

June 5, 2001

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

SUBJECT: ACCEPTANCE FOR REFERENCING OF "BWR VESSEL AND INTERNALS PROJECT, JET PUMP ASSEMBLY INSPECTION AND FLAW EVALUATION GUIDELINES (BWRVIP-41), EPRI TOPICAL REPORT TR-108728," AND APPENDIX A, "DEMONSTRATION OF COMPLIANCE WITH THE TECHNICAL INFORMATION REQUIREMENTS OF THE LICENSE RENEWAL RULE (10 CFR 54.21)"

Dear Mr. Terry:

By letter dated October 15, 1997, as supplemented by letters dated August 4, 1999, and November 17, 2000, the Boiling Water Reactor Vessel and Internals Project (BWRVIP) submitted both proprietary and non-proprietary versions of the report, "BWR Vessel and Internals Project, BWR Jet Pump Assembly Inspection and Flaw Evaluation Guidelines (BWRVIP-41)," EPRI Topical Report TR-108728, for staff review and approval. The staff requested additional information (RAI) in a letter dated February 15, 1999. The BWRVIP responded to the RAI in a submittal dated August 4, 1999. By letter dated June 20, 2000, the staff provided an initial safety evaluation (SE) with several open items to the BWRVIP. By letter dated November 17, 2000, the BWRVIP provided its response to the open items in the staff's initial SE and on February 4, 2001, the staff issued its final safety evaluation report (FSER). Included in the initial submittal was "Appendix A: BWR Jet Pump Assembly Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10 CFR 54.21)," for staff review in accordance with the License Renewal Rule (10 CFR Part 54).

The BWRVIP-41 report, as supplemented, provides generic guidelines intended to present the appropriate inspection and flaw evaluation recommendations to assure safety function integrity of the subject safety-related reactor pressure vessel (RPV) internal components. These guidelines considered degradation susceptibility, degradation mechanisms, loads, and inspection strategies for jet pump assemblies.

As documented in the enclosed license renewal (LR) FSER, the NRC staff has completed its review of the BWRVIP-41, Appendix A report. As indicated in the LR FSER, the staff finds the BWRVIP-41 report acceptable for licensees participating in the BWRVIP to reference in a LR application to the extent specified and under the limitations delineated in the LR FSER. In order for licensees participating in the BWRVIP to rely on the report, they shall commit to the accepted aging management programs (AMPs) defined therein, and complete the action items described in the LR FSER. By referencing the BWRVIP-41 report and the AMPs in it, and completing the action items, an applicant will provide sufficient information for the staff to make a finding that there is reasonable assurance that the applicant will adequately manage the effects of aging so that the intended functions of the reactor vessel internal components

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covered by the scope of the report will be maintained consistent with the current licensing basis during the period of extended operation.

The staff does not intend to repeat its review of the matters described in the report and found acceptable in the FSER when the report appears as a reference in license renewal applications, except to ensure that the material presented applies to the specified plant.

In accordance with the procedures established in NUREG-0390, "Topical Report Review Status," the staff requests that the BWRVIP publish the accepted version of the BWRVIP-41 report within 90 days after receiving this letter. In addition, the published version shall incorporate this letter and the FSER between the title page and the abstract.

To identify the version of the report that was accepted by the staff, the staff requests that the BWRVIP include "A" following the topical report number (e.g., BWRVIP-41-A).

Sincerely,

*/RA/*

Christopher I. Grimes, Branch Chief  
License Renewal and Standardization Branch  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

Project No. 704

Enclosure: Final Safety Evaluation Report

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Christopher I. Grimes, Branch Chief  
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Project No. 704

Enclosure: Final Safety Evaluation Report

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FINAL LICENSE RENEWAL SAFETY EVALUATION REPORT  
BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
FOR APPENDIX A TO THE EPRI PROPRIETARY REPORT TR-108728  
"BWR VESSEL AND INTERNALS PROJECT, BWR JET PUMP ASSEMBLY  
INSPECTION AND FLAW EVALUATION GUIDELINES (BWRVIP-41)"  
FOR COMPLIANCE WITH THE LICENSE RENEWAL RULE (10 CFR PART 54)

## 1.0 INTRODUCTION

### 1.1 Background

By letter dated October 15, 1997, as supplemented by letters dated August 4, 1999, and November 17, 2000, the Boiling Water Reactor Vessel and Internals Project (BWRVIP) submitted both proprietary and non-proprietary versions of the Electric Power Research Institute (EPRI) proprietary report TR-108728, "BWR Vessel and Internals Project, BWR Jet Pump Assembly Inspection and Flaw Evaluation Guidelines (BWRVIP-41)."

