GE Nuclear Energy

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United States Nuclear Regulatory Commission
Washington, DC 20555

Subject: **Stability Reload Licensing Calculations Using Generic DIVOM Curve**

Reference: MFN 01-025, Stability Reload Licensing Calculations Using Generic DIVOM Curve, from Jason S. Post, GENE, Manager Engineering Quality & Safety Evaluations, June 29, 2001, 01-01NRC.DOC.

This letter provides final information concerning the non-conservative reload licensing calculations for stability Option III detect and suppress trip systems. The non-conservatism could result in Option III stability trip system setpoints which do not provide adequate Minimum Critical Power Ratio (MCPR) Safety Limit protection. The affected plants are in two categories:

- Category 1: The Option III trip system (known as the Oscillation Power Range Monitor – OPRM) has been installed and armed. These plants have an existing non-conservative reload licensing analysis for the Option III trip system setpoint.
- Category 2: A commitment has been made to implement the Option III trip system, but it is not yet installed, or has not completed its checkout run and is not yet armed. Therefore, these plants are operating with an adequate reload licensing analysis. However, commitments for implementation of the system may be affected.

The Category 1 and 2 plants are listed in Attachment 1. This final notification is provided under 10 CFR Part 21.21(d) as a reportable condition for the Category 1 plants which have reload licensing calculations performed by GE-NE, and as a transfer of information under 10 CFR Part 21.21(b) for the Category 1 plant which has reload licensing calculations not performed by GE-NE. The licensees for all Category 2 plants have also been notified. The BWROG is informed of this issue and has re-established the stability Detect & Suppress Committee to lead resolution of this issue. This final notification identifies all the affected plants, lists the actions taken and planned, and provides the final advice on this issue.

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Technical Information

Stability solutions, which require detect & suppress reload licensing calculations are stability solutions Options I-D, II, and III. The corresponding reload licensing methodology is defined in NEDO-32465-A, "Reactor Stability Detect & Suppress Solutions Licensing Basis Methodology for Reload Applications," August 1996. The report specifies generic DIVOM (**D**elta CPR/**I**nitial CPR **V**s. **O**scillation **M**agnitude) curves, which are normalized curves of CPR performance vs. hot bundle oscillation magnitude. Two generic curves are specified: one for core wide mode oscillations and one for regional mode oscillations. The regional mode curve is used for Option III to determine the Option III trip system setpoint. The core wide mode curve is used for Option I-D to confirm that the flow-biased APRM flux trip provides adequate MCPR safety limit protection for a core wide mode oscillation initiated on the rated flow control line. The Option II system is not specifically addressed in NEDO-32465-A, but the regional mode curve has been used to confirm that the flow-biased APRM flux trip provides adequate MCPR safety limit protection for a regional mode oscillation initiated on the rated flow control line (GENE-A13-00360-02, "Application of Stability Long-Term Solution Option II to Nine Mile Point Nuclear Station Unit 1," November 18, 1998).

Recent evaluations by GE-NE have shown that the generic DIVOM curves specified in NEDO-32465-A may not be conservative for current plant operating conditions. A figure of merit has been defined for each generic DIVOM curve, which has been used to determine applicability of the existing generic DIVOM curves to the potentially affected plants. This evaluation showed that the plants which implemented stability Options I-D and II are not affected. However, plants which have reload licensing calculations for stability solution Option III are affected. Specifically, a non-conservative deficiency has been identified for use of the generic regional mode DIVOM curve for reload cycles which include high peak bundle power-to-flow ratios. The deficiency results in a non-conservative slope of the regional mode DIVOM curve so that the Option III trip setpoint is over predicted.

Plant-Specific Actions

Category 1 plants: The regional mode DIVOM curve used in stability reload licensing analysis was found to be non-applicable, the automatic trip system was declared inoperable, and plant Technical Specification requirements were invoked. The trip system was not disabled, as it will still provide a measure of automatic protection even if it does not meet the licensing criteria for MCPR Safety Limit protection. Plant-specific actions have varied due to the difference in governing Technical Specifications. The actions which have been taken in response to this situation include:

- For plants whose Technical Specifications allow an unlimited OPRM outage time and contain a Technical Specification 3.0.4 exception which allows plant restart if the system is inoperable: continue operation with the system armed, but declare the trip inoperable.

- For plants whose Technical Specifications have a 120 day OPRM outage time and do not have a Tech Spec 3.0.4 exception:
  - Develop interim trip setpoints based on a more conservative DIVOM curve and declare the system operable, or
  - Process an emergency Technical Specification change to provide an unlimited outage time and provide a Tech Spec 3.0.4 exemption which allows plant restart when the system is inoperable. With these Technical Specification changes, continue plant operation with the system armed, but declared inoperable.

