florida Power Corporation's (FPC) Crystal River Unit 3 (CR-3) was in MODE ONE (POWER OPERATION), operating at 100% Reactor Power and generating 882 megawatts. During preparation for an ASME Section XI test of Borated Water Storage Tank [BP,TK] (BWST) vacuum relief valve [BP,VACB] DHV-70, the stainless steel sensing line which connects the body of the vacuum breaker with the pilot assembly was found to be totally obstructed with corrosion products. DHV-70 is one of two vacuum breakers required to provide vacuum relief to the BWST for protection during full Emergency Core Cooling System (ECCS)/Containment Spray [BE] drawdown. The system engineer was consulted and after an initial investigation, it was concluded the valve would not have worked properly with the sensing line clogged, although a test was not performed. When DHV-70 was removed from the system for testing, it was replaced with a screened rain-hood assembly to maintain an open vent path and prevent debris from entering the BWST. The system engineer conservatively elected to use the rain hood assembly because operators questioned the past practice of blanking-off the flanged connection while the removed valve was being tested. Clarification was sought to determine if one or both valves are required to protect the tank and prevent loss of Net Positive Suction Head (NPSH) to the Makeup & Purification (MU) pumps [CS,P] during maximum flow conditions. Subsequent investigation was completed on December 15, 1995 using the valve manufacturer's flow capacity information at different values of vacuum. This information indicated the two existing vacuum breakers (DHV-69 and 70) were not redundant, in that each considered alone, did not have adequate relief capacity for their intended purpose. A 1-Hour Notification was made to the Nuclear Regulatory Commission (NRC) using the Non-Emergency Event Notification system at 1041 hours on December 15, 1995. The notification was made in accordance with 10CFR50.72(b)(1)(ii)(B) as a suspected design basis issue and Event Number 29724 was assigned.

This report is being submitted in accordance with 10CFR50.73(a)(2)(ii)(B) as a condition outside the design basis of CR-3.

EVENT EVALUATION

The BWST and RB sump [BE,TK] provide borated water for the Decay Heat (DH) Removal pumps which function as the Low Pressure Injection [BP,P] pumps (LPI) during LOCA's, the Reactor Building Spray [BE,P] (BS) pumps, the Makeup Pumps [CB,P] which function as High Pressure Injection (HPI) pumps [BQ,P] during LOCA's, the Spent Fuel Cooling [DA,P] (SF) pumps, and the BWST recirculation pump. The BWST has four 8-inch penetrations at the top of the tank including the two vacuum breakers, a line to the Auxiliary Building Air Handling Exhaust Fans [UC,FAN] which continuously draw air from the top of the BWST, and an overflow line which has a large loop seal that affords tank overpressure protection. See Figure 1.

The basic function of DHV-69 and 70 is to equalize the pressure inside the BWST to provide protection against a collapse of the tank when vacuum is created during drawdown (see Figure 2). The valve setpoint is critical in maintaining adequate net positive suction head (NPSH) to the Makeup Pumps which are aligned to take suction from the BWST in their High Pressure Injection (HPI) mode during a large break loss-of-coolant-accident (LOCA). Analyses for Makeup/HPI Pump NPSH and Allowable Makeup Tank [CB,TK] (MUT) Overpressure assume a vacuum breaker setpoint for the BWST of 12 inches water vacuum for the most limiting case where the BWST is at its lowest level, the operating Makeup/HPI pump is Engineered Safeguards (ES) selected and Decay Heat/Low Pressure Injection and Reactor Building Spray pumps are being throttled for switchover to the RB sump. A vacuum in the BWST of greater than 12 inches water would reduce pressure on the BWST side of the tie-in point, thereby reducing NPSH available. As noted in the above Event Description, maintaining an open vent path in place of the removed vacuum breaker assured adequate vacuum relief capacity. With this arrangement, there was no impact on the health and safety of the public.

The BWST Vacuum Breaker valves are ISI Code Class 2 relief valves required to be tested in accordance with ASME OM-1 "Code for Operation and Maintenance of Nuclear Power Plants". DHV-69 and 70 were last tested on August 2, 1993 and August 6, 1993, respectively. Accurate valve pressure relief setpoints are necessary for the valves to fulfill their intended safety function. ASME OM-1 requires the valves to be repaired or replaced if the "as found" set pressure exceeds the set pressure by 3% or greater, (the upper allowable limit). In this case, the system engineer determined DHV-70 would not have passed the "as found" criteria.

