



EN 39634

March 3, 2003
MFN 03-012

Document Control Desk
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Subject: Part 21 Notification: Fuel Channel Bow Reportable Condition and 60-Day Interim Notification

Introduction

This letter provides notification by GE Nuclear Energy (GENE) in accordance with 10CFR21.21(a)(1) of a Reportable Condition for thermal limits calculations for BWR/6 plants with Global Nuclear Fuel (GNF) Zr-2 thick/thin fuel channels (plants listed as "Affected" in Attachment 1). It is also a 60-Day Interim Notification in accordance with §(a)(2) for two issues, (1) thermal limits calculations for non-BWR/6 plants with the same fuel channels (plants listed as "Potentially Affected" in Attachment 1), and (2) control rod-fuel channel interference for both BWR/6 and non-BWR/6 plants with the same fuel channels (all plants listed as affected or potentially affected in Attachment 1). The fuel channels are supplied by Global Nuclear Fuel-America, Wilmington NC, and are supplied to licensees as a safety related component.

Fuel channel bow has been known to occur, and has been modeled in fuel licensing (thermal limits) analysis, and mitigated in core design. Previous occurrence of fuel channel bow has been known to arise from three sources: initial manufacturing, residual stress relaxation under irradiation, and differential irradiation growth caused by fast fluence gradients. Fluence gradient-based bow is biased towards the center of the core. The channel bow due to these effects has been explicitly included as input to fuel licensing (thermal limits) analyses, is not an issue of concern, and is not discussed further.

Recent experience has shown a new phenomenon that causes channel bow. Presently, channel bow data is available from one BWR/6 plant. Preliminary investigation of the channel bow indicates the root cause is related to "shadow corrosion" caused by the control rod blade when a fuel channel is in a highly controlled location during its initial fuel cycle. This results in absorbed hydrogen-induced growth of the channel wall closest to the control blade, which leads to channel bowing toward the control blade late in life.

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There are two effects from the new phenomenon: (1) the bow assumed in the thermal limits calculations does not represent the new data, and (2) the bias towards the control blade can lead to control rod-fuel channel interference. The available experience and channel dimensional characterization shows the condition to be most significant for BWR/6 plants. This is believed to be related to the larger control blade and smaller channel-to-control blade gap unique to the BWR/6 lattice. These conditions exacerbate the "shadow corrosion" effect, which increases the bow magnitude, and maximizes the potential for interference with the control rod blade.

Thermal Limits Evaluation

The impact on thermal limit calculations has been completed for BWR/6 plants. The impact is greater than 0.01 on Minimum Critical Power Ratio (MCPR), which exceeds the threshold for reportability. Absent a detailed plant-specific calculation, a generic interim penalty of 0.02 on the Operating Limit MCPR (OLMCPR) is recommended for all affected BWR/6 plants. The interim penalty should be applied until plant-specific calculations can be performed. Long-term actions are to update the channel bow data used in the approved fuel licensing models and incorporate the effects of this data into future reload licensing analyses.

The thermal limits calculations have not been completed for the potentially affected non-BWR/6 plants. The magnitude of the bow is believed to be less for non-BWR/6 plants due to the greater separation between the control rod blade and the fuel channel. Preliminary calculations indicate that an OLMCPR penalty is not required for non-BWR/6 plants. The final calculations and recommended actions for the non-BWR/6 plants will be completed by June 6, 2003.

Control Rod-Fuel Channel Interference Evaluation

Control rod-fuel channel interference results in two concerns associated with control rod insertion: When coupled with other design load combinations there is the potential for (1) friction to cause fuel bundle lift, and (2) the transfer of forces to reactor internals such as the top guide, causing higher stresses. The interference will cause increased friction between the control rod blade and the fuel channel which may result in a control rod having a long "settle time" or slower scram speed. Long settle time or decreasing scram speed should be evident long before a control rod would become stuck or fail scram time testing, which are already addressed in existing plant Technical Specifications.

The evaluation of the effects of control rod blade-fuel channel interference has not been completed. Interim recommendations for surveillance actions to detect control rod-fuel channel interference and determine when the friction associated with the interference is sufficient to cause a concern with fuel bundle lift or loads on reactor internals are still being developed. The recommendations will address the extent and frequency of such surveillance actions, and the plants to which they should be applied. The plants that have early indications of this interference are working directly with GENE/GNF to ensure

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continued safe plant operation and development of appropriate actions. The results of this evaluation and interim surveillance recommendations will be provided by April 28, 2003.


Conclusion

This is a Reportable Condition for fuel thermal limits calculations on BWR/6 plants.

This is a 60-Day Interim Report for thermal limits calculations on non-BWR/6 plants (report due June 6, 2003) and for control rod blade-fuel channel interference on all affected and potentially affected plants (report due April 28, 2003). GENE/GNF has formed an internal task force to address the short and long-term implications of this channel bow phenomenon, under the leadership of Mr. Bradley J. Erbes. Brad can be reached on 408-925-1115.

