May 26, 2000

Carl Terry, BWRVIP Chairman
Niagara Mohawk Power Company
Post Office Box 63
Lycoming, NY 13093

SUBJECT: FINAL SAFETY EVALUATION OF THE "BWRVIP VESSEL AND INTERNALS PROJECT, "BWR VESSEL AND INTERNALS PROJECT, LPCI COUPLING INSPECTION AND FLAW EVALUATION GUIDELINES (BWRVIP-42)," (TAC NO. MA1102)

Dear Mr. Terry:

The NRC staff has completed its review of the Electric Power Research Institute (EPRI) proprietary report TR-108726 "BWR Vessel and Internals Project, LPCI Coupling Inspection and Flaw Evaluation Guideline (BWRVIP-42)." This report was submitted to the U.S. Nuclear Regulatory Commission (NRC) for staff review by letter dated December 11, 1997, and was supplemented by letter dated September 8, 1998. It provides generic guidelines intended to present the appropriate inspection recommendations to ensure the integrity and safety function of the subject safety-related low pressure coolant injection (LPCI) couplings.

By letter dated October 21, 1999, the BWRVIP responded to the open items in the staff's initial safety evaluation (SE), dated June 14, 1999. The NRC staff has reviewed the proposed revisions to the BWRVIP-42 report and finds, in the enclosed SE, that the revised guidance of the BWRVIP-42 report, with the modifications as described in the attached SE, is acceptable for inspection of the subject safety-related RPV internal components. This finding is based on information submitted by the above cited letters. The staff has concluded that licensee implementation of the guidelines in the BWRVIP-42 report, as modified, will provide an acceptable level of quality for inspection and flaw evaluation of the safety-related components addressed.

The staff requests that you incorporate the staff's recommendation, as well as your responses to other issues raised in the staff's initial SE, into a revised, final BWRVIP-42 report. Please inform the staff within 90 days of the date of this letter as to your proposed actions and schedule for such a revision.

Please contact C. E. (Gene) Carpenter, Jr., of my staff at (301) 415-2169, if you have any further questions regarding this subject.

Sincerely,

Jack R. Strosnider, Director ***/ra/***
Division of Engineering
Office of Nuclear Reactor Regulation

Enclosure: As stated

cc: See next page

Please contact C. E. (Gene) Carpenter, Jr., of my staff at (301) 415-2169, if you have any further questions regarding this subject.

Sincerely,

Jack R. Strosnider, Director
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Office of Nuclear Reactor Regulation

Enclosure: As stated

cc: See next page

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION SAFETY EVALUATION OF "BWR VESSEL AND INTERNALS PROJECT, LPCI COUPLING INSPECTION AND FLAW EVALUATION GUIDELINES (BWRVIP-42)," EPRI TOPICAL REPORT TR-108726, DECEMBER 1997

1.0 INTRODUCTION

1.1 Background

By letter dated December 11, 1997, as supplemented by letter dated September 8, 1998, the Boiling Water Reactor Vessel and Internals Project (BWRVIP) submitted both the proprietary and non-proprietary versions of the report, "BWR Vessel and Internals Project, BWR LPCI Inspection and Flaw Evaluation Guidelines (BWRVIP-42)," for NRC staff review and approval. The NRC staff requested additional information (RAI) in a letter dated April 14, 1998, and BWRVIP responded to the RAI by letter dated September 8, 1998.

The BWRVIP-42 report contains generic guidelines to BWRVIP members on inspection and flaw evaluation of low pressure coolant injection (LPCI) couplings. These guidelines considered degradation susceptibility, degradation mechanisms, loads, and inspection strategies for LPCI couplings. The intent of the report, when approved by NRC, is to provide an acceptable level of quality and inspection and flaw evaluation guidance to BWRVIP members that can be used to assure adequate BWR LPCI coupling integrity when meeting the specified acceptance criteria.

By letter dated June 14, 1999, the staff forwarded its initial safety evaluation (SE) of the BWRVIP-42 report to BWRVIP. This SE had several open items, repeated below, and requested that BWRVIP address these issues in a timely manner. By letter dated October 21, 1999, BWRVIP responded to the open items in the staff's initial SE.

1.2 Purpose

The staff reviewed the BWRVIP-42 report, as supplemented, to determine whether its revised guidance addressed the open items in the staff's initial SE, and if it would provide acceptable levels of quality for inspection and flaw evaluation (I&E) of the subject safety-related RPV internal components. The review considered the consequences of component failures, potential degradation mechanisms and past service experience, and the ability of the proposed inspections to detect degradation in a timely manner.

