May 16, 2007

Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: DRAFT SAFETY EVALUATION FOR PRESSURIZED WATER REACTOR OWNERS GROUP (PWROG) TOPICAL REPORT (TR) BAW-2461, REVISION 0, RISK-INFORMED JUSTIFICATION FOR CONTAINMENT ISOLATION VALVE ALLOWED OUTAGE TIME CHANGE (TAC NO. MC5722)

Dear Mr. Bischoff:

By letter dated January 14, 2005, the PWROG submitted BAW-2461, Revision 0, "Risk-Informed Justification for Containment Isolation Valve Allowed Outage Time [(AOT)] Change," to the U.S. Nuclear Regulatory Commission (NRC) staff for review. Enclosed for PWROG review and comment is a copy of the NRC staff's draft safety evaluation (SE) for the TR.

Twenty working days are provided to you to comment on any factual errors or clarity concerns contained in the SE. The final SE will be issued after making any necessary changes and will be made publicly available. The NRC staff's disposition of your comments on the draft SE will be discussed in the final SE.

To facilitate the NRC staff's review of your comments, please provide a marked-up copy of the draft SE showing proposed changes and provide a summary table of the proposed changes.

If you have any questions, please contact Sean E. Peters at 301-415-1842.

Sincerely,

/RA/

Stacey L. Rosenberg, Chief
Special Projects Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Draft SE

cc w/ enclosure:
Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

May 16, 2007

Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: DRAFT SAFETY EVALUATION FOR PRESSURIZED WATER REACTOR OWNERS GROUP (PWROG) TOPICAL REPORT (TR) BAW-2461, REVISION 0, RISK-INFORMED JUSTIFICATION FOR CONTAINMENT ISOLATION VALVE ALLOWED OUTAGE TIME CHANGE (TAC NO. MC5722)

Dear Mr. Bischoff:

By letter dated January 14, 2005, the PWROG submitted BAW-2461, Revision 0, "Risk-Informed Justification for Containment Isolation Valve Allowed Outage Time [(AOT)] Change," to the U.S. Nuclear Regulatory Commission (NRC) staff for review. Enclosed for PWROG review and comment is a copy of the NRC staff's draft safety evaluation (SE) for the TR.

Twenty working days are provided to you to comment on any factual errors or clarity concerns contained in the SE. The final SE will be issued after making any necessary changes and will be made publicly available. The NRC staff's disposition of your comments on the draft SE will be discussed in the final SE.

To facilitate the NRC staff's review of your comments, please provide a marked-up copy of the draft SE showing proposed changes and provide a summary table of the proposed changes.

If you have any questions, please contact Sean E. Peters at 301-415-1842.

Sincerely,

/RA/

Stacey L. Rosenberg, Chief
Special Projects Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Draft SE

cc w/ enclosure:
Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

DISTRIBUTION:

PUBLIC (No DPC for 10 working days)	PSPB Reading File	RidsNrrDpr
RidsNrrDprPspb	RidsNrrPMSPeters	RidsNrrLADBaxley
RidsOgcMailCenter	RidsAcrsAcnwMailCenter	RidsNrrDssSnpb
HollyCruz	StaceyRosenberg (Hard Copy)	

ADAMS ACCESSION NO.: ML070950155 *No major changes to SE input. NRR-043

OFFICE	PSPB/PM	PSPB/PM	PSPB/LA	APLA/BC*	PSPB/BC
NAME	HCruz	SPeters	DBaxley via phone	MRubin	SRosenberg
DATE	4/19/07	5/1/07	4/23/07	3/5/07	5/16/07

OFFICIAL RECORD COPY

DRAFT SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TOPICAL REPORT BAW-2461, REVISION 0

"RISK-INFORMED JUSTIFICATION FOR CONTAINMENT ISOLATION VALVE

ALLOWED OUTAGE TIME CHANGE"

PRESSURIZED WATER REACTOR OWNERS GROUP

PROJECT NO. 694

1.0 INTRODUCTION AND BACKGROUND

By letter dated January 14, 2005 (Reference 1), as supplemented by letter dated July 5, 2006 (Reference 2), the former Babcock and Wilcox (B&W) Owners Group, now members of the Pressurized Water Reactor Owners Group (PWROG) submitted risk-informed Topical Report (TR) BAW-2461, Revision 0, "Risk-Informed Justification for Containment Isolation Valve Allowed Outage Time [(AOT)] Change" (Reference 3), for U.S. Nuclear Regulatory Commission (NRC) staff review. The intent of TR BAW-2461 is to support changes to the technical specification (TS) AOT for designated primary containment isolation valves (CIV) by extending the AOT to 168 hours from the current 4 and 72 hours consistent with the acceptance guidelines in Regulatory Guide (RG) 1.174, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,” dated November 2002 (Reference 4), and RG 1.177, “An Approach for Plant-Specific Risk-Informed Decisionmaking: Technical Specifications,” dated August 1998 (Reference 5). The term AOT, as used by TR BAW-2461, is intended to be functionally equivalent to the term “completion time” (CT) as referenced by NUREG-1430, Revision 3, “Standard Technical Specification for Babcock and Wilcox Plants” (Reference 6).

TR BAW-2461 stated that the proposed CT extensions will improve operational safety and reduce unnecessary burden in complying with TS requirements. The extended CTs are also intended to provide additional flexibility in the performance of preventive and corrective maintenance of CIVs in modes 1, 2, 3, and 4, and reduce the potential for plant shutdown and possible plant transients introduced by a mode change evolution. The PWROG CIV CT evaluation concluded that the proposed CT risk impact, using the proposed methodology, is within the acceptance guidelines stated in RG 1.174 and RG 1.177.

1.1 Description of the Proposed Change

The risk-informed evaluation is applicable to penetration flow paths that have at least two CIVs, or one CIV within a closed system. TR BAW-2461 specifically excludes the CIVs in the main steam lines or other CIVs identified on a plant-specific basis to be risk significant for interfacing system loss-of-coolant accidents (LOCAs). Thus, a plant-specific application of the proposed BAW-2461 methodology may not be found acceptable in all cases.

The proposed change revises the TS for B&W Plants, NUREG-1430, Revision 3, Limiting Condition for Operation (LCO), Section 3.6.3, “Containment Isolation Valves,” Conditions A and C to extend the CT for an inoperable CIV. The CT for Condition A is revised from 4 hours to 168 hours. The CT for Condition C is revised from 72 hours to 168 hours. No change is proposed by the PWROG for Condition B (i.e., a penetration flow path with two inoperable CIVs).

1.2 Related NRC Actions

TR BAW-2461 is not related to or in response to any ongoing NRC activities (e.g., generic letters).

2.0 REGULATORY EVALUATION

The CIVs help ensure that adequate primary containment boundaries are maintained during and after accidents by minimizing potential pathways to the environment and help ensure that the primary containment function assumed in the safety analysis is maintained.

NUREG-1430 states that CIVs form part of the containment pressure boundary and provide a means for fluid penetrations not serving accident consequence limiting systems (ACLS) to be provided with two isolation barriers that are closed on a containment isolation signal. These isolation devices are either passive or active (i.e., automatic). Manual valves, deactivated automatic valves secured in their closed position (including check valves with flow through the valve secured), blind flanges, and closed systems are considered passive devices. Two barriers in series are provided for each penetration so that no single credible failure or malfunction of an active component can result in a loss of isolation or leakage that exceeds limits assumed in the safety analysis. One of these barriers may be a closed system. These barriers (typically CIVs) make up the containment isolation system.

The containment isolation signal closes automatic CIVs in fluid penetrations not required for operation of engineered safety systems upon receipt of a high containment pressure or diverse containment isolation signal to prevent leakage of radioactive material. Upon actuation of high pressure injection, automatic CIVs also isolate systems not required for containment or reactor coolant system (RCS) heat removal. Other penetrations are isolated by the use of valves in the closed position or blind flanges. As a result, the CIVs (and blind flanges) help ensure that the containment atmosphere will be isolated in the event of a release of radioactive material to containment atmosphere from the RCS following a design-basis accident (DBA). The LCO in the TS ensures that the CIVs will perform their design safety functions to minimize the loss of reactor coolant inventory and establish a containment boundary during an accident. The operability requirements for CIVs help ensure that the containment is isolated within the time limits assumed in the safety analysis.

The DBAs that result in a release of radioactive material within containment are a LOCA, a main steam line break, and a rod ejection accident. In the accident analysis, it is assumed that CIVs are either closed or function to close within the required isolation time following event initiation. This ensures that potential paths to the environment through CIVs (including containment purge valves) are minimized. The safety analysis assumes that the purge valves are closed at event initiation.

