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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 19, 2009

MEMORANDUM TO: Eric J. Leeds, Director
Office of Nuclear Reactor Regulation

FROM: Marissa Bailey, DPO Panel Chair
Kenneth Karwoski, DPO Panel Member
Robert Tregoning, DPO Panel Member

SUBJECT: DIFFERING PROFESSIONAL OPINION PANEL REPORT CONCERNING CLOSURE PROCESS FOR GENERIC SAFETY ISSUE -191 (DPO-2008-001)

In a memorandum dated November 4, 2008, you appointed us as members of a Differing Professional Opinion (DPO) Ad Hoc Review Panel (DPO Panel) to review a DPO regarding the closure process for Generic Safety Issue (GSI) – 191, "Assessment of Debris Accumulation on PWR Sump Performance." The DPO Panel has reviewed the DPO in accordance with the guidance in Management Directive 10.159, "The NRC Differing Professional Opinions Program." The DPO Panel Report is enclosed for your consideration.

Based on our review of concerns raised in the DPO, the DPO Panel concludes that the staff should continue with the planned review process for evaluating licensee submittals in response to Generic Letter 2004-02 and, therefore, for resolving GSI-191.

We also offer the following recommendations for the staff to consider to ensure that the risk associated with GSI-191 related issues is acceptable: (1) perform an integrated review of the test results from all licensees to ensure that the results are as consistent as practical given the differences in testing approaches; and (2) assess the consequences associated with emergency core cooling system (ECCS) inoperability. Additionally, the staff should continue the interaction with the Boiling-Water Reactor (BWR) community and the internal evaluation to assess the significance of differences in regulatory requirements for resolving BWR and pressurized-water reactor ECCS performance concerns.

Please do not hesitate to contact us if you have any questions regarding the enclosed report.

Enclosure: DPO Panel Report

cc: Ralph Architzel
Renée, Pedersen, DVPM
Trent Wertz, NRR DVOL

A-19

Differing Professional Opinion (DPO) Concerning Closure Process For Generic Safety Issue -191 (DPO-2008-001)

DPO Panel Report

Marissa Bailey, Panel Chair

Kenneth Karwoski, Panel Member

Robert Tregoning, Panel Member

Date: 03/19/09

INTRODUCTION

On October 1, 2008, the U.S. Nuclear Regulatory Commission (NRC) received a Differing Professional Opinion (DPO) concerning the NRC staff closure process for Generic Safety Issue (GSI) – 191, "Assessment of Debris Accumulation on PWR Sump Performance," including associated activities such as review of Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors."

The DPO Ad Hoc Review Panel was formed on November 4, 2008. The Panel consisted of Marissa Bailey, Kenneth Karwoski, and Robert Tregoning. Ms. Bailey served as the Panel chairman while Mr. Karwoski and Mr. Tregoning served as Panel members.

The Panel was tasked to do the following:

- Review the DPO submittal to determine if sufficient information has been provided to undertake a detailed review of the issue.
- Meet with the submitter, as soon a practicable, to ensure that the DPO Panel understands the submitter's concerns and scope of the issues.
- Document the DPO Panel's understanding of the submitter's concerns, provide a Statement of Concerns to the submitter, and request that the submitter review and provide comments, if necessary.
- Maintain the scope of the review to not exceed those issues as defined in the original written DPO and confirmed in the Statement of Concerns.
- Consult with the Director for the Office of Nuclear Reactor Regulation (NRR) as necessary to discuss schedule-related issues, the need for technical support (if necessary), or the need for administrative support for the DPO Panel's activities.
- Perform a detailed review of the issues and conduct any record reviews, interviews, and discussions as the Panel deems necessary for a complete, objective, independent, and impartial review. The DPO Panel should re-interview individuals as necessary to clarify information during the review. In particular, the DPO Panel should have periodic discussions with the submitter to provide the submitter the opportunity to further clarify the submitter's views and facilitate the exchange of information.
- Analyze the "alternative approach" described in the DPO submittal, compare and contrast it to the established approach, and make a recommendation on whether the established approach needs to be changed to incorporate the alternative approach or aspects of the alternative approach. Provide pros and cons to the alternatives.
- Provide monthly status updates on the Panel's activities via e-mail to the NRR Differing Views Office Liaison no later than noon the last day of the month

- Issue a DPO panel report, including conclusions and recommendations to the NRR Director regarding the disposition of the issues presented in the DPO. The report should be a consensus product and include all Panel members' concurrence. Follow the specific instructions for DPO documents.