1.3 Organization of the Report

Because the BWRVIP-42 report, as revised, is proprietary, this SE was written so as not to repeat proprietary information contained in the report or its revision. The staff does not discuss in any detail the provisions of the guidelines nor the parts of the guidelines it finds acceptable. A brief summary of the contents of the BWRVIP-42 report is given in Section 2.0 of this SE, with a detailed evaluation in Section 3.0. The conclusion is summarized in Section 4.0. The presentation of this evaluation is structured according to the organization of the BWRVIP-42 report.

2.0 SUMMARY OF BWRVIP-42 REPORT

The BWRVIP-42 report addresses the following topics in the following order:

- LPCI Coupling Design and Susceptibility Information - The LPCI coupling assemblies are described in detail by a series of illustrations and differences among the various models of BWRs (BWR/4, BWR/5, and BWR/6) are identified. The various types of LPCI coupling susceptibility factors and material degradation mechanisms (e.g., intergranular stress corrosion cracking, IGSCC, which has factors that include environment, materials and stress state; fatigue by flow induced vibration and/or thermal cycling; and, aging embrittlement) that could impact the LPCI couplings are described in general terms. Potential failure locations are addressed from the standpoint of inspection priority, susceptibility to degradation, and consequences of failures in terms of component functions and plant safety.

- Inspection Strategy - The BWRVIP-42 report recommends the specific locations, NDE methods, and inspection frequencies for examinations of the LPCI coupling assemblies. The report also describes the inspection basis and methods, the recommended baseline inspection scope, the reinspection frequency, scope expansion, and reporting of inspection results.

- Loads and Load Combinations - The various types of loads (e.g., pressures, seismic, etc.) of concern are listed and load combinations are described.

- Flaw Evaluation Methodologies - This section presents methods which can be used to determine if observed flaws are acceptable from the structural integrity and leakage points of view. It describes flaw evaluations for the elbow/elbow extension welds and other weld locations and a leakage evaluation.

The BWRVIP-42 report also contains an Appendix A, "BWR LPCI Coupling Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10 CFR 54.21)." Appendix A is not evaluated in this SE report, but will be evaluated under a separate review.

3.0 STAFF EVALUATION

The staff's June 14, 1999, initial SE provided three open items. BWRVIP, in its letter of October 21, 1999, addressed these items, which are discussed below.

Issue 2.2 Potential Failure Locations (Inaccessible Welds)

The staff's June 14, 1999, initial SE stated:

> The BWRVIP Inspection Committee is conducting a study to improve access to welds that were described as inaccessible in the BWRVIP-42 report. The staff will review and evaluate the BWRVIP study before making a determination on the subject of inaccessible LPCI coupling welds.

BWRVIP's October 21, 1999 Response to Issue 2.2:

> Of the seven (7) locations identified as inaccessible, only two are of a priority that are recommended for inspection. One of the two locations is only applicable to the BWR 4/5 design and the other is only applicable to the BWR 6 design. The two locations are full penetration welds and are in uncreviced locations. So at worst, each facility can only have

one inaccessible location and the locations represent the best conditions for resisting IGSCC. As stated in BWRVIP-42, the other inspectable locations, which include creviced areas, can provide indirect or bounding evidence of the condition of the inaccessible locations.

However, the NRC's comment is appropriate and the BWRVIP proposes the following resolution that should allow this issue to be removed from the BWRVIP-42 SE:

The I&E guidelines contain numerous recommendations that require extensive technological development for their implementation such as inspection of the subject LPCI locations. It is possible that, after adequate attempts, the industry may determine that a recommendation (such as the inspection of the hidden LPCI welds), as written, cannot be implemented as set forth in the I&E guideline. Rather than track this inaccessible location issue separately through the staff's SE, we propose that BWRVIP provide a report to the NRC which describes our progress on the development of inspection tooling for inaccessible locations. In addition, to address future situations where a BWRVIP recommendation cannot be implemented, the BWRVIP proposes a programmatic control that includes NRC notification. BWRVIP-42 will be revised to include the below paragraph.

> "If, during the course of implementing these recommendations, it is determined that implementation cannot be achieved as described in the I&E guideline, or that meaningful results are not obtained, the user shall notify BWRVIP with sufficient details to support development of alternative actions. These notifications, as well as planned actions by BWRVIP, will be summarized and reported to the NRC."

It is also proposed that, when the other I&E guidelines are revised for final issuance, the paragraph above be included. These actions allow BWRVIP members to identify recommendations that cannot be implemented and provides for appropriate notification and coordination with the NRC.

Staff's Evaluation:

The staff finds that the paragraph to be included in the revised BWRVIP-42 report should be rewritten as the following:

> "If, during the course of implementing these recommendations, it is determined that implementation cannot be achieved as described in the I&E guideline, or that meaningful results are not obtained, the user shall notify the BWRVIP with sufficient details to support development of alternative actions. These notifications, as well as actions planned by the licensee, will be summarized and reported to the NRC by letter within 90 days."