Attachment 2 is provided as reference information to fully inform the NRC of activities which occurred subsequent to the event notification. The circumstances are not a direct part of the subject event but support the corrective actions identified.

CAUSE

The suspected inoperability of DHV-70 was due to blockage in the sensing line caused by accumulation of corrosion products. A failure analysis completed on February 21, 1996 determined that the root cause of the blocked sensing line was attributed to poor material selection (carbon steel) for the expected valve duty. Normal operation of the valve (valve disc/diaphragm moving upward) creates a pressure pulse which dislodges corrosion products from the valve internals. Debris is then preferentially drawn into the sensing line which operates at a slight negative pressure.

The issue regarding whether or not DHV-69 and 70 were redundant, was caused by inadequate change management and human performance. Design basis documents were

not specific regarding BWST Vacuum Breakers. Contributing causes included inadequate and outdated references. One example was a failure to update assumptions made in the original (1969) sizing calculation for the vacuum breakers. Another appears to be a reliance on "conservative estimates and engineering judgments" by the Architect-Engineer (A/E). In May, 1990, the A/E provided information regarding the effect the vacuum condition in the BWST had on the available NPSH for the Makeup/HPI pumps. The results were based on an evaluation of source documentation for Auxiliary Building Exhaust Fan pressure and the BWST vacuum breaker set pressure with a conclusion that sufficient NPSH margin for the Makeup/HPI pumps continued to exist.

IMMEDIATE CORRECTIVE ACTION

The BWST was determined to be fully OPERABLE with the screened rain-hood installed in place of DHV-70, thereby providing adequate relief capacity.

A work request was initiated to remove and inspect DHV-69 for a common failure mechanism (see Additional Corrective Actions).

ADDITIONAL CORRECTIVE ACTION

In order to drain the Fuel Transfer Canal, part of the normal Decay Heat flow is diverted to the BWST through the recirculation line, thus increasing the potential for a radioactive release through an open vent path in the BWST. Therefore, the following action items (1, 2, 4 and 5), necessary to replace DHV-69 and 70, were required to be completed prior to draining the Fuel Transfer Canal [DF] during the Refuel 10 Outage.

1. The relief capacity for the previously installed BWST Vacuum Breakers was defined by verified, formal calculation.

2. The relief capacity of the replacement vacuum breakers was established prior to installation.

3. The design basis document for the Decay Heat Removal System was revised to strengthen the information related to redundancy of the replacement vacuum breakers and to update available references.

4. An adjustment was made to the setpoint on the replacement vacuum breakers. The purpose of the adjustment was to establish added assurance that the valve will open and provide sufficient flow prior to reaching 12 inches of water column vacuum in the BWST.

5. A second vacuum breaker was obtained as a replacement for DHV-69 and installed prior to draining of the Fuel Transfer Canal as noted above.

6. An evaluation was performed of previous on-line maintenance and surveillance activities associated with DHV-69 and 70 and the previous practice of using a blank flange in place of the vacuum breaker removed for testing. The evaluation recognizes that, with one of the vacuum breakers removed, a single active failure of the remaining vacuum breaker leaves the non-safety related, non-seismic vent path to the Auxiliary Building (AB) Ventilation System as the only source of makeup air to the BWST during drawdown (see Figure 1 line to Aux Building Fans). The loop seal in the overflow line to the AB sump is assumed full of water. Data contained in the evaluation notes that the vent line contains no components, active or passive, which could inadvertently change state and impede makeup air flow; associated pipe supports were designed for worst case wind load which envelopes seismic loads; and the vent line is not installed in the vicinity of high energy lines which precludes whipping, pinching, and deformation as credible events. Therefore, the vent line would have maintained BWST vacuum below the 12 inches water gauge even with both vacuum breakers inoperable.

ACTION TO PREVENT RECURRENCE

1. The previously installed vacuum breakers have been replaced with a model made entirely of stainless steel. The new model does not utilize small bore sensing lines.

