NRC Form 366 (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

Approved OMB No. 3150-0104
Expires 4/30/92

LICENSEE EVENT REPORT (LER)

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TITLE (4) Use of Nonconservative Mass and Energy Release Data for Main Steam Line Break Analysis

EVENT DAY (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)
									Sequoyah, Unit 2	0 5 0 0 0 3 2 8
0 7	1 5	9 2	9 2	0 1 3	0 1	0 3	2 4	9 3		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)	XX 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)
J. W. Proffitt, Compliance Licensing	6 1 5 8 4 3 - 6 6 5 1

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

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)

This LER was revised to reflect changes in the corrective actions.
On July 15, 1992, it was determined that the mass and energy releases used to calculate the pressures, which would be experienced during a main steam line break in the main steam valve vaults, were not conservative. As such, the potential existed to exceed the structural design margins of the walls and slabs for the valve vaults. Utilizing the break exclusion criteria from ASB 3-1, a justification for continued operation was performed that demonstrated that for a one-square-foot break, the resultant pressures would not exceed those used in the original design of the vaults. The design basis calculations involved with this condition were issued in the early 1970s based on information transmitted from Westinghouse in 1971. From all indications, the basic cause is that the original design and licensing basis for the main steam line break in the valve vaults assumed dry steam in the calculation. Modifications will be performed to bring the plant into compliance with the design basis.

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

I. PLANT CONDITIONS

Units 1 and 2 were operating at approximately 100 percent reactor thermal power.

II. DESCRIPTION OF EVENTS

A. Event

On July 15, 1992, it was determined that the mass and energy releases used to calculate the pressures that would be experienced during a main steam (EIIS Code SB) line break (MSLB) in the main steam valve vaults (MSVVs) were not conservative. The structural design pressures for the main steam valve vaults, under the most limiting design basis pressure transient, is a double-ended severance of a main steam line inside the vaults. The calculations, to determine the pressure, used mass and energy release data submitted to TVA by Westinghouse in 1971. The information provided was based upon the largest steam generator depressurization rate consistent with a high quality steam discharge. Subsequent review of a similar mass and energy release calculation for Watts Bar Nuclear Plant (WBN) has prompted Westinghouse to conclude that the mass and energy releases provided may not represent the most limiting break flow for pressure determination in the valve vaults. Westinghouse indicated that the assumption of a dry steam release in a vented compartment such as the valve vaults is not conservative due to moisture entrainment within the discharge. Westinghouse recommended that the methodology outlined in ANSI/ANS Standard 58.2 1980, Appendix E be used to generate the bounding mass and energy release data for determining pressures inside the valve vaults. The use of ANSI/ANS 58.2 methodology significantly increases the mass and energy releases above those presently used in the calculations. The increase in the mass and energy release has the potential to produce pressures that exceed structural design margins and may challenge the structural adequacy of the concrete walls and slabs for the valve vaults. Utilizing the break exclusion criteria from ASB 3-1, a justification for continued operation was performed that demonstrated that for a one-square-foot break, the resultant pressures would not exceed those used in the original design of the vaults.

B. Inoperable Structures, Components, or Systems That Contributed to the Event

None.

C. Dates and Approximate Times of Major Occurrences

Prior to November 8, 1971	A telecon conducted between TVA and Westinghouse requesting MSLB flow transient data.
November 8, 1971	TVA received Westinghouse steam generator blowdown rate information.

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August 1, 1974	TVA issued the west MSVV design pressure determination calculation.
November 3, 1974	TVA issued the west MSVV MSLB transient pressure analysis calculation.
June 2, 1974	TVA issued the east MSVV calculation.
March 6, 1975	TVA issued the calculation for the east MSVV design pressure. The calculation was for the pressure transient resulting from a double-ended MSLB.
September 26, 1975	TVA revised the calculation for the east MSVV design pressure to address the pressure transient resulting from a single-ended MSLB, since pipe whip restraints limited it to a single-ended rupture from the double-ended rupture.
July 10, 1987	Previous calculations were superseded with west MSVV design pressure study for a double-ended main steam line break calculation.
February 2, 1988	TVA issued a calculation for the peak pressure in the east MSVV at SQN, following a steam line break, to resolve deficiencies in previous calculations due to not addressing fluid inertial effects in determining the peak pressure. The modeling still utilized the original blowdown data.
May 13, 1992	Questions concerning the documentation of mass and energy release data were raised from the WBN calculation reconstitution program.
June 23, 1992	Westinghouse notified TVA (WBN) that the mass and energy release data previously supplied was not conservative and not applicable for a pressure transient evaluation of the MSVV. TVA was also advised that the use of ANSI/ANS 58.2, Appendix E was the appropriate method and bounded all sophisticated analyses that could be conducted for this type of event.
June 25, 1992	TVA requested Westinghouse to provide a proposal to calculate the blowdown values using the ANSI/ANS 58.2 Appendix E criteria.

