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September 27, 1996
NPD1VPO:0518

Beaver Valley Power Station, Unit No. 1
Docket No. 50-334, Licensee No. DPR-66
LER-96-003-01

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 96-003-01, 10 CFR 50.73.a.2.iv, "ESF Actuation - Feedwater Isolation Due to Steam Generator Water Level Transient".

T. P. Noonan
Division Vice President
Nuclear Operations/Plant Manager

Attachment

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NRC FORM 366, (5-92) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Beaver Valley Power Station Unit 1	05000334	1 OF 5

ESF Actuation - Feedwater Isolation Due to Steam Generator Water Level Transient

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 NAME	DOCKET NUMBER
03	22	96	96	003	01	09	27	96	Beaver Valley Power Station Unit 2	05000412
									FACILITY NAME: N/A	DOCKET NUMBER: N/A

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 20 CFR § (Check one or more) (11)									
POWER LEVEL (10)	1%		20.402(b)		20.405(c)	X	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		
			20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)		(Specify in abstract below and in Text NRC Form 366A)		
			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 (include Area Code)
T. P. Noonan, Vice-President Nuclear Operations/Plant Manager	(412) 393-7622

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS				COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
E	TA	XXX	XXX	N						

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

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

On March 22, 1996, at 2256 hours, during a Unit 1 shutdown for a refueling outage, a steam generator level transient occurred subsequent to opening the main unit electrical generator output breakers. In response to the generator shutdown, reactor power was reduced, primarily through control rod insertion and a boration that was initiated at that time to position control rods out for test purposes. The boration rate resulted in a power mismatch and caused steam pressure to decrease. In conjunction with reduced feedwater temperatures and steam flow to the turbine, this caused steam generator water level to increase and reactor coolant temperature to drop to 538°F.

At 2312 hours, the "A" steam generator level reached the 75% high steam generator level setpoint which initiated a turbine trip and feedwater isolation signal (FWI). The motor driven auxiliary feed pumps started and the main turbine and the in- service main feed pump tripped as designed. The turbine trip stopped the cooldown and the reactor coolant temperature recovered to the normal no load temperature (547°F) at 2316 hours.

This event was reported pursuant to the requirements of 10CFR50.72(b)(2)(ii) as an event that resulted in an automatic actuation of an Engineered Safety Feature (ESF). The original written report was submitted pursuant to the requirements of 10CFR50.73(a)(2)(iv) as an event that resulted in an automatic actuation of an ESF.

This LER supplement is being submitted to provide additional information pertinent to the event developed as the result of follow-up evaluations which were performed after the original submittal.

DESCRIPTION OF EVENT

On March 22, 1996 at 2312 hours, a station shutdown was in progress when a high steam generator level turbine trip and feedwater isolation (FWI) automatically actuated. Actions were in progress to stabilize the reactor at approximately 1% power while maintaining the turbine at 1800 RPM for turbine trip testing. Preparations for control rod drop testing were also in progress. The main unit generator was removed from the electrical grid and boration of the reactor coolant system commenced at 2256 hours. The boration, in conjunction with declining feedwater temperatures, caused a power mismatch and T_{ave} to start decreasing. Control rods were withdrawn, but had insufficient worth to offset the negative reactivity from the boration.

At 2312 hours, the "A" steam generator level reached the 75% high steam generator level setpoint which initiated a turbine trip and FWI. The motor driven auxiliary feed pumps started, the in-service main feed pump tripped as designed, and the main turbine tripped, stopping the cooldown. The reactor coolant temperature recovered to the normal no load temperature (547 °F) at 2316 hours.

CAUSE OF EVENT

The primary cause of this event was inadequate management administrative controls. Contributing causal factors are discussed below.

Immediate Supervision

- Preparation for this evolution should have included the performance of the boration at low power conditions on the simulator.

- The Assistant Nuclear Shift Supervisor (ANSS) was required, in accordance with procedure, to leave the Control Room and supervise the performance of the turbine pedestal tests. This required the Nuclear Shift Supervisor (NSS) to be directly involved in the plant shutdown, which impaired the oversight function for which the NSS is responsible. In addition, the Shift Technical Advisor (STA) was involved in a briefing for the pending rod drop testing and unavailable to assist in monitoring this part of the shutdown.

- Primarily as a consequence of the above, the evaluation of the impact of work schedule changes on the shutdown, reactor reactivity management and the mitigation of the steam generator level transient and decreasing reactor coolant temperature was less than adequate.

- A boration was started immediately after the opening of the generator output breakers, but rod withdrawal to offset the negative reactivity addition from boration was not started in a timely manner. The operator withdrew control rods several minutes after the boration was started to try to stabilize temperature and an indicated positive startup rate of 0.97 decades per minute (DPM) was momentarily attained.

Procedures

- Existing procedures were inadequate to provide the operator with the necessary guidance to conduct low power operations for plant evolutions when the turbine trip is delayed significantly beyond the generator trip.

Training

- An assessment of operator training demonstrated that conduct of low power operations was not adequately addressed in simulator training.

Human Engineering - Human Machine Interface

At low power conditions, the steam flow and feed flow indications are subject to inherent inaccuracies and can be used only as relative indications. Narrow range steam generator level is the primary source of information that is relied upon for steam generator water inventory, and this indication is significantly affected by shrink and swell effects that can provide misleading information to operators under dynamic conditions. The wide range steam generator level is a better indication of the mass in the steam generator during low power operation.

