

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

December 30, 1988

NRC BULLETIN NO. 88-07, SUPPLEMENT 1: POWER OSCILLATIONS IN BOILING WATER REACTORS (BWRs)

Addressees:

All holders of operating licenses (OLs) or construction permits (CPs) for boiling water reactors (BWRs).

Purpose:

The purpose of this supplement is (1) to provide additional information concerning power oscillations in BWRs and (2) to request that addressees take action to ensure that the safety limit for the plant minimum critical power ratio (MCPR) is not violated.

Description of Circumstances:

Licenses were requested in NRC Bulletin No. 88-07 to take actions to prevent the occurrence of uncontrolled power oscillations during all modes of BWR operation. In addition, as mentioned in the bulletin, the NRC, as a separate action, requested that the BWR Owners Group (BWROG) perform generic evaluations of the BWR plant response to core thermal hydraulic instabilities. The preliminary results of these evaluations and the NRC's ongoing independent study indicate that when regional power oscillations become detectable on the average power range monitors (APRMs), the MCPR safety margin may be insufficient under some operating conditions to ensure that manual actions taken in response to APRM signals would prevent violation of the MCPR safety limit. In addition, design features of many reactor protection systems (e.g., filtered APRM signals to provide a Simulated Thermal Power Monitor in the power/flow scram circuit) render them ineffective for automatic scram protection during regional thermal hydraulic instabilities.

In November 1988, General Electric Company (GE) issued a letter entitled "Interim Recommendations for Stability Actions" to the BWR licensees. The interim corrective actions recommended by GE were reviewed by the NRC and have been found acceptable for those plants which have effective automatic scram protection for regional oscillations. For plants which do not have effective

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automatic scram (such as flow biased scram) protection for regional oscillations, the staff believes that the procedures recommended by GE and adopted by the BWROG may not provide sufficient, reliable protection. Therefore, the staff is requesting that plants without effective automatic scram protection for regional oscillations manually trip the reactor in response to every situation in which two recirculation pumps are tripped with the reactor in the RUN mode. In addition, the BWROG recommendations were addressed to GE-fueled reactors. The staff is addressing the applicability of these recommendations to reactors with fuel supplied by other vendors and for new fuel designs which have not been previously approved. The BWROG recommendations and provisions of this supplement are not applicable to Big Rock Point (Docket No. 50-155) because of unique design features involving a lack of flow control capability, and because existing operating limitations enforced by technical specifications address the stability concerns which are the subject of this supplement.

The NRC is currently working with the BWROG to develop a generic approach to long-term corrective actions. The BWROG is planning to evaluate hardware modifications and/or additions and complementary procedure revisions needed to facilitate stability monitoring and to improve the manual and/or automatic protective actions as needed to avoid neutron flux oscillations and to suppress them if they occur. The BWROG study is expected to be completed within 6 months of the issuance of this supplement and to result in generic recommendations. The BWROG has indicated that these recommendations will be transmitted to addressees in parallel with the NRC review in order to facilitate development of plant-specific solutions within 12 months. The staff expects to issue another generic communication that will provide guidance for long-term resolution of the stability issue.

Actions Requested:

Operating Reactors:

- (1) Within 30 days of receipt of this supplement, all BWR licensees should implement the GE interim stability recommendations described in Attachment 1. However, for those plants that do not have effective automatic scram protection in the event of regional oscillations, a manual scram should be initiated under all operating conditions when two recirculation pumps trip (or "no pumps operating") with the reactor in the RUN mode.
- (2) The boundaries of Regions A, B, and C shown in Figure 1 of the GE recommendations (Attachment 1) were derived for those BWRs using NRC approved GE fuel. For BWRs using fuel supplied by other vendors, these regions should be adopted in principle, but the power/flow boundaries should be based on existing boundaries that have been previously approved by the NRC. For proposed new fuel designs, the stability boundaries should be reevaluated and justified based on any applicable operating experience,

calculated changes in core decay ratio using NRC approved methodology, and/or core decay ratio measurements. There should be a high degree of assurance that instabilities will not occur under any circumstances of operation in Region C.

- (3) The BWROG recommendations of Attachment 1 are ambiguous with respect to permissible conditions for entry of Regions B and C. Although the recommendations state that intentional operation in Region B is not permitted and operation in Region C is permitted only for purposes of fuel conditioning during rod withdrawal startup operations, intentional entry into Region B or C is also allowable in situations where rod insertion or a flow increase is required by procedures to exit Regions A and B after unintentional entry. Licensees should ensure that the procedures and training employed for implementation of these recommendations avoid any similar ambiguity which could lead to operator confusion.

Construction Permit Holders:

All construction permit holders should complete the requested actions above before the date scheduled for fuel loading.

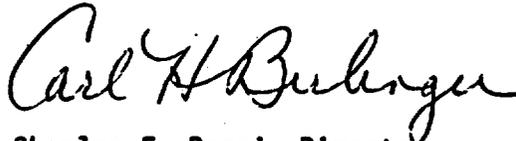
Reporting Requirements:

Within 60 days of receipt of this supplement, pursuant to 10 CFR 50.54(f), all holders of OLs shall advise the NRC by letter whether the requested actions have been completed and implemented. Prior to fuel loading, CP holders shall advise the NRC by letter that the requested actions have been completed and implemented. The staff will evaluate these responses to determine whether any additional action by the staff is necessary.

The required written reports shall be addressed to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C., 20555, under oath or affirmation under the provisions of Section 182a, Atomic Energy Act of 1954, as amended. In addition, a copy of the report shall be submitted to the appropriate Regional Administrator.