2.1 Applicable Regulations

The regulations applicable to the evaluation of TR BAW-2461 include:

Pursuant to Section 50.36 of Title 10 of the *Code of Federal Regulations* (10 CFR) (Reference 7), a licensee's TSs must have surveillance requirements (SRs) relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operations are within safety limits, and that the LCOs will be met. The LCOs are the lowest functional capability, or performance levels, of equipment required for safe operation of the facility. When an LCO of a nuclear reactor is not met, the licensee shall shut down the reactor, or follow any remedial action permitted by the TS until the condition can be met.

Furthermore, the CTs specified in the TSs must be based on reasonable protection of the public health and safety. Therefore, the NRC staff must be able to conclude that there is reasonable assurance that the safety functions affected by the proposed TS CT changes will be performed in accordance with the DBAs identified in Chapter 15 of the licensee's final safety analysis report (FSAR). As set forth in 10 CFR 50.36, a licensee's TS must establish the LCOs that contain certain information. This requirement includes CTs for structures, systems, and components (SSCs) that are required for safe operation of the facility, such as CIVs.

The Maintenance Rule, 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," requires licensees to monitor the performance, or condition, of SSCs against licensee-established goals in a manner sufficient to provide reasonable assurance that SSCs are capable of fulfilling their intended functions. The implementation and monitoring program guidance of RG 1.174, Section 2.3, and RG 1.177, Section 3, states that monitoring performed in conformance with the Maintenance Rule can be used when such monitoring is sufficient for the SSCs affected by the risk-informed application. In addition, 10 CFR 50.65(a)(4), as it relates to the proposed CIV CT extension, requires the assessment and management of the increase in risk that may result from the proposed maintenance activity.

Appendix A of 10 CFR Part 50, General Design Criterion (GDC)-35, "Emergency core cooling," requires suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities to assure that the system safety function can be accomplished assuming a single failure.

Appendix A of 10 CFR Part 50, GDC-54, "Piping systems penetrating containment," requires those piping systems that penetrate primary containment be provided with leak detection, isolation, and containment capabilities having redundancy, reliability, and performance capabilities that reflect the importance to safety of isolating these piping systems.

Appendix A of 10 CFR Part 50, GDC-55, "Reactor coolant pressure boundary penetrating containment," requires that each line that is part of the reactor coolant pressure boundary and that penetrates the primary containment shall be provided with CIVs.

Appendix A of 10 CFR Part 50, GDC-56, "Primary containment isolation," requires that each line that connects directly to the containment atmosphere and penetrates the primary reactor containment shall be provided with CIVs.

Appendix A of 10 CFR Part 50, GDC-57, “Closed system isolation valves,” requires that each line that penetrates the primary reactor containment and is neither part of the reactor coolant pressure boundary nor connected directly to the containment atmosphere to have at least one CIV that shall be either automatic, or locked closed, or capable of remote manual operation.

Finally, 10 CFR 50.90, “Application for amendment of license or construction permit,” addresses the requirements for a licensee desiring to amend its license, which include the TSs.

2.2 Applicable Regulatory Criteria/Guidelines

General guidance for evaluating the technical basis for proposed risk-informed changes is provided in Chapter 19.0, “Use of Probabilistic Risk Assessment (PRA) in Plant-Specific, Risk-Informed Decisionmaking: General Guidance,” of the NRC Standard Review Plan (SRP), NUREG-0800 (Reference 8). More specific guidance related to risk-informed TS changes is provided in SRP Section 16.1, “Risk-Informed Decisionmaking: Technical Specifications.”

RG 1.174, Revision 1, describes a risk-informed approach, acceptable to the NRC staff, for licensees to assess the nature and impact of proposed permanent licensing basis changes by considering engineering issues and applying risk insights.

RG 1.177 identifies an acceptable risk-informed approach, including additional guidance geared toward the assessment of proposed TS CT changes. Specifically, RG 1.177 identifies a three-tiered approach for the licensee’s evaluation of the risk associated with a proposed TS CT change, as described below:

- Tier 1 assesses the risk impact of the proposed change in accordance with acceptance guidelines, as documented in RG 1.174 and RG 1.177. The first tier assesses the impact on operational plant risk based on the change in core damage frequency (ΔCDF) and change in large early release frequency (ΔLERF). It also evaluates plant risk while equipment covered by the proposed CT is out-of-service, as represented by incremental conditional core damage probability (ICCDP) and incremental conditional large early release probability (ICLERP). Tier 1 also addresses PRA quality, including the technical adequacy of the licensee’s plant-specific PRA for the subject application. Cumulative risks of the present TS change in light of past (related) applications, or additional applications under review, are also considered.

- Tier 2 identifies and evaluates any potential risk-significant plant equipment outage configurations that could result if equipment, in addition to that associated with the proposed license amendment, is taken out-of-service simultaneously, or if other risk-significant operational factors, such as concurrent system or equipment testing, are also involved. The purpose of this evaluation is to ensure that there are appropriate restrictions in place such that risk-significant plant equipment outage configurations will not occur when equipment associated with the proposed CT is implemented.

- Tier 3 addresses the licensee’s overall configuration risk management program (CRMP) to ensure that adequate programs and procedures are in place for identifying risk-significant plant configurations, resulting from maintenance or other operational activities, that may not have been considered when the Tier 2 evaluation was performed and appropriate compensatory measures to avoid such configurations were taken. The

CRMP ensures that equipment removed from service prior to, or during, the proposed extended CT will be appropriately assessed from a risk perspective. Compared with Tier 2, Tier 3 provides additional coverage to ensure that risk-significant plant equipment outage configurations are identified in a timely manner, and that the risk impact of out-of-service equipment is appropriately evaluated, prior to performing any maintenance activity over extended periods of plant operation. Tier 3 guidance can be satisfied by the Maintenance Rule (10 CFR 50.65(a)(4)), which requires a licensee to assess and manage the increase in risk that may result from activities such as surveillance testing, and corrective and preventive maintenance. The acceptability of the Maintenance Rule for Tier 3 is subject to the guidance provided in RG 1.177, Section 2.3.7.1, including the technical adequacy of the licensee's Maintenance Rule program and PRA model for the specific application.

RG 1.174 and RG 1.177 also describe risk acceptance guidelines, acceptable implementation strategies, and performance monitoring plans to help ensure that the assumptions and analysis used to support the proposed TS changes will remain valid. The monitoring program should include means to adequately track the performance of equipment that, when degraded, can affect the conclusions of the licensee's evaluation for the proposed licensing basis change.

NUREG-0800, Section 6.2.4, "Containment isolation system," provides deterministic evaluation guidance and acceptance criteria for the review of the containment isolation system.

SRP Section 6.2.4, states that a closed system inside containment can be a containment isolation barrier if it does not communicate with the RCS or containment atmosphere; is protected against missiles and pipe whip; can withstand containment design temperature, structural integrity test pressure, and LOCA transient conditions; and is seismic Category I and Safety Class 2. Similar provisions apply to closed systems outside containment.

3.0 TECHNICAL EVALUATION

The NRC staff has reviewed the analyses in support of the PWROG's original submittal of TR BAW-2461. The evaluation described in this section provides a description of the proposed change, the review methodology used by the NRC staff, the key information used in the review, the applicability of the proposed changes to the regulatory acceptance guidelines, and the NRC staff's findings and conditions.

3.1 Description of the Proposed Change

The following NUREG-1430, Revision 3, LCO 3.6.3 Conditions, Required Actions, and CTs are affected:

- Condition A:

  The NOTE for Condition A is revised as follows:

  Only applicable to penetration flow paths with two [or more] containment isolation valves *with the exception of the containment isolation valves in the main steam lines [and list of specific penetrations (if any) identified by the plant-specific risk-informed process to have high risk significance for ISLOCA].*

A new Required Action A.1 is proposed to address common cause failure (CCF), which results in Required Actions A.1 and A.2 being renamed A.2 and A.3.

The associated CT is revised from 4 hours to 168 hours.

- Condition C:

  The associated CT for Required Action C.1 is revised from 72 hours to 168 hours.

In addition, new LCO 3.6.3 Conditions, Required Actions, and CTs are proposed for the main steam line CIVs, and additional high-risk CIVs and penetration flow paths with closed systems, as shown in TR BAW-2461.

TR BAW-2461 evaluated valves that have containment isolation functions. The proposed TS changes are applicable to CIV penetrations containing two or more CIVs in series or one CIV within a closed loop system inside containment. The analysis also included CIV maintenance activities that cause the CIV to be inoperable as a pressure boundary and maintenance activities that allow a CIV to remain functional as a pressure boundary. CIVs in the main steam lines are explicitly excluded from the proposed CT extension based on a broader risk impact than containment isolation and were not conducive to the methodology proposed by TR BAW-2461. For CIVs located in a penetration flow path connected to the RCS, there is possibility of an interfacing system LOCA through exposure of low pressure piping to RCS pressure. The CIVs identified as risk significant for interfacing system LOCA based on a plant-specific TR BAW-2461 and PRA evaluation (i.e., results are outside the acceptance guidelines for ICCDP and ICLERP) will be specifically identified in the TS with the current CT retained.

