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L-00-032

Beaver Valley Power Station, Unit No. 1
Docket No. 50-334, License No. DPR-66
LER 2000-002-00

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 2000-002-00, 10 CFR 50.73(a)(2)(ii), "Condition Outside Design Basis for One Train of River Water System Inoperable."

Lew W. Myers

Attachment

IE22

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NRC FORM 366 U.S. NUCLEAR REGULATORY COMMISSION
(6-1998)

LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001

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TITLE (4)

Condition Outside Design Basis for One Train of River Water System Inoperable

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL	REVISION	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
02	08	2000	2000	002	00	03	08	2000	None	
									FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1
POWER LEVEL (10)	94 %

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

	20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
	20.2203(a)(1)		20.2203(a)(3)(i)	X	50.73(a)(2)(ii)		50.73(a)(2)(x)
	20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
	20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)	X	OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		10 CFR 21
	20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
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COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED	MONTH	DAY	YEAR
X	YES (If yes, complete EXPECTED SUBMISSION DATE).	NO		04	07	2000

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

During a routine surveillance on the BVPS Unit No. 1 Reactor Plant River Water (RPRW) System B Train pump at 1209 on 2/8/2000, the pump unexpectedly tripped approximately three seconds after a start signal due to an overcurrent condition. Technical Specification 3.7.4.1 was entered due to having only one River Water System pump operable. RPRW pump WR-P-1C (swing pump) was then aligned to the B train and started at 1716 on 2/8/2000. This pump also tripped approximately three seconds after a start signal due to an overcurrent condition. A subsequent evaluation determined that the two overcurrent trip conditions on the RPRW pumps were a result of physical contact between the rotating element (impeller) and the lower casing liner of the pumps. The cause of this condition was due to differential thermal expansion between the pump shaft and the pump casing as a result of an elevated seal injection water temperature. This delta temperature elongated the pump shaft to the point of physical binding. Normally the RPRW Pumps' seal water is supplied by the Filtered Water System at approximately the same temperature as the Ohio River. At the time of the condition, the seal water was being supplied by the Filtered Water System, which was in an abnormal configuration that created the elevated water temperature. This condition is reportable pursuant to 10CFR50.73(a)(2)(ii)(B) as a condition that is outside the design basis of the plant because one train of a two train safety related system (required to be operable per Technical Specification 3/4.7.4.1) was incapable of performing its design safety function for an extended period of time during operation. This seal water supply design defect had the potential to render non-operating RPRW pump(s) inoperable. Therefore this design defect could create a safety hazard, and is also reportable pursuant to 10 CFR 21 requirements. This report satisfies the notification and reporting requirements of 10 CFR Part 21 per the provisions of 10 CFR 21.2(c).

PLANT AND SYSTEM IDENTIFICATION

Westinghouse-Pressurized Water Reactor System
River Water System and Auxiliary River Water System {BI}
Service Water System and Standby Service Water System {BI}
Filtered Water System {KH}
Water Treatment System {KH}

CONDITIONS PRIOR TO OCCURRENCE

Unit 1: Mode 1 at 94 % power

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

DESCRIPTION OF EVENT

During a routine surveillance on the BVPS Unit No. 1 Reactor Plant River Water (RPRW) System {BI} 'B' pump (1WR-P-1B) at 1209 on 2/8/2000, the pump unexpectedly tripped approximately three seconds after a start signal due to an overcurrent condition. Technical Specification 3.7.4.1 was entered due to having only one River Water System pump operable. RPRW pump WR-P-1C (swing pump) was then aligned to the 'B' train and started at 1716 on 2/8/2000. This pump also tripped approximately three seconds after a start signal due to an overcurrent condition.

The following actions were taken as an immediate response to the tripping of the second RPRW System pump: controls were established to maintain the integrity of the 'A' train of the RPRW System, 'B' and 'C' RPRW pumps and associated power supplies were administratively controlled to preserve equipment status until all relevant indications were recorded, the Auxiliary River Water System pumps (BVPS Unit 1) in the Alternate Intake Structure were rotated by hand with no anomalies noted, the Emergency Standby Service Water System pumps (BVPS Unit 2) in the Alternate Intake Structure were verified to be aligned with their self supplied seal water source from the Ohio River, and the Main Intake Structure forebays were verified to be free of obvious ice and debris. A multi-disciplined Event Response Team was formed to investigate this condition.

