Richard L. Anderson
Vice President - Nuclear Operations

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June 21, 2002

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station OP1-17
Washington, DC 20555

SUSQUEHANNA STEAM ELECTRIC STATION
LICENSEE EVENT REPORT 50-387/2002-004-00
PLA - 5495 FILE R41-2

Docket No. 50-387
License No. NPF-14

Attached is Licensee Event Report 50-387/2002-004-00. This event was determined to be reportable per 10CFR50.73(a)(2)(iv)(A), in that the Unit 1 reactor was manually scrammed following a trip of the 1B reactor recirculation pump. The initiation of the manual scram and the associated isolations are considered unplanned actuations of systems that mitigate the consequences of significant events. There were no actual consequences to the health and safety of the public as a result of this event.

for Richard L. Anderson
Vice President – Nuclear Operations

Attachment

cc: Mr. H. J. Miller
Regional Administrator
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

cc: Mr. S. L. Hansell
Sr. Resident Inspector
U.S. Nuclear Regulatory Commission
P. O. Box 35
Berwick, PA 18603-0035

IE22

NRC FORM 366 (7-2001)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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

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

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

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4. TITLE

Manual Scram After 'B' Recirculation Pump Tripped

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 05000
04	22	2002	2002	004	00	06	21	2002	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE	1
10. POWER LEVEL	17%

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)	X	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)		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)
Eric J. Miller - Nuclear Regulatory Affairs	570 / 542-3321

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
X	AD	FUB	G080	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)

At 01:15 on April 22, 2002 with Unit 1 in Mode 1 (Power Operation) at 17% power, plant operators initiated a manual reactor scram in response to anomalous core flow indications observed following a recirculation pump trip that had occurred at 00:16. Following the pump trip, power and flow values plotted on the Unit's power to flow map were found to be in a position left of the natural circulation line. This was unexpected because a second recirculation pump continued to provide forced circulation. While no power flux oscillations were observed, Operations Management elected to scram the reactor because operators were uncertain about core flow indications and plant procedures did not provide a clear response to the observed conditions. Investigation revealed that past industry and internal experience provided insight into the flow instrumentation logic that resulted in a plotted position left of the natural circulation line. Susquehanna's previous response to this information did not adequately educate operators on, or initiate procedural changes to address, this anticipated instrument behavior. To preclude recurrence of this event, procedures now direct operators to utilize a core plate differential pressure correlation in lieu of core flow instrumentation during low flow, single-loop operation. Should an operator plot a point to the left of the natural circulation line despite this tool, procedures have been modified to provide clear direction for reactor scram. Operators have been trained on these changes. This event is reportable for Unit 1 as an unplanned actuation of systems that mitigate the consequences of significant events per 10CFR50.73(a)(2)(iv)(A). There were no actual adverse consequences to the fuel, any plant equipment, or to the health and safety of the public as a result of this event.

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

EVENT DESCRIPTION

On April 22, 2002, Unit 1 was starting up following a scheduled refueling outage. Control rod withdrawals to achieve 20 percent power had just been completed when the 'B' Reactor recirculation pump (EIIS Code: AD) tripped due to a high resistance connection at a fuse holder located in the recirculation pump Motor Generator (M-G) Set local panel. Operators entered off normal procedures and plotted position on the Unit specific power versus flow map. The indicated plant response of 17% power and 27 Million Pounds Mass per hour (Mlb/hr) indicated operation to the left of the natural circulation curve. This response was not expected because the 'A' recirculation pump was still in service. The power to flow map contained the following text box with a line pointing to the natural circulation line:

Natural Circulation Line (Immediate Scram Required)

The operating crew understood that the natural circulation line represented anticipated flow characteristics without any forced circulation (no pumps running) and, with one pump running, questioned the inconsistency of the plotted position. Additionally, the text box on the power to flow map, although clearly requiring a reactor scram when natural circulation was present, did not provide clear direction when parameters indicated a position left of the line. Reactor Engineering and Operations Management were consulted. Following these discussions, the mode switch was taken to shutdown due to the inconsistency of the flow indication and a lack of clear procedural direction for the observed conditions.

