

## PRESSURIZED WATER REACTOR CONTAINMENT SUMP BLOCKAGE (NRC GENERIC LETTER 2004-02)

### CORNERSTONE: MITIGATING SYSTEMS

**APPLICABILITY:** This temporary instruction applies to all holders of operating licenses for pressurized-water reactors.

#### 2515/166-01 OBJECTIVE

01.01 The objective of this Temporary Instruction (TI) is to support the Nuclear Regulatory Commission (NRC) review of licensees' activities in response to NRC Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors (PWRs)." This TI requires NRC inspectors to verify actions implemented in response to NRC Generic Letter 2004-02 are complete and, where applicable, are programmatically controlled. It is not the objective of this TI to determine the adequacy of the licensee actions taken as a response to GL 2004-02; that is an Office of Nuclear Reactor Regulation (NRR) function. NRR will be reviewing licensee GL responses and conducting audits to assess the adequacy of licensee actions.

#### 2515/166-02 BACKGROUND

Generic Safety Issue (GSI) 191 was established to determine whether the transport and accumulation of debris in PWR containments following a loss-of-coolant accident (LOCA) (or other high-energy line breaks if recirculation is credited) will impede the long-term operation of the emergency core cooling systems (ECCS) or containment spray systems (CSS). In the event of a LOCA, materials in the vicinity of the break, such as thermal insulation, coatings, and concrete, would be damaged and dislodged. A fraction of this material would then be transported to the recirculation sump and accumulate on its screens. Debris accumulating on the sump screens has the tendency to form a bed which, much like a filter, results in an increased head loss across the sump screens. The additional head loss due to the accumulation of debris is a safety concern because it has the potential to exceed the net positive suction head (NPSH) margin required to assure the successful operation of the ECCS and CSS pumps. Sump blockage had initially been evaluated in the early 1980s under unresolved safety issue (USI) A-43. Although the

original regulatory guidance to assume 50% screen blockage was determined to be non-conservative and revised in 1985, a backfit was not then considered justified. However, Generic Letter 85-22 advised licensees to consider the revised (mechanistic) guidance in Regulatory Guide 1.82, Revision 1, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," for the conduct of 10 CFR 50.59 reviews associated with the changeout or modification of thermal insulation.

Subsequent blockage events at BWRs and additional research revealed that there could be more and finer debris than previously thought, accumulating uniformly. The effect of filtration of particulates by fibers, previously not considered, would result in higher than previously expected head losses. The Office of Nuclear Regulatory Research (RES) technical review also identified concerns with the potential deleterious effects that both upstream blockage (reducing available NPSH due to lower pool levels) and downstream blockage (from material passing through the screens) could have on ECCS performance. Based upon the findings of its technical evaluation, RES concluded that GSI-191 was a valid concern and recommended detailed plant-specific evaluations to determine the susceptibility of each PWR to sump-clogging.

NRR concurred with RES's conclusion and developed an action plan to resolve GSI-191. Public meetings were held with Nuclear Energy Institute (NEI) and the PWR Owners' Group representatives to discuss development of industry evaluation guidelines for plant-specific sump-clogging evaluations. NRC's plans to revise Regulatory Guide (RG) 1.82 and issue a generic letter to support closure of GSI-191 were also discussed in the meetings. The staff briefed the Advisory Committee on Reactor Safeguards (ACRS) on both the draft generic letter and draft revision to Regulatory Guide 1.82 (DG 1107, Reference 1). Their letter dated February 20, 2003, endorsed issuance of the draft RG and draft generic letter to expedite resolution of GSI-191.

During review of the draft generic communications, concerns were elevated regarding the need for near-term determinations as to whether the ECCS and CSS recirculation functions are in compliance with applicable regulatory requirements, in particular the 10 CFR 50.46 requirement for long-term cooling, when a mechanistic evaluation of debris generation, transport, and accumulation on the sump screens is performed. These concerns were based on recent events such as Davis-Besse Licensee Event Report (LER) 50-346/2002-005-01, which showed the potential for increased failure probability of the ECCS due to debris accumulation and potential debris passage through the screens. Also, LER 50-346/2003-002-00, stated that the high pressure injection (HPI) pumps had been declared inoperable as a result of the potential for debris to damage the pump internals during the recirculation phase of certain postulated LOCAs when the HPI pumps are required to take suction from the containment recirculation sump. Additionally, in February 2003, Los Alamos National Laboratory published the NRC-sponsored technical report LA-UR-02-7562 (Reference 2) which analyzed the potential risk benefit of operator actions to recover from sump clogging events. The ACRS has recommended expeditious resolution of this issue.

Therefore, consistent with the risk significance of the PWR sump-clogging concern, the staff issued NRC Bulletin 2003-01 to request information on compliance and information on compensatory measures if compliance cannot be demonstrated. The underlying purpose of Bulletin 2003-01 was to make sure that the licensees implemented near-term

compensatory measures that reduce the risk associated with sump failure at plants whose sump screens may be degraded or potentially challenged in the event of a LOCA.