The subsequent Event Response Team evaluation determined that the two overcurrent trip conditions on the RPRW pumps were a result of physical contact between the rotating element (impeller) and the lower casing liner of the pumps. The cause of this condition was due to differential thermal expansion between the pump shaft and the pump casing. This condition was precipitated by an elevated seal water temperature (approximately 70 F) that elongated the pump shaft to the point of

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

DESCRIPTION OF EVENT (Continued)

physical binding. At the time of the condition, the seal injection water was being supplied by the Filtered Water System {KH}. This system was modified to be used as a seal water supply source for the RPRW pumps in 1976 as a backup to the safety related seal water source from the Ohio River. This elevated seal water temperature condition was caused by use of a temporary operating procedure that changed the configuration of the Filter Water System to allow maintenance on the water treatment clarifier. The elevated seal water temperature existed for approximately 3 days prior to the condition. Normally the RPRW pumps' seal water is supplied by the Filtered Water System at approximately the same temperature as the Ohio River because an appreciable amount of heat is not normally added to the seal water by the water treating system. The Ohio River water temperature was approximately 35 F during the condition.

Following the Event Response Team evaluation and immediate corrective actions to ensure that the BVPS Unit 1 RPRW pump operating clearances would be maintained, RPRW System train B pump WR-P-1B was declared operable at 0858 on 02/11/00.

Operating Event 10671 was issued by BVPS on 2/10/2000 providing preliminary notification to the industry via the INPO Nuclear Network about this condition. Operating Event 10760 issued on 3/6/2000 provided updated information.

Related Recent Condition:

On 3/3/2000, River Water Pump WR-P-1C at Beaver Valley Power Station (BVPS) Unit 1 was placed into service with bearing and motor cooling water supplied by its own discharge via the safety related 'Y' strainer RW-YS-42. Within 10-15 seconds of pump startup, the seal water pressure dropped to approximately 5 psig from its normal operating pressure of approximately 30 psig. The operator then blew down the strainer and normal seal water operation ensued.

DESCRIPTION OF EVENT (Continued)

A review of the adequacy of the BVPS Unit 1 seal water design for the River Water System was initiated as a result of the condition that occurred with the non-safety related seal water source on 2/8/2000. The recent partial plugging of the 'Y' strainer on 3/3/2000 identifies that starting a River Water Pump which has been idle for a period of time may initially ingest a slug of silt from the Intake Structure bay large enough to restrict the flow of seal water through this strainer. It has been determined that a potential inadequacy exists in the safety related BVPS Unit 1 seal water design for the River Water System pumps that has been credited since initial operation of the Unit. Given that the strainer anomaly was quickly corrected, this seal water design concern involves the operability of a non-operating pump during startup. Seal water strainer plugging during pump operation is more gradual and allows time for operator action.

River Water System Pump WR-P-1C remains in operation with seal water supplied from its self-supplied strainer. An Auxiliary River Water Pump in the Alternate Intake Structure is also available with its own separate seal water supply. BVPS Unit 1 is currently in a refueling outage. The evaluation of the adequacy of the BVPS Unit 1 seal water design for the River Water System is continuing. A supplement to this LER will be provided when the evaluation of the seal water design is complete and additional corrective actions are determined. This evaluation and resulting appropriate measures to prevent recurrence is a mode 4 restraint for BVPS Unit 1.

REPORTABILITY

One train of the River Water System was inoperable following the reconfiguration of the Filtered Water System on 2/5/2000 leading to higher than normal seal water temperature. The higher seal water temperature caused the non-operating RPRW System pump to be inoperable due to thermal pump shaft elongation. This condition is reportable pursuant to 10CFR50.73(a)(2)(ii)(B) as a condition that is outside the design basis of the plant because one train of a two train safety related system (required to be operable per Technical Specification 3/4.7.4.1) was not fully capable of performing its design safety function for an extended period of time during operation. NUREG-1022 defines 'extended period of time' where the LCO allowed outage time is exceeded by more than a modest amount (e.g., 25 percent). The allowed outage time

REPORTABILITY (Continued)

for one train of River Water System pursuant to Technical Specification 3.7.4.1 is 72 hours. The time frame between when the temporary operating procedure was initiated (which resulted in higher than normal seal water temperature) until the second train of River Water System was restored to operable status exceeded 90 hours. This condition was initially reported via the ENS System for information at 1650 on 2/9/2000 and subsequently reported pursuant to 10CFR50.72 (b)(1)(ii)(B) at 1827 on 2/10/2000.

