GE Nuclear Energy

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U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Subject: Telecon-Germane to Safety - BWR Thermal Hydraulic Stability

Attention: Carl H. Berlinger, Chief
Generic Communications Branch

Please find the attached memo of my telecon to you of November 9, 1988. The telecon provided information about the recent preliminary analysis on BWR Thermal Hydraulic Stability.

Very truly yours,

G. B. Stramback
Safety Evaluation Programs Manager

Attachment

cc: H. I. Bliss (CECo-Chicago)
L. S. Gifford (GE-Rockville)
R. C. Mitchell

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Info SRXB/W Hodges

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MEMO OF TELECON

DATE: November 9,1988

TIME: 3:30 p.m.

PERSON CALLING: G. B. Stramback

PERSON CALLED: Carl Berlinger (NRC-NRR, 301-492-1168)

SUBJECT: GE PRC 88-15 BWR Thermal Hydraulic Stability

Carl Berlinger was called in order to document with the NRC the information already provided in a GE to NRC telecon on October 28th. The condition already discussed is being submitted as Germane-to-Safety because of the previous informing of the NRC. It represents closure of GE's evaluation as to reportability under 10 CFR Part 21.

Background:

In response to the LaSalle 2 instability event and NRC Bulletin 88-07, licensees have generally implemented procedures requiring immediate actions to reduce power upon entering regions of potential instability and a manual scram when peak-peak Average Power Range Monitor (APRM) responses indicate the reactor is unstable. These actions were believed to provide substantial margin to the MCPR Safety Limit should core wide or regional instabilities occur. Based upon new information from the ongoing BWR Owners' Group (BWROG) studies of BWR instability, we have reason to question the degree of margin to the MCPR safety limit provided by current procedures in the event of a regional oscillation at some plant types and under some operating conditions.

Basis

GE was requested by the BWROG to perform an assessment of the response of the BWR to thermal hydraulic instabilities. This assessment utilizes the capabilities of the TRAC Model to investigate this phenomenon to a degree not possible just a few years ago. Preliminary results indicate that following trip of two recirculation pumps from high power (i.e. above the rated rod line such as for MEOD), thermal margins may not be sufficient to prevent a violation of the MCPR Safety Limit if regional oscillations were to occur.

Work is continuing, but it now appears possible that under one of the more severe regional oscillation scenarios it is possible to reach the MCPR Safety Limit with an oscillatory APRM signal of approximately

10-15% peak-peak. Since some utilities are using a 10% APRM oscillation as an action point for the operator to scram the plant, it appears likely that insufficient margin exists to assure that the safety limit is adequately protected.

Clearly, plants have been operating for many years with only a few occurrences of instabilities of this type. This indicates that the event discussed above may have a very low probability of occurrence. However, this condition is considered to be a reportable defect which could cause the exceeding of the MCPR Technical Specification Safety Limit.

Corrective Actions & Preventive Measures

The probability of a regional oscillation event resulting in the MCPR Safety Limit being approached under current operating procedures is so low that GE and the Stability Committee believe no immediate actions need be required for any licensee. Nevertheless, to ensure that highly conservative margins are maintained while instability investigations continue, General Electric, with the full support of the Stability Committee is recommending interim corrective actions to modify operating procedures for certain plant types and operating conditions as appropriate. These recommendations are in attachment 1. The BWROG Stability Committee intends to proceed with the currently scheduled November 9, 1988, meeting with NRR to provide interim results of the investigations to date. The owners group intends to continue investigating instability phenomena and associated operating implications so as to come to closure in a timely manner on these issues.

Knowing of the NRC's interest in this issue and Commonwealth Edison's direct involvement with the NRC on this issue due to the LaSalle event, CECo reported on October 28, 1988 this information to the NRC Region III under 10 CFR 50.9. Cognizant NRR personnel were also notified of this information via General Electric and the BWROG at approximately the same time on October 28, 1988.

Attachment 1

To: BWR Utilities

Subject: INTERIM RECOMMENDATIONS FOR STABILITY ACTIONS

GE, working with the BWR Owners' Group, is performing a generic evaluation of plant response to stability related oscillations. The objective is to determine the degree of mitigation provided by the existing reactor protection system and to determine the margin to safety limits associated with possible automatic or manual actions. Preliminary results indicate that for certain plants and operating conditions, interim operating procedures supplementing those previously provided in SIL-380 are appropriate to assure adequate margin to the Minimum Critical Power Ratio (MCPR) safety limit should regional oscillations occur. While these results are preliminary, they indicate a condition which should receive immediate attention.