With this revision to the proposed paragraph, the staff finds that these actions adequately addresses this open item.

<u>Issue 3.3</u> Visual Inspection

The staff's June 14, 1999, initial SE stated:

The specific inspection methods recommended in the BWRVIP-42 report rely on the methodologies described in the BWRVIP-03 Report, dated October, 1995, with the conclusions and exceptions as stated in the staff's SE dated June 8, 1998. The staff has received Revision 1 to the BWRVIP-03 report, dated March 31, 1999, which is intended to address the issues raised in the staff's SE. The staff will review the BWRVIP-03, Revision

1, before making a determination on the acceptability of this report for the subject components.

BWRVIP's October 21, 1999 Response to Issue 3.3:

This issue has been resolved as stated in the NRC's Final Safety Evaluation of the "BWR Vessel and Internals Project, Reactor Pressure Vessel and Internals Examination Guidelines (BWRVIP-03), Revision 1," dated July 15, 1999. When BWRVIP-42 is issued incorporating the NRC's SE, the reference to Modified VT-1 (MVT-1) will be replaced with Enhanced VT-1 (EVT-1).

Staff's Evaluation:

The BWRVIP-03, Revision 1, report (dated March 1999) states " . . . that when Modified VT-1 is specified for a visual inspection, the EVT-1 technique should be applied." Therefore, the staff finds that BWRVIP's response adequately addressed this item provided that their revised visual inspection methodology for LPCI couplings remains consistent with those cited in the BWRVIP–03, Rev. 1, report.

Issue 3.0 Scope Expansion

(Note: This item was not specifically listed as an Issue in the SE but was discussed in the fourth paragraph of Section 3.)

The staff's June 14, 1999, initial SE stated:

The BWRVIP needs to address inspection scope expansion to include these "low and/or no inspection required" locations based on the inspection results of examined sites.

BWRVIP's October 21, 1999 Response to Issue 3.0:

The BWRVIP has addressed the need for scope expansion to "low and/or no inspection required" locations. Section 3.6 of the Guideline states:

> "If one or more flaws are found during the inspection or reinspection of a specific location, all of the remaining locations of the same type in all LPCI couplings in the plant should be inspected during the same refueling outage. In addition, if flaws are found, the effect of degradation of the location on other locations should be considered in determining if scope expansion to other locations is also warranted.

For scope expansion to the other locations, a plant-specific determination should be made on a case-by-case basis on the extent of additional inspections, evaluations, or alternate actions."

The paragraphs recognize the need to expand scope to other locations.

Staff's Evaluation:

The staff finds that BWRVIP's response adequately addressed this item. However, it should be noted that any expansion or modification to the inspection guidance in the BWRVIP-42 report should be reported to the NRC staff, as described above in the staff's evaluation of Issue 2.2.

4.0 CONCLUSION

The staff has reviewed the BWRVIP-42 report, as revised, and finds that the guidance of the BWRVIP-42 report is acceptable for inspection of the subject safety-related internal components except where the staff's conclusions differ from the proposed guidance, as discussed above. The staff has concluded that licensee implementation of the guidelines in BWRVIP-42, with the staff's final comments addressed above, will provide an acceptable level of quality for examination of the safety-related components addressed in the BWRVIP-42 document. The staff requests that the BWRVIP review and resolve the issues raised in the enclosed SE, and incorporate the staff's conclusions into a revised BWRVIP-42 report. Please inform the staff in writing as to this resolution.

5.0 REFERENCES

1. Terry, C., BWRVIP, to USNRC, "BWR Vessel and Internals Project: BWR LPCI Coupling Inspection and Flaw Evaluation Guidelines (BWRVIP-42)," EPRI Report TR-108726, December 11, 1997.

2. Carpenter, C.E., USNRC, to C. Terry, BWRVIP, "Proprietary Request for Additional Information - Review of "BWR Vessel and Internals Project, BWR LPCI Coupling Inspection and Flaw Evaluation Guidelines (BWRVIP-42)" (TAC No. MA1104)," April 18, 1998.

3. Wagoner, V., BWRVIP, to USNRC, "BWRVIP Response to NRC Request for Additional Information on BWRVIP-42 (Reference Project 704)," September 8, 1998.

4. Strosnider, J.R., USNRC, to C. Terry, BWRVIP, "Safety Evaluation of the 'BWR Vessel and Internals Project, BWR LPCI Coupling Inspection and Flaw Evaluation Guidelines (BWRVIP-42)' (TAC No. MA1104)," June 14, 1999.

5. Terry, C., BWRVIP, to Carpenter, C.E., USNRC, "BWRVIP Response to NRC Safety Evaluation of BWRVIP-42," October 21, 1999.