This condition is also reportable pursuant to 10 CFR 21. The installation and use of the Filtered Water System in 1976 by Stone & Webster Engineering Corp (SWEC) to supply seal water to the BVPS Unit 1 RPRW pumps did not provide adequate consideration or control of the water temperature being supplied as seal water to the RPRW pumps. This design defect had the potential to render non-operating RPRW pump(s) inoperable if warmer water happened to flow into the filtered water supply header from the filtered water storage tank or other warmer water sources in cold weather. This would result in the loss of safety function necessary to mitigate the consequences of a design basis accident following a postulated single failure. Therefore this condition involves a basic component with a defect that could create a safety hazard and is reportable pursuant to 10 CFR 21 requirements. This report satisfies the notification and reporting requirements of 10 CFR Part 21 per the provisions of 10 CFR 21.2(c).

A material condition problem was identified on 3/3/2000 which provided further basis that the BVPS Unit 1 seal water design for the RPRW Pumps may not have been sufficient to meet the design basis of the plant. This condition was reported as an update at 1816 on 3/7/2000 to the information previously reported at 1827 on 2/10/2000 pursuant to 10CFR50.72 (b)(1)(ii)(B). A supplement to this LER will be provided when the evaluation of the overall seal water design is complete and additional corrective actions are determined.

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CAUSE OF THE EVENT

The root cause of this condition was inadequate knowledge/technical information of the temperature effect of seal water on the vertical, thermal expansion of a non-operating pump shaft. This is evident by the installation and use of the Filtered Water System as a seal supply in 1976 by SWEC without understanding, or not considering the pump shaft temperature growth concerns. The design change that installed the filtered water connection from the Unit 1 water treating system to the intake structure in 1976 failed to consider the overall effects of seal water temperature on the river water pumps. The seal water temperature was not identified as a critical parameter in site documents. The water treating system temperatures were not designed to be controlled for safety related purposes. The main temperature control designed in the water treatment system is to prevent freezing from occurring. These water treatment system temperatures can and do vary.

The root cause analysis also identified the following causal factors:

1) The pump vendor technical information of the Byron Jackson (28KXH, Single Stage) River Water pump does not identify the limitations of seal water temperature for pump operability. The vendor technical manual detailing the installation, operation and maintenance requirements of the Unit 1 River Water System pumps lacked sufficient information with regard to the temperature effects that seal water would have on shaft length. Additionally, the plant staff was not knowledgeable of this concern.

2) The following were missed opportunities to recognize the adverse effects of warmer seal water. However, the design documents and technical manuals did not identify seal water temperature as a critical parameter.

   - When the temporary operating procedure was first used in July 1990.
   - When determining the reasons for frequent pump lift adjustments during a Service Water Operational Performance Inspection (SWOPI) in 1994. Further investigation and understanding of the bases for pump lift changes may have identified the adverse effects of warmer seal water temperature during pump non-operating conditions.
   - During a design change in 1999 for upgrading an alternate seal water supply system at the main intake structure.

ANALYSIS AND SAFETY IMPLICATIONS

Normally at BVPS Unit 1, one RPRW pump is in service with the second pump in standby. In addition, a third (swing) pump is available to support the RPRW System. The seal water supply for the BVPS Unit 1 RPRW pumps can be provided by the non-safety grade Filtered Water System. Seal water flow is normally provided to idle pumps as well as the running pumps to keep an alarm from actuating on low seal water pressure. Each pump also has a safety grade seal water supply which uses water from the pump discharge through a strainer. This safety grade seal water supply was designed to be continuously aligned to the seal water supply header via a pressure control valve which would provide seal water flow whenever the non-safety related seal water flow becomes inadequate.

If warm water is provided to an idle RPRW pump during cold river water conditions, the warmer seal water travels down along the pump shaft, which is approximately 69 feet long, and increases the shaft temperature. The pump casing temperature is not substantially affected by the seal water temperature because much of it is submersed in the river and is at thermal equilibrium with the river water temperature. This creates a differential thermal growth between the pump shaft and the pump casing. This differential thermal growth can potentially lead to impeller binding as described in this LER.