- Consult with the NRR Director as soon as the Panel believes that a schedule extension is necessary to disposition the DPO.

- Recommend whether the DPO submitter should be recognized if the submitter's actions result in significant contributions to the mission of the agency.

STATEMENT OF CONCERNS

The DPO panel met with the DPO submitter on November 26, 2008, to discuss details of the DPO and to understand the submitter's concerns and the scope of related issues. The DPO submitter's concerns are summarized as follows:

- The reviews of the responses to GL 2004-02 and the resolution of GSI-191 are unnecessarily focused on compliance rather than establishing whether the underlying safety issue has been adequately addressed. The current approach of focusing on compliance should not be required for closure of GSI-191, and is likely not justified from a backfit/cost benefit approach. Licensees have made major plant and operational improvements to address sump recirculation performance, and have demonstrated that the risk of sump failure associated with GSI-191, and related issues such as downstream and chemical effects, is insignificant.

- The staff's approach is inconsistent with Commission guidance provided in two Staff Requirements Memoranda.

- The staff's review process is inefficient and may result in focusing on non-safety significant issues.

The DPO submitter reviewed, commented on, and concurred with this summary of the Statement of Concerns.

ALTERNATIVE APPROACH FOR RESOLVING GSI-191

The submitter's proposed alternate approach would assess whether the plants have adequately resolved the risks associated with GSI-191 without making rigorous compliance determinations. This approach would also reevaluate pressurized water reactor (PWR) and boiling water reactor (BWR) plants to determine if generic safety issues remain due to uncertainties associated with strainer head loss testing, downstream effects, chemical effects, and differences in the regulatory requirements for resolving BWR and PWR emergency core cooling systems (ECCS) performance issues. The submitter believes that this approach would allow staff resources to be focused on those plants with potentially significant safety issues.

EVALUATION

The DPO Panel conducted a detailed review of the submitter's issues described in the Statement of Concerns. The Panel also assessed the DPO submitter's proposed alternative approach to the current GSI-191 closure process. In its review, the Panel interviewed a cross-section of NRC staff involved with GSI-191 resolution: a branch chief, a technical reviewer, and a member of the Integration Review Team (IRT). These individuals were recommended by the submitter. The Panel also interviewed the Chairman for the Committee to Review Generic Requirements to address the backfit/cost-benefit issue raised by the submitter. The Panel reviewed several documents recommended by the submitter and other documents pertaining to the issues described in the Statement of Concerns.

Background

GSI-191 was established in 1996 to assess the effects of sump screen debris blockage on PWR ECCS and containment spray system (CSS) recirculation functions following a loss-of-coolant accident (LOCA) or high-energy line break (HELB). This assessment was initiated in response to: (1) staff concerns about the adequacy of the 50% sump blockage assumption included in many plant licensing bases, and (2) several events involving BWR sump screen clogging that occurred in the early 1990s. The operating experience identified new debris sources that could contribute to PWR sump blockage, such as degraded or failed containment paint coatings. In addition, results of research to address BWR ECCS suction strainer blockage identified new phenomena and failure modes. These findings had not previously been considered in either the development of the licensing bases or the 1985 resolution of Issue A-43, "Containment Sump Performance (Rev. 1)."

The NRC used a two-step approach to resolve this issue. The first step was to issue Bulletin 2003-01,"Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," in June 2003 to inform licensees of the potential significance of this issue. This bulletin also requested that licensees either confirm their compliance with 10 CFR 50.46(b)(5) and other existing applicable regulatory requirements or, until such confirmation can be completed, describe any interim compensatory measures implemented to reduce risk or enhance the capability of the ECCS and CSS recirculation functions.