The staff requested additional information (RAI) in a letter dated February 15, 1999, and the BWRVIP responded to the RAI in a submittal dated August 4, 1999. By letter dated June 20, 2000, the staff provided an initial safety evaluation (SE) with several open items to the BWRVIP. By letter dated November 17, 2000, the BWRVIP provided its response to the open items in the staff's initial SE and on February 4, 2001, the staff issued its final safety evaluation report (FSER).

The BWRVIP-41 report, as supplemented, provides generic guidelines intended to present the appropriate inspection and flaw evaluation recommendations to assure safety function integrity of the subject safety-related reactor pressure vessel (RPV) internal components. These guidelines address all welded and bolted locations identified from design drawings of the jet pump assemblies. Susceptibility considerations for the jet pump are presented, as well as the consequences due to failure at each location. Susceptibility and consequences are factored into the inspection recommendations. Inspection approaches vary depending on the type of plant and its associated jet pump configuration. Options are also presented for justification for reduced inspections through plant-specific analysis. These plant-specific analyses are not addressed in the scope of the BWRVIP-41 report, and NRC approval must be obtained on a case-by-case basis, as appropriate.

### 1.2 Purpose

The staff reviewed the BWRVIP-41 report and its Appendix A, "BWR Jet Pump Assembly Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10 CFR 54.21)," to determine whether its guidance will provide acceptable levels of quality for inspection and flaw evaluation of the subject safety-related RPV internal components within the scope of the report during the period of extended operation. The staff

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also considered compliance with the License Renewal Rule in order to allow applicants for renewal the option of incorporating the BWRVIP-41 guidelines by reference in a plant-specific integrated plant assessment (IPA) and associated time-limited aging analyses (TLAA).

Section 54.21 of the License Renewal Rule requires, in part, that each application for license renewal contain an integrated plant assessment (IPA) and an evaluation of TLAA. The IPA must identify and list those structures and components subject to an aging management review and demonstrate that the effects of aging will be adequately managed so that their intended functions will be maintained consistent with the current licensing basis (CLB) for the period of extended operation. In addition, 10 CFR 54.22 requires that each application include any technical specification changes or additions necessary to manage the effects of aging during the period of extended operation as part of the renewal application.

If a license renewal applicant participating in the BWRVIP confirms that the BWRVIP-41 report applies to it and that the results of the Appendix A, IPA and TLAA evaluation are in effect at its plant, then no further review by the NRC staff of the issues described in the documents is necessary, except as specifically identified by the staff. With this exception, the applicant may rely on the BWRVIP-41 report for the demonstration required by Section 54.21(a)(3) with respect to the components and structures within the scope of the report. Under these circumstances, the NRC staff intends to rely on the evaluation in this license renewal safety evaluation report to make the findings required by 10 CFR 54.29 with respect to a particular application, except as necessary to ensure that the BWRVIP-41 report's conclusions apply to the specified plant.

### 1.3 Organization of this Report

Because the BWRVIP-41 report, as supplemented and modified, is proprietary, this license renewal SE was written so as not to repeat information contained in the propriety portions of the report. The staff does not discuss in any detail the proprietary provisions of the guidelines nor the parts of the guidelines it finds acceptable. A brief summary of the contents of the BWRVIP-41 report is given in Section 2.0 of this license renewal SE, with the NRC staff's evaluation presented in Section 3.0. The conclusions are summarized in Section 4.0. The presentation of the evaluation is structured according to the organization of the BWRVIP-41 report.

## 2.0 SUMMARY OF THE BWRVIP-41 REPORT

The BWRVIP-41 report and its Appendix A contain a generic evaluation of the management of the effects of aging of the subject components so that the intended functions will be maintained consistent with the CLB for the period of extended operation. This evaluation applies to BWR applicants who have committed to implementing the BWRVIP-41 report and want to incorporate the report and Appendix A by reference into a plant-specific IPA and associated TLAA.