CAUSE OF EVENT

This event was directly caused by an unexpected trip of the 'B' recirculation pump, attributable to a high resistance connection at a fuse holder in the 'B' recirculation M-G exciter power circuit. Loss of the M-G Set Generator output caused the 'B' recirculation pump to trip. The 'B' recirculation pump trip placed the unit in a condition that required a manual scram. Procedural guidance available to plant operators for responding to the loss of a single reactor recirculation pump at low power was less than adequate. Appropriate procedural guidance would have prevented reactor scram and precluded the need for this report.

Susquehanna's response to past internal and industry experience (Reference: General Electric Service Information Letter 516, Supplement 2, Core Flow Indication in the Low-Flow Region, and NRC Information Notice 96-16, BWR Operation with Indicated Flow Less Than Natural Circulation) failed to initiate procedural changes to address recirculation flow instrumentation behavior following a recirculation pump trip under low power conditions. At Susquehanna, recirculation flow circuitry incorporates a low level cutoff (zero output) at flows less than 0.8 Mlbs/hr per jet pump. As such, actual flows present within the idle loop could not be incorporated into total core flow estimations. The low recirculation flow indications were not reflective of actual plant conditions, but were instead attributable to this feature of the instrumentation loop. Susquehanna's response to GE SIL 516S2 suggested that,

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

instead of revising low flow characteristics on the station's power to flow maps, operators would instead scram the reactor if the indicated power/flow values were ever found to the left of the natural circulation line. This guidance was not clearly established on the power to flow map, nor was the expectation communicated to operators or the operator training staff. Furthermore, the recirculation flow instrument low level cutoff phenomenon was never incorporated into the simulator model or operator training.

ANALYSIS / SAFETY SIGNIFICANCE

This event is reportable as an unplanned actuation of systems that mitigate the consequences of significant events per 10CFR50.73(a)(2)(iv)(A) for Unit 1. The plant was manually scrammed following a single recirculation pump trip when core flow indications placed the unit in an unanticipated location on the power to flow map. This plotted position was later determined to be a result of instrument logic characteristics and was not a reflection of actual plant conditions. There were no actual consequences to the fuel or any plant equipment, nor was the plant placed in any restricted stability regions as a result of the recirculation pump trip. Core flux oscillations, a concern during reduced core flow conditions, were not experienced during this event. Provided that the water level in the vessel downcomer is maintained above the top of the active fuel, natural circulation is sufficient to ensure a minimum bundle flow for all fuel assemblies that have a relatively high power, and potentially can approach a critical heat flux condition. Full scale critical power test data taken from various fuel designs in use at Susquehanna indicate that substantial thermal margin exists at thermal power levels < 25%. Accordingly, Technical Specifications governing power distribution limits at Susquehanna (Section 3.2) are not applicable when power is below this value. In the subsequent startup and power ascension to 100 percent, no fuel problems were noted. There were no actual adverse consequences to the health and safety of the public as a result of this event.

In accordance with guidance in NUREG-1022, Revision 2, the due date for this report is June 21, 2002.

CORRECTIVE ACTIONS

Corrective actions that have been completed:

- The fuse and its associated fuse holder were replaced. Inspections of other fuses, wiring terminations and fuse holders in the affected panel were satisfactorily performed.
- Routine thermography and preventive maintenance inspections have been established for appropriate recirculation pump panels to ensure fuse contact and wiring integrity.
- A correlation of total core flow versus core plate differential pressure has been incorporated into the appropriate operating procedures for use in single loop operation with operating pump speed less than 75 percent. This action will enhance the accuracy of position plotting on the power to flow map.
- Procedural changes were issued to the appropriate off normal procedures directing the operators to take the mode switch to shutdown if indicated core flow is ever less than natural circulation.

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

- Operations personnel have been trained on the procedural changes implemented in response to this event.

Corrective actions to be completed:

- Revise current responses to GE SIL 516S2 and NRC IN 96-16 to reflect revised procedures for operating in single loop operation.
- Evaluate and implement, as appropriate, simulator program changes that more accurately reflect plant instrumentation response following a reactor recirculation pump trip at low flow/power conditions (reactor recirculation low flow cutoff logic).
- Finalize evaluation of this event through the station's corrective action process.

ADDITIONAL INFORMATION

Past Similar Events: In 1996, GE SIL 516S2 was issued detailing three events where BWR units experienced recirculation pump trips at low power conditions. In all three events, core flow instrumentation indicated that the core flow was below the natural circulation line on the power to flow map.

Failed Component: 4.16 kV Fuse / Fuse Holder F-24B