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July 7, 1992 — Westinghouse notified TVA (WBN) with the preliminary results of the double-ended MSLB, using the ANSI/ANS 58.2, Appendix E criteria. The results indicated that there could be a challenge to the MSVV design.

July 8, 1992 — Westinghouse was requested to evaluate the potential for doing a more sophisticated analysis in order to confirm the initial data since the new mass and energy release appeared to be a potential problem regarding the WBN MSVV structural design.

July 8, 1992 — WBN identified and evaluated the various WBN and SQN calculations determining the respective MSVV pressure profiles using the Westinghouse data and determined that the issue was potentially serious not only to WBN but also to SQN.

July 15, 1992 — Based upon further review Westinghouse advised TVA that a more sophisticated analysis for WBN, if conducted, would not provide substantially lower mass and energy release results than the ANSI/ANS methodology, and TVA should proceed on the basis of the data provided.

WBN notified SQN of the potential condition.

July 15, 1992 — SQN personnel contacted Westinghouse directly. Westinghouse was asked to evaluate the applicability and potential impact of the use of the 1971 data.

July 16, 1992 — Westinghouse notified SQN of the applicability of the issue. SQN initiated a corrective action document and notified NRC as required.

A justification for continued operation was prepared.

D. Other Systems or Secondary Functions Affected

The identified condition has the potential of causing a failure of the MSVV walls. Failure of the MSVV walls could result in damage to the components inside the MSVV. Critical components housed in the MSVV include main steam, feedwater, and auxiliary feedwater component piping.

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E. Method of Discovery

During review of the mass and energy release calculations for WBN, Westinghouse concluded that the mass and energy releases provided may not be the most limiting break flow for the valve vaults. WBN notified SQN of the potential condition.

F. Operator Actions

Not applicable - no operator actions were required.

G. Safety System Response

Not applicable - no safety system responses were required.

III. CAUSE OF EVENT

A. Immediate Cause

The immediate cause of this condition was that perfect moisture separation was assumed in the main steam line break analysis.

B. Root Cause

The apparent root cause of this condition was determined to be (1) the apparent lack of a TVA technical review in the mid-1970s of the blowdown data for applicability in the MSLB pressurization calculations and (2) the lack of notification by Westinghouse to TVA of the methodology change in calculating blowdown energy releases in the latter 1970s.

The first inappropriate action was the use of the Westinghouse blowdown data in the initial calculations for the valve vaults. The data was apparently applied without understanding the limits of its applicability. There is no documentation available which explains "why" the blowdown data was originally transmitted to TVA in 1971; the break postulated was a double-ended break in the turbine building using high quality steam with flow from both the forward and reverse directions.

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At the time the calculations were being developed, it was generally recognized that entrained liquid blowdowns provided limiting results for pressure analysis. It was also recognized that for blowdowns inside containment, MSLBs were bounded by loss of coolant accidents for calculating peak containment pressures. Consequently, it was general practice to consider high quality steam for temperature analyses following MSLBs. Given these considerations, the assumption of high steam quality should have been a review variable during the performance of the calculations. Thus, one of the causes of this condition is concluded to be the lack of a TVA technical review in sufficient detail to have determined the problem with the application of tne Westinghouse data to the MSVVs in terms of break area, model geometry, and steam quality.

The second inappropriate action identified was the failure of Westinghouse to notify TVA that more limiting methods had been developed for calculating mass and energy releases during blowdowns.

IV. ANALYSIS OF EVENT

The design basis event affected by this issue is a rupture of the main steam piping. The MSLB is the design basis event for the pressurization and temperature transients within the MSVV. The main feedwater line break is the design basis event for flooding in the valve vaults and is not impacted by this condition. A MSLB in the valve vault, assuming perfect moisture separation, is the design basis event for temperature in the valve vaults and is not impaired by this condition.

