FENOC
FirstEnergy Nuclear Operating Company

Beaver Valley Power Station
Route 168
P.O. Box 4
Shippingport, PA 15077-0004

Lew W. Myers
Senior Vice President

724-682-5234
Fax: 724-643-8069

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Beaver Valley Power Station, Unit No. 2
Docket No. 50-412 License No. NPF-73
LER 2002-001-00

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

In accordance with Appendix A, Beaver Valley Technical Specifications, the following Licensee Event Report is submitted:

LER 2002-001-00, 10 CFR 50.73(a)(2)(i)(B), "Service Water Conditions for the Recirculation Spray System Lead to Technical Specification Noncompliance."

Lew W. Myers

Attachment

cc: Mr. D. S. Collins
BVPS Project Manager
United States Nuclear Regulatory Commission
Washington, DC 20555

Mr. David M. Kern
BVPS Senior Resident Inspector
United States Nuclear Regulatory Commission

Mr. H. J. Miller, Regional Administrator
United States Nuclear Regulatory Commission
Region 1
475 Allendale Road
King of Prussia, PA 19406

Mr. J. A. Hultz
Ohio Edison Company
76 S. Main Street
Akron, OH 44308

INPO Records Center
700 Galleria Parkway
Atlanta, GA 30339-5957

Mr. L. E. Ryan
Bureau of Radiation Protection
Department of Environmental Protection
RCSOB-13th Floor
P.O. Box 8469
Harrisburg, PA 17105-8469

NRC FORM 366 (7-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004

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LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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4. TITLE
Service Water Conditions for the Recirculation Spray System Lead to Technical Specification Noncompliance

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
01	11	2002	2002	– 001	– 00	03	08	2002	None	
									FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE	1
10. POWER LEVEL	100 %

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

	20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)		50.73(a)(2)(ix)(A)
	20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)		50.73(a)(2)(x)
	20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)		73.71(a)(4)
	20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)		73.71(a)(5)
	20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)		OTHER Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)		
	20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)		
	20.2203(a)(2)(v)	X	50.73(a)(2)(i)(B)		50.73(a)(2)(vii)		
	20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)		
	20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)		

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
L. R. Freeland, Manager Regulatory Affairs / Corrective Action	(724) 682-5284

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
A/D	BE	HX	O015	Y					

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

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

During a surveillance test on January 11, 2002, service water flow rate through the Bravo train of the Recirculation Spray System (RSS) was found to provide insufficient flow as required by Beaver Valley Power Station Unit No. 2 Technical Specification (TS) 4.6.2.2.e.3. Upon discovery, the Bravo RSS train was declared inoperable and TS 3.6.2.2 action statement was entered. The cause of the low flow was blockage of the tubesheet by corrosion products formed in the inlet to the B RSS HX due to the presence of a prior air leak on the inlet endbell. The air leak on the endbell existed because approximately 4 adjacent mechanical fasteners of the 36 on the inlet endbell were loose. The loose fasteners were caused by improper maintenance techniques when the inlet endbell was reassembled during the prior refueling outage.

On January 15, 2002, while planning for the service water flow surveillance test through the Alpha RSS train, it was discovered that both trains of RSS had been inadvertently rendered inoperable during the draining of the B/D RSS heat exchangers on three separate occasions. During the draining of the RSS heat exchangers, a common service water discharge isolation valve was closed per procedure on three separate occasions. Closing this valve placed the service water system in a configuration where the service water flow through the Alpha train of RSS has not been demonstrated to meet the minimum service water flow rate required by TS 4.6.2.2.e.3 of greater than 11,000 gpm for one train of RSS. Thus, during the three periods when the common isolation valve was closed (making the Alpha train of RSS inoperable) while the Bravo train of RSS was inoperable due to corrective maintenance, both trains of RSS were inoperable.

This event is a condition prohibited by the plant's TS and is reportable pursuant to 10 CFR 50.73(a)(2)(i)(B). The Bravo train RSS during its flow blockage and the Alpha train during the common valve closure remained capable of performing their safety function. Thus, the safety significance of this event was small.

