Bryce L. Shriver
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October 8, 2001

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555

SUSQUEHANNA STEAM ELECTRIC STATION
LICENSEE EVENT REPORT 50-387/2001-003-00
PLA - 5382 FILE R41-2

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

Attached is Licensee Event Report 50-387/2001-003-00, which discusses an error in the calculation for the reactor heat balance. This event is reportable as a violation of license condition 2.C(1) of NPF-14 for Unit 1 and NPF-22 for Unit 2.

Bryce L. Shriver
Vice President – Nuclear Site 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

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.

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Susquehanna Steam Electric Station - Unit 1	05000387	1 OF 3

4. TITLE

Licensed Power Limit Exceeded Due To Reactor Heat Balance Calculation Error

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
08	07	2001	2001	003	00	10	08	2001	Susq. SES - Unit 2	05000388
									FACILITY NAME	DOCKET NUMBER
										05000

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)	X 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)	Maximum Power Level License Condition Exceeded
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)
Gerard M. Machalick - Nuclear Licensing	570 / 542-3861

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

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)

On August 7, 2001 with Unit 1 and 2 at 100% power, engineering personnel discovered an error in the reactor heat balance calculation that resulted in a 6 MegaWatt-thermal (MW_{th}) error. Specifically, the main steam moisture fraction value was found to be non-conservative. Operation greater than the licensed maximum power level is reportable as a violation of license condition. The cause of the error was confusion over similar, closely related terms associated with entrained water in steam (moisture fraction, percent moisture). The maximum power level of Unit 1 and Unit 2 was administratively reduced by 7 MW_{th} upon discovery of the error. The reactor heat balance calculations have been subsequently corrected to use an accurate moisture fraction value, and procedures associated with an upcoming turbine replacement project that could affect the reactor heat balance will be revised to ensure that plant test data is accurately used in the reactor heat balance calculation. Although the calculation error resulted in a non-conservative reactor power level indication, the event was not significant due to the small magnitude (0.2%) of the error. Based on consideration of the margin to analyzed maximum power level, there were no adverse consequences 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 August 7, 2001 with Unit 1 and 2 at 100% power, engineering personnel discovered an error in the reactor heat balance calculation that resulted in a 6 MegaWatt-thermal (MW_{th}) error. Specifically, the main steam (EIIS: SB) moisture fraction value was found to be non-conservative. The moisture fraction value used in the calculation was 2.0E-3 (no units). The correct moisture fraction value determined from plant testing is 2.0E-5. The maximum power level of Unit 1 and Unit 2 was administratively reduced by 7 MW_{th} upon discovery of the error.

Subsequent investigation revealed the following summary timeline of events:

- Early 1980's - The moisture fraction value used for initial operation of Susquehanna Unit 1 and 2 was 1.0E-3. This value was the design value for turbine inlet conditions specified by the reactor vendor, General Electric.

- 1996 - The Susquehanna power uprate reviews identified that the reactor heat balance calculation should use actual plant testing results for the moisture fraction instead of the design value. The calculation was revised in an attempt to make the heat balance more accurate. A moisture fraction value of 2.0E-3 was used in error.

- 2001 - The incorrect moisture fraction used in the reactor heat balance calculation is discovered during a review of turbine design specifications for an upcoming turbine replacement project.

CAUSE OF EVENT

The cause of the calculation error is confusion over similar, closely related terms associated with entrained water in steam. Terms such as moisture fraction, percent moisture, carryover and quality represent the same physical parameter and are easily confused. Additionally, the actual plant test value of main steam moisture expressed as a percentage is numerically very close to the design value expressed as a moisture fraction. Procedural control of plant test data was focused on compliance with turbine performance criteria, and was not adequate to ensure the value derived from plant testing was accurately used in the reactor heat balance calculation. As a result, an incorrect but closely related term was used in error.

ANALYSIS / SAFETY SIGNIFICANCE

The calculation error resulted in a non-conservative reactor power indication, but was not significant due to the small magnitude (0.2%) of the error. 10CFR50 Appendix K requires accident analysis from 102% reactor power to allow for instrument inaccuracy. This maximum analyzed power level is 3510 MW_{th} for Susquehanna. Actual instrument accuracy at Susquehanna is better than assumed in the regulations, and this results in a safety margin to the maximum analyzed power level of approximately 10 MWth. Since the magnitude of the error is less than the available margin, the maximum analytical power level

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

has not been exceeded and the licensing analysis for operating both Susquehanna units remains valid. Based on consideration of the margin to analyzed maximum power level, there were no adverse consequences to the health and safety of the public as a result of this event.

Due to fluctuations in the actual power level, the average reactor power is typically less than the rated thermal power license limit. An exhaustive historical search for actual shift average power levels was not conducted to quantify the number of occurrences that the license limit was exceeded. However, a review of limited data in 2001 revealed a few instances of shift average reactor power greater than the license limit. This report is submitted per section 2.G of Unit 1 operating license NPF-14 and 2.E of Unit 2 operating license NPF-22 as a violation of license condition 2.C(1), maximum power level. In accordance with guidance in NUREG-1022, Revision 2, the due date for this report is October 8, 2001.

CORRECTIVE ACTIONS

The following describes the corrective action strategy for the reactor heat balance calculation error:

Corrective actions that have been completed are:

- The initial corrective action taken upon discovery of the error was to administratively reduce the maximum reactor power of Unit 1 and Unit 2 by 7 MW_{th}.
- Following the cause determination for the error, administrative and computer-based reactor heat balance calculations were reviewed and corrected to ensure that accurate moisture fraction values are used.
- The basis and accuracy of all parameters in the reactor heat balance calculation has been validated.

Corrective Action to be completed is:

- Procedures and specifications that will be used to obtain and implement plant test data for the upcoming turbine replacement project will be reviewed and revised to ensure that test data is accurately used in reactor heat balance calculations.

ADDITIONAL INFORMATION

Past Similar Events: LER 50-388/95-003-00, Shift Average Maximum Power Level Exceeded

Failed Component: None