For MSLBs in the valve vault, ANSI/ANS 58.2 utilizes a conservative methodology for determining the mass and energy releases resulting from a MSLB within the main steam valve vaults. The methodology is based upon blowdowns discharged from a double-ended severance of a main steam pipe. This type of break is required by the current design; however, if the requirements of Branch Technical Position MEB 3-1 are met, this type of break does not need to be considered. Based on the analysis outlined below, the intent of the branch technical position are considered to be met.

Review of the postulated pipe break locations in the main steam system determined that the only design basis break postulated for the main steam pipe located in the east and west valve vaults for both units is located at the terminal end flued head anchors in the valve vault walls for each steam line. There are no stress-related breaks that have to be considered in the valve vault.

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The position taken, i.e., that the requirements of Branch Technical Position MEB 3-1 are met, is considered applicable to the piping from the steam generator nozzle to the flued head anchor in the valve vault wall. The Class B (ASME Class 2 equivalent) portion of the piping extends to the flued head anchor in the valve vault wall. Based upon Branch Technical Position MEB 3-1, the MSVV structure should be designed for mass and energy releases corresponding to break sizes of one square foot to address the environmental effects and jet impingement effects on essential equipment.

The design of the valve vaults was based on a double-ended rupture of the main steam line without considering moisture entrainment. The effective area of this break is 5.6 square feet. A one square-foot break limits the flow out of the break to values significantly below the double-ended flow rates. The smaller break size reduces fluid velocities and level swells in the steam generators to the point that appreciable entrainment of liquid in the steam would not be expected. For a limited break outside containment, flow through the break would be essentially equally fed by all four steam generators. Thus, the effective flow increase due to the break in any one generator would be limited to the flow out of a 0.25 square-foot break. Based on Moody critical flow for no line loss and a quality of zero, the flow rate through a one square-foot hole at 1,000 psia is 7,970 pounds per second. The enthalpy of this fluid would be relatively low (about 550 BTU/lbm). The steam flow used to design the valve vault walls was greater than 10,000 pounds per second with a high enthalpy (approximately 1,200 BTU/lbm). It can, therefore, be concluded that a one square-foot break would not result in higher valve vault pressures than had been used in the original design of the vaults.

V. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

Utilizing the break exclusion criteria, a justification for continued operation was performed, which demonstrated that for a one square-foot break, the resultant pressures would not exceed the original design basis.

B. Actions to be Taken

The condition described involves the use of nonconservative vendor data supporting the plant design basis. In this particular case, the use of the Westinghouse data was for a very limited and specialized application. Furthermore, during the Cycle 4 refueling outages for each unit, the Chapter 15 accident analysis was extensively revisited and revised by Westinghouse as part of several major modifications. Given the extensive reviews performed by both TVA and Westinghouse, there is a reasonable level of confidence that there are no further conditions of this type.

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From a broader perspective, the problem with the calculation was identified as part of the Watts Bar Calculation Reconstitution Program. No other problems have been identified that document non-conservative use of vendor data that resulted in significant challenges to the plant design basis. Although the Watts Bar calculation program is still ongoing, the initial extent of condition has been validated. Additionally, if any significant problems are identified, they will be handled in accordance with the Corrective Action Program.

TVA will perform modifications to bring the plant into compliance with the original design basis. The modification will involve modifying each of the flued head anchor-sleeve openings to decrease the flow area, thereby limiting the rate of mass and energy entering the valve vault following a main steam line circumferential break at one flued head anchor. To limit the flow area, a plate will be welded on the end of the sleeve. The flow area will be sized to limit the pressure in the main steam valve vault to less than the original design basis of the floor and walls.

VI. ADDITIONAL INFORMATION

A. Failed Components

None.

B. Previous Similar Events

A review of previously reported events identified a number of events associated with the main steam system, the MSVVs inadequate vendor information, and inadequate reviews of vendor information. Corrective actions for these events included procedure guidance for Engineering not to rely solely on vendor information and performing additional reviews in the particular subject area to address extent of condition. However, the corrective actions reviewed could not have prevented or identified this condition at an earlier point in time.

VII. COMMITMENT

TVA will perform modifications to bring the plant into compliance with the original design basis. These modifications will be completed by the end of each unit's Cycle 6 refueling outage.