Category 2 plants: Since the system is not armed, remedial actions are not needed. Possible plant specific actions include:

- Delay Option III trip system implementation until the issue is resolved and an applicable approved methodology exists.
- Develop an interim trip setpoint based on a more conservative DIVOM curve and use it during the system checkout period. Arm the system with the interim setpoint if the checkout period shows that this produces reasonable system performance.
- Implement the system with a non-conservative setpoint and immediately declare the system inoperable.

All Category 1 and 2 plants should participate in the BWROG Detect & Suppress Committee activity to develop and obtain approval for an improved methodology.

Option I-D and Option II plants: Analysis of the applicable figure of merit has shown that these plants are not affected. However, these plants should confirm that the applicable DIVOM curve remains valid for each subsequent reload analysis performed with this methodology. In addition, these plants should participate in BWROG Detect & Suppress Committee activity since changes to the Option III methodology will likely also affect Options I-D and II.

Figure of Merit

A figure of merit has been provided in the GE-NE Part 21 notification (SC01-01) to the affected licensees. Additional guidance has been provided to the BWROG on how to calculate a plant-specific value for the figure of merit (OG01-0228-01). A separate figure of merit is provided for the core wide and regional mode DIVOM curves. The figure of

merit is applied consistent with the stability reload licensing application basis for each stability solution. For Option III, the figure of merit is applied on the highest licensed rod line, consistent with the Option III trip setpoint reload licensing calculation. For Options II and I-D, the figure of merit is applied on the rated rod line, consistent with the flow-biased APRM flux trip safety limit protection calculation.

CONCLUSION

This letter provides the final notification on this issue under 10 CFR 21.21. Category 1 plants have taken appropriate action. Category 2 plants have been notified and appropriate action options defined. The non-affected plants with detect & suppress stability solutions, Options I-D and II, have been notified that they need to check the applicable figure of merit for each reload to confirm continued applicability of the existing generic DIVOM curves. The BWROG has re-established the Detect & Suppress Committee to lead development of an improved methodology for performing stability detect & suppress reload licensing calculations.

If you have any questions, please call me.

Sincerely,

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PRC File

Attachments:
1. Affected Plants
2. Reportable Condition Evaluation per §21.21(d)

Attachment 1 – Affected Plants

Category 1	Category 2	Utility	Plant
	X	AmerGen Energy Co.	Clinton
		AmerGen Energy Co.	Oyster Creek
	X	Carolina Power & Light Co.	Brunswick 1
	X	Carolina Power & Light Co.	Brunswick 2
X		Detroit Edison Co.	Fermi 2
X		Energy Northwest	Columbia
		Entergy Nuclear Northeast	FitzPatrick
		Entergy Nuclear Northeast	Pilgrim
		Entergy Operations, Inc.	Grand Gulf
		Entergy Operations, Inc.	River Bend
		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
		Nebraska Public Power District	Cooper
		Niagara Mohawk Power Corp.	Nine Mile Point 1
X		Niagara Mohawk Power Corp.	Nine Mile Point 2
		Nuclear Management Co.	Duane Arnold
		Nuclear Management Co.	Monticello
		Pooled Equipment Inventory Co.	PIM
	X	PPL Inc.	Susquehanna 1
	X	PPL Inc.	Susquehanna 2
	X	Public Service Electric & Gas Co.	Hope Creek
X		Southern Nuclear Operating Co.	Hatch 1
X		Southern Nuclear Operating Co.	Hatch 2
		Tennessee Valley Authority	Browns Ferry 1
X		Tennessee Valley Authority	Browns Ferry 2
X		Tennessee Valley Authority	Browns Ferry 3
		Vermont Yankee Nuclear Power Corp.	Vermont Yankee

Categories:

1. Option III installed and operational: The system was declared inoperable. Plant specific mitigation actions have been taken.
2. Committed to Option III, but not yet implemented: Acceptable plant-specific action options to delay implementation, etc., have been defined.

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:

The reload licensing analysis performed by GE-NE for the following Category 1 plants are affected:

- Browns Ferry 2, Cycle 12
- Browns Ferry 3, Cycle 10
- Fermi 2, Cycle 8
- Hatch Unit 1, Cycle 20
- Hatch Unit 2, Cycle 16
- Nine Mile Point 2, Cycle 8
- Perry, Cycle 9

The remaining Category 1 plant is Columbia. GE was informed by the licensee that Columbia, Cycle 16 is affected.

The plants in Category 2, which have committed to stability Option III, but have not implemented this solution are:

- Brunswick 1, 2 (Currently has Enhanced Option I-A implemented, which is not affected, but is changing to Option III with extended power uprate)
- Clinton
- Dresden 2, 3
- Hope Creek
- LaSalle 1, 2
- Limerick 1, 2
- Peach Bottom 2, 3
- Quad Cities 1, 2
- Susquehanna 1, 2

(iii) Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect:

GE Nuclear Energy, San Jose, California.

(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:

The Safety Limit MCPR is a specified acceptable fuel design limit as defined by General Design Criteria 10 of 10CFR50 Appendix A. The Safety Limit MCPR is applied to ensure fuel cladding integrity is not lost as a result of over–heating. The Safety Limit MCPR defines the minimum allowable critical power ratio (CPR) at which 99.9 percent of the rods in the core are expected to avoid boiling transition during the most limiting anticipated operational occurrence (AOO).