### 2.1 BWRVIP-41 Topics

The BWRVIP-41 report addresses the following topics in the following order:

- Jet Pump Assembly Analysis - The jet pump assemblies are described in detail by a series of illustrations and differences among the various models of BWRs (BWR/3 through

BWR/6). The various types of jet pump assembly susceptibility factors and material degradation mechanisms that could impact the jet pump assemblies are described in general terms, 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, thermal (aging) embrittlement. 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-41 report recommends the specific locations, NDE methods, and inspection frequencies for examinations of the jet pump 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., pressure, seismic, etc.) of concern and the load combinations are listed and load combinations are described. Consideration for degraded assemblies are also detailed.
- Structural Evaluation Methodologies - This section presents methods which can be used to determine allowable flaw size determinations for different parts of the assemblies, set screw gap evaluation, and the ability of the riser brace to prevent jet pump disassembly.

The BWRVIP-41 report also contains Appendix A, "Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule, (10 CFR 54.21)." Appendix A to the BWRVIP-41 report is evaluated in this SE report.

## 2.2 Identification of Structures and Components Subject to an Aging Management Review

10 CFR 54.21(a)(1) requires that an IPA identify and list those structures and components within the scope of license renewal that are subject to an aging management review. Structures and components subject to an aging management review are those structures and components that (1) perform an intended function, as described in 10 CFR 54.4, without moving parts or without a change in configuration or properties and (2) are not subject to replacement based on a qualified life or specified time period. These structures and components are also referred to as "passive" and "long-lived" structures and components, respectively.

Section 2.0 of the BWRVIP-41 report describes the intended function of the jet pump assembly. The jet pump assembly is required to ensure the capability to shut down the reactor and maintain it in a safe-shut down condition and prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to 10 CFR Part 100 guidelines. Therefore, the intended safety functions for the jet pump assembly are to:

1. Ensure two-thirds core height reflooding capability; and
2. Maintain Low Pressure Coolant Injection (LPCI) operability for those plants that use the recirculation system to inject LPCI.

The intended functions are preserved under normal, upset, emergency and faulted conditions.

The failure consequence assessments in Sections 2.3.1 through 2.3.12 of the BWRVIP-41 report identify the jet pump components that are needed for one or both of the functional requirements. These assessments demonstrate that the adjusting screws, diffuser collar, and sensing lines are not required to accomplish either function. Therefore, they are not in the evaluation boundary for licence renewal and are not subject to aging management review. The remaining 10 components in the jet pump assembly are within the evaluation boundary and, as described in Appendix A of the BWRVIP-41 report, they are passive and long-lived, as determined by 10 CFR 54.21(a)(1). These components are listed below:

- |                          |  |
|--------------------------|--|
| 1. Riser brace           | 6. Inlet                                 |
| 2. Beam/bolt assembly    | 7. Mixer                                 |
| 3. Nozzle thermal sleeve | 8. Restrainer bracket and wedge assembly |
| 4. Riser Pipe            | 9. Diffuser and tailpipe                 |
| 5. Transition piece      | 10. Adapter/lower ring                   |

Components (1) through (10) except (3) are subject to aging management review. The aging management review of the nozzle thermal sleeve will be provided by individual applicants.

### 2.3 Effects of Aging

The BWRVIP-41 report identified the aging mechanisms and aging effects for the jet pump assembly using the guidance from NUMARC 90-03, "BWR Reactor Pressure Vessel License Renewal Industry Report," Revision 1, dated June 1992, and the resolution to the NRC's questions on the industry report. The BWRVIP-41 report also used NUREG-1557, "Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal," dated October 1996, to correlate the aging effects and their associated aging mechanisms. Using these reports, the BWRVIP-41 report concluded that crack initiation/growth and fatigue are included in the aging effects that require aging management review for the jet pump assembly. The industry report also concludes that internals components are not susceptible to thermal embrittlement and neutron embrittlement provided that the materials of construction are wrought austenitic stainless or Ni-Cr-Fe alloy. The susceptibility factors of environment, materials and stress state are discussed in Section 2.2 of the BWRVIP-41 report.

In general, except for the transition piece (because the material is not susceptible to stress corrosion cracking), it was determined that:

- Many locations in the jet pump assembly are subject to an aggressive environment and are therefore characterized by a region of high electrochemical potential (ECP).
- Jet pump assembly materials at locations where a heat affected zone or excessive cold work exists may be susceptible to IGSCC.
- The degradation history suggests that most jet pump assembly components regardless of the grade of material are susceptible, and,
- Regions with the highest expected crack susceptibility are the creviced locations, especially those creviced regions subject to high weld residual stresses.



