Constellation Energy
Nine Mile Point Nuclear Station

P.O. Box 63
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July 12, 2004
NMP1L 1845

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

SUBJECT: Nine Mile Point Unit 1
Docket No. 50-220; DPR-63

Licensee Event Report 04-002, "Changes and Errors in the Methodology Used by General Electric and Global Nuclear Fuel to Demonstrate Compliance with Emergency Core Cooling System Performance Requirements"

Gentlemen:

In accordance with 10 CFR 50.46(a)(3)(ii) and 10 CFR 50.73(a)(2)(ii)(B), we are submitting Licensee Event Report 04-002, "Changes and Errors in the Methodology Used by General Electric and Global Nuclear Fuel to Demonstrate Compliance with Emergency Core Cooling System Performance Requirements."

Very truly yours,

Timothy J. O'Connor
Plant General Manager

TJO/CDM/jm
Attachment

cc: Mr. H. J. Miller, NRC Regional Administrator, Region I
Mr. G. K. Hunegs, NRC Senior Resident Inspector

IE22

NRC FORM 366 (1-2001) 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)

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TITLE (4)

Changes and Errors in the Methodology Used by General Electric and Global Nuclear Fuel to Demonstrate Compliance with Emergency Core Cooling System Performance Requirements

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
05	14	2004	2004	– 002 –	00	07	12	2004	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1
POWER LEVEL (10)	100

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

	20.2201(b)		20.2203(a)(3)(ii)	X	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
	20.2203(a)(2)(iii)	X	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)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Miguel A. Armenta, Supervisor Fuels	315-349-7340

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

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

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

On May 14, 2004, at approximately 0917 hours with the plant operating at 100% power, General Electric (GE) informed Nine Mile Point Nuclear Station, LLC, (NMPNS) of a change in the calculation of Peak Cladding Temperature (PCT) and maximum local cladding oxidation. A new heat source has been postulated during the Loss of Coolant Accident (LOCA) event which involves the recombination of hydrogen and oxygen within the fuel bundles during core heatup. Based on 10 CFR 50, Appendix K, inputs and assumptions, the additional heat generated resulted in an estimated 25 degree F increase in PCT and a 1.73% increase in maximum local oxidation. Consequently, the previous LOCA analysis was potentially non-conservative relative to PCT and maximum local cladding oxidation, and a conservative estimate of the calculated increase in local cladding oxidation exceeded the 17% limit of 10 CFR 50.46(b)(2) by 1.23%. This event was initially reported to the NRC on May 14, 2004 in an 8-hour non-emergency report in accordance with 10 CFR 50.46(a)(3)(ii) and 10 CFR 50.72(b)(3)(ii)(B).

The cause of this event is that the heating effects of the hydrogen-oxygen recombination phenomenon were not properly considered during the original development of the LOCA evaluation methodology.

Corrective actions include a 2% Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) reduction, an 8% Peak Linear Heat Generation Rate (PLHGR) reduction when the containment is allowed to be deinerted above 25% power, and additional analyses to further evaluate the hydrogen-oxygen recombination phenomenon using more appropriate best-estimate/upper bound LOCA evaluation methodology. NMPNS will provide a supplement to this LER following completion of the evaluation if the results substantially alter the conclusions and/or corrective actions.

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

I. Description of Event

On May 14, 2004, at approximately 0917 hours with the plant operating at 100% power, the Nine Mile Point Unit 1 (NMP1) control room was notified of the issuance by General Electric (GE) of 10 CFR 50.46 Notification Letter 2003-05, dated May 13, 2004, informing Nine Mile Point Nuclear Station, LLC, (NMPNS) of a change in the calculation of Peak Cladding Temperature (PCT) and maximum local cladding oxidation. A new heat source has been postulated during the Loss of Coolant Accident (LOCA) event which involves the recombination of hydrogen and oxygen within the fuel bundles during core heatup. The additional heat will raise the temperature of the steam heat sink in the bundle, resulting in a potential increase in the PCT and local oxidation. This recombination is spontaneous at temperatures above approximately 900 degrees F. The hydrogen is generated by the steam-zirconium reaction during heatup. The oxygen enters the vessel either as a dissolved gas in the Emergency Core Cooling System (ECCS) water or through the break when the vessel fully depressurizes and draws the containment noncondensible gases back into the vessel. Based on 10 CFR 50, Appendix K, inputs and assumptions, the additional heat generated resulted in an estimated 25 degree F increase in PCT and a 1.73% increase in maximum local oxidation. The LOCA evaluation models, which were used by GE and Global Nuclear Fuel (GNF) to demonstrate compliance with 10 CFR 50.46, did not include the effects of this new heat source. Consequently, the previous LOCA analysis was potentially non-conservative relative to PCT and maximum local cladding oxidation, and a conservative estimate of the calculated increase in local cladding oxidation exceeded the 17% limit of 10 CFR 50.46(b)(2) by 1.23%. This event was initially reported to the NRC on May 14, 2004 in an 8-hour non-emergency report (Event No. 40749) in accordance with 10 CFR 50.46(a)(3)(ii) and 10 CFR 50.72(b)(3)(ii)(B).

The Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) fuel thermal limits ensure that the ECCS acceptance criteria of 10 CFR 50.46 will not be exceeded during a design-basis LOCA event. To ensure the fuel cladding remains intact during a LOCA, 10 CFR 50.46 requires that the calculated fuel element PCT not exceed 2200 degrees F and the calculated total oxidation limit not exceed 0.17 times the total cladding thickness before oxidation. If the total oxidation limit were to be exceeded during a LOCA, the fuel cladding could become embrittled during the quench phase, which could cause the cladding to fracture and fragment during the cooldown period. This could compromise the structural integrity and coolable geometry of the core, and could ultimately result in the loss of core cooling.

The effects of the hydrogen-oxygen recombination phenomenon have been evaluated for non-jet pump plants (i.e., GE BWR/2 plants), which applies to NMP1, using SAFER/CORECOOL methodology by incorporating the heat of reaction due to the recombination of oxygen released from the ECCS liquid and the oxygen entering the vessel from the containment. The evaluations were performed assuming that the recombination occurs within the fuel channels at the cladding surface and that the oxygen concentration in the containment is 4% by volume, which corresponds to the Technical Specification limit. The additional source of oxygen from the containment will only contribute to increasing the PCT for non-jet pump plants since the oxygen enters the vessel late in the LOCA event. For jet pump plants, the oxygen enters the vessel after the core has reflooded, which limits the oxygen available for recombination with the hydrogen released from metal-water reaction. For non-jet pump plants, the LOCA scenario is different in that the core remains uncovered and there is no period of reflooding for large breaks. The MAPLHGRs for BWR/2 plants are optimized to limit both the 10 CFR 50, Appendix K, PCT and the local oxidation below the 10 CFR 50.46 limits. Therefore, the effects of the hydrogen-oxygen recombination phenomenon on local oxidation were also evaluated. The impact of this phenomenon for non-jet pump plants is a 25 degree F increase in PCT and a 1.73% increase in maximum local oxidation. The current LOCA analyses result in a PCT of 2164 degrees F relative to the 2200 degree F limit and a maximum local oxidation of <16.5% relative to the 17% limit. Note that this phenomenon will have no impact at or below the power level where Technical Specification monitoring of thermal limits is required (i.e., 25% power).

As a compensatory measure, GE determined that a 1% reduction in Peak Linear Heat Generation Rate (PLHGR) will produce a 13 degree F reduction in PCT and a 0.68% reduction in maximum local cladding oxidation. The

I. Description of Event (Cont'd.)

compensatory 1% PLHGR reduction was determined for the bounding 5 loop operating condition and assuming a containment oxygen concentration of 4% by volume as required by the Technical Specifications for an inerted containment. Therefore, for NMP1 with a 0.5% oxidation margin to the 10 CFR 50.46 limit, a 2% MAPLHGR reduction [((1.73 – 0.5) ÷ 0.68) <2%] will restore compliance with 10 CFR 50.46. The 2% MAPLHGR reduction has been implemented.