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PLANT AND SYSTEM IDENTIFICATION

Westinghouse-Pressurized Water Reactor System (PWR)
Recirculation Spray System (BE)
Service Water System (BI)

CONDITIONS PRIOR TO OCCURRENCE

Unit 2: Mode 1 at 100 % power

There were no systems, structures, or components beyond the equipment involved that were inoperable that contributed to the event.

DESCRIPTION OF EVENT

During a surveillance test on January 11, 2002, the service water flow rate through the Bravo train of the Recirculation Spray System (RSS) was found to provide insufficient flow as required by Beaver Valley Power Station (BVPS) Unit No. 2 Technical Specification (TS) Surveillance Requirement (SR) 4.6.2.2.e.3. The Bravo train includes the B and D RSS heat exchangers (See attached simplified figure). During the test, the B RSS heat exchanger was exhibiting low service water flow (3498 gpm) and the D RSS heat exchanger was exhibiting high service water flow (6971 gpm), with a total flow rate less than the required TS required flow rate of 11,000 gpm. Upon discovery of the low flow condition, the Bravo train of RSS was declared inoperable and the action statement for TS 3.6.2.2 was entered which permits a 72 hour allowed outage time.

The service water side of the B RSS heat exchanger was opened. About three gallons of loose corrosion products (primarily composed of iron oxides) were found covering the inlet tubesheet side of the B RSS heat exchanger. The corrosion products were removed from the B RSS heat exchanger. The service water side of the D RSS heat exchanger was also inspected and no significant blockage was found (approximately 1/3 gallon of corrosion products). A post maintenance service water flow surveillance test through the Bravo train of RSS demonstrated acceptable results. The Bravo train of RSS was declared operable and the action statement was exited on January 13, 2002, within the 72 hour allowed outage time.

On January 15, 2002, while planning for the service water flow surveillance test through the Alpha train of RSS, it was discovered that both trains of RSS had been inadvertently rendered inoperable on three separate occasions while the B and D RSS heat exchangers were being drained following their surveillance test. Service water flow through the two Alpha train and the two Bravo train RSS heat exchangers is carried out to the Ohio River via two discharge pipes. These two service water discharge pipes are cross-connected just downstream of the four (A, B, C & D) RSS heat exchangers by a normally locked open manual isolation valve (2SWS-82). During the draining of the B and D RSS heat exchangers, 2SWS-82 was closed per the draining procedure on three separate occasions. 2SWS-82 was closed for approximately 2 hours on January 11, for approximately 1.5

hours on January 12, and for approximately 4 hours on January 13. Closing 2SWS-82 placed the service water system in a configuration where the service water flow through the Alpha train of RSS has not been demonstrated to meet the minimum service water flow rate required by TS SR 4.6.2.2.e.3 of greater than 11,000 gpm for one train of RSS. Thus, during the three periods when 2SWS-82 was closed (making the Alpha train of RSS inoperable) and the Bravo train of RSS was inoperable for corrective maintenance, both trains of RSS were inoperable. TS 3.6.2.2 does not permit both trains of RSS to be inoperable in Modes 1 through 4; thus, TS 3.0.3 was applicable. TS 3.0.3 requires that action shall be initiated within one hour to place the Unit into a Mode in which the application specification does not apply. Since this condition was not recognized at the time, the actions required by TS 3.0.3 were not implemented, which is a condition prohibited by TS.

CAUSE OF EVENT

The cause of the low flow through the B RSS heat exchanger was blockage of the tubesheet by loose corrosion products. The corrosion products were formed in the inlet piping to the B RSS heat exchanger due to air leaking into the inlet endbell of the B RSS heat exchanger. The air leakage path existed because approximately 4 adjacent mechanical fasteners of the 36 on the inlet endbell were loose. The loose fasteners were caused by improper maintenance techniques when the inlet endbell was reassembled during the last refueling outage in October 2000.