Some of the welds in the jet pump assembly are creviced. Each weld region is included in the applicable BWRVIP-41 Section 2.2 discussion of the potential failure locations.

#### 2.4 Aging Management Program

10 CFR 54.21(a)(3) requires, for each component identified, that the applicant demonstrate that the effects of aging will be adequately managed so that the intended function will be maintained consistent with the CLB for the period of extended operation. The jet pump assemblies receive a visual inspection in accordance with Section XI of the American Society of Mechanical Engineers (ASME) Code. The as-revised BWRVIP-41 report's aging management program (AMP) includes (a) identification of susceptible components determined to be limiting from the standpoint of thermal aging susceptibility (i.e., ferrite and molybdenum contents, casting process, and operating temperature, explained below) and/or neutron irradiation embrittlement (neutron fluence), and (b) for each "potentially susceptible" component, aging management is accomplished through either a supplemental examination of the affected component based on the neutron fluence to which the component has been exposed during the license renewal term, or a component-specific evaluation to determine its susceptibility to loss of fracture toughness.

Aging effects will be managed by an inspection program incorporating the strategy and recommendations described in Section 3.0 of the as-revised BWRVIP-41 report. The inspection methods and implementation guidance address the:

- Jet pump assembly locations that the revised BWRVIP-41 report requires to be inspected,
- Extent of baseline inspection for each location,
- Extent of reinspection for each location,
- Methodology for scope expansion should degradation be detected, and
- Analysis methods determine the need for corrective action if degradation is detected.

#### Neutron Embrittlement and/or Thermal Embrittlement

The BWRVIP-41 report does not recommend an inspection of cast stainless steel (CASS) jet pump assembly components, stating that CASS components are not susceptible to IGSCC and that the neutron fluence in the annulus region is not large enough to cause neutron embrittlement and/or thermal embrittlement. However, the BWRVIP-41 report does not contain any data to indicate the threshold for neutron embrittlement and/or thermal embrittlement of CASS and does not identify the neutron fluence levels the CASS jet pump assembly components are subjected to. The staff notes that neutron embrittlement and/or thermal embrittlement of CASS components becomes a concern only if cracks are present in the components. Therefore, if the individual applicant can show that cracks have not occurred in the CASS components, then the staff can conclude that loss of fracture toughness resulting from neutron embrittlement and/or thermal embrittlement will not be a significant aging effect.

Further, the BWRVIP and the NRC's Office of Nuclear Regulatory Research (RES) is engaged in a joint confirmatory research program to determine the effects of high levels of neutron fluence on BWR internals. The results of the joint BWRVIP/RES program into the effects of neutron fluence on BWR internals should be considered by the applicant in evaluating the need for additional inspections of CASS jet pump assemblies in the renewal period. This

determination by the applicant will allow the staff to conclude that the applicant has an adequate aging management program for the CASS jet pump assemblies.

It should also be noted that the BWRVIP has stated it intends to revise Section 3.0 of the BWRVIP-41 report to state that, if a meaningful inspection of components, such as the hidden thermal sleeve welds, can not be obtained after a feasibility study on the development of inspection tooling, the licensee will notify the BWRVIP with sufficient details to support development of alternative actions, such as a flaw tolerance evaluation, and the BWRVIP will notify the NRC.

## 2.5 Time-Limited Aging Analyses (TLAA)

10 CFR 54.21(1)(c) requires that each application for license renewal contain an evaluation of TLAA as defined in 10 CFR 54.3, and that the applicant shall demonstrate that :

- (i) The analyses remain valid for the period of extended operation:
- (ii) The analyses have been projected to the end of the period of extended operation; or
- (iii) The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

TLAA are those licensee calculations and analyses that:

- (1) involve the jet pump assembly within the scope of license renewal,
- (2) consider the effects of aging,
- (3) involve time-limited assumptions defined by the current operating term,
- (4) were determined to be relevant by the licensee in making a safety determination,
- (5) involve conclusions or provide the basis for conclusions related to the capability of the jet pump assembly components to perform their intended function, and
- (6) are contained or incorporated by reference in the CLB.

If a plant-specific analysis identified by an applicant meets all six criteria above, the analysis will be considered a TLAA for license renewal and evaluated by the applicant.