2. FPC reviewed other vacuum breakers installed at CR-3 to determine if they are subject to the same failure mechanism (blocked sensing line). The search criteria yielded nine (9) other valves which function as vacuum breakers. These include four (4) valves associated with the Sodium Hydroxide Storage Tanks [BE,TK] (BST-1 and BST-2) which are no longer used, two (2) valves associated with the Decay Heat Closed Cycle Surge Tanks [CC,TK] (DCT-1A and DCT-1B), two (2) valves associated with the Emergency Feedwater Tank [BA,TK] (EFT-2), and one (1) valve associated with the Nuclear Services Closed Cycle Surge Tank [CC,TK] (SWT-1). The valves installed on the permanently decommissioned BST-1 and BST-2 tanks do not present a safety concern. The valves installed on DCT-1A and DCT-1B, and the valve installed on SWT-1 (a piston check valve) also do not present a safety concern because these tanks utilize a nitrogen blanket which minimizes internal corrosion. In addition, the tanks' volume is not drawn down during any design basis event. The valves installed on EFT-2 are manufactured from stainless steel which is not susceptible to the failure mechanism of the previously installed BWST vacuum breakers. No additional actions were identified.

3. A chronology of the BWST vacuum breaker design basis and change management was developed for use in identifying possible programmatic and/or human performance issues. Although no programmatic changes were identified, the chronology and recommendations, will be forwarded to design, systems, and procurement engineering for review as a "lessons learned". Engineering personnel will be reminded when using older references such as the 1969 vacuum breaker sizing calculation, that a more critical approach is necessary to validate the information to be used in design and procurement activities.

PREVIOUS SIMILAR EVENTS

There have been no previous reportable events at CR-3 involving inadequate sizing of vacuum breakers. Based on a review of the Nuclear Plant Reliability Data System (NPRDS), CR-3 is the only plant that uses the AGCO Type 93 valve as a vacuum breaker. There have been no previous NPRDS reports made on these breakers by CR-3.

ATTACHMENT

Attachment 1 -Abbreviations, Definitions and Acronyms

Figure 1 - BWST Arrangements

Figure 2 - Type 93 Vacuum Relief Valve

ATTACHMENT 1 - ABBREVIATIONS, DEFINITIONS AND ACRONYMS

BS	Building Spray
CR-3	Crystal River Unit 3
ECCS	Emergency Core Cooling Systems
FPC	Florida Power Corporation
HPI	High Pressure Injection
LOCA	Loss of Coolant Accident
LPI	Low Pressure Injection
MODE ONE	POWER OPERATION (Greater Than 5 Percent Rated Thermal Power)
MU	Makeup and Purification System
NPSH	Net Positive Suction Head - a measure of the head (pressure) available to prevent cavitation.
Problem Report	A Problem Report documents a condition or event which impacts CR-3 and warrants evaluation, root cause analysis, or corrective actions beyond what it would receive if documented and processed by other methods.

NOTES: ITS defined terms appear capitalized in LER text (e.g. MODE ONE)

Defined terms/acronyms/abbreviations appear in parentheses when first used (e.g. Reactor Building (RB)).

EIIS codes appear in square brackets (e.g. Makeup Tank [CB,TK])

ATTACHMENT 2 - BACKGROUND AND TESTING ACTIVITIES RELATED TO REPLACEMENT FOR DHV-70

On December 18, 1995, while preparing to replace DHV-70 with a valve withdrawn from stock, a bench test was performed to establish the "as-found" data for the valve. The mechanical shop engineer noted the valve did not meet the requirement for the valve to fully open at 4.0 ounces per square inch vacuum which converts to 6.928 inches water column. The valve which failed the bench test had been purchased in 1994 using a safety related, commercial grade dedication procurement method. The dedication involved the use of source inspection as a basis for the dedication and the inspector witnessed the functional test, noting a set pressure of 6.9 inches water column. A Quality Material Problem Report (QMPR) was issued on January 5, 1996 with a disposition to return the valve to the vendor, Anderson, Greenwood & Company (AGCO). The return instructions require AGCO to perform an "as-found" lift test and inform FPC of the results along with recommended corrective action required, prior to proceeding with any repair. After discussions between AGCO and FPC engineers regarding testing techniques, it was concluded that FPC's techniques utilized a rapid buildup of vacuum versus a gradual buildup and this may have contributed to the problem.