Of the conditions identified in LCO 3.6.3, Conditions A and C were evaluated by TR BAW-2461. The risk impact of two CIVs inoperable in a penetration (i.e., Condition B) was not evaluated by TR BAW-2461. The CT for this configuration is generally limited by the LCO to a CT of 1 hour and remains unchanged by the TR. For CIVs in ACLS flow paths, the proposed CT is only applicable to the containment isolation function. An ACLS used for accident mitigation that contain CIVs that also function as containment pressure boundaries were evaluated only with regard to the valve impact on loss of containment isolation. The CT limitations with respect to ACLS function remain unchanged.

3.2 Key Information Used in the Review

Key information used in the NRC staff's review is contained in TR BAW-2461, Chapter 3.0, "Engineering Evaluation," associated Sections 3.2, "Traditional Engineering Evaluation," Section 3.3, "Tier 1: Evaluation of Risk Impact," and Section 3.4, "Tiers 2 and 3: Avoidance of Risk-Significant Plant Configurations and Configuration Risk Management," and Section 3.5, "Maintenance Rule Monitoring Program," of BAW-2461, dated January 2005, as supplemented by PWROG letter dated July 5, 2006, in response to the NRC staff's request for additional information (RAI).

3.3 Comparison Against Regulatory Criteria/Guidelines

In accordance with SRP Chapter 19 and Section 16.1, the NRC staff's evaluation of TR BAW-2461 to extend CIV CTs to 168 hours used the three-tier approach and the five key principles outlined in RGs 1.174 and RG 1.177 and are presented in the following sections.

3.3.1 Traditional Engineering Evaluation

The traditional engineering evaluation addresses Key Principles 1, 2, 3, and 5 of the NRC staff's philosophy of risk-informed decisionmaking, which concerns compliance with current regulations and evaluation of defense in depth, safety margins, and performance measurement strategies.

Key Principle 1: Compliance With Current Regulations

The extended CT proposed by TR BAW-2461 maintains compliance with the TSs. The emergency core cooling system (ECCS) is designed to meet the requirements of 10 CFR 50.46 and GDC-35 of Appendix A to 10 CFR Part 50. Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities are provided to assure that the system safety function can be accomplished assuming a single active failure. The unavailability of one ECCS train, in addition to one of the injection lines affected by the assumed break, will not compromise the ability of the ECCS to mitigate a design-basis LOCA. Thus, with the inoperability of a single ECCS isolation valve to open, the remaining ECCS train is sufficient to perform the design function of ECCS for mitigating a design-basis LOCA.

The PWROG has evaluated the penetrations associated with the ECCS, which includes portions of the decay heat removal system (DHRS) that serve as a part of ECCS, and their supporting systems, and confirmed that their systems do not contain any containment isolation valves which would close on a containment isolation signal and compromise the safety function of the mitigation system.

The proposed CIV CTs do not affect the design or function of these valves; therefore, compliance with the GDCs is not changed by the proposed CTs. Also, if the basis for extending the CTs is acceptable, then 10 CFR 50.36 will be met by establishing a TS LCO and appropriate SR for the CIVs. The basis in TR BAW-2461 for extending the CIV CTs is risk-informed. The acceptance guidance for accepting CT changes for plants utilizing risk information is discussed in Sections 2.2 and 3.4.2 of this safety evaluation (SE).

Based on the above, the NRC staff finds that the safety function of the ECCS will not be affected by the proposed changes of CIV CT in TSs and thus compliance with current regulations is maintained.

Key Principle 2: Evaluations of Defense in Depth

The extended CT time proposed by TR BAW-2461 results in a small risk impact on containment failure and bypass. Redundancy, independence, and diversity are maintained for the containment isolation system. The balance between prevention, mitigation, and containment integrity are maintained. Defense against CCF was evaluated and no new potential CCF mechanisms were identified. The proposed extended CIV CT does not rely on additional operator actions or an over reliance on programmatic activities. The likelihood of an accident or transient is not impacted. A licensee's CRMP provides a means to identify and limit potentially

high risk configurations while a licensee's implementation and monitoring program helps ensure that the TR analysis remains valid for the proposed CIV CT. Based on the above, the NRC staff finds that defense in depth is maintained.

Key Principle 3: Evaluation of Safety Margins

The safety analysis assumptions or inputs to the safety analysis are not impacted by the proposed extended CIV CT. The safety-analysis acceptance criteria, as stated in the updated final safety analysis, are maintained. The plant will be operated and maintained as before. Therefore, the NRC staff finds that adequate safety margins are maintained.

Key Principle 5: Performance Measurement Strategies-Implementation and Monitoring Program

Depending on the penetration's risk significance and the frequency and length of time of the CIV CT, the unavailability of the CIV and the containment isolation function may be impacted. Therefore, a licensee adopting TR BAW-2461 will need to establish an implementation and monitoring program including performance criteria, on a plant-specific basis, consistent with the analysis assumptions and conclusions of the TR. The evaluation of the licensee's implementation and monitoring program is provided in Section 3.4.4 of this SE.

3.3.2 Staff Technical Evaluation (PRA) - Key Principle 4

The proposed change to extend CIV CTs employs a risk-informed approach using risk insights to justify changes to the CIV CTs. The risk metrics ΔCDF, ΔLERF, ICCDP, and ICLERP were used by TR BAW-2461 to estimate the risk impact of the proposed changes and are consistent with the acceptance guidelines of RGs 1.174 and 1.177.

The risk evaluation presented below addresses the NRC staff's philosophy of risk-informed decision making, that if the proposed changes result in a change in risk, then the increase should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.

3.3.3 Description of the Proposed Methodology

The scope of the risk analysis as stated by TR BAW-2461 addresses the following situations:

- Penetrations that must close or stay closed to prevent a large early release following core damage.

- Penetrations that must close or stay closed to prevent loss of RCS inventory and subsequent core damage, and large early release, from an interfacing system LOCA.

- Penetrations that need to stay open, post-accident, to support an ACLS function, but may need to isolate later in the accident (or upon failure of the ACLS train).

TR BAW-2461 used plant-specific PRA data provided by the participating PWROG utilities. Participating PWROG plants were surveyed to develop a methodology and assumptions that

would be applicable to participating licensees. Plant estimates for CDF, initiating events, risk achievement worth (RAW) values, and additional information were collected from each participating licensee. The most limiting PRA parameter estimates from the participating plants were used to evaluate the proposed CIV CT.

In addition, plant-specific CIV failure rate estimates for various valve types and failure modes were also obtained from each participating plant. For each valve type, the median failure rate was selected from the participating plant data for each failure mode. To limit the analysis scope, TR BAW-2461 then selected the highest median failure rate for each failure mode and applied that rate to all valve types. A review of generic data sources indicated that the values selected by TR BAW-2461 are also consistent with these sources.

Since plant-specific PRAs do not necessarily model the CIVs and systems in detail, the PWROG provided specific qualitative and quantitative analyses using simplified models applicable to each penetration flow path proposed for a CT extension. As a result, plant-specific PRA models were not used for the TR BAW-2461 evaluation, except to provide limiting baseline CDF, RAW, common cause beta factor, and component failure rate estimates.

TR BAW-2461 did not credit or screen on penetration flow path line size. In the PWROG RAI response, the PWROG clarified that the methodology assumes that any size penetration flow path will have the potential to contribute to LERF. TR BAW-2461 was modified following an RAI response such that the cumulative risk for multiple penetrations (i.e., separate LCO 3.6.3 condition entry) can be estimated under Tier 3 without consideration of line size (i.e., ICCDP and ICLERP for each condition entry may be summed).

The penetration configurations used in TR BAW-2461 are intended to be conservative. The methodology assumed the limiting valve type for each penetration flow path analyzed. No credit was given for ventilation or filtration, to limit the impact of a large early release. The intent by the PWROG was to provide a methodology that would have generic applicability to the participating plants. The NRC staff finds that the applicability and conservatism of the assumptions used in the TR will need to be confirmed on a plant-specific basis. These assumptions should include the acceptance guidelines for RG 1.174 and 1.177

The PWROG included the risk impact of both random pipe failure and CIVs installed in systems with non-seismically qualified piping. The TR BAW-2461 risk assessment for the proposed extended CIV CT during Modes 1, 2, 3, and 4 also included valves in maintenance where the pressure boundary is or is not maintained during the proposed CT.

In addition, TR BAW-2461 evaluated partially opened CIVs, which have the potential to impact ACLS penetrations due to the CIV not meeting its containment isolation function, and possibly not satisfying the ACLS function as well. The PWROG determined that a partially opened CIV may further increase CDF and will impact LERF for the proposed CT extension, due to the delay in isolating the penetration and due to the impact of the degraded mitigation system CDF during the ACLS degraded condition (extended CIV CT). Therefore, the PWROG estimated the increase in LERF by adjusting the CDF based on the loss of the ACLS flow path, in addition to the LERF impact of the inoperable CIV.