Accordingly, the recommended "Interim Stability Corrective Actions for BWRs Using GE Fuel" contained in the enclosure are provided for implementation on your plant(s). Ongoing analysis will better define the degree of conservatism in this approach. However, given today's understanding of the situation, it is prudent to immediately implement these recommendations on an interim basis.

We believe that the attached recommendations will help to prevent instability and provide clear and concise guidelines for operator action to keep plant operation within acceptable bounds in the unlikely event of regional oscillations. Furthermore, by taking decisive action to avoid the region in which low stability margins exist, post event speculation regarding possible safety limit violations can be avoided.

(Original signed by)
P. W. Marriott, Manager
Licensing and Consulting Services

ENCLOSURE
INTERIM STABILITY CORRECTIVE ACTIONS
FOR BWRs USING GE FUEL

BACKGROUND

General Electric, working with the BWR Owner's Group, is continuing to perform generic evaluations of the BWR plant response to core thermal hydraulic instabilities. These evaluations assess the mitigation provided by the existing reactor protection systems and the margin to safety limits associated with possible automatic or manual actions.

The preliminary results of this evaluation indicate that for certain plants and operating conditions, interim actions are appropriate to assure adequate margin to the Minimum Critical Power Ratio (MCPR) safety limit in the event of core thermal hydraulic instabilities. While these results are preliminary, they indicate a condition which should receive immediate attention.

The GE review has identified two groups of plants for which the corrective actions are slightly different because of features of their reactor protection systems which mitigate the effects of thermal hydraulic instabilities. These groups are:

Group 1	BWR/2 and BWR/3 plants	
	BWR/4 plants	with APRM flow biased neutron flux scram (unfiltered APRM signal)
Group 2	BWR/4 plants	with Simulated Thermal Power Monitor (filtered APRM signal)
	BWR/5 and BWR/6 plants	

Operating BWR plants in the United States are identified by Group in Table 1.

The analyses are based on an evaluation of GE 8X8 fuel. These interim actions are an improvement over those provided in SIL 380 Revision 1.

SIL 380, Revision 1, provided general guidelines on the detection and suppression of core thermal hydraulic instabilities. The following interim corrective actions are provided to supplement SIL 380, Revision 1. Where any conflicts arise between these corrective actions and SIL 380, Revision 1, these corrective actions take precedence.

INTERIM CORRECTIVE ACTIONS

1. Intentional operation shall not be allowed in Region A or Region B of Figure 1.

2. If Region A is unintentionally entered:

   Group 1 plant operators shall take immediate actions to exit the region. Immediate action consists of either:

   Insertion of a predefined set of control rods which will most effectively reduce core thermal power.

   or

   Increasing recirculation pump speed if one or more pumps are in operation. Starting a recirculation pump to exit this region is NOT an appropriate action.

   Group 2 plant operators shall manually scram the reactor to exit the region.

3. If Region B is unintentionally entered:

   Group 1 and Group 2 plant operators shall take immediate action to exit the region. Immediate action consists of:

   Insertion of a predefined set of control rods which will most effectively reduce core thermal power.

   or

   Increasing recirculation pump speed or recirculation flow (FCV plants) if one or more pumps are in operation. Starting a recirculation pump or shifting from low to high speed (FCV plants) to exit this region is NOT an appropriate action.