During the last refueling outage (approximately 15 months prior to the surveillance test on January 11, 2002), the service water full flow surveillance tests through both trains of the RSS were performed successfully. After these tests were completed, all four RSS heat exchangers were opened and cleaned as part of normal practice. The heat exchangers were then closed and left in a partially drained lay-up condition along with the heat exchangers inlet piping. During the surveillance test on January 11, 2002, a small leak from the inlet endbell gasketed flange on the B RSS heat exchanger was observed. This leakage was visually quantified to be approximately 1/2 gpm. Although this leakage was small, this leakage path allowed air (oxygen) to enter into the affected area of the 16-inch supply piping during the past 15 months since the last surveillance test. This had provided a richer than normal oxygen environment inside the pipe which transformed the normal tightly formed passivation layer of magnetite (Fe_3O_4) on the inside surface of the pipe into softer, more porous and far less adherent hematite (Fe_2O_3), as determined by laboratory analysis of the corrosion products. This layer delaminated from the piping wall during the full flow test on January 11, 2002. A contributing cause of this event was the lack of a post-maintenance test or inservice leak check following the maintenance in the last refueling outage which allowed the condition (loose bolts, leak path) to go undetected for the operating cycle.

The cause for the inadvertent entries into TS 3.0.3 when 2SWS-82 was closed is inadequate/ incomplete design aspects. The original change to require 2SWS-82 to be locked open to reduce system backpressure was not effectively managed and documented. The underlying reason that 2SWS-82 is locked open is to maintain the configuration of service water system piping from the RSS heat exchangers to support adequate flow through either train of RSS. Prior to January 11, 2002, the service water flow surveillance testing of the RSS had previously occurred during

shutdown conditions when RSS was not required to be operable. The previous revision of the procedure for draining a RSS heat exchanger was only applicable during outage periods and had closed 2SWS-82 as a precaution for industrial safety purposes given that other outage related work may be ongoing. However, 2SWS-82 is not required to be closed to drain the RSS heat exchanger. When the need arose in January 2002 for draining the B and D RSS heat exchangers in a mode where the Alpha train RSS was required to be operable, the procedure for draining a RSS heat exchanger was revised to be applicable in all modes. The personnel who developed and performed the newly revised procedure were not readily able to recognize that the closure of 2SWS-82 in Modes 1-4 would render the Alpha RSS train inoperable due to low service water flow.

REPORTABILITY

The low service water flow rate condition in the BVPS Unit 2 B RSS heat exchanger due to corrosion product build-up was first identified on January 11, 2002 and the TS 3.6.2.2 required actions were promptly initiated at the time of discovery. The actual time that the corrosion products built up to a level that would have caused an unacceptable flow to occur cannot be determined. However, it is reasonable to conclude that this condition occurred at least 78 hours prior to when it was discovered, given the nature of the cause and that corrosion product build-up is not a prompt process. Therefore, BVPS Unit 2 could have experienced a service water flow rate less than that required by TS SR 4.6.2.2.e.3, which would render the Bravo RSS train inoperable. This condition likely occurred for a time frame longer than allowed by TS 3.6.2.2 Action Statement A which states that the RSS subsystem must be restored to operable within 72 hours or be in Hot Standby within the following 6 hours. Therefore, this was a condition prohibited by the plant's Technical Specifications and is reportable pursuant to 10 CFR 50.73(a)(2)(i)(B).

When 2SWS-82 was closed on three separate occasions during the draining of the Bravo train RSS heat exchangers between January 11 and 13, 2002, the Alpha train of RSS was inadvertently made inoperable due to a lack of a valid surveillance test to show sufficient service water flow rate through the Alpha train RSS heat exchangers in this configuration. This inadvertently resulted into entries into TS 3.0.3 since both RSS trains were inoperable when 2SWS-82 was closed. TS 3.0.3 requires that action shall be initiated within one hour to place the Unit into a Mode in which the application specification does not apply. Since the entries into TS 3.0.3 were not recognized, no actions were taken within one hour for each occurrence. This was a condition prohibited by the plant's Technical Specifications and is reportable pursuant to 10 CFR 50.73(a)(2)(i)(B).