For penetration flow paths connected to the RCS, there is potential for CDF to be affected in addition to LERF due to an interfacing system LOCA. The TR analysis addresses the probability of a failed open CIV penetration flow path from the RCS to the environment. TR BAW-2461 stated that since an interfacing system LOCA is assumed to go to core damage, the effectiveness of mitigation systems besides containment isolation is not considered significant. All failed open penetration flow paths with an RCS connection were assumed to have CDF and LERF contributions. Licensee's incorporating TR BAW-2461 will need to confirm the applicability of the above conditions for their plant (i.e., interfacing system LOCA mitigation is not credited).

3.3.4 Analysis Approach

The CIVs were grouped into general categories as shown below.

- Penetration flow paths connected directly to the RCS.
- Penetration flow paths connected directly with the containment atmosphere.
- Penetration flow paths connected to a closed loop system inside containment.

Additional subgroups in each category identify penetration flow paths that have an ACLS function and ones that do not. Normally closed (NC), and normally open (NO), CIVs and seismic, and non-seismic, configurations were also included in the above categories. TR BAW-2461 also considered non-seismically induced pipe failure and assumed that non-seismic piping fails for a seismic event. The TR failure mode and effects analysis (FMEA) and risk methodology assessed the ICCDP and ICLERP impact using the proposed CIV CT of 168 hours and the 72 hour ACLS CT for CIV configurations that impact an ACLS function.

The TR methodology evaluates single line penetration flow paths that are evaluated separately, or in combination, depending on the penetration flow path configuration. To address additional penetration flow path configurations (parallel valves), or multiple pathways, TR BAW-2461 provides additional guidance to evaluate this risk.

Each penetration CIV flow path category is subdivided into flow path configurations (A thru G) to assess the potential risk of release paths to the outside environment given the inoperable CIV. The CIV penetration flow path category risk result is combined with additional flow path configurations to obtain the overall risk for each penetration flow path ICCDP and ICLERP estimate.

The TR BAW-2461 FMEA, and risk evaluation penetration flow categories, are based on piping type (seismic, non-seismic), the failure mode of the CIVs, normal CIV position, ACLS function, penetration flow path connection (i.e., RCS, containment atmosphere, closed loop) and other criteria. The methodology qualitatively estimates ICCDP and ICLERP for each penetration flow path class description (category) and configuration. The risk impact results are presented in TR BAW-2461, Table 3-3, "FMEA and Risk Calculation for CIV Penetrations" as summarized below.

Class Description 1 - Penetrations Connected to the RCS with no ACLS Function

This category is for penetration flow paths connected to the RCS but with no ACLS function except containment isolation. CIVs, both NC and NO, are considered along with the seismic capability, random failure, and exposure to RCS pressure on the associated piping. The general failure mode addressed by Category 1 is one CIV inoperable and the second CIV failing to close, or remain closed, in an extended CT.

The TR analysis shows that for penetration flow paths with an inoperable CIV and less than two closed valves connected to the RCS, and a low pressure, or environmental, penetration flow path, the estimated risk did not meet the acceptance guidelines for ICCDP and ICLERP as stated by RG 1.177.

The following condition is identified by TR BAW-2461 for this configuration.

- The extended CT will not be applied to CIVs in penetrations connected to the RCS that have two NC CIVs if there are no other valves between the RCS and the environment (i.e., low pressure piping or opening) that may be used for backup isolation and cannot be confirmed closed. In that case, the operable CIV will be verified closed within the original 4-hour CT, thus satisfying the TS Required Action.

  The specific penetrations where this is applicable, or where there is a risk significance for ISLOCA (as determined by the plant-specific risk-informed process including plant-specific LOCA analysis), will be identified on a plant-specific basis prior to implementation of the proposed TS change. They will be listed explicitly in the proposed TS revision, and the current CT will be retained.

Class Description 2 - Penetration Connected to the RCS with an ACLS Function

This category includes penetration flow paths connected to the RCS that have at least two CIVs, an ACLS function, and a containment isolation function. The CIVs are either NC, or NO initially. The general failure mode for this condition is the failure of the second CIV to close with one of the CIVs inoperable and in the proposed extended CT. Since the penetration flow path has an ACLS function, consideration is given to the position of the inoperable CIV. The interfacing system LOCA risk for this category is considered identical to the above Class 1 non-ACLS configuration with an inoperable CIV. Therefore, the above conditions for Class Description 1 apply for Class 2 as well.

Class Description 3 - Penetrations Connected to Containment Atmosphere with no ACLS Function

This category is for penetration flow paths connected directly to the containment atmosphere with the CIVs providing containment isolation with no ACLS function. The penetration has at least two CIVs. The failure mode addressed by this class is the failure of the second CIV to close, or remain closed, when one of the CIVs is inoperable and in the proposed extended CT.

Class Description 4 - Penetrations Connected to Containment Atmosphere with an ACLS Function

This category is for penetration flow paths connected directly to the containment atmosphere that include an ACLS function and containment isolation. The penetration has at least two CIVs. The CIVs are NO, or NC, or partially open initially. The failure mode considered for this category is the failure of the second CIV to close with a CIV inoperable, and in the proposed extended CT. With an ACLS function, the evaluation considered whether the inoperable CIV is confirmed to be open.

Class Description 5 - Penetrations Connected to a Closed Loop System Inside Containment

This category is for penetration flow paths connected to a closed loop system inside containment with no ACLS function. The closed loop system may interface with the containment atmosphere or the RCS via the steam generators. No ACLS function is assumed for these penetration flow paths, with generally only one CIV and the closed loop acting as the second barrier. Two failure modes are addressed: (1) the failure of the closed loop inside containment with the CIV inoperable and in the proposed extended CT, and (2) the failure of the CIV with the closed loop inside containment inoperable for a pressure boundary not shared with the RCS. The closed loop is considered a second barrier for the analysis and the proposed LCO 3.6.3, TS condition.

Class Description 6 - Penetrations Connected to Closed Loop Systems Inside Containment with an ACLS Function

This category is for CIV penetration flow paths connected to a closed loop system inside containment that also include an ACLS function. The closed loop system can interface with containment atmosphere or the RCS via the steam generators. Two general failure modes were considered: (1) the failure of the closed loop inside containment, given that the CIV is inoperable and in the proposed extended CT; and (2) the CIV is inoperable, given that the pressure boundary of the closed loop inside containment is inoperable for a pressure boundary not shared with the RCS. The closed loop is considered a second CIV for the analysis and the proposed LCO 3.6.3, TS condition.

Overall, the PWROG evaluation concluded that penetration flow paths with direct connection to the containment atmosphere, or closed loop systems inside containment, supported an extended CIV CT and met the RG 1.177 acceptance guidelines for ICCDP and ICLERP. In general, penetration flow paths that connect to the RCS also showed acceptable risk for an extended CIV CT. However, the PWROG analysis for RCS penetration flow paths that connect with low pressure piping outside containment did not result in an acceptable risk impact in all cases due to ISLOCA potential.

3.4 Risk Evaluation

Key Principle 4: Risk Evaluation

The changes proposed by the licensee employ a risk-informed approach using risk insights to justify changes to CIV CTs. The risk metrics ΔCDF, ΔLERF, ICCDP, and ICLERP used by the PWROG to evaluate the impact of the proposed changes are consistent with those presented in RGs 1.174 and 1.177. The evaluation of the TR risk evaluation is provided in the following sections of this SE.

3.4.1 Tier 1: PRA Applicability and Insights

To simplify the analysis, the most limiting plant-specific valve type median failure rate (i.e., fails open, fail closed, fails to remain closed) was selected for use in the analysis. The most limiting plant-specific PRA parameters, including base CDF, from the participating plants were used. The methodology also employed limiting plant-specific RAW values to account for the incremental risk of an ACLS function being out of service.

For the quantitative evaluation of the risk impact of extending the current CIV CT from 4 hours or 72 hours to a proposed duration of 168 hours, the PWROG developed a methodology that organized the various CIV penetrations into categories. These categories were then associated with possible flow path configurations to complete the remainder of the flow path from the RCS or containment atmosphere to the environment. For each defined category and configuration, the PWROG developed generic penetration flow paths to assess at-power risk for the associated penetration flow path CIVs.

The methodology used in TR BAW-2461 is generic, and therefore, each participating licensee requesting a CIV CT extension will need to confirm the applicability of the TR BAW-2461 penetration flow path configuration results to its particular plant. A plant-specific analysis must be performed to ensure the applicability of the TR with respect to penetration configurations and CT risk impact for inoperable CIVs to ensure that the acceptance guidelines of RG 1.174 and 1.177 are met.

