SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TOPICAL REPORT NEDO-33349, REVISION 1

"BWR APPLICATION TO RG 1.97, REVISION 4"

BOILING WATER REACTOR OWNERS' GROUP

PROJECT NO. 691

1.0 INTRODUCTION AND BACKGROUND

By letter dated August 31, 2007 (Reference 1), the Boiling Water Reactor (BWR) Owners' Group (BWROG) submitted licensing topical report (LTR) NEDO-33349, Revision 1, "BWR [Boiling Water Reactor] Application to RG [Regulatory Guide] 1.97, Revision 4," for U.S. Nuclear Regulatory Commission (NRC) staff review. The LTR provides the technical justification for the use of Regulatory Guide (RG) 1.97 Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," issued June 2006 (Reference 2), for currently licensed boiling water reactors (BWRs). By letters dated October 31, 2008 (Reference 3), September 14, 2009 (Reference 4), and September 10, 2010 (Reference 5), the BWROG submitted supplemental material in response to the NRC staff's request for additional information.

Licensees of plants with operating licenses issued before June 2006 committed to follow either Revision 2 or 3 of RG 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," (References 6 and 7). Both Revisions 2 and 3 of RG 1.97 prescribe a detailed list of variables to monitor and specify comprehensive design and qualification criteria to be met by the instrumentation monitoring variable. Revision 4 of RG 1.97 endorses with exceptions and clarifications, Institute of Electrical and Electronics Engineers (IEEE) Std. 497-2002, "IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations," (Reference 8). IEEE Std. 497-2002 establishes flexible, performance-based criteria for the selection, performance, design, qualification, display, and quality assurance of accident monitoring variables. Licensees of plants with operating licenses issued before June 2006 may convert to the criteria of RG 1.97, Revision 4, or use those criteria when performing modifications that do not involve a conversion. The guidance in Regulatory Position 1 of RG 1.97, Revision 4, should be followed in these cases.

Revisions 2 and 3 of RG 1.97 group the monitored variables into five types. Each type separates the variables based on the general purpose (or function) of the variables. Individual variables may be monitored for multiple functions and, therefore, belong to multiple types. Type A variables supply the primary information required to permit the control room operators to take specific manually controlled actions for which no automatic control is provided and that are required for safety systems to accomplish their safety function for design basis events. Type B variables indicate whether plant safety functions are being accomplished. Type C variables provide information indicating the potential for being breached or the actual breach of the barriers to fission product releases. Type D variables indicate the operation of individual safety

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systems and other systems important to safety. Type E variables provide information for use in determining the magnitude of a release of radioactive materials and continual assessment of such releases.

Revisions 2 and 3 of RG 1.97 present design and qualification criteria separated into three categories that provide a graded approach depending on the importance to safety of the measurement of a specific variable. Category 1 provides for environmental and seismic qualification, redundancy, continuous real-time display, and on-site Class 1E power sources.

Category 2 provides for environmental qualification but is less stringent in that it does not include seismic qualification, redundancy, or continuous display, and only a highly-reliable power source is needed. Category 3 provides for high-quality commercial-grade equipment and recommends only offsite power.

This mixture of type and category results in the need for several instruments to meet the criteria for multiple type and category combinations. In cases where a single variable monitors multiple functions, some licensees have provided one set of instrumentation that meets the highest category criteria of the multiple functions of that variable.

Since the criteria in Revisions 2 and 3 of RG 1.97 are similar, this document will refer to both revisions as RG 1.97, Revision 3, unless differences in criteria between the two need to be noted. In those cases, this document will refer specifically to Revision 2 or Revision 3.

RG 1.97, Revision 4, endorses with exceptions and clarifications, IEEE Std. 497-2002, which classifies accident monitoring variables into Types A, B, C, D, or E. The selection criteria in IEEE Std. 497-2002 are as follows:

> Type A variables are those variables that provide the primary information required to permit the control room operating staff to (a) take specific planned manually-controlled actions for which no automatic control is provided and that are required for safety systems to perform their safety-related functions as assumed in the plant accident analysis licensing basis, and (b) take specific planned manually-controlled actions for which no automatic control is provided and that are required to mitigate the consequences of an anticipated operational occurrence.
>
> Type B variables are those variables that provide primary information to the control room operators to assess the plant safety functions.
>
> Type C variables are those variables that provide primary information to the control room operators to indicate the potential for breach or the actual breach of the fission product barriers including extended ranges.
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> Type D variables are those variables that are required in procedures and licensing basis documents to (a) indicate the performance of those safety systems and auxiliary supporting features necessary for the mitigation of design basis events, (b) indicate the performance of other systems necessary to achieve and maintain a safe shutdown condition, and (c) verify safety system status.

Type E variables are those variables required for use in determining the magnitude of the release of radioactive materials and continually assessing such releases.

IEEE Std. 497-2002 does not use the RG 1.97, Revision 3, approach of establishing design and qualification categories. Instead, the design and qualification of each variable is based on functional need. The net result is essentially the same as the RG 1.97, Revision 3, categorization, with minor exceptions as follows:

The design and qualification criteria for Type A in RG 1.97, Revision 4, is equivalent to Category 1 in RG 1.97, Revision 3; however, (1) environmental qualification is not required if the instrument performs its required accident monitoring function in an environment which is not harsh for the design basis event the instrument is needed for and (2) seismic qualification is not required if the instrument's accident monitoring function is not required following a seismic event.

The design and qualification criteria for Types B and C in RG 1.97, Revision 4, are equivalent to Category 1 in RG 1.97, Revision 3. Variables that are classified as Type B or Type C, Category 2 or 3 do not need to meet the Type B or Type C design and qualification criteria of RG 1.97, Revision 4.

The design and qualification criteria for Type D in RG 1.97, Revision 4, is equivalent to Category 2 in RG 1.97, Revision 3; however, (1) environmental qualification is not required if the instrument performs its required accident monitoring function in an environment which is not harsh; (2) seismic qualification is not required if the instrument's accident monitoring function is not required following a seismic event; and (3) if an interruption in power is tolerable a continuously available source of power is not required. Variables that were classified as Type D, Category 3 do not need to meet the Type D design and qualification criteria of RG 1.97, Revision 4.

The design and qualification criteria for Type E instrumentation in RG 1.97, Revision 4, are equivalent to Category 3 in RG 1.97, Revision 3. However, if an interruption of power is not tolerable, a continuously available source of power is required.

Note: Instruments classified as more than one type should either meet the more limiting criteria or separate instruments can be provided for each type.

Although not specifically stated in IEEE Std. 497-2002, the intent of the IEEE working group was that RG 1.97, Revision 3, Type D, Category 1 variables would become IEEE Std. 497-2002 Type B variables (There are no RG 1.97, Revision 3, BWR Type D, Category 1 variables). Additionally, RG 1.97, Revision 3, Type B and C backup and diagnostic variables would be expected to become IEEE Std. 497-2002 Type D or E variables, respectively (i.e., RG 1.97, Revision 3, Type B, Category 2 variables would become IEEE Std. 497-2002 Type D variables and RG 1.97, Revision 3, Type C, Category 2 and 3 variables would become IEEE Std. 497-2002 Type E variables). Some RG 1.97, Revision 3, backup and diagnostic variables might not warrant classification as IEEE Std. 497-2002 Type D or E variables, if they do not meet the selection criteria for Type D or E variables.

2.0 REGULATORY EVALUATION

The primary purpose of accident monitoring instrumentation is to display plant variables that provide information required by the control room operators during accident situations. This information provides the necessary support for the operators to take manual actions to initiate safety systems and other appropriate systems important to safety.

Criterion 13, "Instrumentation and Control," of Appendix A, General Design Criteria for Nuclear Power Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Domestic Licensing of Production and Utilization Facilities" (Reference 9) requires operating reactor licensees to provide instrumentation to monitor variables and systems over their anticipated ranges for accident conditions as appropriate to ensure adequate safety.

Criterion 19, "Control Room," of Appendix A to 10 CFR Part 50 requires operating reactor licensees to provide a control room from which actions can be taken to maintain the nuclear power unit in a safe condition under accident conditions, including loss-of-coolant accidents (LOCAs).

Criterion 64, "Monitoring Radioactivity Releases," of Appendix A to 10 CFR Part 50 requires operating reactor licensees to provide the means for monitoring the reactor containment atmosphere, spaces containing components to recirculate LOCA fluids, effluent discharge paths, and the plant environs for radioactivity that may be released as a result of postulated accidents.

The regulation in 10 CFR 50.34(f), "Additional TMI-related Requirements," requires certain operating reactor licensees to provide additional instrumentation related to the findings from the Three Mile Island (TMI) accident.

The regulation in 10 CFR 50.44, "Combustible Gas Control for Nuclear Power Reactors," requires operating reactors to meet requirements for combustible gas control and monitoring.

NUREG-0737, "Clarification of TMI Action Plan Requirements," dated November 30, 1980 (Reference 10), provides TMI-related action items approved for implementation.

NUREG-0737, Supplement No. 1, "Requirements for Emergency Response Capability," (Generic Letter No. 82-33)," dated December 17, 1982 (Reference 11), provides additional clarifications regarding NUREG-0737.

RG 1.97, Revisions 2, 3, 4, describes a method acceptable to the NRC staff for complying with the Commission's regulations to provide instrumentation for monitoring plant variables and systems during and after an accident.