SAFETY IMPLICATIONS

The service water flow rate surveillance test of the Bravo RSS train on January 11, 2002 recorded a flow rate of 3498 gpm in the B RSS heat exchanger and 6971 gpm in the D RSS heat exchanger. The combined flow rates of 10469 gpm is less than the 11,000 gpm required by TS SR 4.6.2.2.e.3. The 11,000 gpm service water flow rate value is needed to show acceptable design basis accident (DBA) transient results with the design basis maximum river water temperature of 89F and one train of RSS. An evaluation was performed for the design basis accident transients using the as-found

service water flow rates through the Bravo train of the RSS. Acceptable containment analyses results were determined using the maximum observed service water system temperature (80F) throughout the past BVPS Unit 2 operating cycle. Containment pressure was shown to remain below the peak pressure of 45 psia, containment pressure would return to subatmospheric conditions in less than 60 minutes, and remain subatmospheric indefinitely. Thus, the Bravo train of RSS would have acceptably performed its safety functions throughout the time since the last surveillance test demonstrated adequate service water flow through the Bravo train of RSS. Therefore, this event was not an unanalyzed condition that significantly degraded plant safety.

When 2SWS-82 was closed, it was calculated that the total Alpha RSS train service water flow would have been 10,642 gpm, which is less than the 11,000 gpm required by TS 4.6.2.2.e.3. However, similar to the evaluation performed for the Bravo RSS train, an evaluation of the DBA transients was performed using the service water system temperature observed during the time that 2SWS-82 was closed and the calculated service water flow rate in the Alpha train. Acceptable containment analyses results were determined. Thus, although the Alpha train of RSS was inoperable due to service water flow being less than the minimum required value, the Alpha train of RSS would have acceptably performed its safety functions during the time when 2SWS-82 was closed.

It cannot be precisely determined when the service water flow rate was degraded below the TS minimum required service water flow rate in the Bravo train of RSS due to corrosion product build-up. However, given that an evaluation showed the Bravo RSS train could have performed its safety function throughout the operating cycle (given the observed degraded service water flow rates and the maximum observed service water temperature), the Probabilistic Safety Assessment (PSA) model would not be impacted. The PSA model is also not impacted by the degraded condition to the Alpha RSS Train when 2SWS-82 was closed since the Alpha RSS train could still have performed its safety function. Moreover, the containment heat removal design safety function is more conservative than the required PSA function, since the PSA model does not require that the containment be maintained at subatmospheric conditions nor is it limited to the peak containment design pressure of 45 psig. Therefore, there was no increase in risk due to the closure of 2SWS-82 beyond that associated with the Bravo train RSS unavailability during its draining and cleaning.

Based on the above, the safety significance of this event was small.

CORRECTIVE ACTIONS

1. The B RSS heat exchanger was cleaned and inspected. Subsequent service water flow rate surveillance testing of the Bravo RSS train showed acceptable results with no further evidence of flow blockage.

2. The D RSS heat exchanger was cleaned and inspected as an extent of condition. Very little debris (iron oxide scale as seen in the B RSS heat exchanger) was found.

3. The service water flow rate surveillance test was subsequently performed through the Alpha train of RSS (A and C RSS heat exchangers) with no flow anomalies identified.

4. An engineering evaluation concluded that the structural integrity of the D RSS heat exchanger was not adversely affected due to the observed higher than normal flow rate when the B RSS heat exchanger flow rate was degraded.

5. Additional enhancements are being evaluated for the torque checks on the RSS heat exchanger top and bottom endbells.

6. The procedure which is used to drain the RSS heat exchangers has been revised to remove instructions to close 2SWS-82.

7. The BVPS Unit 2 Operations Manual will be revised to include a note describing the reason for 2SWS-82 being locked open and a permanent placard was placed at the valve location describing the reason the valve is locked open.

Corrective action completion is being tracked through the corrective action program.

PREVIOUS SIMILAR EVENTS

A review of past Beaver Valley Power Station Units 1 and 2 Licensee Event Reports found one similar event involving inadequate service water flow within the last five years:

BVPS Unit 2 LER 99-007, “Forced Shutdown Due to Inoperable Emergency Diesel Generator”

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Simplified Service Water System Flow Arrangement For the RSS Heat Exchangers
(Normal System Arrangement Shown)