The above vacuum breaker is a Type 96A0606RS vacuum relief valve purchased in 1994 as a replacement for the existing Type 930608RC valve for DHV-69 and 70. The equivalency evaluation for the replacement indicates the decision was based on an attempt to standardize valve design presently used in another application and for ease of maintenance. Per discussion with the responsible procurement engineer, AGCO had also informed FPC the Type 93 valve was no longer being marketed as a vacuum relief device. The need for a spare replacement valve was related to several actions resulting from a review of the ISI classification for DHV-69 and 70 identified as part of a focused, configuration management effort. The review confirmed the valves should have been ISI Code Class 2 and that a Code Class 4 designation had been incorrectly assigned when ISI flags were originally added to CR-3 flow diagrams. In an attempt to justify the Code Class 4 designation, an evaluation was performed of alternate venting paths including the line to the Auxiliary Building Air Handling System and the BWST loop seal (see Figure 1). These paths were noted as not seismically designed and their integrity could not be assured. Problem Report EEPR 91-0014 was issued in July, 1991 to identify the need to replace several non safety-related parts installed based on the incorrect ISI designation and to change the drawings to identify the correct classification. One of the changes made, was to replace the carbon steel sensing line and fittings with stainless tube and fittings to provide better resistance to corrosion due to the salt air environment in which the valves are exposed. During performance of the work needed to change out the non safety-related parts, DHV-70 was found to be degraded and Problem Report 93-0194 was issued to determine if the operability of the BWST was affected. The problem report was determined to be not reportable on the basis a fully operable "redundant" DHV-69.