Please contact me if you have any questions on this issue, the Reportable Condition notification, the 60-Day Interim Report, or the planned follow-on actions at (408) 925-5362.

Sincerely,



Jason S. Post, Manager
Engineering Quality and Safety Evaluations

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PRC File

Attachment 1 - Affected and Potentially Affected Plants

<u>Affected</u>	<u>Potentially Affected</u>	<u>Utility</u>	<u>Plant</u>
X		AmerGen Energy Co.	Clinton
	X	AmerGen Energy Co.	Oyster Creek
	X	Carolina Power & Light Co.	Brunswick 1
	X	Carolina Power & Light Co.	Brunswick 2
	X	Constellation Nuclear	Nine Mile Point 1
	X	Constellation Nuclear.	Nine Mile Point 2
	X	Detroit Edison Co.	Fermi 2
		Dominion Generation	Millstone 1
		Energy Northwest	Columbia
	X	Entergy Nuclear Northeast	FitzPatrick
	X	Entergy Nuclear Northeast	Pilgrim
X		Entergy Operations, Inc.	Grand Gulf
X		Entergy Operations, Inc.	River Bend
	X	Entergy Nuclear Northeast	Vermont Yankee
		Exelon Generation Co.	CRIT Facility
	X	Exelon Generation Co.	Dresden 2
	X	Exelon Generation Co.	Dresden 3
	X	Exelon Generation Co.	LaSalle 1
	X	Exelon Generation Co.	LaSalle 2
	X	Exelon Generation Co.	Limerick 1
	X	Exelon Generation Co.	Limerick 2
	X	Exelon Generation Co.	Peach Bottom 2
	X	Exelon Generation Co.	Peach Bottom 3
	X	Exelon Generation Co.	Quad Cities 1
	X	Exelon Generation Co.	Quad Cities 2
X		FirstEnergy Nuclear Operating Co.	Perry 1
	X	Nebraska Public Power District	Cooper
	X	Nuclear Management Co.	Duane Arnold
	X	Nuclear Management Co.	Monticello
		Pooled Equipment Inventory Co.	PIM
	X	PPL Susquehanna LLC.	Susquehanna 1
	X	PPL Susquehanna LLC	Susquehanna 2
	X	Public Service Electric & Gas Co.	Hope Creek
	X	Southern Nuclear Operating Co.	Hatch 1
	X	Southern Nuclear Operating Co.	Hatch 2
	X	Tennessee Valley Authority	Browns Ferry 1*
	X	Tennessee Valley Authority	Browns Ferry 2
	X	Tennessee Valley Authority	Browns Ferry 3

* Not currently operating

Attachment 2 - Reportable Condition per §21.21(d)

- (i) Name and address of the individual informing the Commission:
J. S. Post, Manager, Engineering Quality & Safety Evaluations, GE Nuclear Energy, 175 Curtner Avenue, San Jose, CA 95125.
- (ii) Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect:
Global Nuclear Fuel (GNF) Zr-2 thick/thin fuel channels.
- (iii) Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect:
Global Nuclear Fuel – Americas; Wilmington, North Carolina.
- (iv) Nature of the defect or failure to comply and safety hazard which is created or could be created by such defect or failure to comply:
Potential to exceed minimum critical power ratio (MCPR) safety limit for anticipated operational occurrence.
- (v) The date on which the information of such defect or failure to comply was obtained:
Potential deviation identified on December 16, 2002. Identified as a potential defect for evaluation as a potentially reportable condition on January 2, 2003.
- (vi) In the case of a basic component which contains a defect or failure to comply, the number and locations of all such components in use at, supplied for, or being supplied for one or more facilities or activities subject to the regulations in this part:
Affected and potentially affected plants are defined in Attachment 1.
- (vii) The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action (note, these are actions specifically associated with the identified Reportable Condition):
- GENE/GNF is recommending that an interim administrative penalty of 0.02 on the operating limit minimum critical power ratio (OLMCPR) should be

implemented for the affected plants. This can be updated by a plant-specific calculation incorporating appropriate recent channel bow data.

- GENE/GNF will refine bow characterization, root cause, and clarify dependencies for use in future core design and fuel cycle evaluations. Based on this information, effective preventive actions can be developed.
- GENE/GNF is evaluating the thermal limits effect on non-BWR/6 plants. This evaluation will be completed by June 6, 2003.
- GENE/GNF is evaluating the effect of control rod-fuel channel interference. This is expected to lead to interim control rod surveillance recommendations. The interim recommendations will be provided by April 28, 2003.

(viii) Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees:

- If a plant has early indications of control rod-fuel channel interference caused by channel bow, they should work directly with GENE/GNF to ensure continued safe plant operation and development of appropriate actions.