The second step was to issue GL 2004-02 which requested that licensees perform plant-specific evaluations of the ECCS and CSS recirculation functions to address the potential adverse effects of post-accident debris blockage and operation with debris-laden fluids. The letter also requested that licensees implement corrective actions – including plant modifications – as necessary to ensure recirculation system function and demonstrate compliance with regulatory staff positions concerning the availability of their PWR ECCS for long-term recirculation during a LOCA. The plant-specific evaluations and corrective actions were to be accomplished in accordance with the NRC's resolution schedule. The information requested by GL 2004-02 was considered a compliance exemption to the rule in accordance with 10 CFR 50.109(a)(4)(i).

Since issuance of GL 2004-02, licensees have made substantial progress in addressing strainer performance issues by performing plant modifications. Most importantly, almost all PWRs have increased the surface area of their ECCS strainers by one or two orders of magnitude. In addition, some licensees have removed problem materials such as fibrous insulation and

adopted water control measures to delay, or alleviate, the need for ECCS and CSS recirculation for smaller LOCAs. The NRC believes that the risk associated with ECCS performance will be substantially reduced once licensees complete necessary plant modifications.

The strategy for ensuring acceptable licensee responses to GL 2004-02 has focused on conducting confirmatory testing and analysis in important technical areas (e.g., chemical effects), monitoring the progress of licensee corrective actions, reviewing test protocols, and observing licensee head loss testing. The staff has also performed in-depth audits of selected licensees' evaluations and corrective actions taken in response to GL 2004-02. Currently, the staff is reviewing each licensee's submittal as part of the closure process for the GL.

The ECCS performance issue is complex, highly uncertain, and involves many technical disciplines. The resolution requires licensees to assess pipe breaks at various locations, determine the extent of damage to various other components, assess the amount of debris transported to the sump, assess the possible chemical interactions that may occur within the debris field, and evaluate the effect of this debris on sump performance. In addition, the resolution requires licensees to investigate the effects of debris that passes through the sump on downstream components (e.g., blockage of core passages).

Panel Review of the Statement of Concerns

The submitter's first concern is that the reviews of the responses to GL 2004-02 and the resolution of GSI-191 are unnecessarily focused on compliance rather than whether the underlying safety issue has been addressed. The DPO Panel concludes that the staff's approach for resolving ECCS performance issues is focused on compliance. However, the DPO Panel believes that this approach is appropriate. Safety is an NRC strategic goal, and compliance with the regulatory requirements presumptively assures that adequate safety is maintained. This concept is a fundamental tenet of the regulatory framework. Thus, the staff's focus on ensuring compliance with 10 CFR 50.46(b)(5) is appropriate.

In relation to this first concern, the submitter suggests that the staff's current approach would not likely be justified by a regulatory analysis to evaluate the appropriateness of backfit measures The NRC staff, however, is operating under the premise that this issue falls under the compliance exception to the backfit rule. Therefore, the Panel concludes that it is not pertinent to conduct a regulatory analysis because licensees are required to comply with the regulations regardless of backfit considerations. In addition, given the uncertainties and complexity of the issue, it would be challenging to perform a rigorous regulatory analysis with sufficient accuracy to evaluate backfit considerations.

The submitter's second concern is that the staff's approach is inconsistent with Commission guidance provided in two Staff Requirements Memoranda. Upon review of these memoranda, the DPO Panel concludes that the staff's approach is consistent with Commission guidance. In these memoranda, the Commission indicated, in part, that the staff should focus on realistic scenarios (rather than all possible scenarios) and approach the issue holistically. The staff and the industry are not assessing all possible scenarios. The NRC staff and industry have made bounding assumptions throughout the evaluation to simplify this very complex issue and minimize the number of scenarios considered. It is recognized that this simplified approach can lead to extremely conservative margins in certain technical areas. The NRC staff is attempting

to broadly balance conservative and non-conservative margins among the technical areas using an integrated review team (IRT). This assessment is necessarily qualitative and relies on engineering judgment because it is difficult to quantify margins in each technical area given the high uncertainties and complexity of the evaluation. Additionally, when the overall assessment of compliance has been unclear or in dispute among the IRT, the staff has thus far adopted the more conservative position.