The susceptibility of the jet pump components to fatigue (Section 2.2.2 of the BWRVIP-41 report) results in a TLAA issue. Two sources of fatigue need to be considered: system cycling fatigue and vibrational fatigue. System cycling fatigue is due to changes in temperature and pressure. For vibrational fatigue, the time spent at the component's resonant frequency determines whether vibrational fatigue will cause failure and when it will occur. The TLAA issue is evaluated using the requirements in 10 CFR 54.21(c)(1)(iii). Implementation of the inspection strategy described in Section 3.0 of BWRVIP-41 demonstrates that the effects of fatigue on the intended functions will be adequately managed for the period of extended operation.

## 3.0 STAFF EVALUATION

The staff's FSER on the BWRVIP-41 report for the current term was transmitted by letter dated February 4, 2001, to Carl Terry, BWRVIP Chairman. The NRC staff determined that the

contents and recommendations in the BWRVIP-41 report, when coupled with the resolution of the open item regarding CASS, provides a sufficient and acceptable basis for performing examinations and evaluating postulated flaw indications for the subject jet pump components.

The staff has further reviewed the BWRVIP-41 report's Appendix A to determine if it demonstrates that the effects of aging on the jet pump assembly components' intended functions will be maintained consistent with the CLB for the period of extended operation in accordance with 10 CFR 54.21(a)(3). This is the last step in the IPA described in 10 CFR 54.21(a).

Besides the IPA, 10 CFR Part 54 requires an evaluation of TLAA in accordance with 10 CFR 54.21(c). The staff reviewed the BWRVIP-41 report to determine if the TLAA covered by the report was evaluated for license renewal in accordance with 10 CFR 54.21(c)(1).

### 3.1 Structures and Components Subject to Aging Management Review

The staff agrees that the jet pump components are subject to aging management review because they perform their intended functions without moving parts or without a change in configuration or properties. The staff concludes that BWR applicants for license renewal must identify the jet pump components as subject to aging management review to meet the applicable requirements of 10 CFR 54.21(a)(1).

### 3.2 Intended Functions

The staff agrees that the intended safety functions of the jet pump assembly components are as stated. Their safety function is to ensure a two-thirds core height reflooding capability and to maintain Low Pressure Coolant Injection (LPCI) operability for those plants that use the recirculation system to inject LPCI.

### 3.3 Effects of Aging

The information necessary to demonstrate compliance with the requirements of the license renewal rule 10 CFR 54.21 is provided in Appendix A of the BWRVIP-41 report. The BWR Reactor Pressure Vessel Industry Report NUMARC 90-03, Revision 1, and the resolution to the NRC's questions on that Industry Report were used to identify the aging mechanisms for the jet pump assembly components. If the industry report concluded that the aging mechanism is significant then the aging mechanism is included in the aging management review. Using this methodology, the BWRVIP determined that crack initiation and growth and fatigue are the only aging effects that required aging management review.

The staff notes that, since the jet pump assembly is constructed using several cast austenitic stainless steel (CASS) components, thermal embrittlement and neutron embrittlement is a potential degradation mechanism. It is important to note that thermal and/or neutron embrittlement of CASS components becomes a concern only if cracks are present in the components, and that cracking has not been observed in CASS jet pump assembly components. Thermal embrittlement and/or neutron embrittlement does not, in and of itself, cause cracking to occur, but it does reduce the structural margin of the material in resisting crack propagation due to other initiators (e.g., IGSCC or fatigue).

The staff finds that thermal embrittlement and/or neutron embrittlement are aging effects that also require aging management review for the jet pump assembly. The applicant shall evaluate all four aging effects (crack initiation/growth, fatigue, thermal embrittlement, and neutron embrittlement) for applicability to their facility.

