

General Information or Other (PAR)

Event # 39634

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Region: 4 City: San Jose County: State: CA	Docket #: Agreement State: Yes License #:
NRC Notified by: JASON S. POST HQ Ops Officer: ERIC THOMAS Emergency Class: NON EMERGENCY 10 CFR Section: 21.21 UNSPECIFIED PARAGRAPH	Notifications: MOHAMED SHANBAKY R1 WALTER RODGERS R2 MONTE PHILLIPS R3 DALE POWERS R4 MICHAEL JOHNSON NRR

## PART 21 NOTIFICATION - FUEL CHANNEL BOW

GE Nuclear reports a new phenomenon that causes fuel channel bow. "Shadow Corrosion" is the hydrogen-induced growth of the channel wall closest to the control blade when the fuel channel is in a highly controlled location during its initial fuel cycle. The hydrogen-induced growth leads to channel bowing toward the control blade late in life. This condition is believed to be most significant for BWR/6 plants.

There are two effects of the new phenomenon:

1. It is not accounted for by thermal limit calculations
2. The bias towards the control blade can lead to control rod-fuel channel interference.

To mitigate the impact on thermal limits, an interim penalty of .02 has been applied to the Operating Limit Minimum Critical Power Ratio for all BWR/6's. In the long-term, updated channel bow data will be used in the approved fuel licensing models and this data will be incorporated into future reload licensing analyses. Recommended actions for non-BWR/6 plants are expected by June 6, 2003.

Concerns related to the control rod-fuel channel interference include: 1) friction that could cause fuel bundle lift, 2) transfer of forces to reactor internals causing higher stresses, and 3) slower scram speeds. There have been no interim actions designated to mitigate these effects, but recommendation for a surveillance to help detect control rod-fuel channel interference is expected by April 28, 2003.

Affected plants at present are all BWR/6's. Potentially affected plants are all BWR's, with the exception of Columbia Generating Station.

\*\*\* UPDATE ON 6/6/03 AT 1821EDT FROM JASON POST TO GERRY WAIG \*\*\*

"The NRC was previously notified of a Reportable Condition for fuel thermal limits calculations on BWR/6 plants. Subsequent analysis has shown that it is not a reportable condition on BWR/2-5 plants. This completes the

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commitment made in the reference letter to evaluate the impact on BWR/2-5 thermal limits calculations by June 6, 2003."

Notified (via email) R1DO (James Linville), R2DO ( Kerry Landis), R3DO (Ken O'Brien), R4DO (Dave Loveless), NRR (David Matthews).

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**GE Nuclear Energy**

General Electric Company  
175 Curtner Ave., San Jose, CA 95125

June 6, 2003  
MFN 03-038

Document Control Desk  
United States Nuclear Regulatory Commission  
One White Flint North  
11555 Rockville Pike  
Rockville, Maryland 20852-2738

**Subject: Part 21 Notification: Channel Bow Thermal Limits Impact, GNF-A  
Thick/Thin Fuel Channels, BWR 2-5 Plants**

**Reference: Letter JS Post (GENE) to Document Control Desk (NRC), "Part 21  
Notification: Fuel Channel Bow Reportable Condition and 60-Day Interim  
Notification," MFN 03-012, March 3, 2003**

The reference letter provided 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 due to channel bow. It was also a 60-Day Interim Notification in accordance with §(a)(2) for thermal limits calculations for BWR/2-5 plants with the same fuel. These 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 occurrences of fuel channel bow have 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 and is not an issue of concern.

Recent experience has shown a new phenomenon that causes channel bow. Investigation of the new channel bow phenomenon 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.

The available experience and channel dimensional characterization shows the condition to be most significant for BWR/6 plants. This is due to the larger control blade and

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smaller channel-to-control blade gap unique to the BWR/6 lattice. These conditions exacerbate the "shadow corrosion" effect, which increases the bow magnitude.

The thermal limits calculations assume a core average bow. An inaccuracy is introduced into the thermal limits calculation if the assumed bow does not represent the actual channel bow data. The impact on thermal limit calculations was reported in the reference letter for BWR/6 plants to be 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) was recommended for all affected BWR/6 plants. The interim penalty was to be applied until plant-specific calculations can be performed.

The impact on thermal limits calculations for BWR/2-5 plants has also now been completed. The magnitude of the bow is less for BWR/2-5 plants due to the greater separation between the control rod blade and the fuel channel and the maximum MCPR impact on any operating cycle has been found to be 0.002. This is within the uncertainty range for this calculation and is below the threshold for a Reportable Condition. 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.

#### Conclusion

The NRC was previously notified of a Reportable Condition for fuel thermal limits calculations on BWR/6 plants. Subsequent analysis has shown that it is not a reportable condition on BWR/2-5 plants. This completes the commitment made in the reference letter to evaluate the impact on BWR/2-5 thermal limits calculations by June 6, 2003.

Please contact me if you have any questions on this notification at (408) 925-5362.

Sincerely,



Jason S. Post, Manager  
Engineering Quality and Safety Evaluations

cc: S. D. Alexander (NRC-NRR/DISP/PSIB) Mail Stop 6 F2  
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J. F. Klapproth (GENE)  
H. J. Neems (GENE)  
PRC File

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**Attachment 1 - Affected and Not-Affected Plants**

- (1) Previously identified as affected, interim 0.02 MCPR penalty recommended pending plant-specific calculations
- (2) Evaluation completed, no MCPR penalty recommended

<u>(1)</u>	<u>(2)</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