The licensee's analysis must be applied to penetrations analyzed in TR BAW-2461. Any additional CIV configurations, CT extensions, or non-bounding risk parameter values not evaluated by TR BAW-2461 should be addressed by plant-specific analyses.

3.4.1.1 PRA Technical Adequacy

The objective of the PRA review is to determine whether the generic-risk assessments used in evaluating the proposed CIV extended CTs were of sufficient scope and detail. The NRC staff reviewed the information provided in TR BAW-2461 and, based on the above discussion, the NRC staff concludes that the PWROG adequately addressed the issue of capability and that the risk analysis was of sufficient scope and detail to estimate the risk measures associated with the proposed CIV extended CTs on a generic basis.

To ensure the applicability of TR BAW-2461 to a licensee’s plant, additional information on PRA quality with respect to Tier 3 will be required by licensees addressing the following areas:

1. The plant-specific PRA reasonably reflects the as-built, as-operated, plant.

2. Applicable PRA updates, including individual plant examination (IPE)/individual plant examination of external events (IPEEE), peer reviews, and self assessment findings and modifications.

3. Conclusions of the industry/Nuclear Energy Institute (NEI) peer review and self assessment, including the disposition of significant facts and observations applicable to the proposed CIV extended CTs.

4. PRA quality assurance programs/procedures.

5. PRA adequacy and completeness with respect to evaluating the proposed CIV CT extension risk and applicability to the plant.

3.4.1.2 PRA Insights

The intent of TR BAW-2461 is to provide a generic methodology applicable to participating PWROG plants. The risk impact of extending CIV CTs for various penetration configurations is summarized in Table 3-3 of the TR. The results show that the risk impacts of the proposed CIV CTs are generally within the ICCDP and ICLERP acceptance guidelines of RG 1.177. The PWROG did not specifically address ΔCDF and ΔLERF in TR BAW-2461 regarding the acceptance guidelines of RG 1.174. The PWROG stated that it is not expecting that on-line CIV preventive maintenance will increase with the proposed 168-hour CIV. TR BAW-2461 further stated that the CIV maintenance unavailability will be monitored through the licensee's Maintenance Rule program. To address this, licensee's adopting TR BAW-2461 will need to assess, on a plant-specific basis, the ΔCDF and ΔLERF acceptance guidance of RG 1.174, including the expected frequency of entering the proposed CT and the expected mean CT for CIV maintenance.

To implement TR BAW-2461, it is expected that a licensee would reference Table 3-3 to develop plant-specific CIV penetration flow path configurations consistent with the TR. Once the plant-specific configurations are established, any risk significant penetration flow paths are to be identified and documented by the licensee as not eligible for an extended CIV CT based on flow path or maintenance configuration. A licensee that implements TR BAW-2461, must demonstrate, by plant-specific analyses, the applicability of the TR input parameter assumptions and analysis with respect to its particular plant.

TR BAW-2461, through the PWROG RAI response dated July 5, 2006, adds a TS action to address CCF for like valves within the original 4-hour inoperable CIV CT. The new action is applicable to redundant valves in the same penetration with similar design. This new TS action is to verify that the redundant CIVs are not susceptible to the same CCF mode prior to extending the CT for the inoperable CIV. This is required because the methodology presented in TR BAW-2461 does not specifically consider CCF in the evaluation to extend the CIV CT to 168 hours.

The TR BAW-2461 analysis assumes only one CIV is in maintenance at any one time. While it is not expected that multiple CIVs will be out of service simultaneously with extended CTs, the TR does not preclude the practice. TS LCO 3.6.3, Note 2, allows separate condition entry for each penetration flow path which could result in multiple simultaneous extended CIV CTs, which is not consistent with the TR analysis. Based on this, a licensee's proposed TS LCO 3.6.3 must limit the cumulative risk impact of multiple failed CIVs. The NRC staff concludes that a CIV in an extended 168-hour CT should be specifically limited by LCO 3.6.3 such that only a single CIV is in an extended CT at any one time. This will ensure that the conclusions of the TR continue to be met (i.e., a single CIV in the proposed extended CT) and will maintain the current LCO 3.6.3 separate condition entry provision.

In addition, the licensee must confirm that its Tier 3 CRMP addresses simultaneous inoperable CIV LCOs (i.e., separate condition entry) such that the cumulative CIV risk, including LERF, are maintained consistent with the assumptions and conclusions of TR BAW-2461.

3.4.1.3 PRA Uncertainty

The parameters used (e.g.,valve failure rates and PRA parameters) were based on limiting participating plant-specific estimates. The valve failure rates were stated as being median values obtained from the participating licensee plant PRA models with the limiting valve type being used in the analysis. The PRA parameters were obtained through a survey of the participating plants, with the limiting values selected. The PWROG, in its RAI response, performed sensitivity studies for the CIV failure rate and the individual system and pipe size group failure rate. For the TR analysis, the PWROG selected the highest generic system and pipe size group failure rate based on EPRI TR-102266.

Based on the TR methodology, penetration flow paths can be shown to be sensitive to pipe failure rates. The PWROG, in its RAI response, demonstrated conservatism in the selection of 100 pipe sections per penetration flow path. The response also showed that using the highest system and pipe size group failure rate shown in the EPRI report would result in an ICLERP value within 5E-8 for these penetration flow paths. It is also noted that there are expected to be a limited number of penetration flow paths in this category and that the pipe failure rate used in the analysis was based on the worst-case, generic PWR system and pipe size group.

To evaluate the impact of valve failure rates on the analysis, the PWROG increased the valve failure rates by a factor of 2. The increased valve failure rates did not change the conclusions of TR BAW-2461, except for configurations associated with Category 1.4, and Configurations E, F, and G. For Configuration E, the ICLERP increased from 3.6E-8 to 8.0E-8 and for Configurations F and G, ICLERP increased from 3.3E-8 to 6.6E-8. The ICLERP estimates are greater than the RG 1.177 acceptance guidance of 5E-8 for Category 1.4, Configurations E, F, and G. For the listed penetration flow path configurations, ICLERP is impacted by pipe failures caused by a seismic event and the operable CIV failing to close. The PWROG RAI response stated that there are few, if any, penetration flow paths that will meet this category. In addition, the PRA parameters for these configurations were limiting, based on plant-data, and the pipe failure rates are expected to be conservative, based on the system and pipe size group number and associated number of pipe sections selected.

As a further check, the NRC staff reviewed NUREG-1715, Volume 3, "Component performance study-Air-Operated Valves, 1987-1998," and Volume 4, "Component Performance Study-Motor-Operated Valves, 1987-1998 Commercial Power Reactors" (Reference 9), data for motor-operated and air operated valve failures. Although limited to motor-operated and air operated valves, the data presented in NUREG-1715 shows that the CIV failure probability estimates used by TR BAW-2461 are consistent with the failure rates given in NUREG-1715. NUREG-1715 also indicated a statistically significant decreasing trend for both motor-operated and air-operated valve failures on demand on a per fiscal year basis for risk important systems.

Based on the above, a licensee implementing TR BAW-2461 will need to confirm the above penetration results on a plant-specific basis, such that the proposed CIV CT risk remains within the acceptance guidance of RG 1.177 and 1.174 and the analysis conclusions of TR BAW-2461 for the plant-specific case.

3.4.1.4 External Events

Seismic Events

The impact of a seismic event is included in the TR CIV risk estimates with respect to non-seismic pipe failures in penetration flow paths. No credit is given for non-seismic pipe in a

seismic event. Non-seismically qualified piping is assumed to always fail during a seismic event. The seismic initiating event frequency and seismic CDF used in the TR BAW-2461 must be verified as bounding for the plant-specific case, or plant-specific information, used. For plants that used a seismic-margin analysis, a quantitative assessment of seismic CDF is not considered in the TR limiting seismic CDF estimate. Therefore, each licensee will need to confirm that the seismic CDF referenced for TR BAW-2461 is bounding for its plant, or incorporate a plant-specific seismic CDF estimate. In addition, the seismic initiating event frequency will need to be defined and justified for each licensee implementing TR BAW-2461.

Additional seismic risk may contribute to the CIV risk estimates. For example, licensee's should confirm that seismic induced relay chatter (spurious CIV actuation - USI A46) or seismic commitments/analysis/assumptions from the IPEEE have been resolved. Conclusions with regard to containment performance (i.e, containment isolation including relay chatter) should be confirmed with respect to the proposed 168-hour CIV CT.

Fire and High Winds, Floods, and Other External Events

TR BAW-2461 considered the contribution of fire/high winds and other (HFO) external events with respect to the proposed CIV CT to be a small risk contributor compared to the failure probability of the operable CIV. TR BAW-2461 based this conclusion on the probability of an internal fire or external events occurring during the proposed CIV CT being sufficiently small. However, the NRC staff is concerned that fire and external event risk may not be sufficiently small with respect to the proposed 168-hour CIV CT.