### 3.4 Aging Management Programs

The staff evaluated the BWRVIP's aging management program to determine if it contains the following 10 elements constituting an adequate aging management program for license renewal:

- (1) Scope of Program: The program contains preventative measures to mitigate fatigue and stress corrosion cracking (SCC); inservice inspection (ISI) to monitor the effects of SCC on the intended function of the components, and repair and/or replacement as needed to maintain the ability to perform the intended function. Based on the BWRVIP's determination of the two aging effects that require aging management review for the jet pump assembly (e.g., crack initiation and growth and fatigue), and the staff's concerns regarding thermal and/or neutron embrittlement, the applicant shall evaluate all four aging effects for applicability to their facility.
- (2) Preventive Actions: Maintaining high water purity reduces susceptibility to SCC. Hydrogen additions are effective in reducing electrochemical (corrosion) potentials in the recirculation piping system, but are less effective in the core region. Noble metal additions, through a catalytic action, appear to increase the effectiveness of hydrogen additions in the core region. The staff has reviewed and approved the BWRVIP-62 report, which describes these mitigative actions.
- (3) Parameters Monitored or Inspected: Inspection and flaw evaluation are performed in accordance with the NRC-approved BWRVIP-41 guidelines.
- (4) Detection of Aging Effects: Inspection in accordance with the NRC-approved BWRVIP-41 guidelines, as modified to resolve the item on thermal sleeve weld inspection, will ensure that degradation is detected before any loss of the intended function of the jet pump assembly welds.
- (5) Monitoring and Trending: The inspection schedule, in accordance with ASME Section XI, IBW-2400, and reliable examination methods provide timely detection of cracks. Scope of examination expansion and re-inspection beyond the baseline inspection are required if flaws are detected.
- (6) Acceptance Criteria: Any degradation is evaluated in accordance with applicable NRC-approved BWRVIP guidelines. Flaws detected in CASS components are evaluated in accordance with the applicable procedures of ASME Section XI, IWB-3500.
- (7) Corrective Actions: Repair is in conformance with the NRC-approved BWRVIP-51 report and/or ASME Section XI, IWA-4000 and IWB-4000. Replacement is in accordance with IWA-7000 and IWB-7000.
- (8) & (9) Confirmation Process and Administrative Controls: Site QA procedures, review and approval processes and administrative controls are implemented in accordance with the requirements of Appendix B to 10 CFR Part 50 will continue to be adequate for the license renewal period.

- (10) Operating Experience: Instances of SCC have occurred in jet pump assemblies (NRC Bulletin 80-07), hold down beams (NRC Information Notice (IN) 93-101), and jet pump riser pipe elbows (IN 97-02).

The staff's final safety evaluation of the BWRVIP-41 report was transmitted by letter dated February 4, 2001 to Carl Terry, BWRVIP Chairman. For the reasons set forth in that FSER, the staff concluded that the inspection strategy and evaluation methodologies discussed in the BWRVIP-41 report, as revised to include the resolution of the identified issues, is acceptable. Implementation of the above inspection program provides reasonable assurance that the identified aging effects will be adequately managed such that the intended functions of the subject safety-related RPV internal components will be maintained consistent with the CLB in the extended operating period.

### 3.5 Time Limited Aging Analyses (TLAA)

The susceptibility of the jet pump components to fatigue results in a TLAA issue and requires plant-specific evaluation by the applicant. The TLAA issue is evaluated using the requirements in 10 CFR 54.21(c)(1)(iii). Implementation of the inspection strategy described in Section 3.0 of the BWRVIP-41 report demonstrates that the effects of system cycling and vibration fatigue on the intended functions will be adequately managed for the period of extended operation.

Based on the staff's concerns regarding thermal and/or neutron embrittlement, thermal and/or neutron embrittlement is a TLAA issue. Thermal and/or neutron embrittlement of CASS components becomes a concern only if cracks are present. If the applicant can show that cracks do not occur in the CASS components, then it can be concluded that the loss of fracture toughness resulting from thermal and/or neutron embrittlement will not be a significant aging effect. These conclusions also apply for the period of extended operation.

## 4.0 CONCLUSIONS

The staff has reviewed the subject BWRVIP-41 report and the associated Appendix A, as submitted by the BWRVIP. On the basis of its review, as set forth above, the staff concludes that the BWRVIP-41 report and the associated Appendix A provides an acceptable demonstration that the BWRVIP member utilities referencing this report will adequately manage the aging effects of reactor vessel components within the scope of the report, with the exception of the noted renewal applicant action items set forth in Section 4.1 below, so that there is reasonable assurance that the jet pump components will perform their intended functions in accordance with the CLB during the period of extended operation. The staff also concludes that, upon completion of the renewal applicant action items, the BWRVIP-41 report and the associated Appendix A provides an acceptable evaluation of time-limited aging analyses for the jet pump assembly components for the BWRVIP member utilities for the period of extended operation.