3.0 TECHNICAL EVALUATION

3.1 NEDO-33349 Recommendations

NEDO-33349 lists the variables that should be monitored during and after an accident in accordance with RG 1.97, Revision 4. The BWROG performed an analysis to evaluate how each accident monitoring function is currently being monitored. Based on the results of the

analysis, NEDO-33349 recommends key variables for checking the performance of each accident monitoring function. This includes changes to some of the functions and function changes for some variables. The recommendations also include what would be considered changes in type under RG 1.97, Revision 3, for several variables. In some cases, variables are recommended that differ from those recommended by RG 1.97, Revision 3. In other cases, NEDO-33349 recommends that the variable recommended by RG 1.97, Revision 3, no longer be considered an accident monitoring variable.

3.1.A Type A Variables

NEDO-33349 recommends that Reactor Pressure Vessel (RPV) Water Level, RPV Pressure, Drywell Pressure, Suppression Pool Temperature, and Suppression Pool Water Level be classified as RG 1.97, Revision 4, Type A variables for design basis events. The selection of Type A variables is plant specific. Each licensee that uses NEDO-33349 should review its plant design against NEDO-33349 in the selection of Type A variables. For some plants the NEDO-33349 recommendation for Type A variables may not be applicable. Some plants may have additional Type A variables. Other plants, may find it necessary to justify deviations for not including individual Type A variables recommended by NEDO-33349.

The NRC staff accepts the NEDO-33349 recommendation that RPV Water Level, RPV Pressure, Drywell Pressure, Suppression Pool Temperature, and Suppression Pool Water Level be classified as RG 1.97, Revision 4, Type A variables, with the caveat that each licensee should review its plant design against NEDO-33349 in the selection of Type A variables.

3.1.B Type B Functions

RG 1.97, Revision 3, recommends that Reactivity Control, Core Cooling, Maintaining Reactor Coolant System Integrity, and Maintaining Containment Integrity as the Type B plant safety functions. NEDO-33349 recommends that (1) Reactivity Control, (2) Level Control, (3) Pressure Control, and (4) Primary Containment Control as the Type B plant safety functions.

The change in terminology for the safety functions from RG 1.97, Revision 3, to that used in NEDO-33349 is the result of naming conventions associated with the BWR Emergency Procedures Guidelines (EPGs).

The RG1.97, Revision 3, Core Cooling function relates to fuel cladding barrier integrity where the fuel remains intact when the water level in the reactor is maintained above a predetermined level. The water level in the reactor ensures that core cooling is maintained. Therefore, the NEDO-33349 Level Control function replaces the RG 1.97, Revision 3, Core Cooling function.

The reactor coolant pressure boundary provides a barrier to the release of primary coolant from the reactor coolant system to the primary containment. The BWR EPG for RPV Control uses pressure, level, and power control in an integrated manner to fulfill the RG 1.97, Revision 3, Reactor Coolant System Integrity function. Along with other pressure instrumentation the reactor coolant system pressure is maintained. Monitoring RPV pressure instrumentation satisfies both the RG 1.97, Revision 3, Maintaining Reactor Coolant System Integrity function and the NEDO-33349 Pressure Control function. Therefore, the NEDO-33349 Pressure Control function replaces the RG 1.97, Revision 3, Maintaining Reactor Coolant System Integrity function.

The primary containment includes isolation features that provide a barrier to the release of radioactive material due to a postulated LOCA from the primary containment. RG 1.97, Revision 3, refers to these features as fulfilling the Maintaining Containment Integrity function. NEDO-33349 refers to these features as the Primary Containment Control function. Therefore, the NEDO-33349 Primary Containment Control function replaces the RG 1.97, Revision 3, Maintaining Containment Integrity function.

3.1.B.1 Type B Reactivity Control Variables

3.1.B.1.1 Neutron Flux

RG 1.97, Revision 3, recommends that Type B, Category 1 instrumentation be provided to monitor Neutron Flux to provide function detection and accomplishment of mitigation of the Reactivity Control function. NEDO-31558, "Position on NRC Regulatory Guide 1.97, Revision 3, Requirements for Post-Accident Neutron Monitoring System," issued April 1, 1988 (Reference 12), proposed alternate design and qualification criteria for Neutron Flux monitoring instrumentation at BWR plants. In its safety evaluation dated January 13, 1993 (Reference 13), the NRC staff accepted NEDO-31558 for BWR plants with applications submitted before January 14, 1993. NEDO-31558 was reissued as NEDO-31558-A, March 1993 (Reference 14) to incorporate the January 13, 1993 safety evaluation. NEDO-33349 recommends that Neutron Flux remain an RG 1.97, Revision, 4 Type B variable with the NEDO-31558 alternate design and qualification criteria. Neutron Flux also meets the criteria of an RG 1.97, Revision 4, Type D variable, as it provides status information on the Reactor Protection System (RPS) and the Control Rod Drive (CRD) System performance.

The NRC staff agrees with the classification of Neutron Flux as an RG 1.97, Revision 4, Type B key variable, with the NEDO-31558 alternate design and qualification criteria, to provide information about the accomplishment of the Reactivity Control function.

3.1.B.1.2 Control Rod Position

RG 1.97, Revision 3, recommends that Type B, Category 3 instrumentation be provided to monitor Control Rod Position for verification of the Reactivity Control function. NEDO-33349 recommends that Control Rod Position need not be considered as an RG 1.97, Revision 4, Type B variable. The justification given in NEDO-33349 is that Control Rod Position is not a key variable for providing information about the accomplishment of the Reactivity Control function. Control Rod Position does, however, meet the criteria of an RG 1.97, Revision 4, Type D variable, as it provides status information on the RPS and the CRD System performance.

As an RG 1.97, Revision 3, Type B, Category 3 variable, Control Rod Position does not need to meet the RG 1.97, Revision 4, Type B design and qualification criteria. The NRC staff agrees that Control Rod Position is not a key variable for providing information about the accomplishment of the Reactivity Control function and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type B variable for the Reactivity Control function.

3.1.B.1.3 Reactor Coolant System Soluble Boron Concentration

RG 1.97, Revision 3, recommends that Type B, Category 3 instrumentation be provided to monitor Reactor Coolant System (RCS) Soluble Boron Concentration (Grab Sample) to provide

verification of the Reactivity Control function. NEDO-33349 recommends that RCS Soluble Boron Concentration (Grab Sample) need not be considered as an RG 1.97, Revision 4, Type B variable. The justification given in NEDO-33349 is that RCS Soluble Boron Concentration (Grab Sample) is not a key variable for providing information about the accomplishment of the Reactivity Control function.

As an RG 1.97, Revision 3, Type B, Category 3 variable RCS Soluble Boron Concentration (Grab Sample) does not need to meet the RG 1.97, Revision 4, Type B design and qualification criteria. The NRC staff agrees that RCS Soluble Boron Concentration (Grab Sample) is not a key variable for providing information on the accomplishment of the Reactivity Control function and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type B variable for the Reactivity Control function. However, this does not release licensees from meeting the requirements of 10 CFR 50.34(f)(1)(viii) and NUREG-0737, Item II.B.3.

3.1.B.2 Type B Level Control Variables

3.1.B.2.1 Reactor Pressure Vessel Water Level

RG 1.97, Revision 3, recommends that Type B, Category 1 instrumentation be provided to monitor RPV Water Level (Coolant Level in Reactor Vessel) to provide function detection, accomplishment of mitigation, and verification of the Core Cooling function. NEDO-33349 recommends that RPV Water Level be classified as an RG 1.97, Revision 4, Type B variable for the Level Control function. The justification given in NEDO-33349 is that RPV Water Level is the same Type B variable as Coolant Level in the Reactor Vessel for monitoring the RG 1.97, Revision 3, Core Cooling function. RPV Water Level is equivalent to Coolant Level in Reactor Vessel and Level Control is equivalent to Core Cooling. The terminology difference is the result of naming conventions associated with the BWR EPGs.

The NRC staff agrees with the classification of RPV Water Level as an RG 1.97, Revision 4, Type B key variable to provide information about the accomplishment of the Level Control function.

3.1.B.2.2 BWR Core Temperature

RG 1.97, Revision 3, recommends that Type B (without any category designation) instrumentation be provided to monitor BWR Core Temperature (RG 1.97, Revision 3) or BWR Core Thermocouples (RG 1.97, Revision 2) to provide diverse indication of water level for the Core Cooling function. NEDO-33349 recommends that BWR Core Temperature need not be considered as an RG 1.97, Revision 4, Type B variable. The justification given in NEDO-33349 is that not monitoring BWR Core Temperature is a generically approved deviation.

NUREG-0737, Supplement 1, does not require the monitoring of BWR Core Temperature, pending further developments and considerations. The RG 1.97, Revision 3, recommendation for BWR Core Temperature monitoring has never been imposed and has not been reviewed as part of compliance with RG 1.97. The NRC staff agrees that BWR Core Temperature is not a key variable for providing information on the accomplishment of the Level Control function and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type B variable for the Level Control function.

3.1.B.3 Type B Pressure Control Variables

3.1.B.3.1 Reactor Pressure Vessel Pressure

RG 1.97, Revision 3, recommends that Type B, Category 1 instrumentation be provided to monitor RPV Pressure (Reactor Coolant Pressure) to provide function detection, accomplishment of mitigation, and verification of the Maintaining Reactor Coolant System Integrity function. NEDO-33349 recommends that RPV Pressure remains as an RG 1.97, Revision 4, Type B variable for the Pressure Control function. The justification given in NEDO-33349 is that monitoring RPV Pressure satisfies both the RG 1.97, Revision 3, Maintaining Reactor Coolant System Integrity function and the NEDO-33349 Pressure Control function. Therefore, the NEDO-33349 Pressure Control function replaces the RG 1.97, Revision 3, Maintaining Reactor Coolant System Integrity function.