The NRC recognized that complex evaluations are required to analyze recirculation performance during design basis accidents if debris generation, transport and accumulation are analyzed mechanistically. The NRC staff also recognized that the methodology needed to perform these evaluations was not then available. As a result, that information was not requested in the bulletin, but addressees were informed that the staff was preparing a generic letter that would request this information. Generic Letter 2004-02 is the follow-on to the bulletin. Generic Letter 2004-02 requested that addressees perform a mechanistic evaluation of the potential for the adverse effects of post-accident debris blockage and operation with debris-laden fluids to impede or prevent the recirculation functions of the ECCS and CSS following all postulated accidents for which the recirculation of these systems is required. The generic letter also requested that addressees implement any needed plant modifications. In support of the generic letter, the staff issued a safety evaluation (SE) endorsing acceptable portions of the generic industry guidance. The SE may be used to assist in determining the status of regulatory compliance. For areas not addressed in the industry guidance, the staff provided guidance in the SE (Accession Number ML043280641) for evaluating those areas. Individual addressees may also develop an alternative to the approaches mentioned in this paragraph for responding to this generic letter. However, additional staff review will be required to assess the adequacy of such approaches.

For additional background on the technical and safety concerns and descriptions of selected plant events, see the Discussion and Background Sections in Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors (Accession Number ML031600259)" or <http://www.nrc.gov/reading-rm/doc-collections/gen-comm/gen-letters/2004/gl200402.pdf>

#### 2515/166-03      INSPECTION REQUIREMENTS

- 03.01    Verify the implementation of the plant modifications and procedure changes committed to by the licensee in their GL 2004-02 response.
  
- 03.02    Verify that changes to the facility or procedures, as described in the UFSAR, that are identified in the licensee's GL 2004-02 response were reviewed and documented in accordance with 10 CFR 50.59. Verify that the licensee has obtained NRC approval prior to implementing those changes that require such approval as stated in 10 CFR 50.59.

#### 2515/166-04      GUIDANCE

##### General Guidance

In lieu of performing a separate inspection for this TI, the Region can use the actions performed by the licensee in response to GL 2004-02 as samples for regularly scheduled baseline inspection activities.

As part of closing out GSI-191, the NRC needs to verify that the plant modifications and procedure changes identified in the licensee's September 2005 or subsequent GL 2004-02 responses were properly implemented. The plant modifications and procedure changes may be implemented over several refueling outages with the licensee to send a letter to the NRC informing the staff when all the corrective actions are complete. The inspector should use the submitted licensee response and supporting documentation as the basis for identifying those corrective actions to be inspected.

At multi-unit sites, inspectors should verify the installation of all significant modifications identified in GL 2004-02 responses for each unit. If common to all units, procedure and programmatic changes need only to be inspected for one unit.

### Specific Guidance

04.01 The inspector should use Inspection Procedure 71111.17, "Permanent Plant Modifications," as the basis for verifying the implementation of licensee modifications. The inspector should verify the installation of all significant modifications identified in the licensee's GL 2004-02 responses for each unit. The inspector should perform the activities associated with an "Annual Review" as identified in Section 71111.17-02, "Inspection Activities," including the activities in Section 02.02.d. If the inspection is performed as part of a "Biennial Review," inspectors should perform the activities identified in Section 71111.17-02, "Inspection Activities," including the activities in Section 02.02.b. Inspectors are to only verify the implementation of the identified corrective actions. The determination of the adequacy of the corrective actions in addressing the concerns in GSI-191 and GL 2004-02 is not within in the scope of this inspection. NRR will be reviewing licensee GL responses and conducting audits to assess the adequacy of licensee actions. If an inspector has an adequacy concern, they should contact the Branch Chief, Safety Issues Resolution Branch of NRR.

- a. With the exception of Section 02.02.d (Annual Review) and Section 02.02.b (Biennial Review), no additional specific guidance is needed.
- b. As part of the inspection activities for Section 02.02.d., "Updating Review," of Inspection Procedure 71111.17, "Permanent Modifications," verify that plant procedures have been updated to include programmatic controls that as a minimum:
  - i. Control the introduction of materials into containment that could impact sump performance. This includes materials such as insulation that could affect the chemical composition of the water.
  - ii. Identify the need to perform an assessment of the introduction of new materials into containment or a change in the amount of existing materials in containment (e.g., insulation, signs, coatings, and foreign materials) for potential adverse effects on the ECCS and CSS recirculation functions.

- iii. Control any action, as appropriate, credited by the licensee as part of their resolution of GSI-191.