Any BWRVIP member utility may reference this report in a license renewal application to satisfy the requirements of (1) 10 CFR 54.21(a)(3) for demonstrating that the effects of aging on the reactor vessel internal components within the scope of this topical report will be adequately managed and (2) 10 CFR 54.21(c)(1) for demonstrating the appropriate findings regarding evaluation of TLAA for the jet pump components for the period of extended operation. The staff also concludes that, upon completion of the renewal applicant action items set forth in Section 4.1 below, referencing the BWRVIP-41 report and its Appendix A in a license renewal

application and summarizing in an FSAR supplement the aging management programs and the TLAA evaluations contained in this report, will provide the staff with sufficient information to make the necessary findings required by Sections 54.29(a)(1) and (a)(2) for components within the scope of this report.

#### 4.1 Renewal Applicant Action Items

The following are license renewal applicant action items to be addressed in the plant-specific license renewal application when incorporating the BWRVIP-41 report and the associated Appendix A in a renewal application:

- (1) The license renewal applicant is to verify that its plant is bounded by the BWRVIP-41 report. Further, the renewal applicant is to commit to programs described as necessary in the BWRVIP-41 report to manage the effects of aging on the functionality of the jet pump components during the period of extended operation, including actions planned to mitigate the issue concerning the inspection of welds that are presently inaccessible, and the thermal and/or neutron embrittlement TLAA. Applicants for license renewal will be responsible for describing any such commitments and identifying how such commitments will be controlled. Any deviations from the aging management programs within the BWRVIP-41 report described as necessary to manage the effects of aging during the period of extended operation and to maintain the functionality of the reactor vessel components or other information presented in the report, such as materials of construction, will have to be identified by the renewal applicant and evaluated on a plant-specific basis in accordance with 10 CFR 54.21(a)(3) and (c)(1).
- (2) 10 CFR 54.21(d) requires that an FSAR supplement for the facility contain a summary description of the programs and activities for managing the effects of aging and the evaluation of TLAA for the period of extended operation. Those applicants for license renewal referencing the BWRVIP-41 report for the jet pump components shall ensure that the programs and activities specified as necessary in the BWRVIP-41 report are summarily described in the FSAR supplement.
- (3) 10 CFR 54.22 requires that each application for license renewal include any technical specification changes (and the justification for the changes) or additions necessary to manage the effects of aging during the period of extended operation as part of the renewal application. In its Appendix A to the BWRVIP-41 report, the BWRVIP stated that there are no generic changes or additions to technical specifications associated with the jet pump assembly as a result of its aging management review and that the applicant will provide the justification for plant-specific changes or additions. Those applicants for license renewal referencing the BWRVIP-41 report for the jet pump assembly shall ensure that the inspection strategy described in the BWRVIP-41 report does not conflict or result in any changes to their technical specifications. If technical specification changes do result, then the applicant should ensure that those changes are included in its application for license renewal.

## 5.0 REFERENCES

1. Letter from Carl Terry, BWRVIP, to USNRC, "BWR Vessel and Internals Project, BWR Jet pump Assembly Inspection and Flaw Evaluation Guidelines (BWRVIP-41)," EPRI Report TR-108728, dated October 1997.
2. Letter from Jack R. Strosnider, USNRC, to Carl Terry, BWRVIP, "Final Safety Evaluation of the BWR Vessel and Internals Project, BWR Jet Pump Assembly Inspection and Flaw Evaluation Guidelines (BWRVIP-41)," EPRI Report TR-108728, dated February 4, 2001.
3. C.E. Carpenter, USNRC, to C. Terry, BWRVIP, "Proprietary Request for Additional Information - Review of "BWR Vessel and Internals Project, Jet Pump Assembly Inspection and Flaw Evaluation Guidelines (BWRVIP-41)" (TAC No.M99870), dated February 12, 1999.
4. NUREG-1557, Summary of Technical Information and Agreements from Nuclear Management and Resources Council Industry Reports Addressing License Renewal, October 1996.
5. V. Wagoner, BWRVIP, to USNRC, "BWRVIP Response to NRC Request for Additional Information on BWRVIP-41 (Reference Project 704)," August 4, 1999.
6. C.I. Grimes, USNRC to D. J. Walters, Licence Renewal Issue No. 9-0030, "Thermal Aging Embrittlement of Cast Austenitic Stained\ss Steel Components" dated May 19, 2000.

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