The NRC staff agrees with the classification of RPV Pressure as an RG 1.97, Revision 4, Type B key variable to provide information on the accomplishment of the Pressure Control function.

3.1.B.3.2 Drywell Pressure

RG 1.97, Revision 3, recommends that Type B, Category 1 instrumentation be provided to monitor Drywell Pressure to provide function detection, accomplishment of mitigation, and verification of the Maintaining Reactor Coolant System Integrity function. NEDO-33349 recommends that Drywell Pressure need not be considered as an RG 1.97, Revision 4, Type B variable for the Pressure Control function. The justification given in NEDO-33349 is that the Reactor Control EPGs include RPV Pressure as the key variable for providing information on the accomplishment of the Pressure Control function. Drywell Pressure serves as a key variable for other RG 1.97, Revision 4, Type B functions.

The NRC staff agrees that Drywell Pressure is not a key variable for providing information on the accomplishment of the Pressure Control function and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type B variable for the Pressure Control function.

3.1.B.3.3 Drywell Sump Level

RG 1.97, Revision 3, recommends that Type B, Category 1 instrumentation be provided to monitor Drywell Sump Level to provide function detection, accomplishment of mitigation, and verification of the Maintaining Reactor Coolant System Integrity function. NEDO-33349 recommends that Drywell Sump Level need not be considered as an RG 1.97, Revision 4, Type B variable. The justification given in NEDO-33349 is that Drywell Sump Level is not relied on in the safety analysis or the EPGs for small or large leaks.

The NRC staff agrees that Drywell Sump Level is not a key variable for providing information on the accomplishment of the Pressure Control function and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type B variable for the Pressure Control function.

3.1.B.4 Type B Primary Containment Control Variables

3.1.B.4.1 Drywell Pressure/Containment Pressure

RG 1.97, Revision 3, recommends that Type B, Category 1 instrumentation be provided to monitor Primary Containment Pressure to provide function detection, accomplishment of mitigation, and verification of the Maintaining Containment Integrity function. NEDO-33349 recommends that Drywell Pressure/Containment Pressure be classified as an RG 1.97, Revision 4, Type B variable for the Primary Containment Control function. The justification given in NEDO-33349 is that Drywell Pressure and Containment Pressure are essentially the same instruments for BWR Mark I and II containments, and the two terms are used interchangeably. In Mark III containments, the Drywell Pressure and Containment Pressure instruments have only minor differences in their readings. The EPGs use Drywell Pressure.

The NRC staff agrees with the classification of Drywell Pressure/Containment Pressure as an RG 1.97, Revision 4, Type B key variable to provide information on the accomplishment of the Primary Containment Control function.

3.1.B.4.2 Suppression Pool Temperature

NEDO-33349 recommends that Suppression Pool Temperature be classified as an RG 1.97, Revision 4, Type B variable to provide information on the Primary Containment Control function. The justification given in NEDO-33349 is that Suppression Pool Temperature is an EOP entry condition for the Primary Containment Control function. Suppression Pool Temperature is monitored and controlled to protect equipment in the primary containment and to ensure containment integrity for the duration of an accident.

The NRC staff agrees with the classification of Suppression Pool Temperature as an RG 1.97, Revision 4, Type B key variable to provide information on the accomplishment of the Primary Containment Control function.

3.1.B.4.3 Suppression Pool Water Level

NEDO-33349 recommends that Suppression Pool Water Level be classified as an RG 1.97, Revision 4, Type B variable to provide information on the Primary Containment Control function. The justification given in NEDO-33349 is that Suppression Pool Water Level is an EOP entry condition. Suppression Pool Water Level is monitored and controlled to ensure adequate quench volume to absorb heat capacity associated with emergency depressurization, provide reactor vessel makeup via Emergency Core Cooling Systems (ECCS), and minimize hydraulic-mechanical loading of equipment and structures located in the primary containment and/or the suppression chamber.

The NRC staff agrees with the classification of Suppression Pool Water Level as an RG 1.97, Revision 4, Type B key variable to provide information on the accomplishment of the Primary Containment Control function.

3.1.B.4.4 Primary Containment Isolation Valve Position

RG 1.97, Revision 3, recommends that Type B, Category 1 instrumentation be provided to monitor Primary Containment Isolation Valve (CIV) Position to provide information on the accomplishment of mitigation of the Maintaining Containment Integrity function. NEDO-33349 recommends that CIV Position be reclassified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that Type B variables provide information to plant operators for assessing the execution of plant safety functions. The BWR Type B Primary Containment Control function variables are Drywell Pressure, Suppression Pool Temperature, and Suppression Pool Water Level. CIV Position is not relied on in the safety analysis or in BWR EPGs. CIV Position does, however, meet the criteria of an RG 1.97, Revision 4, Type D variable, as it provides information on the status of CIV system performance.

The NRC staff agrees that CIV Position is not a key variable for providing information on the accomplishment of the Primary Containment Control function and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type B variable for the Primary Containment Control function.

3.1.C Type C Fission Product Barriers

RG 1.97, Revision 3, recommends that Fuel Cladding, Reactor Coolant Pressure Boundary, and Containment are the Type C fission product barriers. NEDO-33349 recommends that (1) Fuel Cladding, (2) Reactor Coolant Pressure Boundary, and (3) Primary Containment be the RG 1.97, Revision 4, Type C fission product barriers. These fission product barriers are the same, as the terminology changed from “Containment fission product barrier” in RG 1.97, Revision 3, to “Primary Containment fission product barrier” in NEDO-33349, as a result of the naming conventions associated with the BWR EPGs.

3.1.C.1 Type C Fuel Cladding Variables

3.1.C.1.1 Reactor Pressure Vessel Water Level

NEDO-33349 recommends that RPV Water Level be classified as an RG 1.97, Revision 4, Type C variable to provide information on the Fuel Cladding fission product barrier. The justification given in NEDO-33349 is that RPV Water Level is the parameter that most directly indicates the integrity of the fuel cladding fission product barrier. The integrity of the fuel cladding barrier is maintained when the core remains adequately cooled by water in the reactor. A breach of the fuel cladding barrier is assumed when adequate core cooling cannot be restored or has not been maintained. RPV Water Level is the most directly indicative parameter in determining adequate core cooling effectiveness. Other plant specific instrumentation is available to determine if core damage has occurred and the magnitude of the damage. This other instrumentation does not need to be classified as RG 1.97, Revision 4, Type C instrumentation.

The NRC staff agrees with the classification of RPV Water Level as an RG 1.97, Revision 4, Type C key variable to provide information about the integrity of the Fuel Cladding fission product barrier. However, since a decrease in RPV Water Level is only a precursor to fuel damage, each licensee should identify plant specific backup instrumentation to provide information to determine if core damage has occurred. This plant specific backup

instrumentation does not need to meet the RG 1.97, Revision 4, Type C design and qualification criteria.

3.1.C.1.2 Radioactivity Concentration or Radiation Level in Circulating Primary Coolant

RG 1.97, Revision 3, recommends that Type C, Category 1 instrumentation be provided to monitor Radioactivity Concentration or Radiation Level in Circulating Primary Coolant to detect a breach in the Fuel Cladding fission product barrier. NEDO-33349 recommends that Radioactivity Concentration or Radiation Level in Circulating Primary Coolant need not be considered as an RG 1.97, Revision 4, Type C variable. The justification given in NEDO-33349 is that not monitoring Radioactivity Concentration or Radiation Level in Circulating Primary Coolant is a generically approved deviation.

The RG 1.97, Revision 3, recommendation for Radioactivity Concentration or Radiation Level in Circulating Primary Coolant has never been imposed and has not been reviewed as part of compliance with RG 1.97. The NRC staff agrees that Radioactivity Concentration or Radiation Level in Circulating Primary Coolant is not a key variable for providing information on the integrity of the Fuel Cladding fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Fuel Cladding fission product barrier.

3.1.C.1.3 Analysis of Primary Coolant

RG 1.97, Revision 3, recommends that Type C, Category 3 instrumentation be provided to monitor Analysis of Primary Coolant to provide detailed analysis, accomplishment of mitigation, verification, and long-term surveillance of the Fuel Cladding fission product barrier. NEDO-33349 recommends that Analysis of Primary Coolant need not be considered as an RG 1.97, Revision 4, Type C variable. The justification given in NEDO-33349 is that not monitoring the Analysis of Primary Coolant is a generically approved deviation.

The RG 1.97, Revision 3, recommendation for the Analysis of Primary Coolant has not been reviewed as part of compliance with RG 1.97. The NRC staff agrees that Analysis of Primary Coolant is not a key variable for providing information on the integrity of the Fuel Cladding fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Fuel Cladding fission product barrier. However, this does not release licensees from meeting the requirements of 10 CFR 50.34(f)(1)(viii) and NUREG-0737, Item II.B.3.

3.1.C.1.4 BWR Core Temperature

RG 1.97, Revision 3, recommends that Type C (without any category designation) instrumentation be provided to monitor BWR Core Temperature (Revision 3) or BWR Core Thermocouples (Revision 2) to provide diverse indication of water level for the Fuel Cladding fission product barrier. NEDO-33349 recommends that BWR Core Temperature need not be considered as an RG 1.97, Revision 4, Type C variable. The justification given in NEDO-33349 is that not monitoring BWR Core Temperature is a generically approved deviation.