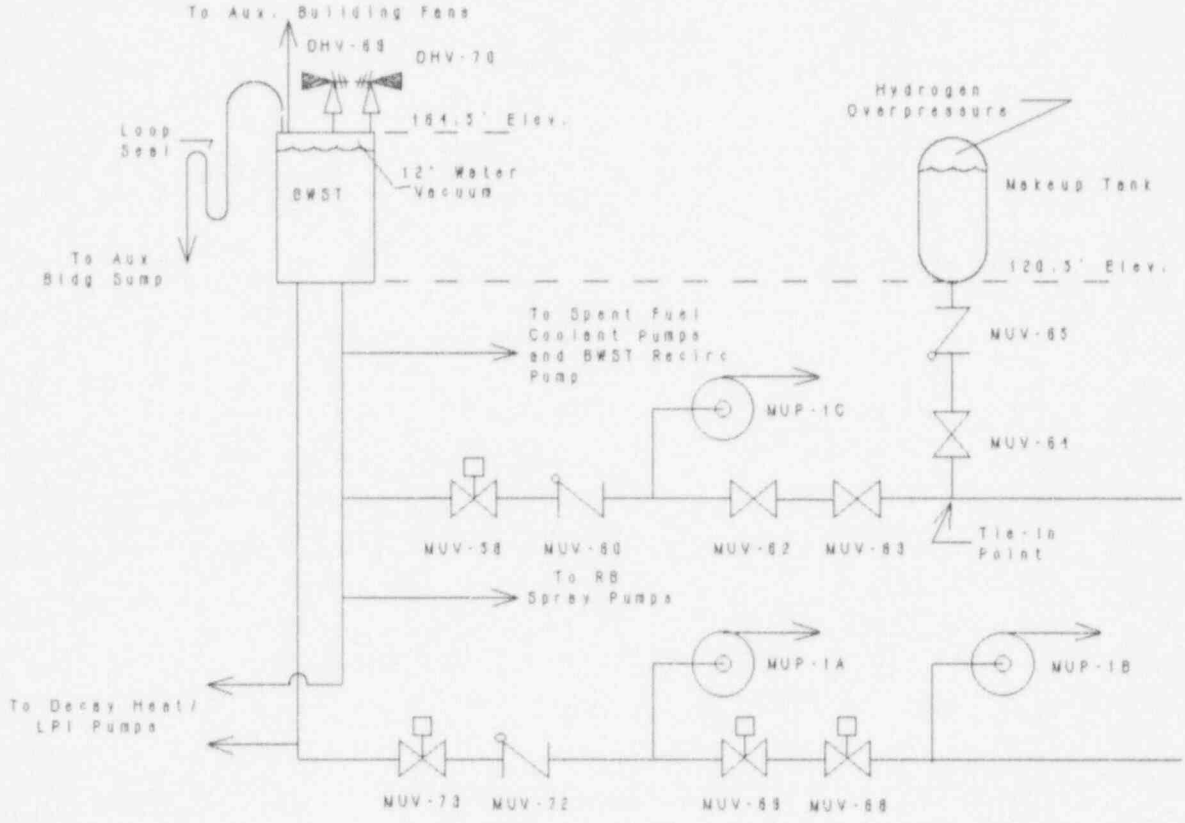
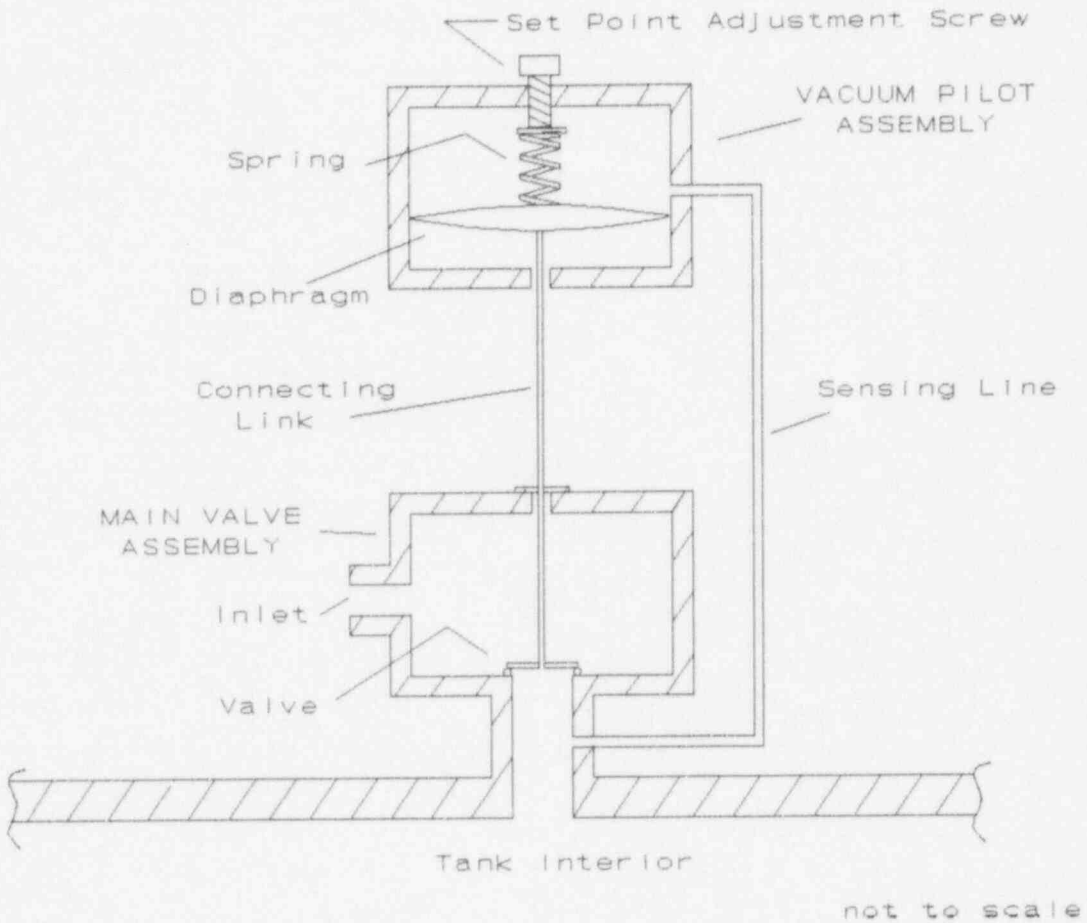

To Aux. Building Fans
DHV-69
DHV-70
184.5' Elev.
Loop Seal
12" Water Vacuum
BWST
To Aux Bldg Sump
Hydrogen Overpressure
Makeup Tank
120.5' Elev.
To Spent Fuel Coolant Pumps and BWST Recirc Pump
MUV-65
MUP-1C
MUV-61
MUV-58
MUV-60
MUV-62
MUV-63
Tie-In Point
To RB Spray Pumps
MUP-1A
MUP-1B
To Decay Heat/ LPI Pumps
MUV-73
MUV-72
MUV-69
MUV-68

Figure 1



SIMPLIFIED VACUUM RELIEF VALVE

FIGURE 2