A review of the Crystal River, Davis Besse, and Oconee IPEEE shows that CDF contribution from fire risk for each plant is as follows:

- Crystal River, Unit 3- Fire CDF contribution estimated at 4E-5/year.
- Davis Besse- Fire CDF contribution estimated at 2.5E-5/year.
- Oconee, Units 1, 2, and 3- Fire CDF contribution estimated at 5.0E-6/year.

A review of HFO events shows that the above licensees generally used a screening approach and, therefore, did not quantitatively estimate a CDF contribution from HFO events. However, HFO events, in some cases, (Oconee, Units 1, 2, and 3 for example) can contribute significantly to overall CDF.

Although TR BAW-2461 assumes the risk from external events to be insignificant with respect to the proposed CIV extended CT, the TR assumes only the internal plant CDF in the analysis. For some participating plants, internal fires and other external event risk may contribute significantly to overall plant baseline risk, which may impact the TR methodology results such that a plant-specific application of the TR BAW-2461 methodology may not be found acceptable in all cases.

In addition, RG 1.174, Section 2.2.5.5, "Comparisons With Acceptance Guidelines," states that for very small increases of CDF and LERF, as shown in Region III, Figures 3 and 4 of RG 1.174, a detailed quantitative assessment of baseline risk (internal and external events) is not necessary and the change in risk would be considered regardless of whether there is a calculation of the total baseline risk. There is no requirement to calculate the total baseline risk.

However, if there is an indication that the risk may be considerably higher than 1E-4/reactor-year for CDF (or 1E-5/reactor-year for LERF), then the focus should be on finding ways to decrease rather than increase the risk.

Therefore, the potential for external events should be assumed credible during the extended CIV, and licensees implementing TR BAW-2461 must demonstrate that external event risk, including fire, by either quantitative or qualitative means, will not have an adverse impact on the conclusions of the plant-specific application of TR BAW-2461. Specifically: (1) the risk from external events cannot make the total baseline risk exceed 1E-4/yr CDF, or 1E-5/yr LERF, without justification, (2) the risk from external events (i.e., high winds, floods and other) should be specifically evaluated with respect to the extended CIV CT, and (3) fire risk should be specifically addressed. The evaluation should include fire-induced spurious actuation (including containment performance) with respect to the proposed 168-hour CIV CT.

3.4.1.5 Cumulative Risk

With respect to past plant-specific license amendments or additional plant-specific applications for a TS change under review, the cumulative risk must be evaluated on a plant-specific basis consistent with the guidance given in RG 1.174, Section 2.2.6 and 3.3.2, and addressed in a licensee's plant-specific application.

3.4.1.6 Transition and Shutdown Risk (CIV extended CT)

TR BAW-2461 did not provide a specific assessment of transition risk, although TR BAW-2461 qualitatively discusses transition risk as a potential reason to extend a CIV CT. The NRC staff notes that the additional benefit to transition risk would only occur when unscheduled corrective maintenance could not be completed within the proposed TS CT. For failures occurring during surveillance, transition risk should be considered, but this should have a limited impact on the analysis. The proposed extended CIV CTs may provide additional flexibility in the performance of preventive and corrective maintenance during power operation, including a reduced potential for plant shutdown and possible plant transients introduced by this reactor mode change. With respect to the proposed extended CIV CT, the transition risk averted may provide a qualitative risk benefit, but is not credited or quantified in the risk evaluation performed by TR BAW-2461.

3.4.2 Tier 2: Avoidance of Risk-Significant Plant Configurations

For the Tier 2 analysis, a licensee must provide reasonable assurance that risk significant plant equipment outage configurations will not occur when specific plant equipment is out of service, in accordance with the proposed TS change. A Tier 2 program is intended to limit the degradation of plant mitigation capabilities with a CIV out of service (LCO condition), such that defense in depth is maintained. The TR BAW-2461 evaluation identified generic Tier 2 conditions as a result of the proposed CT extension for CIVs beyond those already identified by the TSs, such as the redundant CIV on the same penetration, support systems, additional equipment taken out of service, or equipment credited in the CIV CT evaluation.

TR BAW-2461 also stated that CIVs subject to CCF evaluations are to be documented on a plant-specific basis by licensees since the analysis performed by the TR assumed that no CIV CCF would be present upon entering the extended CIV CT. Additionally, TR BAW-2461 is not applicable to the main steam lines. Furthermore, certain other lines, identified as risk-significant configurations with respect to interfacing system LOCA, are excluded from

TR BAW-2461. These lines will be identified by licensees on a plant-specific basis when implementing TR BAW-2461. For licensees adopting TR BAW-2461, a plant-specific evaluation should be performed specific to Tier 2 with confirmation that the TR is applicable to their plant.

3.4.3 Tier 3: Risk-Informed Configuration Risk Management

A Tier 3 program ensures that while a CIV is in an LCO, additional activities will not be performed that could further degrade the capability of the plant to respond to a condition the inoperable CIV or system was designed to mitigate and, therefore, increase plant risk beyond that assumed by TR BAW-2461. Tier 3 programs: (1) ensure that additional maintenance does not increase the likelihood of an initiating event intended to be mitigated by the out-of-service equipment, (2) evaluate the effects of additional equipment out of service during CIV maintenance activities that would adversely impact CIV CT risk, such as from redundant systems or components, and (3) evaluate the impact of maintenance on equipment or systems assumed to remain operable by the CIV CT TR BAW-2461 analysis.

Accordingly, a licensee should develop a program to ensure that it appropriately evaluates the risk impact of out-of-service equipment before performing a maintenance activity. Licensees can utilize the overall CRMP (as referenced in RG 1.177) through the Maintenance Rule (10 CFR 50.65(a)(4)) if the PRA risk assessment quality aspects of this program meet the quality needs of a risk-informed licensing action. Specifically, the rule requires that, before performing any maintenance activity, the licensee must assess and manage the potential risk increase that may result from a proposed maintenance activity. Therefore, a licensee's submittal must include a discussion on: (1) the licensee's CRMP for assessing the risk associated with removal of CIVs from service and (2) their conformance to the requirements of 10 CFR 50.65(a)(4), and the additions and clarifications outlined in Section 2.3.7.2 of RG 1.177, as they relate to the proposed CIV CTs.

TR BAW-2461 stated that a licensee's CRMP will ensure that:

- No action or maintenance activity is performed that will remove equipment that is functionally redundant to the inoperable CIV, including the redundant CIVs on the same penetration and support systems for the redundant CIV.

- No action or maintenance activity is performed that will significantly increase the likelihood of challenge to the CIVs. Challenges to the CIVs include DBAs that result in a release of radioactive material within containment (LOCA, main steam line break, and rod ejection accident). Another challenge to the CIVs is the removal of equipment from service that may cause a significant increase in the likelihood of core damage while in the proposed CT, which may in turn increase the large early release via the inoperable CIV.

- No action or maintenance activity is performed that will remove equipment that supports success paths credited in the CT risk evaluation. This includes the other series valves, if any, credited in the risk assessment for RCS penetrations that otherwise would be at risk significant for interfacing system LOCA.

NUREG-1430 allows multiple simultaneous condition entries (TS 3.6.3, NOTE 2, "Separate condition entry is allowed for each penetration flow path") for LCO 3.6.3, but not for multiple CIVs associated with the same flow path (i.e., multiple inoperable CIVs in the same flow path are limited by TS 3.6.3). However, multiple LCO 3.6.3 entries for single inoperable CIVs in multiple penetrations would result in CDF, LERF, ICCDP, and ICLERP estimates which are greater than those assumed in TR BAW-2461. Simultaneous multiple TS entries and the subsequent impact on risk were not specifically evaluated by the TR.

CTs, as implemented per the NRC staff findings and conditions of this SE, including limiting an extended CIV CT to a single LCO entry at any one time, and the maintenance rule (10 CFR 50.65(a)(4)) are intended to limit the overall risk associated with extended CIV CT interval maintenance. Because a CRMP does not typically include the containment isolation function, and plant PRAs do not model all the CIVs, participating licensees adopting TR BAW-2461 must include CIV plant-specific Tier 3 information in their plant-specific submittals regarding the estimation of ΔCDF, ΔLERF, ICCDP, and ICLERP within their respective CRMP.

Therefore, CIV maintenance including multiple simultaneous LCO entries for single inoperative CIVs in multiple penetrations must be evaluated on a plant-specific basis to ensure that the TR BAW-2461 conclusions, including risk estimates of ΔCDF, ΔLERF, ICCDP, and ICLERP are reasonable when implementing the proposed CIV CTs.