NUREG-0737, Supplement 1, does not require the monitoring of BWR Core Temperature, pending further developments and considerations. The RG 1.97, Revision 3, recommendation for BWR Core Temperature monitoring has never been imposed and has not been reviewed as

part of compliance with RG 1.97. The NRC staff agrees that BWR Core Temperature is not a key variable for providing information on the integrity of the Fuel Cladding fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Fuel Cladding fission product barrier.

3.1.C.2 Type C Reactor Coolant Pressure Boundary Variables

3.1.C.2.1 Reactor Pressure Vessel Water Level

NEDO-33349 recommends that RPV Water Level be classified as an RG 1.97, Revision 4, Type C variable to provide information on the Reactor Coolant Pressure Boundary fission product barrier. The justification given in NEDO-33349 is that RPV Water Level is the Type C variable most directly associated with the Reactor Coolant Pressure Boundary fission product barrier. The control of RPV Water Level is considered a key parameter for maintaining the Reactor Pressure Boundary fission product barrier.

The NRC staff agrees with the classification of RPV Water Level as an RG 1.97, Revision 4, Type C key variable to provide information on the integrity of the Reactor Coolant Pressure Boundary fission product barrier.

3.1.C.2.2 Reactor Pressure Vessel Pressure

RG 1.97, Revision 3, recommends that Type C, Category 1 instrumentation be provided to monitor RPV Pressure to detect the potential for a breach or actual breach, accomplishment of mitigation, and long-term surveillance of the Reactor Coolant Pressure Boundary fission product barrier. NEDO-33349 recommends that RPV Pressure remains as an RG 1.97, Revision 4, Type C variable for the Reactor Coolant Pressure Boundary fission product barrier. The justification given in NEDO-33349 is that RPV Pressure is one of several variables needed to address all potential breaches of the reactor coolant pressure boundary.

The NRC staff agrees with the classification of RPV Pressure as an RG 1.97, Revision 4, Type C key variable to provide information on the integrity of the Reactor Coolant Pressure Boundary fission product barrier.

3.1.C.2.3 Drywell Pressure/Containment Pressure

RG 1.97, Revision 3, recommends that Type C, Category 1 instrumentation be provided to monitor Drywell Pressure to detect a breach and to verify the integrity of the Reactor Coolant Pressure Boundary fission product barrier. NEDO-33349 recommends that Drywell Pressure remains as an RG 1.97, Revision 4, Type C variable for the Reactor Coolant Pressure Boundary fission product barrier. The justification given in NEDO-33349 is that Drywell Pressure is one of several variables needed to address all potential breaches of the reactor coolant pressure boundary. NEDO-33349 also states that Drywell Pressure and Containment Pressure are essentially the same instruments for BWR Mark I and II containments, and the two terms are used interchangeably. In Mark III containments, the Drywell Pressure and Containment Pressure instruments have only minor differences in their readings.

The NRC staff agrees with the classification of Drywell Pressure/Containment Pressure as an RG 1.97, Revision 4, Type C key variable to provide information on the integrity of the Reactor Coolant Pressure Boundary fission product barrier.

3.1.C.2.4 Suppression Pool Water Level

RG 1.97, Revision 3, recommends that Type C, Category 1 instrumentation be provided to monitor Suppression Pool Water Level to detect a breach, accomplish mitigation, verification, and long-term surveillance of the Reactor Coolant Pressure Boundary fission product barrier. NEDO-33349 recommends that Suppression Pool Water Level remains as an RG 1.97, Revision 4, Type C variable for the Reactor Coolant Pressure Boundary fission product barrier. The justification given in NEDO-33349 is that Suppression Pool Water Level is one of several variables needed to address all potential breaches of the reactor coolant pressure boundary.

The NRC staff agrees with the classification of Suppression Pool Water Level as an RG 1.97, Revision 4, Type C key variable to provide information on the integrity of the Reactor Coolant Pressure Boundary fission product barrier.

3.1.C.2.5 Suppression Pool Temperature

NEDO-33349 recommends that Suppression Pool Temperature be classified as an RG 1.97, Revision 4, Type C variable for the Reactor Coolant Pressure Boundary fission product barrier. The justification given in NEDO-33349 is that Suppression Pool Temperature is one of several variables needed to address all potential breaches of the reactor coolant pressure boundary.

The NRC staff agrees with the classification of Suppression Pool Temperature as an RG 1.97, Revision 4, Type C key variable to provide information on the integrity of the Reactor Coolant Pressure Boundary fission product barrier.

3.1.C.2.6 Primary Containment Area Radiation

RG 1.97, Revision 3, recommends that Type C, Category 3 instrumentation be provided to monitor Primary Containment Area Radiation to detect a breach and verify the integrity of the Reactor Coolant Pressure Boundary fission product barrier. NEDO-33349 recommends that Primary Containment Area Radiation need not be classified as an RG 1.97, Revision 4, Type C variable. The justification given in NEDO-33349 is that Primary Containment Area Radiation may indicate radiation release from fuel cladding failure and reactor coolant pressure boundary breach, but it is not a direct indicator of the integrity of the Reactor Coolant Pressure Boundary fission product barrier. The variables for the BWR Type C Reactor Coolant Pressure Boundary fission product barrier are RPV Water Level, RPV Pressure, Drywell Pressure/Containment Pressure, Suppression Pool Water Level, and Suppression Pool Temperature. Primary Containment Area Radiation does, however, meet the criteria of an RG 1.97, Revision 4, Type E variable, as it provides the magnitude of release for Containment Area Radiation.

As an RG 1.97, Revision 3, Type C, Category 3 variable Primary Containment Area Radiation does not need to meet the RG 1.97, Revision 4, Type C design and qualification criteria. The NRC staff agrees that Primary Containment Area Radiation is not a key variable for providing information on the integrity of the Reactor Coolant Pressure Boundary fission product barrier

and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Reactor Coolant Pressure Boundary fission product barrier.

3.1.C.2.7 Drywell Drain Sump Level

RG 1.97, Revision 3, recommends that Type C, Category 1 instrumentation be provided to monitor Drywell Drain Sump Level to detect a breach, accomplishment of mitigation, verification, and long-term surveillance of the Reactor Coolant Pressure Boundary fission product barrier. NEDO-33349 recommends that Drywell Drain Sump Level need not be considered as an RG 1.97, Revision 4, Type C variable. The justification given in NEDO-33349 is that Drywell Drain Sump Level is isolated when a LOCA occurs. The drywell drain sump level is not used for other than normal operation to determine the potential degradation in the reactor coolant pressure boundary, so that repairs can be made before failure occurs.

The NRC staff agrees that Drywell Drain Sump Level is not a key variable for providing information on the integrity of the Reactor Coolant Pressure Boundary fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Reactor Coolant Pressure Boundary fission product barrier.

3.1.C.3 Type C Primary Containment Variables

3.1.C.3.1 Drywell Pressure/Containment Pressure

RG 1.97, Revision 3, recommends that Type C, Category 1 instrumentation be provided to monitor Primary Containment Pressure to detect the potential for a breach and the accomplishment of mitigation of the Containment function. NEDO-33349 recommends that Drywell Pressure be classified as an RG 1.97, Revision 4, Type C variable for the Primary Containment fission product barrier. The justification given in NEDO-33349 is that Drywell Pressure and Containment Pressure are essentially the same instruments for BWR Mark I and II containments, and the two terms are used interchangeably. In Mark III containments the Drywell Pressure and Containment Pressure instruments have only minor difference in their readings. Drywell Pressure indication is used as the EPG entry condition which supports plant mitigation strategies related to Primary Containment Control functions. Drywell Pressure is used for the determination of Primary Containment integrity.

The NRC staff agrees with the classification of Drywell Pressure/Containment Pressure as an RG 1.97, Revision 4, Type C key variable to provide information on the integrity of the Primary Containment fission product barrier.

3.1.C.3.2 Suppression Pool Temperature

NEDO-33349 recommends that Suppression Pool Temperature be classified as an RG 1.97, Revision 4, Type C variable to provide information on the Primary Containment fission product barrier. The justification given in NEDO-33349 is that Suppression Pool Temperature is monitored to detect conditions leading to containment breach and to verify the effectiveness of ECCS action in preventing containment breach. Maintaining Suppression Pool Temperature within limits is an EPG action to ensure the maintenance of the containment pressure suppression function during accident conditions.

The NRC staff agrees with the classification of Suppression Pool Temperature as an RG 1.97, Revision 4, Type C key variable to provide information on the integrity of the Primary Containment fission product barrier.

3.1.C.3.3 Suppression Pool Water Level

NEDO-33349 recommends that Suppression Pool Water Level be classified as an RG 1.97, Revision 4, Type C variable to provide information on the Primary Containment fission product barrier. The justification given in NEDO-33349 is that Suppression Pool Water Level is an EPG entry condition for the Primary Containment function and is monitored and controlled below limits to protect equipment in the primary containment. Suppression Pool Water Level is monitored and controlled to maintain containment integrity for the duration of an accident.

The NRC staff agrees with the classification of Suppression Pool Water Level as an RG 1.97, Revision 4, Type C key variable to provide information on the integrity of the Primary Containment fission product barrier.