Filtered water is normally at or near river water temperature because an appreciable amount of heat is not normally added to the process by the water treating system. Therefore, under normal conditions, the temperature concerns of the Filtered Water System had not caused a problem. Past effects are difficult to ascertain due to the multiple variables and availability of limited historical data. In the abnormal occasions when there may have been an appreciable amount of heat added to the water treating system or the Filtered Water Storage Tank, river water pump susceptibility with this elevated temperature concern is limited to the colder months when river temperature is low. This is because in the other months when the river water temperature is higher, the river water pump casing is also at a higher temperature, thereby limiting the differential temperature between the river water pump shaft and casing. A review of past river water pump starts reveals that these pumps have started successfully multiple times over a wide range of possible thermal conditions. From 1/4/99 to 2/8/00 alone, there have been collectively over 70 successful starts of the RPRW pumps (WR-P-1 A, B and C). With the exception of this recent condition, it cannot be conclusively determined if in the past, that a RPRW pump would have failed to start due to the differential temperature of the filtered water temperature and the actual river water temperature. However, favorable historical pump start performance indicates that the effects on past pump operability would have been limited.

ANALYSIS AND SAFETY IMPLICATIONS

The effect of having warmer than normal filtered water being supplied to an operating RPRW pump at either BVPS unit is negligible due to the extremely large volume of pumped water transferring heat from the small volume of seal water as it passes through the pump. This maintains a relatively isothermal temperature condition between the pump shaft and the pump casing of a running pump. Thus this condition would not completely remove all river water cooling capability via the Unit 1 River Water System since at least one pump always remains in operation.

Contrary to the BVPS Unit 1 River Water System design, the BVPS Unit 2 Service Water System utilizes both Train A and B pumps operating to provide cooling to both safety related and non-safety related plant components. [BVPS Unit 1 has a separate river water system to provide cooling for non-safety related equipment.] Since BVPS Unit 2 operates with both trains of Service Water pumps in service, this condition would not prevent operability of the Unit 2 Service Water System since the condition can only adversely affect a non-operating pump.

The BVPS Unit 1 Auxiliary River Water (ARW) System pumps and BVPS Unit 2 Standby Service Water (SWE) System pumps, located in the Alternate Intake Structure, are not normally in operation. However, the ARW pumps were able to be rotated by hand and the SWE pumps were not receiving seal water from the Filtered Water System. Therefore these pumps were not adversely affected by this condition and were available to be used for safety related equipment cooling in place of the BVPS Unit 1 River Water pumps or the BVPS Unit 2 Service Water pumps, respectively, if needed. These Alternate Intake Structure pumps rely mainly on self supplied seal water. Although filtered water could have been used for the pumps in the Alternate Intake Structure in the past, the long run of underground piping and low flow to the Alternate Intake Structure would have tended to remove potential abnormal heat from filtered water enroute to the Alternate Intake Structure.

A probabilistic risk assessment was performed for the condition involving warmer seal water at Unit 1. This assessment assumed 1) that operators are given credit to start the 'A' and 'B' Auxiliary River Water pumps and 2) this condition began at 2210 on 2/5/2000 when the temporary operating procedure redirected the filtered water configuration. With the 'B' train declared functional (but not yet operable due to the need to complete assessments) at 2116 on 2/9/2000, it was determined that the maximum change in Core Damage Frequency (CDF) for this condition correlates to a 'High White' condition (i.e., in the upper portion of the White band, 1.0E-06 < delta CDF < 1.0E-05) in the forthcoming NRC Significance Determination Process (SDP). Thus this condition would be categorized as low to medium SDP risk.

CORRECTIVE ACTIONS

1. Administrative controls were implemented to place and maintain the seal water supply source for BVPS Unit 1 RPRW pumps as being self supplied from the respective pumps discharge strainer or the pumped fluid common strainer (WR-S-2). The use of the Filtered Water System or Cyclone Separator have been precluded as seal water/lubricating fluid for the BVPS Unit 1 RPRW pumps, the BVPS Unit 1 Auxiliary River Water System pumps, the BVPS Unit 2 Service Water System pumps, and the BVPS Unit 2 Standby Service Water System pumps, pending further evaluation.

2. Investigation of the various seal water sources for the River Water pumps has identified the need to replace the River Water pump seal water safety related strainer design before entering Mode 4.

3. Applicable vendor technical information and design documents will be revised for the River and Service Water pumps to reflect the seal water temperature effects on the pump. This will be complete by August 31, 2000.

A supplement to this LER will be provided when the evaluation of the BVPS Unit 1 seal water design for the River Water System is complete and additional corrective actions are determined.

PREVIOUS SIMILAR EVENTS

A review of LERs for Beaver Valley Power Station Unit 1 and Unit 2 identified two occurrences involving design or operational issues on the BVPS Unit 1 River Water System or BVPS Unit 2 Service Water System within the last three years.

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

BVPS Unit 2 LER 99-011, 'Inoperability of Service Water System Train B Due to Deformed Discharge Expansion Joint on In-Service Pump 2SWS*P21C'