The submitter's third concern is that the staff's review process is inefficient and may result in focusing on non-safety significant issues. The resolution of ECCS performance issues has been approached in a non-traditional manner. Normally, plants develop a technical basis and then design a structure, system, or component to adhere to the technical basis. However, to address safety concerns associated with ECCS performance issues, licensees initially modified their plants before completing the evaluation to demonstrate the adequacy of those modifications. It is also preferable to finalize detailed guidance for assessing the adequacy of plant modifications before making the modifications. However, detailed guidance has evolved as staff and licensees have learned from ongoing industry and NRC-sponsored testing. The guidance has only stabilized over the last year or so.

The DPO Panel concludes that this non-traditional approach has been inefficient because initial plant modifications may not have been sufficient to ensure compliance with 10 CFR 50.46(b)(5). Licensees are required to make subsequent modifications if their evaluations indicate that the initial actions are not adequate. In addition, if detailed guidance were available before modifications were enacted, licensees could first assess ECCS performance and then design and implement necessary plant modifications. However, the staff's approach has required that licensees enact some initial, rapid safety improvements to address the risk associated with potentially inadequate ECCS and CSS performance. The DPO Panel concludes that this strategy has resulted in improved plant safety since the issuance of GL 2004-02 and has provided additional assurance of public health and safety given the uncertainties and complexities associated with this issue.

Panel Assessment of Proposed Alternative Approach GSI-191

The submitter advocates a risk assessment to determine if plants have adequately addressed ECCS performance concerns. The DPO Panel believes that a rigorous, quantitative risk assessment of ECCS performance will be extremely difficult given the complexities and uncertainties associated with the tests and analyses. It is also inefficient to consider uncertainties associated with strainer head loss testing and chemical effects separate from other GSI-191 issues. All these issues affect the risk of sump strainer clogging and it will be difficult to assess the adequacy of the licensee modifications (i.e., those responding to GL 2004-02) without considering the effects of all issues simultaneously. This approach could require more licensee modifications to address any subsequent safety concerns. In addition, deferring these issues will likely delay the final assurance of plant compliance with 50.46(b)(5). The current NRC resolution strategy will likely result in a faster resolution of the issues, especially downstream effects, than the alternative approach.

The Panel agrees with the submitter that risks associated with BWR ECCS performance should be reassessed. This reassessment should consider the knowledge gained during the resolution of GSI-191 to determine if any additional regulatory actions are needed to ensure acceptable

BWR ECCS performance. Any actions would stem from differences between the BWR and PWR evaluation criteria used to resolve ECCS performance concerns.

CONCLUSION

As discussed in the Evaluation, the DPO Panel found that the staff's approach for resolving GSI-191 is appropriately focused on compliance and is consistent with Commission guidance. Evolving knowledge associated with several technical issues impeded detailed guidance development, and subsequently led to some inefficiencies with the staff's approach. However, the staff's approach has required that licensees enact some initial, rapid safety improvements that have resulted in improved plant safety since the issuance of GL 2004-02. This strategy has provided additional assurance of public health and safety given the uncertainties and complexities associated with GSI-191.

In light of these findings, the DPO Panel concludes that the staff should continue with the planned GL review process for evaluating licensee submittals in response to GL 2004-02.

The DPO Panel also concludes that the alternative approach proposed by the DPO submitter for reviewing the responses to GL 2004-02 and closing out GSI-191 is not preferable to the staff's current approach. However, the Panel does agree with the submitter that risks associated with BWR ECCS performance should be reevaluated (see Recommendations).

RECOMMENDATIONS

Given the complexity of the issue, the resolution of ECCS performance issues will require significant engineering judgment. Because of uncertainties associated with the use of engineering judgment, the DPO Panel recommends that the staff consider the following activities to ensure that the risk associated with GSI-191 related issues is acceptable:

- Perform an integrated review of the test results from all licensees to ensure that the results are as consistent as practical given the differences in testing approaches. This review should also assess the variability associated with individual test results in order to gain insights on sump head loss margins in the licensee evaluations.