3.1.C.3.4 Reactor Pressure Vessel Pressure

RG 1.97, Revision 3, recommends that Type C, Category 1 instrumentation be provided to monitor RPV Pressure to detect the potential for breach and accomplishment of mitigation of the Containment fission product barrier. NEDO-33349 recommends that RPV Pressure need not be classified as an RG 1.97, Revision 4, Type C variable for the Primary Containment function. The justification given in NEDO-33349 is that RPV Pressure is not a direct or indirect indicator of a breach in the primary containment barrier.

The NRC staff agrees that RPV Pressure is not a key variable for providing information on the integrity of the Primary Containment fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Primary Containment fission product barrier.

3.1.C.3.5 Containment and Drywell Hydrogen

RG 1.97, Revision 3, recommends that Type C, Category 1 instrumentation be provided to monitor Containment and Drywell Hydrogen to detect the potential for breach and the accomplishment of mitigation for the Containment fission product barrier. The regulation in 10 CFR 50.44 accepts the use of RG 1.97, Type C, Category 3 instrumentation to monitor Containment and Drywell Hydrogen. NEDO-33349 recommends that Containment and Drywell Hydrogen need not be considered as an RG 1.97, Revision 4, Type C variable. The justification given in NEDO-33349 is that Containment and Drywell Hydrogen concentration requirements based on 10 CFR 50.44, which indicates that monitoring of Containment and Drywell Hydrogen is not needed for design basis events but is needed for beyond design basis events, do not meet the criteria for inclusion as an RG 1.97, Revision 4, Type C variable.

As an RG 1.97, Revision 3, Type C, Category 3 variable, as determined by 10 CFR 50.44, Containment and Drywell Hydrogen does not need to meet the RG 1.97, Revision 4, Type C design and qualification criteria. The NRC staff agrees that Containment and Drywell Hydrogen is not a key variable for providing information on the integrity of the Primary Containment fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C

variable for the Primary Containment fission product barrier. However, this does not release licensees from meeting the requirements of 10 CFR 50.44.

3.1.C.3.6 Containment and Drywell Oxygen

RG 1.97, Revision 3, recommends that Type C, Category 1 instrumentation be provided to monitor Containment and Drywell Oxygen to detect the potential for breach and accomplishment of mitigation for the Containment fission product barrier. The regulation in 10 CFR 50.44 accepts the use of RG 1.97, Revision 3, Type C, Category 2 instrumentation to monitor Containment and Drywell Oxygen. NEDO-33349 recommends that Containment and Drywell Oxygen need not be considered as an RG 1.97, Revision 4, Type C variable. The justification given in NEDO-33349 is that Containment and Drywell Oxygen concentration requirements based on 10 CFR 50.44, which indicates that Containment and Drywell Oxygen is not needed for design basis events but is needed for beyond design basis events, do not meet the criteria for inclusion as an RG 1.97, Revision 4, Type C variable.

As an RG 1.97, Revision 3, Type C, Category 2 variable, as determined by 10 CFR 50.44, Containment and Drywell Oxygen does not need to meet the RG 1.97, Revision 4, Type C design and qualification criteria. The NRC staff agrees that Containment and Drywell Oxygen is not a key variable for providing information on the integrity of the Primary Containment fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Primary Containment fission product barrier. However, this does not release licensees from meeting the requirements of 10 CFR 50.44.

3.1.C.3.7 Containment Effluent Radioactivity - Noble Gases

RG 1.97, Revision 3, recommends that Type C, Category 3 instrumentation be provided to monitor Containment Effluent Radioactivity - Noble Gases (from identified release points including Standby Gas Treatment) to detect an actual breach, accomplishment of mitigation, and verify the integrity of the Containment fission product barrier. NEDO-33349 recommends that Containment Effluent Radioactivity - Noble Gases need not be considered as an RG 1.97, Revision 4, Type C variable. The justification given in NEDO-33349 is that Containment Effluent Radioactivity - Noble Gases may be an indicator of radiation release, but it is not a direct indicator of the integrity of the primary containment barrier. RPV Pressure, Drywell Pressure/Containment Pressure, Suppression Pool Temperature, and Suppression Pool Water Level provide information about the Primary Containment function. Containment Effluent Radioactivity - Noble Gases does, however, meet the criteria of an RG 1.97, Revision 4, Type E variable, as it provides the magnitude of release for Containment Effluent Radioactivity - Noble Gases.

As an RG 1.97, Revision 3, Type C, Category 3 variable Containment Effluent Radioactivity - Noble Gases does not need to meet the RG 1.97, Revision 4, Type C design and qualification criteria. The NRC staff agrees that Containment Effluent Radioactivity - Noble Gases is not a key variable for providing information on the integrity of the Primary Containment fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Primary Containment fission product barrier.

3.1.C.3.8 Effluent Radioactivity - Noble Gases

RG 1.97, Revision 3, recommends that Type C, Category 2 instrumentation be provided to monitor Effluent Radioactivity - Noble Gases (from buildings or areas where penetrations and hatches are located, e.g., auxiliary building, fuel handling building, and secondary containment, that are in direct contact with primary containment) to indicate a breach in the Containment fission product barrier. NEDO-33349 recommends that Effluent Radioactivity - Noble Gases need not be considered as an RG 1.97, Revision 4, Type C variable. The justification given in NEDO-33349 is that Effluent Radioactivity - Noble Gases may be an indicator of radiation release, but it is not a direct indicator of the integrity of the primary containment barrier. RPV Pressure, Drywell Pressure/Containment Pressure, Suppression Pool Temperature, and Suppression Pool Water Level provide information about the Primary Containment function. Effluent Radioactivity - Noble Gases does, however, meet the criteria of an RG 1.97, Revision 4, Type E variable, as it provides the magnitude of release for Effluent Radioactivity - Noble Gases.

As an RG 1.97, Revision 3, Type C, Category 2 variable Containment Effluent Radioactivity - Noble Gases does not need to meet the RG 1.97, Revision 4, Type C design and qualification criteria. The NRC staff agrees that Effluent Radioactivity - Noble Gases is not a key variable for providing information on the integrity of the Primary Containment fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Primary Containment fission product barrier.

3.1.C.3.9 Radiation Exposure Rate

RG 1.97 Revision 2 recommends that Type C, Category 2 instrumentation be provided to monitor Radiation Exposure Rate (inside buildings or areas, such as the auxiliary building, fuel handling building, and secondary containment, that are in direct contact with the primary containment where penetrations and hatches are located) to indicate a breach of the Containment fission product barrier. NEDO-33349 recommends that Radiation Exposure Rate need not be considered as an RG 1.97, Revision 4, Type C variable. The justification given in NEDO-33349 is that Radiation Exposure Rate may be an indicator of radiation release, but it is not a direct indicator of the integrity of the primary containment barrier. RPV Pressure, Drywell Pressure/Containment Pressure, Suppression Pool Temperature, and Suppression Pool Water Level provide information about the Primary Containment function. Radiation Exposure Rate does, however, meet the criteria of an RG 1.97, Revision 4, Type E variable, as it provides the magnitude of release for Radiation Exposure Rate.

RG 1.97, Revision 3, does not recommend Radiation Exposure Rate as a Type C variable. As an RG 1.97, Revision 2 Type C, Category 2 variable Radiation Exposure Rate does not need to meet the RG 1.97, Revision 4, Type C design and qualification criteria. The NRC staff agrees that Radiation Exposure Rate is not a key variable for providing information on the integrity of the Primary Containment fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Primary Containment fission product barrier.

3.1.D Type D System Status

RG 1.97, Revision 3, recommends that the status of the following groups of systems be monitored for information indicating the operation of individual systems or other systems important to safety: Condensate and Feedwater System, Primary Containment Related

Systems, Main Steam System, Safety Systems, Residual Heat Removal (RHR) Systems, Cooling Water System, Radwaste Systems, Ventilation Systems, and Power Supplies.

NEDO-33349 recommends that the performance status of the following groups of systems be monitored: (1) Containment System, (2) Reactor Protection System and Control Rod Drive System, (3) Safety Relief Valve (SRV) System, (4) Reactor Core Isolation Cooling (RCIC) System, (5) High Pressure Coolant Injection (HPCI) or High Pressure Core Spray (HPCS) System, (6) RHR System, (7) Low Pressure Core Spray (LPCS) System, (8) Cooling Water System, (9) RHR Service Water System, (10) Essential Service Water System, (11) RPV Isolation System, (12) Containment Isolation System, (13) Secondary Containment System, (14) Control Room Environment System, (15) Standby Liquid Control System (SLCS), (16) Power Systems, (17) Equipment Area Cooling Water System, (18) Essential Pneumatic Gas Supply System, and (19) Isolation Condenser System. NEDO-33349 also recommends that the status of variables in the following RG 1.97, Revision 3, systems need not be monitored: (20) Condensate and Feedwater System, (21) Main Steam System, and (22) Radwaste Systems.

3.1.D.1 Type D Containment System Variables

3.1.D.1.1 Drywell Pressure/Containment Pressure

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Drywell Pressure to check the operation of the Primary Containment Related Systems. NEDO-33349 recommends that Drywell Pressure remains an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance. NEDO-33349 also states that Drywell Pressure and Containment Pressure are essentially the same instruments for BWR Mark I and II containments and the two terms are used interchangeably. In Mark III containments the Drywell Pressure and Containment Pressure instruments have only minor differences in their readings.

The NRC staff agrees with the classification of Drywell Pressure/Containment Pressure as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance.