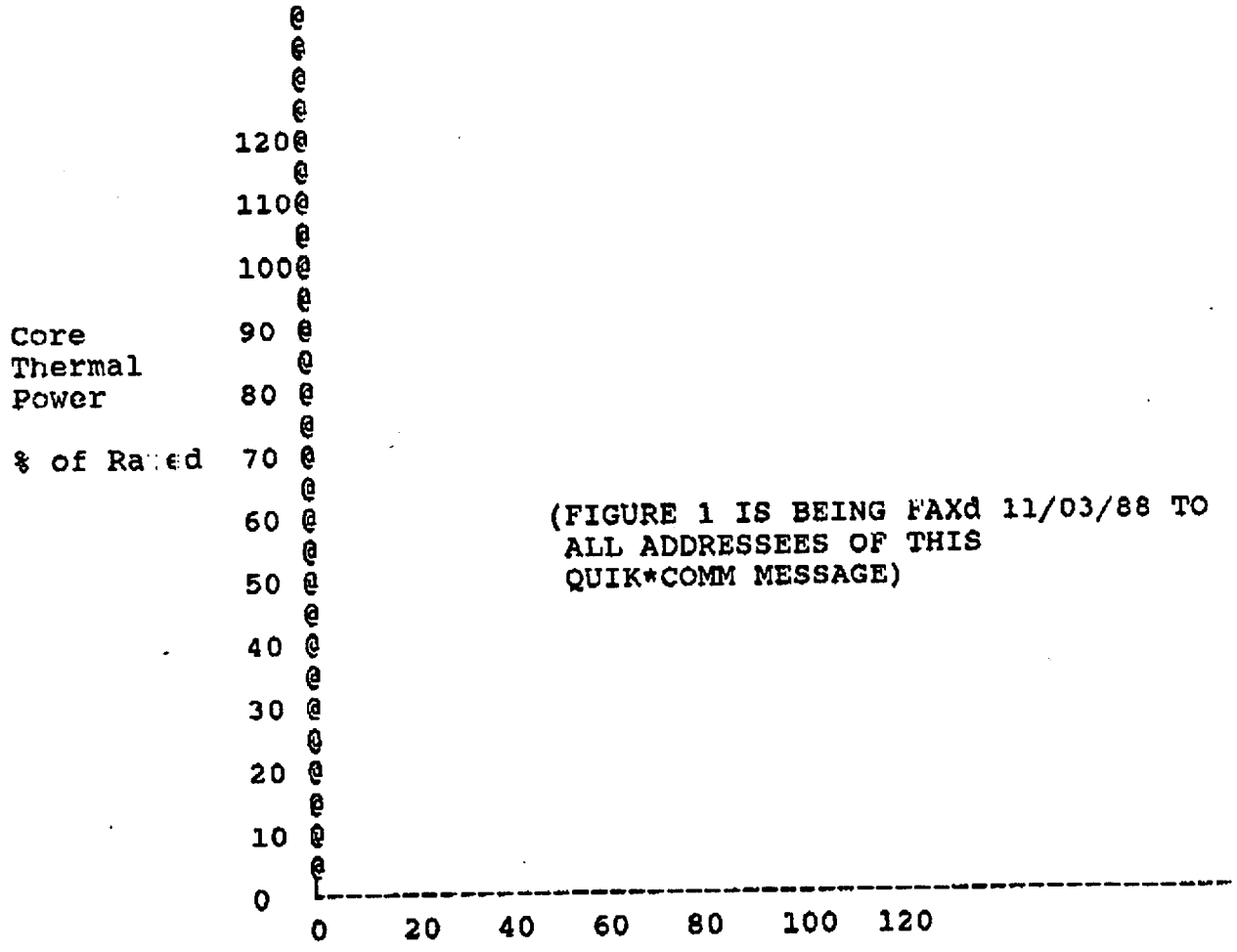
4. Intentional operation in Region C shall be allowed only for control rod withdrawals during startup requiring PCIOMR. This region should be avoided for control rod sequence exchanges, surveillance testing and reactor shutdowns.

   During control rod withdrawal, flux monitoring should be conducted in accordance with SIL 380, Revision 1.

5. If at any time during operation in Region A,B or C, core thermal hydraulic instability occurs, the plant operator shall manually scram the reactor.

   Evidence of thermal hydraulic instability consists of APRM peak to peak oscillations of greater than 10% or periodic LPRM upscale or downscale alarms in addition to the guidance provided in SIL 380, Revision 1.

FIGURE 1
DEFINED OPERATING REGIONS



(FIGURE 1 IS BEING FAXd 11/03/88 TO ALL ADDRESSEES OF THIS QUIK*COMM MESSAGE)