- Assess the consequences associated with ECCS inoperability. Specifically, staff should assess the consequences (risk) of inadequate ECCS performance to ensure that public health and safety will be maintained. It is likely that this risk assessment will be qualitative or semi-quantitative, or may need to assume conditional probabilities of ECCS performance to account for the complexities and uncertainties associated with the analysis. Additionally, this risk assessment should not only reflect plant modifications designed to achieve compliance with 10 CFR 50.46(b)(5), but should also reflect other compensatory measures that licensees have enacted to supplement/augment their normal core cooling capability

There has been a significant improvement in the staff's and industry's understanding of ECCS performance over the last few years. This information has been and continues to be factored

into the ECCS evaluations and plant modifications for PWRs. Given that PWRs have been incorporating this improved understanding into ECCS design and operation, the issue of ECCS performance may be more significant for BWRs. The staff has engaged the BWR community on this issue. Additionally, the staff is evaluating the significance of differences in the regulatory requirements for originally resolving BWR and PWR ECCS performance issues to determine if any additional regulatory action is needed to ensure compliance with 10 CFR 50.46(b)(5). The staff should continue both the interaction with the BWR community and the internal staff evaluation. Staff should focus resources on the plants or groups of plants where modifications/changes would have the most significant safety benefit.

REFERENCES

1. GSI-191, "Assessment of Debris Accumulation on PWR Sump Performance," prioritized September, 1996.

2. Memorandum from A. C. Thadani to S. J. Collins, "RES Proposed Recommendation for Resolution of GSI-191, 'Assessment of Debris Accumulation on PWR Sump Performance,'" dated September 28, 2001.

3. NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Recirculation During Design-Basis Accidents at Pressurized-Water Reactors," dated June 9, 2003.

4. Memorandum from R. W. Borchardt, to C. E. Ader, "Request for Review of Proposed Bulletin 2003-XX, 'Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors' (TAC No. MB 8052)," dated April 2, 2003 (ML030830478). (Non-Publicly Available)

5. Memorandum from C. E. Ader to W.D. Travers, "Minutes of the Committee to Review Generic Requirements Meeting Number 393," dated March 23, 2004 (ML040840034).

6. Memorandum from A. Vietti-Cook to L. A. Reyes and J. T. Larkins, "Staff Requirements – Meeting with ACRS, 1:30 p.m., Wednesday, June 2, 2004, Commissioners' Conference Room, One White Flint North, Rockville, Maryland (Open to Public Attendance)," dated June 30, 2004

7. NRC Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," dated September 13, 2004 (ML042360586).

8. Memorandum from J. N. Hannon to C. Haney, "Regulatory Analysis for the Generic Letter Pertaining to the Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," dated September 24, 2004 (ML042310676).

9. Memorandum from A. L. Bates to L. A. Reyes, "Staff Requirements – Briefing on Resolution of GSI-191, Assessment of Debris Accumulation on PWR Sump Performance, 1:30 p.m., Wednesday, October 25, 2006, Commissioners' Conference Room, One White Flint North, Rockville, Maryland (Open to Public Attendance)," dated November 16, 2006 (ML063200471).

10. Letter from W. H. Ruland to A. Pietrangelo, "Revised Content Guide for Generic Letter 2004-02 Supplemental Responses," dated November 21, 2007 (ML073110389).

11. Memorandum from B. W. Sheron to R. W. Borchardt and J. E. Dyer, "User Need Request to Revise Regulatory Guide 1.82 and Address Identified Disparities in Treatment of Debris-Induced Clogging of Emergency Core Cooling System Strainers (NRR-2007-007)," dated December 31, 2007 (ML073120209). (Non-Publicly Available)

12. Memorandum from M. L. Scott to W. H. Ruland, "NRC Staff Process for Review of Licensee Supplemental Responses to Generic Letter 2004-02 (TAC NO. MC9003)," dated March 25, 2008 (ML073380168). (Non-Publicly Available)

13. Letter from W. H. Ruland to A. R. Pietrangelo, "Revised Guidance for Review of Final Licensee Responses to Generic Letter 2004-02, 'Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors'," dated March 28, 2008 (ML080230234).