3.1.D.1.2 Suppression Pool Temperature

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Suppression Pool Water Temperature to check the operation of the Primary Containment Related Systems. NEDO-33349 recommends that Suppression Pool Temperature remains an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance.

The NRC staff agrees with the classification of Suppression Pool Temperature as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance.

3.1.D.1.3 Suppression Pool Water Level

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Suppression Pool Water Level to check the operation of the Primary Containment Related Systems. NEDO-33349 recommends that Suppression Pool Water Level remains an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance.

The NRC staff agrees with the classification of Suppression Pool Water Level as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance.

3.1.D.1.4 Drywell Temperature

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Drywell Atmosphere Temperature to check the operation of Primary Containment Related Systems. NEDO-33349 recommends that Drywell Temperature remains an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance.

The NRC staff agrees with the classification of Drywell Temperature as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance.

3.1.D.1.5 Suppression Chamber Spray Flow

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Suppression Chamber Spray Flow to check the operation of the Primary Containment Related Systems. NEDO-33349 recommends that Suppression Chamber Spray Flow need not be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance. The justification given in NEDO-33349 is that the containment performance assessment does not rely upon Suppression Chamber Spray Flow. Containment performance information is provided by Drywell Pressure/Containment Pressure, Drywell Temperature, Suppression Pool Temperature, and Suppression Pool Water Level.

The NRC staff agrees with the reclassification of Suppression Chamber Spray Flow as not being an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance.

3.1.D.1.6 Drywell Spray Flow

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Drywell Spray Flow to check the operation of the Primary Containment Related Systems. NEDO-33349 recommends that Drywell Spray Flow need not be considered as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment System performance. The justification given in NEDO-33349 is that the containment performance assessment does not rely upon Drywell Spray Flow. Containment performance information is provided by Drywell Pressure/Containment Pressure, Drywell Temperature, Suppression Pool Temperature, and Suppression Pool Water Level.

The NRC staff agrees with the reclassification of Drywell Spray Flow as not being an RG 1.97, Revision 4, Type D variable to provide information on the status of Containment System performance.

3.1.D.2 Type D Reactor Protection System and Control Rod Drive System Variables

3.1.D.2.1 Neutron Flux

NEDO-33349 recommends that Neutron Flux be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of the RPS and CRD System performance. The justification given in NEDO-33349 is that Neutron Flux meets the criteria of a Type D variable because it demonstrates the status of the RPS and CRD System performance. NEDO-31558 proposed alternate design and qualification criteria for Neutron Flux monitoring instrumentation at BWR plants. The NRC staff accepted NEDO-31558 for BWR plants with applications submitted before January 14, 1993.

The NRC staff agrees with the classification of Neutron Flux as an RG 1.97, Revision 4, Type D variable with the NEDO-31558 alternate design and qualification criteria to provide information on the status of the RPS and CRD System performance.

3.1.D.2.2 Control Rod Position

NEDO-33349 recommends that Control Rod Position be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of the RPS and CRD System performance. The justification given in NEDO-33349 is that Control Rod Position indication system is used to determine that the RPS has performed its safety function by control rod insertion following an accident. The Control Rod Position system confirms that the CRD System has performed its safety function. The control rod position indication is a normal operating system that is not required to be seismically designed. Its function is completed before experiencing a harsh environment.

The NRC staff agrees with the classification of Control Rod Position as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the status of the RPS and the CRD System performance.

3.1.D.3 Type D Safety Relief Valve System Variables

3.1.D.3.1 Safety Relief Valve Position

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Primary System SRV Position for detection of accident and boundary integrity indication of the Main Steam System. NEDO-33349 recommends that SRV Position be classified as an RG 1.97, Revision 4, Type D variable to provide information on the SRV System performance. The justification given in NEDO-33349 is that SRV Position is a backup instrument only and is not required to be environmentally or seismically qualified. NEDO-33160, “Regulatory Relaxation for the Post Accident SRV Position Indication System,” issued December 13, 2004 (Reference 15), changed the RG 1.97, Revision 3, classification of SRV Position from Category 2 to Category 3. With a safety evaluation dated September 25, 2006 (Reference 16), the NRC staff accepted NEDO-33160. NEDO-33160 was reissued as NEDO-33160-A, October 2006

(Reference 17) to incorporate the September 25, 2006 safety evaluation. This change in category does not relieve licensees from meeting the requirements of 10 CFR 50.34(f) or NUREG-0737, Item II.D.3.

The NRC staff agrees with the classification of SRV Position as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the status of the SRV System performance. However, this does not relieve licensees from meeting the requirements of 10 CFR 50.34(f) or NUREG-0737, Item II.D.3.

3.1.D.4 Type D Reactor Core Isolation Cooling System Variables

3.1.D.4.1 Reactor Core Isolation Cooling System Flow

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor RCIC Flow to check the operation of Safety Systems. NEDO-33349 recommends that RCIC System Flow remains classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of RCIC System performance. The justification given in NEDO-33349 is that RCIC is required only for anticipated operational occurrences. It is not associated with any events requiring environmental or seismic qualification, and, therefore, is not required to be environmentally or seismically qualified.
The NRC staff agrees with the classification of RCIC System Flow as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the status of RCIC System performance.

3.1.D.4.2 Condensate Storage Tank Water Level

RG 1.97, Revision 3, recommends that Type D, Category 3 instrumentation be provided to monitor Condensate Storage Tank Level for indication of available water for cooling of the Condensate and Feedwater System. NEDO-33349 recommends that Condensate Storage Tank Water Level be reclassified as an RG 1.97, Revision 4, Type D variable to provide information on the status of RCIC System performance. The justification given in NEDO-33349 is that Condensate Storage Tank Level provides information on the status of the RCIC System, and, therefore, does not need to provide information on the Condensate and Feedwater System. The condensate storage tank is required only for anticipated operational occurrences. Condensate Storage Tank Level is not associated with any events requiring environmental or seismic qualification.

The NRC staff agrees with the reclassification of Condensate Storage Tank Level as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the status of RCIC System performance.

3.1.D.5 Type D High Pressure Coolant Injection or High Pressure Core Spray System Variables

3.1.D.5.1 High Pressure Coolant Injection or High Pressure Core Spray System Flow

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor HPCI Flow to check the operation of Safety Systems. NEDO-33349 recommends that

HPCI or HPCS System Flow remains classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of HPCI or HPCS System performance.

The NRC staff agrees with the classification of HPCI or HPCS System Flow as an RG 1.97, Revision 4, Type D variable to provide information on the status of HPCI or HPCS System performance.

3.1.D.5.2 Condensate Storage Tank Water Level

RG 1.97, Revision 3, recommends that Type D, Category 3 instrumentation be provided to monitor Condensate Storage Tank Level for indication of available water for cooling of the Condensate and Feedwater System. NEDO-33349 recommends that Condensate Storage Tank Water Level be reclassified as an RG 1.97, Revision 4, Type D variable to provide information on the status of HPCI or HPCS System performance. The justification given in NEDO-33349 is that Condensate Storage Tank Level provides information on the status of the HPCI or HPCS System, and, therefore, does not need to provide information on the Condensate and Feedwater System. The condensate storage tank is required only for anticipated operational occurrences. Condensate Storage Tank Level is not associated with any events requiring environmental or seismic qualification.

The NRC staff agrees with the reclassification of Condensate Storage Tank Level as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the status of the HPCI or HPCS System performance.

3.1.D.6 Type D Residual Heat Removal System Variables

3.1.D.6.1 Residual Heat Removal System Flow

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor RHR System Flow to check the operation of RHR Systems. NEDO-33349 recommends that RHR System Flow remains classified as an RG 1.97, Revision 4, Type D variable to provide RHR System performance information.

The NRC staff agrees with the classification of RHR System Flow as an RG 1.97, Revision 4, Type D variable to provide information on the status of RHR System performance.

3.1.D.6.2 Residual Heat Removal System Valve Position

NEDO-33349 recommends that RHR System Valve Position be classified as an RG 1.97, Revision 4, Type D variable to provide information on RHR System performance. The justification given in NEDO-33349 is that RHR System valve lineup can be used instead of flow indication for individual RHR operating modes. The BWR RHR system provides multiple operating modes including Low Pressure Coolant Injection (LPCI), suppression pool cooling, shutdown cooling, and drywell spray. The system uses common pumps and piping for the various systems that it feeds.

The NRC staff agrees with the classification of RHR System Valve Position as an RG 1.97, Revision 4, Type D variable to provide information on the status of RHR System performance.

3.1.D.6.3 Suppression Chamber Spray Flow

NEDO-33349 recommends that Suppression Chamber Spray Flow be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of RHR System performance. The justification given in NEDO-33349 is that Suppression Chamber Spray Flow is one of the modes considered in the EPGs.

Previously approved deviations from RG 1.97, Revision 3, have allowed the use of RHR Flow, Suppression Chamber Temperature, and Suppression Chamber Pressure as acceptable alternatives if it can be shown that (1) use of these variables can accurately and reliably measure the effectiveness of the suppression chamber spray in a timely manner, and (2) the position of the spray throttling valves can be monitored and the sprays adequately controlled from the control room using the alternate variables. The use of these alternate variables is acceptable under RG 1.97, Revision 4. The NRC staff agrees with the classification of Suppression Chamber Spray Flow or alternate instrumentation as an RG 1.97, Revision 4, Type D variable to provide information on the status of RHR System performance.