The Technical Specifications include provisions which allow inerting of the containment to be delayed for up to 24 hours following a plant startup and allow the containment to be deinerted up to 24 hours prior to a scheduled shutdown. To accommodate these deinerted periods, GE performed an evaluation to estimate the PLHGR reduction necessary to limit the PCT to a level that would reduce the metal-water reaction and hydrogen generation to insignificant levels, thereby ensuring that hydrogen-oxygen recombination is also reduced to insignificant levels. Based on this evaluation, which conservatively assumed unlimited available oxygen, it was concluded that a PLHGR reduction of 32% (or PLHGR/MAPLHGR multiplier of 0.68) is sufficient to reduce the amount of hydrogen available for recombination to insignificant levels. With this estimated PLHGR reduction, the maximum PCT and local oxidation will remain below the limits of 10 CFR 50.46 during plant startups and shutdowns. The evaluation was subsequently refined to assume an air environment (oxygen concentration of 21% by volume), which resulted in an estimated PLHGR reduction of 8% (or PLHGR/MAPLHGR multiplier of 0.92) for compliance with the 10 CFR 50.46 limits. Administrative controls have been implemented to ensure that the 8% PLHGR reduction is applied during plant startups and shutdowns when the containment is deinerted. Note that no PLHGR reduction is necessary at or below 25% power since hydrogen-oxygen recombination is not a concern at these low power levels.

II. Cause of Event

Based on the results of the cause evaluation performed by GE, "[t]he mechanism and possible impact of this postulated phenomenon was not clearly known during the development of LOCA methodology." Therefore, the SAFER and CORECOOL analysis models did not account for the potential heat generated by the recombination of hydrogen and oxygen near the surface of the fuel and the resulting impact on the PCT and local oxidation during a LOCA. Accordingly, the cause of this event is that the heating effects of the hydrogen-oxygen recombination phenomenon were not properly considered during the original development of the LOCA evaluation methodology for 10 CFR 50.46 and 10 CFR 50, Appendix K, rulemaking.

III. Analysis of Event

As reported by GE in 10 CFR 50.46 Notification Letter 2003-05, dated May 13, 2004, the impact of the hydrogen-oxygen recombination phenomenon for non-jet pump plants is a 25 degree F increase in PCT and a 1.73% increase in maximum local cladding oxidation. The current LOCA analyses for NMP1 result in a PCT of 2164 degrees F relative to the 2200 degree F limit of 10 CFR 50.46(b)(1) and a maximum local oxidation of <16.5% relative to the 17% limit of 10 CFR 50.46(b)(2). Although adequate margin to the PCT limit existed to accommodate the 25 degree increase, the 1.73% increase in maximum local oxidation exceeded the available margin to the 17% limit by 1.23%. The event is reportable in accordance with 10 CFR 50.46(a)(3)(ii) as "[a]ny change or error correction that results in a calculated ECCS performance that does not conform to the criteria set forth in paragraph (b) of this section..." The event is reportable under this criteria because the increase (change) in maximum local oxidation was potentially non-conservative relative to the 17% limit of 10 CFR 50.46(b)(2) and, as such, did not conform to the criteria.

The event is also reportable in accordance with 10 CFR 50.73(a)(2)(ii)(B) as "[a]ny event or condition that resulted in ... [t]he nuclear plant being in an unanalyzed condition that significantly degraded plant safety." The event is reportable under

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III. Analysis of Event (Cont'd.)

this criteria because 10 CFR 50.46(a)(3)(ii) requires reporting "... as described in ... [10 CFR] 50.73" and the previous LOCA evaluation was potentially non-conservative relative to PCT and maximum local oxidation which could have resulted in plant operation in an unanalyzed condition. The event is being reported under 10 CFR 50.73(a)(2)(ii)(B) because this is the most appropriate reporting criteria pursuant to the reporting requirements of 10 CFR 50.46(a)(3)(ii). However, NMPNS has concluded that the reported condition does not represent a condition that significantly degraded plant safety or posed a threat to the health and safety of plant personnel or the public. This conclusion is based on the calculated increase in PCT not meeting the 50 degree F "significant change" criteria of 10 CFR 50.46(a)(3)(i) and the results of the following safety assessment.

The SAFER/CORECOOL LOCA evaluation methodology for NMP1 first determines the limiting line break with nominal inputs and various single failures across the entire break spectrum. The 10 CFR 50, Appendix K, requirements are then included and the PCT and oxidation thickness are recalculated for the limiting break. These results become the licensing basis values and must comply with the 10 CFR 50.46 criteria. Next, an upper-bound PCT is determined by adding an estimate of uncertainties to a best-estimate calculation of the PCT for the limiting break. Finally, the upper-bound PCT is compared with the Appendix K PCT to demonstrate the conservatism of the Appendix K analysis models. It is important to note that the reported 25 degree F increase in PCT and 1.73% increase in maximum local oxidation were conservatively estimated with the Appendix K models. Additional analyses are planned which will incorporate the effects of the hydrogen-oxygen recombination phenomenon into the more appropriate best-estimate/upper-bound methodology. It is anticipated that the results of these analyses will show that the calculated PCT and maximum local cladding oxidation both remained bounded by their respective 10 CFR 50.46 limits, and that the associated 2% MAPLHGR reduction can be eliminated.