Stability solution Options III is defined to provide Safety Limit MCPR protection via automatic instability detection and suppression. The licensing basis for stability detect & suppress reload calculations is defined in NEDO-32465-A, "Reactor Stability Detect & Suppress Solutions Licensing Basis Methodology for Reload Applications," August 1996. The report specifies generic DIVOM (**D**elta CPR/**I**nitial CPR **V**s. **O**scillation **M**agnitude) curves, which are normalized curves of CPR performance vs. hot bundle oscillation magnitude. The specified reload licensing calculations use a generic regional mode DIVOM curve which has been found to be non-conservative for current core and fuel designs.

The safety significance of this issue is that if (1) the plant was operating on a high rod line very close to the MCPR Operating Limit, (2) an event were to occur which caused a significant core flow reduction, (3) the event resulted in a reactor instability, and (4) the instability excited a higher harmonic instead of the fundamental mode so that a regional mode instability occurred, then a small portion of the core could experience boiling transition before automatic reactor scram terminated the reactor instability. With the non-conservative setpoints, the scram would still occur, even if the system was armed, but declared inoperable. There is no threat to fuel damage or to public health and safety from this defect.

(v) The date on which the information of such defect or failure to comply was obtained:

May 3, 2001. Initial NRC notification under 10 CFR 21.21 made June 29, 2001.

(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:

A defect has been confirmed to exist at the plants listed in Category 1 of the table in Attachment 1. A defect does not currently exist at the Category 2 plants, but they are listed in this notification since their implementation of stability Option III will likely be impacted by this defect.

(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):

Action	Responsible	Status/Schedule
Inform all BWR licensees of the issue	GE Nuclear Energy	Complete: BWROG conference calls June 26, 27, 29, 2001, Part 21 notification issued June 29, 2001, MFN 01-025
Determine the application limits for the core wide and regional mode DIVOM curves documented in NEDO-32465-A and define a corresponding figure of merit which may be used by licensees to assess applicability of stability reload licensing calculations	GE Nuclear Energy	Complete: Included in SC01-01, June 29, 2001
Declare the Option III trip system inoperable and invoke required plant specific Technical Specification actions	Affected licensees	Completed shortly after initial notification by each affected licensee
Perform a detailed review of the issue, including the proposed interim method, with representatives of the BWROG	GE Nuclear Energy	Complete: Meeting held in San Jose, July 9-11, 2001
Issue guidance on plant-specific determination of the figure of merit	GE Nuclear Energy	Complete: Issued in OG01-0228-01, July 16, 2001
Use the figure of merit to determine applicability of each potentially affected stability reload licensing calculations	GE Nuclear Energy and affected licensees	Completed July 2001
Calculate interim stability Option III trip system setpoints based on a preliminary bounding regional mode DIVOM curve, as requested by licensees	GE Nuclear Energy	Complete for BF 2 - C12, BF 3 - C10, Fermi 2 - C8, Hatch 1 - C20, Hatch 2 - C16, and NMP2 - C8
Perform plant-specific actions to implement interim setpoints, process Technical Specification modifications, delay Option III implementation, etc	Affected licensees	Complete as needed
Present a recommendation to form a new Detect & Suppress Committee to the BWROG	GE Nuclear Energy	Complete: BWROG General Meeting, July 24, 2001

Action	Responsible	Status/Schedule
Approve funding for the BWROG Detect & Suppress Committee	Affected licensees	Complete: Funding Request (OG01-0263-01) issued August 20, 2001, subsequently approved
Describe the detect & suppress reload methodology, DIVOM curve issue, and proposed plan for resolution to the NRC	GE Nuclear Energy and BWROG	Complete: Meeting held August 16, 2001
Planned BWROG activity:	GE Nuclear Energy and BWROG	
- Develop and assess existing DIVOM curve data base, define additional TRACG cases needed		- 3Q01
- Complete additional TRACG cases		- 4Q01
- Assess TRACG results, develop revised methodology		- 1Q02
- Present revised methodology to the NRC		- 2Q02
- Issue licensing documentation for revised methodology		- 3Q02
- Obtain NRC approval		- 4Q02

(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:

1. The GE-NE Part 21 notification to BWR licensees includes a figure of merit, which may be used to determine applicability of existing generic DIVOM curves. Each plant which uses a DIVOM curve in performance of stability reload licensing calculations should confirm applicability of the DIVOM curve for each reload.
2. Recommend that all plants which have or plan to implement stability solution Options I-D and III participate in the BWROG Detect & Suppress Committee activity.
3. The NRC stated that they do not intend to review calculations based on the interim method as described to the NRC on August 16, 2001. Therefore, it is acceptable to use the interim method to determine the stability Option III setpoint until the revised methodology is developed and approved.