ANALYSIS OF THE EVENT

A turbine trip and feedwater isolation occurred during this event; therefore, it is reportable pursuant to the requirements of 10CFR50.73(a)(2)(iv) as an event or condition that resulted in a manual or automatic actuation of any Engineered Safety Feature (ESF).

This analysis is based on the results from the follow-up investigation performed subsequent to the submittal of the original LER.

During a routine shutdown evolution, reactor power is reduced to <10% power, steam dump operation is set in the steam pressure mode of control, the generator output breakers are opened, the turbine is tripped and control rods are inserted into the reactor core to complete the transition from Mode 1 to Mode 3 over a fairly short period of time. The shutdown sequence being used when the event occurred, although in accordance with plant procedures, was not routine. The schedule was modified to include rod drop testing, to address an industry issue (NRC Bulletin 96-01, "Control Rod Insertion Problems," dated March 8, 1996) associated with incomplete control rod insertion at other Westinghouse Pressurized Water Reactors (PWRs). In-place management administrative controls and expectations for the conduct of low power operations with required schedule changes were inadequate to effectively address the changing plant conditions as they evolved.

Core reactivity conditions were affected by multiple factors after the opening of the output breakers including: 1) decreasing feedwater temperature, 2) changing steam flow rates, 3) control rod withdrawal, 4) changing fission product poison inventory, 5) boration of the reactor coolant, and 6) the mismatch between reactor power and steam demand.

Feedwater temperature was decreasing rapidly, due in part, to the Electro-hydraulic control (EHC) system of the turbine generator switching from the load control mode to the speed control mode (with the governor valves closing) when the output breakers were opened. The governor valves were closing to maintain synchronous speed and also adjusting for changing steam pressure, resulting in a reduction of extraction steam flow to the feedwater heaters and a reduction in heater drains flow. The steam dump valves were opening in the steam pressure mode of control.

Boration of the reactor coolant system in preparation for the pending rod drop testing was started at 2256 hours at approximately 42 gallons per minute. Commencing at 2301, reactor control rods were intermittently withdrawn 52 steps over a 13 minute period, which, in conjunction with T_{ave} declining, caused an indicated startup rate of 0.97 DPM. Procedural guidance and training did not effectively emphasize the acceptable startup rates. Xenon concentration was increasing due to reduced burnout and decay of iodine.

Boration was continued, although T_{ave} was decreasing and the steam dump valves were going closed (an indication that reactor power was below secondary steam demand).

An analysis was performed by Reactor Engineering which determined that the maximum calculated startup rate during this event was 0.72 DPM.

CORRECTIVE ACTIONS

1. Operating procedures for Unit 1 will be revised by September 30, 1996 to require a higher reactor power when performing turbine trip testing. This will place a greater demand on the automatic turbine bypass system ensuring increased system stability. Operating procedures for Unit 2 were revised August 28, 1996.

2. The requirement to have an operations supervisor present during the turbine pedestal tests was eliminated from the test procedure on September 4, 1996, since this test is no longer performed on line. Unit 2 does not have this procedural requirement.

3. Simulator training which includes reactor control at end of life and steam generator level control at low power has been conducted, and additional simulator training has been scheduled for licensed operating personnel.

4. Industry operating experience lessons learned from low power operation and reactivity events will be re-emphasized as an ongoing part of licensed operator training.

5. Startup and shutdown procedures will be revised for Unit 1 by September 30, 1996 to reflect a requirement to display the feed flow, steam flow, steam generator narrow range and wide range levels on an expanded scale on the computer display to enhance operator control and diagnostics during low power operation. The procedures for Unit 2 were revised August 28, 1996.

6. Operations Management has implemented a policy to normally maintain two Senior Reactor Operators (SROs) and the STA in the controls area during prolonged startups and shutdowns.

7. A standard practice of Nuclear Safety Review Board (NSRB) review of startup and shutdown data has been implemented to strengthen low power operations until operator training has been completed.

8. Licensed operating personnel have been trained on this event.

9. Procedures will be revised to provide additional guidance for low power operations by September 30, 1996.

10. The NSRB has reviewed this event. The board concluded that prolonged low power operations are to be avoided and if any delays should occur during startup or shutdown at low power levels, the reactor is to be shutdown, with no delays, by means acceptable to operations management.

11. Significant changes to the startup and shutdown procedures are being validated on the plant simulator prior to use.

REPORTABILITY

This event was reported to the NRC in accordance with 10CFR50.72(b)(2)(ii) on March 22, 1996. The original written report was submitted on April 19, 1996 in accordance with 10CFR50.73(a)(2)(iv) as an event involving an Engineered Safety Feature (ESF) actuation. This supplement is being submitted to provide additional information pertinent to the event developed as the result of follow-up evaluations which were performed after the original submittal.

SAFETY IMPLICATIONS

There were minimal implications to the health and safety of the public due to this event. Safety systems functioned as designed. Plant parameters were restored in accordance with plant procedures.

PREVIOUS SIMILAR EVENTS

The following similar events have been previously reported regarding ESF actuations resulting from steam generator level transients:

LER 2-94-006

LER 2-94-007