3.4.4 Implementation and Monitoring Program

RG 1.174 and RG 1.177 also establish the need for an implementation and monitoring program to ensure that extensions to TS CTs do not degrade operational safety over time and that no adverse degradation occurs due to unanticipated degradation or CCF mechanisms. An implementation and monitoring program is intended to ensure that the impact of the proposed TS change continues to reflect the reliability and availability of SSCs impacted by the change. With respect to the proposed CIV CT, the application of the three-tiered approach in evaluating the proposed CIV CTs provides additional assurance that the changes will not significantly impact the key principle of defense in depth.

An implementation and monitoring plan should ensure CIV reliability and availability remains consistent with (or bounded by) the CIVs performance assumed for the proposed CIV CT extension and that the containment isolation function has not been adversely impacted. RG 1.174 states that monitoring performed in conformance with the maintenance rule of 10 CFR 50.65 can be used when such monitoring is sufficient for the SSCs affected by the risk-informed application. TR BAW-2461 is based on generic-plant characteristics, therefore, each licensee adopting TR BAW-2461 must confirm plant-specific implementation and monitoring of CIVs in accordance with the guidance of RG 1.174 and RG 1.177 in its individual submittals.

TR BAW-2461 and the PWROG, in their RAI response, stated that to ensure that plant risk is not adversely impacted by the proposed change, licensee's will establish performance criteria and track maintenance unavailability for the containment isolation system under the maintenance rule program, 10 CFR 50.65.

3.5 Comparison With Regulatory Guidance

The proposed change to provide an extended CIV CT meets the acceptance guidance of RGs 1.174 and 1.177 and the guidance outlined in Chapter 19.0 and Section 16.1 of NUREG-0800. The proposed CIV CTs do not affect the design or function of these valves; therefore, compliance with the referenced GDCs is not changed by the proposed CTs. Also, with the basis for extending the CTs shown to be acceptable, then 10 CFR 50.36 is also met.

3.6 TR BAW-2461 Revisions

1. TR BAW-2461, Table 2-1 will be revised to add an LCO Required Action to address CCF in the redundant CIV.

2. To address the CRMP and the multiple LCO entry of CIVs allowed by LCO 3.6.3, the TR will be modified to include an additional guidance and methods appendix to estimate LERF and ICLERP for inoperable CIVs for entry in LCO 3.6.3.

3. To clarify the PWROG intent of TR BAW-2461, the option to screen penetration line sizes and thresholds in estimating LERF impact is removed from TR BAW-2461. The last two sentences in Assumption 3, Section 3.3.2 are deleted and replaced with the following:

   > Therefore, a conservative estimate of cumulative LERF risk for multiple penetrations in the LCO simultaneously can be determined by combining the ICLERP probabilities alone, without regard for cumulative line size.

4. Change bullet on page 3-30 to read:

   "The extended AOT will not be applied to CIVs in penetrations connected to the RCS that have two NC CIVs if there are no other valves between the RCS and the environment (i.e., low pressure piping, or opening) that may be used for backup isolation. In that case, the operable CIV will be verified closed within the original 4-hour AOT, thus satisfying the TS Required Action."

   Similar changes are also proposed for bullets on pages 3-41 and 4-2 of TR BAW-2461.

5. Add the following bullet in Section 4.3 of TR BAW-2461.

   "If the extended AOT is applied to an RCS penetration that has two NC CIVs, then when entering the AOT, confirm that there is at least one other closed valve between the RCS and any low pressure piping or opening."

6. Revise the first bullet on page 3-43, from "Supports for" to "support system."

4.0 <u>LIMITATIONS AND CONDITIONS</u>

4.1 Staff Findings and Conditions and Limitations

The results presented in TR BAW-2461 are consistent with the acceptance guidelines given in RGs 1.177 and 1.174 and show a small increase in plant risk due to the extension of a CIV CT to 168 hours. This conclusion is predicated on adopting TR BAW-2461 in a manner consistent with the NRC staff's SE and the guidelines and assumptions identified in TR BAW-2461. In addition, the NRC staff's approval of this TR is subject to the following limitations and conditions:

1. Based on TR BAW-2461, the CIV methodology, PRA parameters, configurations, and data used to evaluate an extended CIV CT to 168 hours is limited to the following plants.

   - Davis-Besse
   - Oconee Units 1, 2, and 3
   - Crystal River 3

   Other licensees requesting to use the TR methodology must provide the same level of information provided by these demonstration plants to ensure that TR BAW-2461 is applicable to their plant.

2. Because not all penetrations have the same impact on ΔCDF, ΔLERF, ICCDP, or ICLERP, verify the applicability of TR BAW-2461 to the specific plant, including verification that: (a) the CIV configurations for the specific plant match the configurations in TR BAW-2461, and (b) the risk-parameter values used in TR BAW-2461 are bounding for the specific plant. Any additional CIV configurations, CT extensions, or non-bounding risk parameter values not evaluated by TR BAW-2461 should be addressed in the plant-specific analyses. [Note that CIV configurations and extended CTs not specifically evaluated by TR BAW-2461, or non-bounding risk parameter values outside the scope of the TR, will require NRC staff review and licensee development of the specific penetrations and related justifications for the proposed CTs].

3. Each licensee adopting TR BAW-2461 will need to confirm that the plant-specific risk assessment including both internal and external events is within the assumptions of TR BAW-2461 and the acceptance guidelines of RG 1.174 and 1.177. The licensee's application verifies that external event risk, including seismic, fires, floods, and high winds, either through quantitative or qualitative evaluation, is shown to not have an adverse impact on the conclusions of the plant-specific analysis for extending the CIV CTs. Specifically: (1) the risk from external events cannot make the total baseline risk exceed 1E-4/yr CDF, or 1E-5/yr LERF, without justification, (2) the risk from external events (i.e., high winds, floods and other) should be specifically evaluated with respect to the extended CIV CT, and (3) fire risk should be specifically addressed. The evaluation should include fire-induced spurious actuation (including containment performance) with respect to the proposed 168-hour CIV CT.

   Additionally, each licensee will need to confirm that the seismic CDF referenced for TR BAW-2461 is bounding for its plant, or incorporate a plant-specific seismic CDF estimate. Furthermore, the seismic initiating event frequency will need to be defined and justified for each licensee implementing TR BAW-2461. See Section 3.4.1.4 of this SE.

4. For licensees adopting TR BAW-2461, confirmation should be provided that the Tier 2 and Tier 3 conclusions of the TR are applicable to the licensee's plant and that plant-specific Tier 2 evaluations including CCF and risk-significant configurations including interfacing system LOCA have been evaluated and included under Tier 2 and Tier 3 including the CRMP as applicable.

   - The proposed 168-hour CIV CT will not be applied to CIVs in penetrations connected to the RCS that have two NC CIVs if there are no other valves between the RCS and the environment (i.e., low pressure piping, or opening) that may be used for backup isolation and cannot be confirmed closed. In that case, the operable CIV will be verified closed within the original 4-hour CT, thus satisfying the TS Required Action. See Section 3.3.4 of this SE.

     The specific penetrations where this is applicable or where interfacing system LOCA is shown to be risk-significant (as determined by the plant-specific risk-informed process including plant-specific LOCA analysis) will be identified on a plant-specific basis prior to implementation of the proposed TS change. They will be listed explicitly in the proposed TS revision and the current CT will be retained.

     TR BAW-2461 stated that since an interfacing system LOCA is assumed to go to core damage, the effectiveness of mitigation systems besides containment isolation is not considered significant. All failed open penetration flow paths with an RCS connection were assumed to have CDF and LERF contributions in TR BAW-2461. Licensees incorporating TR BAW-2461 will need to confirm the applicability of the above assumption for their plant.

   - The specific penetrations with CCF potential will be identified by the licensee on a plant-specific basis. Upon entry into TS LCO 3.6.3, Condition A, the utility will confirm that the redundant similarly-designed CIV has not been affected by the same failure mode as the inoperable CIV. This verification will be performed before entering into the extended portion of the CT (i.e., within 4 hours). The specific penetrations with CCF potential will be identified on a plant-specific basis and listed in a plant-specific TS interpretation document or other administrative source. See Section 3.4.1.2 of this SE.

   - No action or maintenance activity is performed that will remove equipment that is functionally redundant to the inoperable CIV, including the redundant CIV(s) on the same penetration and support systems for the redundant CIV. See Section 3.3 of TR BAW-2461.

   - No action or maintenance activity is performed that will significantly increase the likelihood of challenge to the CIVs. Challenges to the CIVs include DBAs that result in a release of radioactive material within containment (LOCA, main steam line break, and rod ejection accident). Also included is the removal of equipment from service that may cause a significant increase in the likelihood of core damage while in the proposed CT, which may increase the large early release via the inoperable CIV. See Section 3.4 of TR BAW-2461.

- No action or maintenance activity is performed that will remove equipment that supports success paths credited in the CT risk evaluation. This includes the other series valves, if any, credited in the risk assessment for RCS penetrations that otherwise would be risk-significant (i.e., interfacing system LOCA). See Section 3.4 of TR BAW-2461.

