



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

August 19, 1992

TO: ALL BOILING WATER REACTOR (BWR) LICENSEES OF
OPERATING REACTORS

SUBJECT: RESOLUTION OF THE ISSUES RELATED TO REACTOR VESSEL
WATER LEVEL INSTRUMENTATION IN BWRs PURSUANT TO
10 CFR 50.54(F) (GENERIC LETTER NO. 92-04)

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this generic letter to request information regarding the adequacy of and corrective actions for Boiling Water Reactor (BWR) water level instrumentation with respect to the effects of noncondensable gases on system operation.

Background and Safety Considerations

As discussed in NRC Information Notice No. 92-54 "Level Instrumentation Inaccuracies Caused by Rapid Depressurization," the staff is concerned that noncondensable gases may become dissolved in the reference leg of BWR water level instrumentation and can lead to a false high level indication after a rapid depressurization event. The dissolved gases which accumulate over time during normal operation can rapidly come out of solution during depressurization and displace water from the reference leg. A reduced reference leg level will result in a false high level indication. This is important to safety because water level signals are used for actuating automatic safety systems and for guidance to operators during and after an event.

On July 29, 1992, the NRC staff held a public meeting with the Regulatory Response Group (RRG) of the Boiling Water Reactor Owners Group (BWROG) to discuss the effect of inaccuracies in the reactor vessel level instrumentation system in BWRs. During the meeting, the BWROG and its consultant, General Electric Company (GE), presented the results of analyses assessing the safety implications of the postulated error in level indication. The analyses consisted of two basic parts: (1) an assessment of the mechanism and potential magnitude of errors in the level instruments and (2) a review of the relevant licensing basis transients and accidents to determine the effect of this error on plant response, including post-accident operator actions.

The BWROG analyses indicated that significant errors in level indication can occur as a result of degassing the instrument reference leg if noncondensable gas is dissolved in the reference leg and if the reactor abruptly depressurizes below 450 psig.

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The NRC staff reviewed the BWROG analyses and selected design basis accident scenarios which lead to a lowering of the reactor vessel water level and has concluded that automatic safety systems will be actuated at pressures well above 450 psig, even for postulated worst-case noncondensable gas concentrations in the reference legs. Therefore, the NRC is confident that all emergency cooling systems will initiate as they were designed to do. In addition, the BWROG discussed diverse signals which would also initiate ECCS for reactor water level lowering events. The NRC staff reviewed the backup systems and concluded that the ECCS would be initiated by diverse signals as analyzed by the BWROG.

After ECCS actuation, reactor water level indication is used by the operators for long term actions (i.e., maintaining adequate reactor water level and ensuring adequate core cooling). Operators would not utilize only reactor vessel level indications to determine accident mitigation actions but would also utilize other indications such as containment pressure, temperature, and humidity to determine accident mitigation strategies. Additionally, events characterized by gradual depressurization would lead to a reduced error in the indicated level. There are two or four reference leg columns in each plant, depending on plant design. The amount of noncondensable gases dissolved in each depends primarily upon system leakage and geometry. Because of this, a common mode, common magnitude level indication error is unlikely. Operators would therefore see a mismatch in indicated level alerting them to a level indication problem. Finally, emergency procedure guidelines (EPGs) state that when reactor vessel water level is indeterminate, operators should flood the reactor vessel using at least one pump guided by the unaffected diverse instrumentation (i.e., high containment pressure indication). Reactor operators are trained to deal with these situations should they occur.

Upon reviewing the information provided by the BWROG and the staff's assessment, the staff concluded that interim plant operation is acceptable. The bases for the staff's conclusion are as follows: 1) the level instrumentation is expected to initiate safety systems prior to a significant depressurization of the reactor; 2) emergency procedures which are currently in place in conjunction with operator training are expected to result in adequate operator actions; and 3) an abrupt depressurization event resulting in a common mode, common magnitude level indication error is unlikely.

For longer term operation however, the staff considers potential water level instrumentation inaccuracies an important issue because level indication has safety and control functions in all

modes of BWR operation. Furthermore, since the analyses provided are of a generic nature and the magnitude of possible errors depends strongly upon plant-specific factors such as system leakage and geometry, it is important that the analyses be reviewed promptly by all individual licensees.