3.1.D.6.4 Drywell Spray Flow

NEDO-33349 recommends that Drywell Spray Flow be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of RHR System performance. The justification given in NEDO-33349 is that Drywell Spray Flow is one of the modes considered in the EPGs.

Previously approved deviations from RG 1.97, Revision 3, have allowed the use of RHR Flow, Drywell Temperature, and Drywell Pressure as acceptable alternatives if it can be shown that (1) use of these variables can accurately and reliably measure the effectiveness of the drywell spray in a timely manner, and (2) the position of the spray throttling valves can be monitored and the sprays adequately controlled from the control room using the alternate variables. The use of these alternate variables is acceptable under RG 1.97, Revision 4. The NRC staff agrees with the classification of Drywell Spray Flow or alternate instrumentation as an RG 1.97, Revision 4, Type D variable to provide information on the status of RHR System performance.

3.1.D.6.5 Residual Heat Removal System Heat Exchanger Outlet Temperature

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor RHR System Heat Exchanger Outlet Temperature to check the operation of RHR Systems. NEDO-33349 recommends that RHR System Heat Exchanger Outlet Temperature remains classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that RHR System Heat Exchanger Outlet Temperature provides information on the status of decay heat removal performance of the RHR System.

The NRC staff agrees with the classification of RHR System Heat Exchanger Outlet Temperature as an RG 1.97, Revision 4, Type D variable to provide information on the status of decay heat removal performance of the RHR System.

3.1.D.7 Type D Low Pressure Core Spray System Variables

3.1.D.7.1 Low Pressure Core Spray System Flow

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor LPCI System Flow to monitor the operation of Safety Systems. NEDO-33349 recommends that LPCS System Flow remains classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that LPCS System Flow provides information on the status of LPCS System performance and that LPCI and LPCS systems perform the same functions. The differences in nomenclature are the result of BWR plant naming conventions.

The NRC staff agrees with the classification of LPCS System Flow as an RG 1.97, Revision 4, Type D variable to provide information on the status of LPCS System performance.

3.1.D.7.2 Core Spray Flow

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Core Spray System Flow to check the operation of Safety Systems. NEDO-33349 recommends that Core Spray Flow be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that Core Spray Flow provides information on the status of LPCS System performance.

The NRC staff agrees with the classification of Core Spray Flow as an RG 1.97, Revision 4, Type D variable to provide information on the status of LPCS System performance.

3.1.D.8 Type D Cooling Water System Variables

3.1.D.8.1 Cooling Water Temperature to Engineered Safety Feature System Components

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Cooling Water Temperature to Engineered Safety Feature (ESF) System Components to check the operation of the Cooling Water System. NEDO-33349 recommends that Cooling Water Temperature to ESF System Components be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of Cooling Water System performance. The justification given in NEDO-33349 is that various BWR plants use plant specific alternate means to monitor Cooling Water System performance. Each licensee would need to document plant specific deviations for providing information on the status of Cooling Water System performance.

The NRC staff agrees with the classification of Cooling Water Temperature to ESF System Components, or alternate instrumentation, as an RG 1.97, Revision 4, Type D variable to provide information on the status of Cooling Water System performance.

3.1.D.9 Type D Residual Heat Removal Service Water System Variables

3.1.D.9.1 Residual Heat Removal Service Water System Flow

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Cooling Water Flow to ESF System Components to check the operation of the Cooling Water System. NEDO-33349 recommends that RHR Service Water System Flow be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of the RHR Service Water System performance. The justification given in NEDO-33349 is that various BWR use plant specific alternate means to monitor RHR Service Water System performance. Each licensee would need to document plant specific deviations for providing information on the status of RHR Service Water System performance.

The NRC staff agrees with the classification of RHR Service Water System Flow, or alternate instrumentation, as an RG 1.97, Revision 4, Type D variable to provide information on the status of RHR Service Water System performance.

3.1.D.10 Type D Essential Service Water System Variables

3.1.D.10.1 Essential Service Water System Flow

NEDO-33349 recommends that Essential Service Water System Flow be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Essential Service Water System performance. The justification given in NEDO-33349 is that various BWR plants use plant specific alternate means to monitor Essential Service Water System performance. Each licensee would need to document plant specific deviations for providing information on the status of Essential Service Water System performance.

The NRC staff agrees with the classification of Essential Service Water System Flow, or alternate instrumentation, as an RG 1.97, Revision 4, Type D variable to provide information on the status of Essential Service Water System performance.

3.1.D.11 Type D Reactor Pressure Vessel Isolation System Variables

3.1.D.11.1 Main Steam Isolation Valve Position

NEDO-33349 recommends that Main Steam Isolation Valve (MSIV) Position be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of the RPV Isolation System performance. The justification given in NEDO-33349 is that MSIV Position provides information on the status of the RPV Isolation System performance.

The NRC staff agrees with the classification of MSIV Position as an RG 1.97, Revision 4, Type D variable to provide information on the status of RPV Isolation System performance.

3.1.D.11.2 Cleanup System Isolation Valve Position

NEDO-33349 recommends that Cleanup System Isolation Valve Position be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of the RPV Isolation System performance. The justification given in NEDO-33349 is that Cleanup System Isolation Valve Position provides information on the status of the RPV Isolation System performance.

The NRC staff agrees with the classification of Cleanup System Isolation Valve Position as an RG 1.97, Revision 4, Type D variable to provide information on the status of RPV Isolation System performance.

3.1.D.11.3 Shutdown Cooling System Isolation Valve Position

NEDO-33349 recommends that Shutdown Cooling System Isolation Valve Position be classified as an RG1.97 Revision 4 Type D variable to provide information on the status of the RPV Isolation System performance. The justification given in NEDO-33349 is that the Shutdown Cooling System Isolation Valve Position provides information on the status of the RPV Isolation System Performance.

The NRC staff agrees with the classification of Shutdown Cooling System Isolation Valve Position as an RG 1.97, Revision 4, Type D variable to provide information on the status of RPV Isolation System performance.

3.1.D.11.4 Other Reactor Pressure Vessel Normally Open Isolation Valve Position Inside Containment

NEDO-33349 recommends that Other RPV Normally Open Isolation Valve Position Inside Containment be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of the RPV Isolation System performance. The justification given in NEDO-33349 is that this variable provides information on the status of the RPV Isolation System performance.

The NRC staff agrees with the classification of Other RPV Normally Open Isolation Valve Position Inside Containment as an RG 1.97, Revision 4, Type D variable to provide information on the status of RPV Isolation System performance.

3.1.D.11.5 Other Reactor Pressure Vessel Normally Closed Isolation Valve Position Inside Containment That Require Opening for LOCA

NEDO-33349 recommends that Other RPV Normally Closed Isolation Valve Position Inside Containment That Require Opening for LOCA be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that this variable provides information on the status of the RPV Isolation System performance.

The NRC staff agrees with the classification of Other RPV Normally Closed Isolation Valve Position Inside Containment That Require Opening for LOCA as an RG 1.97, Revision 4, Type D variable to provide information on the status of the RPV Isolation System performance.

3.1.D.11.6 Other Reactor Pressure Vessel Normally Open Isolation Valve Position Outside Containment

NEDO-33349 recommends that Other RPV Normally Open Isolation Valve Position Outside Containment be classified as an RG 1.97, Revision 4, Type D variable to provide information on the status of the RPV Isolation System performance. The justification given in NEDO-33349 is that Other RPV Normally Open Isolation Valve Position Outside Containment provides information on the status of RPV Isolation System performance.

The NRC staff agrees with the classification of Other RPV Normally Open Isolation Valve Position Outside Containment as an RG 1.97, Revision 4, Type D variable to provide information on the status of the RPV Isolation System performance.

3.1.D.11.7 Other Reactor Pressure Vessel Normally Closed Isolation Valve Position Outside Containment That Require Opening for Pipe Breaks Outside Containment

NEDO-33349 recommends that Other RPV Normally Closed Isolation Valve Position Outside Containment That Require Opening for Pipe Breaks Outside Containment be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that this variable provides information on the status of the RPV Isolation System performance.

The NRC staff agrees with the classification of Other RPV Normally Closed Isolation Valve Position Outside Containment That Require Opening for Pipe Breaks Outside Containment as an RG 1.97, Revision 4, Type D variable to provide information on the status of the RPV Isolation System performance.

3.1.D.11.8 Other Reactor Pressure Vessel Normally Closed Isolation Valve Position Outside Containment That Do Not Require Opening for either LOCA or Pipe Breaks Outside Containment

NEDO-33349 recommends that Other RPV Normally Closed Isolation Valve Position Outside Containment That Do Not Require Opening for either LOCA or Pipe Breaks Outside Containment be classified as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the status of RPV Isolation System performance. The justification given in NEDO-33349 is that for Other RPV Normally Closed Isolation Valve Position Outside Containment That Do Not Require Opening for either LOCA or Pipe Breaks Outside Containment, the position is known before an accident, and the valves are not required to open for either LOCAs or pipe breaks outside containment and, therefore, do not need to be environmentally or seismically qualified.

The NRC staff agrees with the classification of Other RPV Normally Closed Isolation Valve Position Outside Containment That Do Not Require Opening for either LOCA or Pipe Breaks Outside Containment as a RG1.97 Revision 4 Type D variable, without environmental or seismic qualification, to provide information on the status of RPV Isolation System performance.