04.02 The inspector should use Inspection Procedure 71111.02, "Evaluations of Changes, Tests, or Experiments," as the basis for verifying if licensee facility and procedure changes made as part of the licensee's resolution of GSI-191 were reviewed and documented in accordance with 10 CFR 50.59.

#### 2515/166-05 REPORTING REQUIREMENTS

Document inspection results including findings, if applicable, in a resident inspectors' integrated inspection report (i.e., quarterly inspection report) and send a copy of the applicable sections via e-mail to Michael L. Scott (MLS3@NRC.GOV).

The results of an inspection of any modification or change should be included in the applicable inspectable area of the inspection report (i.e., 1R02, 1R17). At a minimum, the inspectors should briefly describe the areas reviewed and results of the inspection, including answers to the following questions and inspection observations in Section 4OA5, "Other," of the next integrated inspection report. (This is an interim deviation from the requirements of IMC 0612).

a. Did the licensee implement the plant modifications and procedure changes committed to in their GL 2004-02 responses?

b. Has the licensee updated its licensing bases to reflect the corrective actions taken in response to GL 2004-02?

#### 2515/166-06 COMPLETION SCHEDULE

The installation of modifications committed to in licensees' GL 2004-02 responses will occur during refueling outages identified in the GL 2004-02 response. In most cases the outages will be before December 31, 2007. Inspectors should be prepared to perform all or most of the inspection activities in this TI during that refueling outage. In any event, the inspection activities identified in this TI should be completed by December 31, 2008.

#### 2515/166-07 EXPIRATION

This TI will expire on December 31, 2008.

#### 2515/166-08 CONTACT

For questions regarding the performance of this TI and emergent issues, contact David Cullison at (301) 415-1212 or DGC@NRC.GOV.

## 2515/166-09 STATISTICAL DATA REPORTING

All direct inspection effort expended on this TI is to be charged to 2515/166 for reporting by the Regulatory Information Tracking System (RITS) with an IPE code of SI. All indirect inspection effort on this TI is to be charged to a specific inspection report number with an IPE code GIP/GIPD.

## 2515/166-10 ORIGINATING ORGANIZATION INFORMATION

### 10.01 Organizational Responsibility

This TI was initiated by the Safety Issues Resolution Branch (NRR/DSS/SSIB).

### 10.02 Resource Estimate

The estimated direct inspection effort to perform this TI is estimated to be 10-80 hours per PWR unit.

### 10.03 Training

No specialized training is needed to perform inspection requirements in this TI beyond basic training for inspectors (specified in IMC 1245, "Inspector Qualifications"). However, if technical support is needed during the inspection of licensee actions, contact David Cullison at (301) 415-1212 or DGC@NRC.GOV

### 10.04 References

Generic Letter 04-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-water Reactors," September 2004 (accession number ML042360586)

Safety Evaluation of the NEI report on "Pressurized Water Reactor Containment Sump Evaluation Methodology (NEI 04-07), dated May 28, 2004," December 2004. (Accession number ML043280641)

Regulatory Guide 1.82, Revision 3, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," November 2003. (accession number ML030420318).

Regulatory Guide 1.187, "Guidance for Implementation of 10 CFR 50.59, Changes, Tests, and Experiments," April 2000 (accession number ML003759710)

Los Alamos National Laboratory Technical Report LA-UR-02-7562, "The Impact of Recovery From Debris-Induced Loss of ECCS Recirculation on PWR Core Damage Frequency," dated February 2003 (accession number ML030690174).

NUREG/CR-6808, "Knowledge Base for the Effect of Debris on Pressurized Water Reactor Emergency Core Cooling Sump Performance," dated February 2003; available at

<http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6808/cr6808.pdf> (or accession numbers ML030780733 and ML030920540).

NEI 02-01, Revision 1, "Condition Assessment Guidelines: Debris Sources Inside PWR Containments," dated September 2002 (accession number ML030420318).

Generic Letter 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System After a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment."

10 CFR 50.59, "Changes, Tests, and Experiments."

NRC Staff Responses to Industry Pre-Meeting Questions and Comments on Bulletin 2003-01 Provided in Support of June 30, 2003 NRC Public Meeting, June 30, 2003 (accession number ML031810371).

Revised NRC Staff Responses to Three Industry Questions on Bulletin 2003-01 Submitted Prior to the June 30, 2003, Public Meeting, August 7, 2003 (accession number ML032180011).

END

ATTACHMENT 1

Revision History For  
Temporary Instruction 2515/166

Commitment Tracking Number	Issue Date	Description of Change	Training Needed	Training Completion Date	Comment Resolution Accession Number
N/A	03/16/06	<p><u>TI 2515/166</u> has been issued to support the NRC review of licensees' activities in response to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors (PWRs)." The verification activities explained in the TI will also support the staff's closure of Generic Safety Issue - 191, "Assessment of Debris Accumulation on PWR Sump Performance."</p>	None	N/A	ML060520046