REGION A — REACTOR POWER GREATER THAN THE 100% ROD LINE
CORE FLOW LESS THAN 40% OF RATED CORE FLOW

REGION B — REACTOR POWER BETWEEN THE 80% AND 100% ROD LINES
CORE FLOW LESS THAN 40% OF RATED CORE RATED

REGION C — REACTOR POWER GREATER THAN THE 80% ROD LINE
CORE FLOW BETWEEN 40% AND 45% OF RATED CORE FLOW

TABLE 1
U.S OPERATING REACTOR GROUPS*

GROUP 1

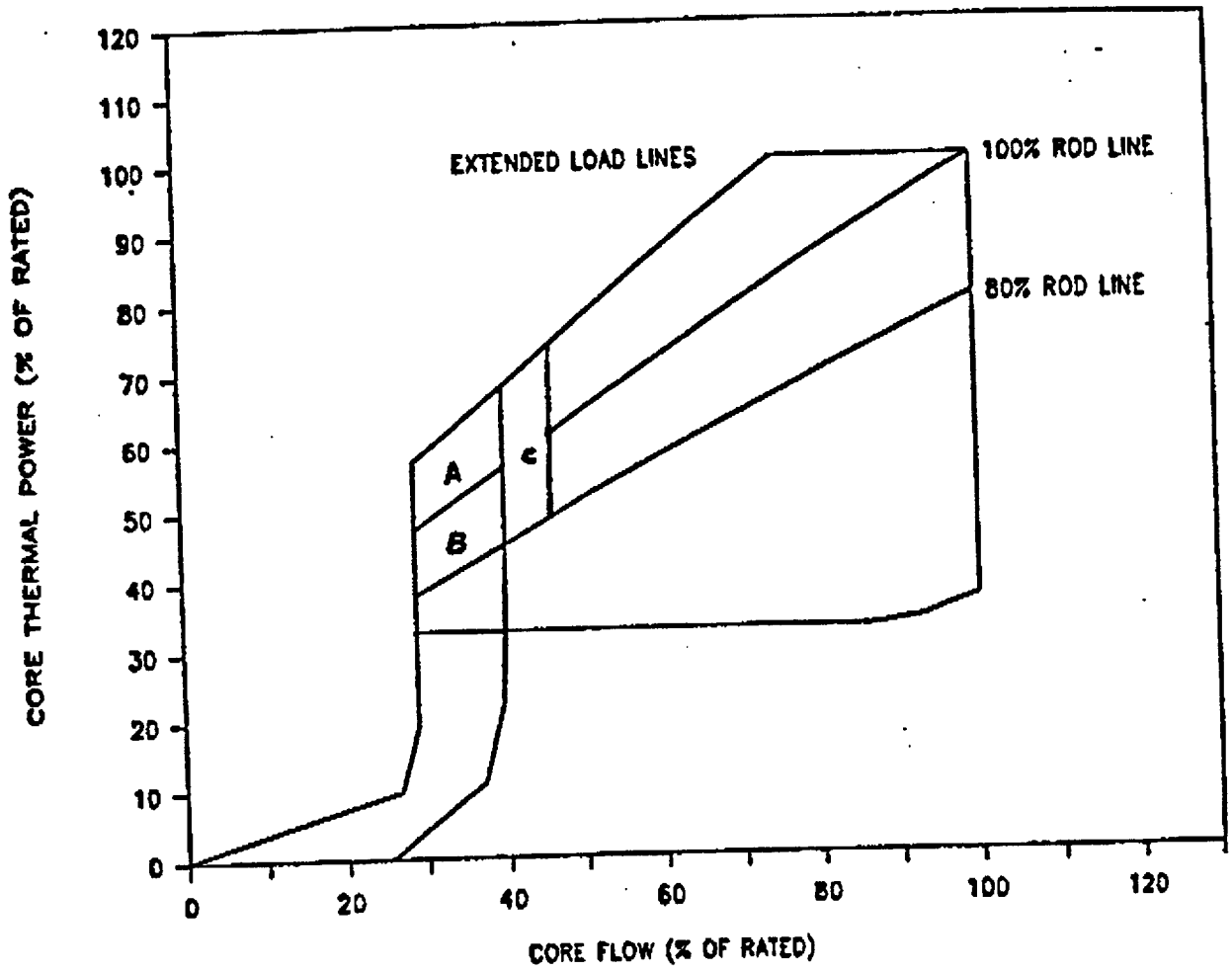
OYSTER CREEK
NINE MILE 1
DRESDEN 2,3
MILLSTONE 1
QUAD CITIES 1,2
PILGRIM
MONTICELLO
DUANE ARNOLD
COOPER
VERMONT YANKEE
PEACH BOTTOM 2,3
LIMERICK

GROUP 2

BRUNSWICK 1,2
HATCH 1,2
BROWNS FERRY 1,2,3
FERMI 2
FITZPATRICK
HOPE CREEK
SUSQUEHANNA 1,2
LASALLE 1,2
HANFORD 2
SHOREHAM
NINE MILE PT 2
CLINTON
PERRY
RIVER BEND
GRAND GULF 1,2

* Based on information available to GE. Excludes Big Rock Point

FIGURE 1
DEFINED OPERATING REGIONS



REGION A	REACTOR POWER GREATER THAN THE 100% ROD LINE CORE FLOW LESS THAN 40% OF RATED CORE FLOW
REGION B	REACTOR POWER BETWEEN THE 80% AND 100% ROD LINES CORE FLOW LESS THAN 40% OF RATED CORE RATED
REGION C	REACTOR POWER GREATER THAN THE 80% ROD LINE CORE FLOW BETWEEN 40% AND 45% OF-RATED CORE FLOW