14. GL Supplemental Response Detailed Area Review Results (ML082620300). (Non-Publicly Available)

15. GL Supplemental Response Integration Team Review Results (ML082701092). (Non-Publicly Available)

16. NUREG-1409, "Backfitting Guidelines," U.S. Nuclear Regulatory Commission, Washington, DC, July 1990 (ML032230247)

17. Memorandum from R. B. Elliot to G.M. Holahan, "Completion of Staff Reviews of NRC Bulletin 96-03, 'Potential Plugging of Emergency Core Cooling Suction Strainers by Debris in Boiling-Water Reactors,' and NRC Bulletin 95-02, 'Unexpected Clogging of a Residual Heat Removal (RHR) Pump Strainer While Operating in Suppression Pool Cooling Mode,' (TAC Number MA0704)," dated October 18, 2001 (ML0129702290).

MEMORANDUM TO: Eric J. Leeds, Director
Office of Nuclear Reactor Regulation

FROM: Marissa Bailey, DPO Panel Chair
Kenneth Karwoski, DPO Panel Member
Robert Tregoning, DPO Panel Member

SUBJECT: DIFFERING PROFESSIONAL OPINION PANEL REPORT CONCERNING CLOSURE PROCESS FOR GENERIC SAFETY ISSUE -191 (DPO-2008-001)

In a memorandum dated November 4, 2008, you appointed us as members of a Differing Professional Opinion (DPO) Ad Hoc Review Panel (DPO Panel) to review a DPO regarding the closure process for Generic Safety Issue (GSI) – 191, "Assessment of Debris Accumulation on PWR Sump Performance." The DPO Panel has reviewed the DPO in accordance with the guidance in Management Directive 10.159, "The NRC Differing Professional Opinions Program." The DPO Panel Report is enclosed for your consideration.

Based on our review of concerns raised in the DPO, the DPO Panel concludes that the staff should continue with the planned review process for evaluating licensee submittals in response to Generic Letter 2004-02 and, therefore, for resolving GSI-191.

We also offer the following recommendations for the staff to consider to ensure that the risk associated with GSI-191 related issues is acceptable: (1) perform an integrated review of the test results from all licensees to ensure that the results are as consistent as practical given the differences in testing approaches; and (2) assess the consequences associated with emergency core cooling system (ECCS) inoperability. Additionally, the staff should continue the interaction with the Boiling-Water Reactor (BWR) community and the internal evaluation to assess the significance of differences in regulatory requirements for resolving BWR and pressurized-water reactor ECCS performance concerns.

Please do not hesitate to contact us if you have any questions regarding the enclosed report.

Enclosure:
DPO Panel Report

cc: Ralph Architzel
Renée, Pedersen, DVPM
Trent Wertz, NRR DVOL

ADAMS ML090070103

OFFICE	NMSS/DPO	NRR/DPO	RES/DPO
NAME	MBailey	KKarwoski	RTregoning
DATE	3/ 19 /09	3/ 19 /09	3/ 19 /09

OFFICIAL RECORD COPY

Marissa Bailey

From: Kenneth Karwoski
Sent: Wednesday, March 18, 2009 9:54 PM
To: Marissa Bailey
Subject: RE: Final DPO report

Marissa,

I concur with the DPO Panel Report. Please sign for me.

Thanks,

Ken

From: Marissa Bailey
Sent: Wednesday, March 18, 2009 1:59 PM
To: Robert Tregoning; Kenneth Karwoski
Subject: Final DPO report

Attached is our final DPO report (same version as in ADAMS). The OE secretary is preparing the concurrence package. It should be ready by tomorrow morning.

Ken, please review and e-mail me your concurrence. I'll sign and concur for you and attach your e-mail to the package.

Rob, what's your availability tomorrow? Maybe I'll take a visit to the Church Street building.

Marissa Bailey
Deputy Director
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