Basis for Compliance Determination

The level errors that could result from the effects of noncondensable gas may prevent the level instrumentation systems in BWRs from satisfying the following regulations:

- (1) General Design Criterion (GDC) 13, "Instrumentation and control," which requires that "Instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety." Existing instrumentation may not accurately monitor reactor vessel water level under accident conditions.
- (2) GDC 21, "Protection system reliability and testability," which requires that "The protection system shall be designed for high functional reliability...commensurate with the safety function to be performed." The instrumentation may not be reliable under rapid depressurization conditions.
- (3) GDC 22, "Protection system independence," which requires that "The protection system shall be designed to assure that the effects of natural phenomena, and of normal operating, maintenance, testing, and postulated accident conditions...do not result in loss of the protection function." The natural phenomena of degassing may cause a loss of the reactor vessel water level indication function following a rapid depressurization.
- (4) Section 50.55a(h) of Title 10 of the Code of Federal Regulations (10 CFR 50.55a(h)), which requires that protection systems, for those plants with construction permits issued after January 1, 1971, shall meet the requirements stated in editions of the Institute of Electrical and Electronics Engineers Standard "Criteria for Protection Systems for Nuclear Power Generating Stations" (IEEE-279). Section 4.20 of IEEE-279 requires that "The protection system shall be designed to provide the operator with accurate,

complete, and timely information pertinent to its own status and to generating station safety." The water level instrumentation for the reactor vessel may not be accurate after a rapid depressurization event.

Requested Actions

1. In light of potential errors resulting from the effects of noncondensable gas, each licensee should determine:
 - a. The impact of potential level indication errors on automatic safety system response during all licensing basis transients and accidents;
 - b. The impact of potential level indication errors on operator's short and long term actions during and after all licensing basis accidents and transients;
 - c. The impact of potential level indication errors on operator actions prescribed in emergency operating procedures or other affected procedures not covered in (b).
2. Based upon the results of (1), above, each licensee should notify the NRC of short term actions taken, such as:
 - a. Periodic monitoring of level instrumentation system leakage; and,
 - b. Implementation of procedures and operator training to assure that potential level errors will not result in improper operator actions.
3. Each licensee should provide its plans and schedule for corrective actions, including any proposed hardware modifications necessary to ensure the level instrumentation system design is of high functional reliability for long term operation. Since this instrumentation plays an important role in plant safety and is required for both normal and accident conditions, the staff recommends that each utility implement its longer term actions to assure a level instrumentation system of high functional reliability at the first opportunity but prior to starting up after the next refueling outage commencing 3 months after the date of this letter.

Required Information

Because of the importance of plant-specific aspects of this issue and the potential magnitude of the errors, the staff requires, pursuant to 10 CFR 50.54(f) and Section 182 of the Atomic Energy Act, that you provide a response to this letter by September 27, 1992.

Merely committing to evaluate the safety significance as part of the individual plant examination (IPE) program is not an acceptable alternative to the actions described herein, since the licensee should resolve this issue as a matter of compliance.

Backfit Discussion

In accordance with NRC procedures, the actions requested herein are considered a backfit to assure that facilities are in compliance with existing regulatory requirements discussed above. Thus, a backfit analysis is not required by 10 CFR 50.109(a)(4)(i), and the staff performed a documented evaluation as discussed in 10 CFR 50.109(a)(6). The documented evaluation is provided in the preceding discussions.

Burden Information

This request is covered by Office of Management and Budget Clearance Number 3150-0011, which expires May 31, 1994. The estimated average number of burden hours is 200 person hours for each licensee response, including the time required to assess the questions, search data sources, gather and analyze the data, and prepare the required response. These estimated average burden hours pertain only to the identified response-related matters and do not include the time for actual implementation of the requested actions. Comments on the accuracy of this estimate and suggestions to reduce the burden may be directed to Ronald Minsk, Office of Information and Regulatory Affairs (3150-0011), NEOB-3019, Office of Management and Budget, Washington, D.C. 20503 and to the U.S. Nuclear Regulatory Commission, Information and Records Management Branch, Division of Information Support Services, Office of Information and Resources Management, Washington, D.C. 20555.