GE performed a conservative analysis of the effects of hydrogen-oxygen recombination for 10 CFR Part 21 reportability using the SAFER/CORECOOL LOCA evaluation methodology with inputs based on nominal assumptions and conditions (as opposed to Appendix K assumptions). GE had established with the NRC that the threshold for Part 21 reportability is a PCT of 2200 degrees F and a maximum local cladding oxidation of 17% based on a nominal (best-estimate) analysis. Exceeding these values is an indication of the inability to maintain a coolable geometry in the core during a LOCA, which could pose a significant safety hazard and would be considered a reportable condition. Above the 2200 degree F PCT limit, the core metal-water reaction increases substantially and the additional heat from the reaction may lead to cladding melt. The 17% local oxidation limit ensures that the fuel cladding remains sufficiently ductile to avoid brittle fracture failure when quenched during rewetting or reflooding. The results of the nominal assumptions analysis show that the PCT and maximum local oxidation remain below the threshold for Part 21 reportability. Therefore, no fuel cladding melt or brittle fracture would occur that would constitute a substantial safety hazard and, as such, there was no major reduction in the degree of protection provided to public health and safety.

The results of the GE nominal assumptions analysis described above are consistent with the Probabilistic Risk Assessment (PRA) realistic evaluation of the functional success criteria for a large water break LOCA. Furthermore, a qualitative risk assessment of the hydrogen-oxygen recombination phenomenon concluded that the impact of this phenomenon was of low risk-significance.

As previously discussed, this event was initially reported to the NRC on May 14, 2004 in an 8-hour non-emergency report. Included in the reported corrective actions, NMPNS stated that "[o]perations will place administrative controls/procedure changes to preclude operating without containment inerted at or above 25% power to limit oxygen available for this postulated phenomenon." As discussed in Section I of this LER, the administrative controls were modified based on further evaluation to apply an 8% PLHGR reduction (or PLHGR/MAPLHGR multiplier of 0.92) during plant startups and shutdowns when above 25% power. These administrative controls were intended to address the deinerted periods (i.e., periods when the containment oxygen concentration is >4% by volume) allowed by the Technical Specifications when

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III. Analysis of Event (Cont'd.)

inerting of the containment is delayed for up to 24 hours following a plant startup and when the containment is deinerted up to 24 hours prior to a scheduled shutdown. It was subsequently confirmed that the basis for these Technical Specification provisions is the low probability of a LOCA occurring during the 24-hour periods following startup and prior to shutdown when the containment is allowed to be deinerted. Since the additional heating effects of the hydrogen-oxygen recombination phenomenon have no impact on the probability of a LOCA occurring, NMPNS has concluded that use of the Technical Specification provisions allowing plant operation with the containment deinerted had no significant impact on the safety functions and margins of safety as defined in the Technical Specifications. In addition, based on the current licensing basis LOCA assumptions and supplemental information provided by GE, the administrative controls to apply the 8% PLHGR reduction during plant startups and shutdowns are not required since there would be no credible challenge to the 10 CFR 50.46 limits.

IV. Corrective Actions

1. A 2% MAPLHGR reduction was implemented to restore compliance with the 10 CFR 50.46 limits.

2. Administrative controls were implemented to ensure that an 8% PLHGR reduction is applied during plant startups and shutdowns when the containment is deinerted. This action is no longer required.

3. Additional analyses are planned which will incorporate the effects of the hydrogen-oxygen recombination phenomenon into the more appropriate best-estimate/upper bound LOCA evaluation methodology. NMPNS will provide a supplement to this LER if the results of this evaluation substantially alter the conclusions and/or corrective actions.

V. Additional Information

A. Failed Components:

None

B. Previous similar events:

No previous similar events were identified.

C. Identification of components referred to in this Licensee Event Report:

Components	IEEE 805 System ID	IEEE 803A Function
Reactor Core	AC	RCT
ECCS	BM	P, MO
Reactor Vessel	AD	RPV
Primary Containment	NH	N/A
Jet Pump	AD	P