This request is covered by Office of Management and Budget Clearance Number 3150-0011 which expires December 31, 1989. The estimated average burden hours is approximately 100 to 200 person-hours per response, including assessment of the new recommendations, searching data sources, gathering and analyzing the data, and preparing the required reports. These estimated average burden hours pertain only to these identified response-related matters. Comments on the accuracy of this estimate and suggestions to reduce the burden may be directed to the Office of Management and Budget, Room 3208, New Executive Office Building, Washington, D.C. 20503, and to the U.S. Nuclear Regulatory Commission, Records and Reports Management Branch, Office of Administration and Resource Management, Washington, D.C. 20555.

If you have any questions about this matter, please contact one of the technical contacts listed below or the Regional Administrator of the appropriate regional office.

For 
Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation

Technical Contacts: L. Phillips, NRR
(301) 492-3235

P. C. Wen, NRR
(301) 492-1172

Attachments:

1. "Interim Recommendations for Stability Actions," GE, November 1988.
2. List of Recently Issued NRC Bulletins

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

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.

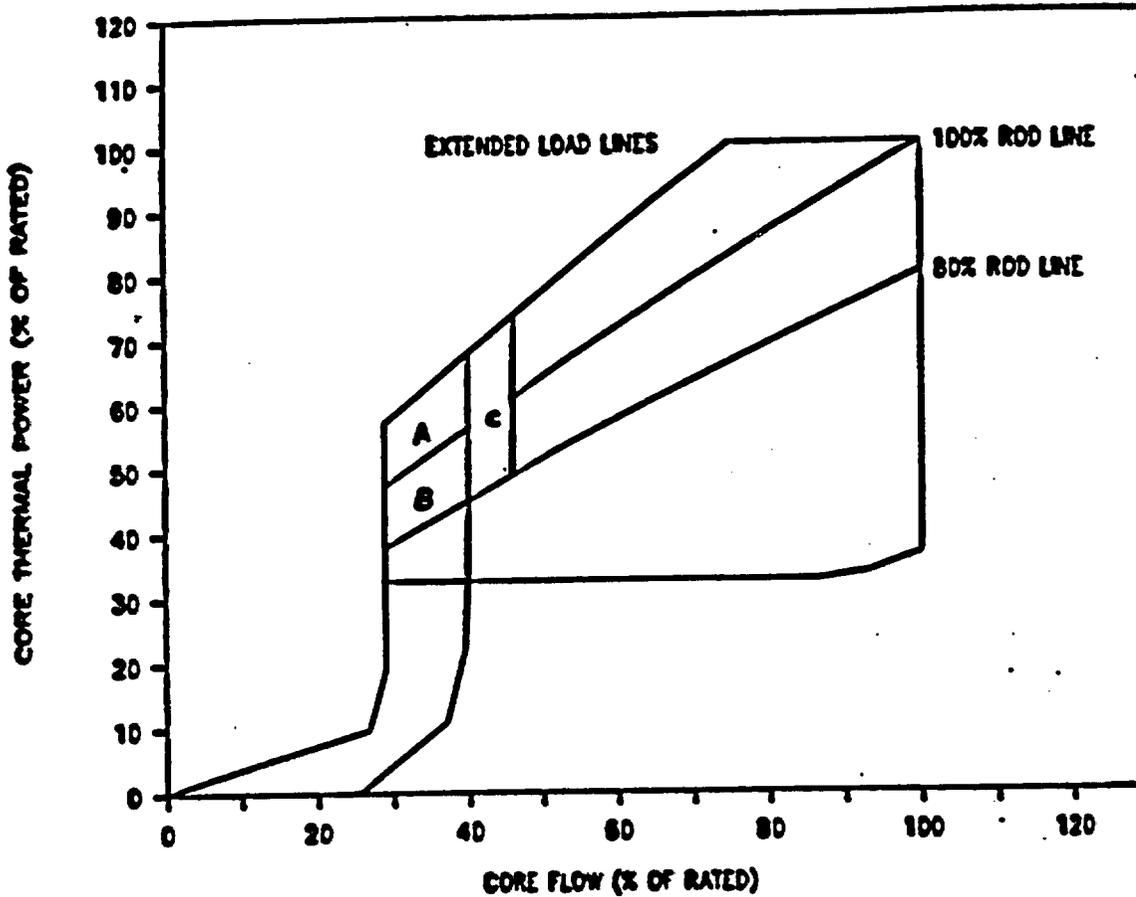
4. Intentional operation in Region C shall be allowed only for control rod withdrawals during startup requiring PCIOMR. This region should be avoided for control rod sequence exchanges, surveillance testing and reactor shutdowns.

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**



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 FLOW**

REGION C

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

TABLE 1
US OPERATING REACTOR GROUPS*

GROUP 1

OYSTER CREEK
NINE MILE 1
DRESDEN 2,3
MILLSTONE 1
QUAD CITIES 1,2
PILGRIM
MONTECELLO
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

* Based on information available to GE. Excludes Big Rock

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This requirement for information was approved by the Office of Management and Budget under blanket clearance number 3150-0011. Comments on burden and duplication should be directed to the Office of Management and Budget, Reports Management, Room 3208, New Executive Office Building, Washington, D.C. 20503.

If you have any questions about this matter, please contact one of the technical contacts listed below or the Regional Administrator of the appropriate regional office.

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TECH ED B. Colure 12/12/88	BC:OGCB:DOEA CHBerlinger 12/ /88	D:DOEA CERossi 12/ /88		

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*TECH ED
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12/12/88

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OGC
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Additional comments from OGC (S. Lewis) regarding Reporting Requirements were incorporated and reviewed by CRGR staff (C. Sakenas) CHB 12/27/88

Changes made meet the intent of the CRGR comments and recommendations.
OK'd 12/27 3:55 p.m. telecon by Cheryl Sakenas w/Carl Berlinger.

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