Although no specific request or requirement is intended, the following information would be helpful to the NRC in evaluating the cost of complying with this generic letter:

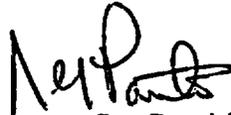
- (1) the licensee staff time and costs to perform requested inspections, corrective actions, and associated testing;
- (2) the licensee staff's time and costs to prepare the requested reports and documentation;

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- (3) the additional short-term costs incurred as a result of the inspection findings such as the costs of the corrective actions or the costs of down time; and
- (4) an estimate of the additional long-term costs which will be incurred in the future as a result of implementing commitments such as the estimated costs of conducting future inspections or increased maintenance.

Please address your response to this generic letter to the U.S. Nuclear Regulatory Commission, Attn: Document Control Desk, Washington, D.C. 20555 pursuant to 10 CFR 50.4(a) of the NRC's regulations.

Sincerely,



James G. Partlow
Associate Director for Projects
Office of Nuclear Reactor Regulation

Enclosure:
List of recently issued generic letters.

Technical Contact: Timothy E. Collins, NRR
" (301) 504-2897

LIST OF RECENTLY ISSUED GENERIC LETTERS

<u>Generic Letter No.</u>	<u>Subject</u>	<u>Date of Issuance</u>	<u>Issued To</u>
<u>90-02 SUPPLEMENT 1</u>	ALTERNATIVE REQUIREMENTS FOR FUEL ASSEMBLIES IN THE DESIGN FEATURES SECTION OF TECHNICAL SPECIFICATIONS	07/31/92	ALL LWR LICENSEES AND APPLICANTS
<u>87-02 SUPPLEMENT 1</u>	SAFETY EVALUATION REPORT NO. 2 ON SQUG GENERIC IMPLEMENTATION PROCEDURE, REVISION 2.	05/22/92	ALL USI A-46 LICENSEES WHO ARE SQUG MEMBERS
<u>92-03</u>	COMPILATION OF THE CURRENT LICENSING BASIS: REQUEST FOR VOLUNTARY PARTICIPATION IN PILOT PROGRAM	03/19/92	ALL NUCLEAR POWER PLANT APPLICANTS AND LICENSEES
<u>92-01 REVISION 1</u>	REACTOR VESSEL STRUCTURAL INTEGRITY, 10CFR50.54(f)	3/06/92	ALL HOLDERS OF OP LICENSES OR CONST. PERMITS FOR NUCLEAR PWR PLANTS (EXCEPT YANKEE ATOMIC FOR YANKEE NUC PWR STA.)
<u>92-02</u>	RESOLUTION OF GENERIC ISSUE 79, UNANALYZED REACTOR VESSEL (PWR) THERMAL STRESS DURING NATURAL CONVECTION COOLDOWN	03/06/92	ALL HOLDERS OF OP LICENSES OF CONST. PERMITS FOR PWRs
<u>92-01</u>	REACTOR VESSEL STRUCTURAL INTEGRITY, 10CFR50.54(f)	<u>NOT ISSUED</u> Revision Listed Above	ALL HOLDERS OF OP LICENSES OR CONST. PERMITS FOR NUCLEAR PWR PLANTS (EXCEPT YANKEE ATOMIC FOR YANKEE NUC PWR STA.)
* <u>89-10 SUPPLEMENT 4</u>	CONSIDERATION OF VALVE MISPOSITIONING IN BWRs	02/14/92	ALL LICENSEES OF OP NUC PWR PLANTS AND HOLDERS OF CONSTRUC. PERMITS FOR PWR PLANTS

* NOTE: 89-10 Supp. 4 -
Accession No. 9202070037 has been changed to 9202250311.

- (3) the additional short-term costs incurred as a result of the inspection findings such as the costs of the corrective actions or the costs of down time; and
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EDITED: J. MAIN
 DATE: 8/13/92

SRXB:DST*	SRXB:DST*	SICB/DST*	D:DST*	C:DOBA*
TCollins: Bah	RJones	SNewberry	ATHadani	GMarcus
8/17/92	8/17/92	8/17/92	8/18/92	8/18/92

AD:PNRR	OGC*	D:ADT*
JPartlow	SLewis	WRussell
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* See previous concurrence

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JPartlow	SLewis
Collins	WRussell
Collins R/F	RJones

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8/17/92

BJ
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JK
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