5. TR BAW-2461 was based on generic-plant characteristics. Each licensee adopting TR BAW-2461 must confirm plant-specific Tier 3 information in their individual submittals. The licensee must discuss conformance to the requirements of the maintenance rule (10 CFR 50.65(a)(4)), as they relate to the proposed CIV CTs and the guidance contained in NUMARC 93.01, Section 11, as endorsed by RG 1.182, including verification that the licensee's maintenance rule program, with respect to CIVs, includes a LERF/ICLERP assessment (i.e., CRMP). See Section 3.4.3 of this SE.

6. TS LCO 3.6.3 Note 2 allows separate condition entry for each penetration flow path. Therefore, each licensee adopting TR BAW-2461 will address the simultaneous LCO entry of an inoperable CIV in separate penetration flow paths such that the proposed 168-hour CIV CT LCO will be limited to no more than one CIV at any given time. In addition, the licensee must confirm that its Tier 3 CRMP addresses simultaneous inoperable CIV LCOs (i.e., separate condition entry) such that the cumulative CIV risk, including LERF, are maintained consistent with the assumptions and conclusions of TR BAW-2461. See Section 3.4.1.2 of this SE.

7. The licensee shall verify that the plant-specific PRA quality is acceptable for this application in accordance with the guidelines given in RG 1.174 and as discussed in Section 3.4.1.1 of this SE.

8. The cumulative risk impact of previous licensee changes or current license changes under review with respect to the proposed CIV CT extension will be addressed per the acceptance guidelines of RG 1.174, Sections 2.2.6 and 3.3.2. See Section 3.4.1.5 of this SE.

9. Closed systems inside and outside containment, which are considered to be containment isolation barriers, must meet the provisions outlined in NUREG-0800, Section 6.2.4, “Containment Isolation System.” See Section 2.2 of this SE.

10. With an extended CIV CT, the possibility exists that the CIV unavailability will be impacted. Depending on the penetration risk significance and the frequency and length of time of the CIV CT, the unavailability of the containment isolation function may also be impacted. Therefore, licensee’s adopting TR BAW-2461 will need to establish an implementation and monitoring program for CIVs, including performance criteria, on a plant-specific basis. See Sections 3.4.1.2 and 3.4.4 of this SE.

11. The PWROG did not specifically address ΔCDF and ΔLERF in TR BAW-2461 regarding the acceptance guidelines of RG 1.174. The PWROG stated that it is not expecting that on line CIV preventive maintenance will increase with the proposed 168-hour CIV. To address this, licensee’s adopting TR BAW-2461 will need to assess, on a plant-specific basis, the ΔCDF and ΔLERF acceptance guidance of RG 1.174 including the expected

frequency of entering the proposed CT and the expected mean CT for CIV maintenance. See Section 3.4.1.2 of this SE.

4.2 Regulatory Commitment

The RG 1.177 Tier 3 program ensures that while a CIV is in an LCO condition, additional activities will not be performed that could further degrade the capabilities of the plant to respond to a condition for which the inoperable CIV or system was designed to mitigate, and as a result, increase plant risk beyond that assumed by the TR BAW-2461 analysis. A licensee's implementation of RG 1.177 Tier 3 guidelines generally implies the assessment of risk with respect to CDF. However, the proposed CIV CT impacts containment isolation and consequently LERF and ICLERP, as well as CDF. Because the extended CIV CTs are also based on the LERF and ICLERP metrics, the management of risk in accordance with 10 CFR 50.65(a)(4) for these extended CIV CTs must also assess LERF and ICLERP.

Therefore, a licensee's CRMP, including those implemented under the maintenance rule of 10 CFR 50.65(a)(4), must describe how LERF/ICLERP is assessed as well as demonstrating PRA quality as part of the licensee's Tier 2 and Tier 3 assessment. Since NUMARC 93-01 implements ICLERP as the quantitative risk metric (i.e., based on a zero maintenance model), and RG 1.177 utilizes ICLERP (i.e., based on an average maintenance model), the licensees, in their implementation of TR BAW-2461 will need to demonstrate the equivalence for Tier 3 decisionmaking. The methodology for assessing LERF and ICLERP are to be documented in the plant-specific application as a regulatory commitment (i.e., included in the licensee's commitment tracking system in accordance with NEI 99-04, Revision 0, "Guidelines for Managing NRC Commitment Changes") (Reference 10) in the licensees' plant-specific applications referencing TR BAW-2461.

The NRC staff finds that reasonable controls for the implementation and for subsequent evaluation of proposed changes pertaining to regulatory commitment(s) can be provided by the licensees' administrative processes, including their commitment management program. The NRC staff has agreed that NEI 99-04 provides reasonable guidance for the control of regulatory commitments made to the NRC staff (see Regulatory Issue Summary 2000-17, "Managing Regulatory Commitments Made by Power Reactor Licensees to the NRC Staff," dated September 21, 2000). The NRC staff notes that this establishes a voluntary reporting system for the operating data that is similar to the system established for the reactor oversight process performance indicators program. The commitments would be controlled in accordance with the industry guidance or comparable criteria employed by a specific licensee. The NRC staff may choose to verify the implementation and maintenance of these commitments in a future inspection or audit. Should licensees choose to incorporate a regulatory commitment into the final safety analysis report or other document with established regulatory controls, the associated regulations would define the appropriate change-control and reporting requirements.

5.0 CONCLUSION

The risk impact of the proposed 168-hour CT for a CIV as estimated by ΔCDF, ΔLERF, ICCDP, and ICLERP, is consistent with the acceptance guidelines specified in RG 1.174, RG 1.177, and NRC staff guidance outlined in Chapter 16.1 of NUREG-0800. The NRC staff finds that the risk analysis methodology and approach used by the PWROG to estimate the CIV

CT risk impacts were reasonable and of sufficient quality for the intended application. However, to be within these guidelines, some CIVs may not qualify for the proposed CT. Specifically, CIVs located in the main steam lines are excluded on a generic basis. In addition, CIVs found to be risk significant with respect to interfacing system LOCA will be identified and excluded on a plant-specific basis. Thus, plant-specific application of the proposed methodology may not support an increased CT for all CIV configurations addressed by TR BAW-2461.

Although TR BAW-2461 identified generic guidance in implementing the TR, the Tier 2 evaluation did not identify plant-specific risk-significant plant equipment configurations requiring TSs, procedures, or compensatory measures. Therefore, a plant-specific Tier 2 analysis must be done for plants adopting TR BAW-2461 to confirm or adjust this aspect of the evaluation, as appropriate.

TR BAW-2461 references a CRMP (Tier 3) using 10 CFR 50.65(a)(4) to manage plant risk when CIVs are taken out of service. CIV availability will also be monitored and assessed under the maintenance rule (10 CFR 50.65) to confirm that performance continues to be consistent with the analysis assumptions used to justify the proposed 168-hour CIV CT. Based on the above, and contingent on the licensee adequately addressing the SE conditions and limitations and regulatory commitment as part of the basis of a risk-informed application, the NRC staff finds the proposed 168-hour CT acceptable for the CIVs evaluated in TR BAW-2461 pending that each plant submit a risk-informed assessment showing that the guidelines identified in TR BAW-2461 are satisfied.

6.0 REFERENCES

1. The B&W Owners Group, “Request for Approval of BAW-2461, Revision 0, ‘Risk-Informed Justification for Containment Isolation Valve Allowed Outage Time Change,’“January 14, 2005, Accession No. ML051600236.

2. PWR Owners Group, “Responses to NRC Request for Additional Information Regarding the Review of BAW-2461, ‘Risk Informed Justification for Containment Isolation Valve Allowed Outage Time Change,’“ July 5, 2006, Accession No. ML061880299.

3. B&W Owners Group, Topical Report BAW-2461, “Risk-Informed Justification for Containment Isolation Valve Allowed Outage Time Change,” Accession No. ML071090548.

4. U.S. Nuclear Regulatory Commission, RG 1.174, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,” November 2002.

5. U.S. Nuclear Regulatory Commission, RG 1.177, “An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications,” August 1998.

6. U.S. Nuclear Regulatory Commission, NUREG-1430, “Standard Technical Specifications - Babcock and Wilcox Plants,” June 2004.

7. U.S. *Code of Federal Regulations*, “Domestic Licensing of Production and Utilization Facilities,” Part 50, Title 10, “Energy.”

8. U.S. Nuclear Regulatory Commission, NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, June 1987.

9. U.S. Nuclear Regulatory Commission, NUREG-1715, Accession Nos. ML011800236 and ML012630199.

10. Nuclear Energy Institute 99-04, Revision 0, “Guidelines for Managing NRC Commitment Changes,” July 1999.

Principle Contributor: C. Doutt

Date: May 16, 2007