3.1.D.12 Type D Containment Isolation System Variables

3.1.D.12.1 Normally Open Containment Isolation Valve Position Inside Containment

NEDO-33349 recommends that Normally Open CIV Position Inside Containment be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is Normally Open CIV Position Inside Containment provides information on the status of Containment Isolation System performance.

The NRC staff agrees with the classification of Normally Open CIV Position Inside Containment as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment Isolation System performance.

3.1.D.12.2 Normally Closed Containment Isolation Valve Position Inside Containment That Require Opening for LOCA

NEDO-33349 recommends that Normally Closed CIV Position Inside Containment That Require Opening for LOCA be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that this variable provides information on the status of Containment Isolation System performance.

The NRC staff agrees with the classification of Normally Closed CIV Position Inside Containment That Require Opening for LOCA as an RG 1.97, Revision 4, Type D variable to provide information on the status of Containment Isolation System performance.

3.1.D.12.3 Containment Isolation Valve Position Outside Containment That Require Opening for LOCA

NEDO-33349 recommends that CIV Position Outside Containment That Require Opening for LOCA be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that this variable provides information on the status of the Containment Isolation System performance.

The NRC staff agrees with the classification of CIV Position Outside Containment That Require Opening for LOCA as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Containment Isolation System performance.

3.1.D.12.4 Normally Closed Containment Isolation Valve Position Inside or Outside Containment That Do Not Require Opening for LOCA

NEDO-33349 recommends that Normally Closed CIV Position Inside or Outside Containment That Do Not Require Opening for LOCA be classified as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the status of Containment Isolation System performance. The justification given in NEDO-33349 is that for Normally Closed CIV Position Inside or Outside Containment That Do Not Require Opening for LOCA the position is known before an accident, and the valves are not required to open for a LOCA and, therefore, do not need to be environmentally qualified or seismically qualified.

The NRC staff agrees with the classification of Normally Closed CIV Position Inside or Outside Containment That Do Not Require Opening for LOCA as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the status of Containment Isolation System performance.

3.1.D.13 Type D Secondary Containment System Variables

3.1.D.13.1 Secondary Containment Isolation Damper Position

NEDO-33349 recommends that Secondary Containment Isolation Damper Position be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that Secondary Containment Isolation Damper Position provides information on the status of the Secondary Containment System performance.

The NRC staff agrees with the classification of Secondary Containment Isolation Damper Position as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Secondary Containment System performance.

3.1.D.13.2 Standby Gas Treatment Flow

NEDO-33349 recommends that Standby Gas Treatment Flow be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that Standby Gas Treatment Flow provides information on the status of the Secondary Containment System performance.

The NRC staff agrees with the classification of Standby Gas Treatment Flow as an RG 1.97, Revision 4, Type D variable to provide Secondary Containment System performance.

3.1.D.14 Type D Control Room Environment System Variables

3.1.D.14.1 Control Room Isolation Damper Position

NEDO-33349 recommends that Control Room Isolation Damper Position be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that Control Room Isolation Damper Position provides information on the status of the Control Room Environment System performance.

The NRC staff agrees with the classification of Control Room Isolation Damper Position as an RG 1.97, Revision 4, Type D variable to provide Control Room Environment System performance.

3.1.D.14.2 Emergency Ventilation Damper Position

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Emergency Ventilation Damper Position to check the operation of the Ventilation Systems. NEDO-33349 recommends that Emergency Ventilation Damper Position remains classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that Emergency Ventilation Damper Position provides information on the status of the Control

Room Environment System performance. Differential pressure can be used as an acceptable alternative.

The NRC staff agrees with the classification of Emergency Ventilation Damper Position, or alternate instrumentation, as an RG 1.97, Revision 4, Type D variable to provide information on the status of the Control Room Environment System performance.

3.1.D.15 Type D Standby Liquid Control System Variables

3.1.D.15.1 Standby Liquid Control System Flow or Pumps Running

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Standby Liquid Control System (SLCS) Flow to monitor operation of Safety Systems. NEDO-33349 recommends that SLCS Flow or Pumps Running remains classified as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification. The justification given in NEDO-33349 is that SLCS Flow or Pumps Running provides information on the status of SLCS performance. The SLCS is not associated with any events requiring environmental or seismic qualification.

The NRC staff agrees with the classification of SLCS Flow or Pumps Running as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the status of SLCS performance.

3.1.D.15.2 Standby Liquid Control System Storage Tank Level

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor SLCS Storage Tank Level to check the operation of Safety Systems. NEDO-33349 recommends that SLCS Storage Tank Level be classified as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification. The justification given in NEDO-33349 is that SLCS Storage Tank Level provides information on the status of the SLCS performance. The SLCS is not associated with any events requiring environmental or seismic qualification.

The NRC staff agrees with the classification of SLCS Storage Tank Level as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the status of SLCS performance.

3.1.D.16 Type D Power Systems Variables

3.1.D.16.1 AC and DC Power Status

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Status of Standby Power to check the system status of Power Supplies. NEDO-33349 recommends that AC and DC Power Status be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that AC and DC Power Status provides information on the status of Power Systems performance.

The NRC staff agrees with the classification of AC and DC Power Status as an RG 1.97, Revision 4, Type D variable to provide information on the status of Power Systems performance.

3.1.D.17 Type D Equipment Area Cooling Water System Variables

3.1.D.17.1 Equipment Area Cooling System Cooling Water Temperature

NEDO-33349 recommends that Equipment Area Cooling System Cooling Water Temperature be classified as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that Equipment Area Cooling System Cooling Water Temperature provides information on the status of Equipment Area Cooling System performance.

The NRC staff agrees with the classification of Equipment Area Cooling System Cooling Water Temperature as an RG 1.97, Revision 4, Type D variable to provide information on the status of Equipment Area Cooling Water System performance.

3.1.D.18 Type D Essential Pneumatic Gas Supply System Variables

3.1.D.18.1 Essential Pneumatic Gas Supply Pressure

NEDO-33349 recommends that Essential Pneumatic Gas Supply Pressure be classified as RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that Essential Pneumatic Gas Supply Pressure provides information on the status of the Essential Pneumatic Gas Supply System performance.

The NRC staff agrees with the classification of Essential Pneumatic Gas Supply Pressure as a RG1.97, Revision 4, Type D variable to provide information on the status of the Essential Pneumatic Gas Supply System performance.

3.1.D.19 Type D Isolation Condenser System Variables

3.1.D.19.1 Isolation Condenser System Shell-Side Water Level

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Isolation Condenser System Shell-Side Water Level to check the operation of Safety Systems. NEDO-33349 recommends that Isolation Condenser System Shell-Side Water Level be classified as an RG 1.97, Revision 4, Type D variable for plants with isolation condensers. The justification given in NEDO-33349 is that isolation condensers are associated with BWR/2 and BWR/3 plant designs. For BWR/2 and BWR/3 plants, the performance of the isolation condenser is indicated by Type B instrumentation, and system status is indicated by Type D Condensate Return Valve Position and Type D Isolation Condenser Shell Water Level.

The NRC staff agrees with the classification of Isolation Condenser System Shell-Side Water Level as an RG 1.97, Revision 4, Type D variable to provide information on the status of Isolation Condenser System performance, for plants with isolation condensers. Plants with isolation condensers should review their plant design and propose plant specific Type B variables to provide information on the accomplishment of the Isolation Condenser function and Type D variables to provide information on the status of the Isolation Condenser System performance.

3.1.D.19.2 Isolation Condenser System Valve Position

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor Isolation Condenser System Valve Position to check the status of Safety Systems. NEDO-33349 recommends that Isolation Condenser System Valve Position Level be classified as an RG 1.97, Revision 4, Type D variable for plants with isolation condensers. The justification given in NEDO-33349 is that isolation condensers are associated with BWR/2 and BWR/3 plant designs. For BWR/2 and BWR/3 plants, the performance of the isolation condenser is indicated by Type B instrumentation, and system status is indicated by Type D Condensate Return Valve Position and Type D Isolation Condenser Shell Water Level.

The NRC staff agrees with the classification of Isolation Condenser System Valve Position as an RG 1.97, Revision 4, Type D variable to provide information on the status of Isolation Condenser System performance for plants with isolation condensers. Plants with isolation condensers should review their plant design and propose plant specific Type B variables to provide information on the accomplishment of the Isolation Condenser function and Type D variables to provide information on the status of the Isolation Condenser System performance.

3.1.D.20 Type D Condensate and Feedwater System Variables

3.1.D.20.1 Main Feedwater Flow

RG 1.97, Revision 3, recommends that Type D, Category 3 instrumentation be provided to monitor Main Feedwater Flow for detection of operation and analysis of cooling of the Condensate and Feedwater System. NEDO-33349 recommends that Main Feedwater Flow need not be considered as an RG1.97, Revision 4, Type D variable for the Condensate and Feedwater System. The justification given in NEDO-33349 is that Main Feedwater Flow is a normal operating system.

The NRC staff agrees with the reclassification of Main Feedwater Flow as not being a RG1.97, Revision 4, Type D variable for the Condensate and Feedwater System.

3.1.D.21 Type D Main Steam System Variables

3.1.D.21.1 Main Steam Isolation Valve Leakage Control System Pressure

RG 1.97, Revision 3, recommends that Type D, Category 2 instrumentation be provided to monitor MSIV Leakage Control System Pressure to indicate pressure boundary maintenance of the Main Steam System. NEDO-33349 recommends that MSIV Leakage Control System Pressure need not be considered as a RG 1.97, Revision 4, Type D variable for the Main Steam System. The justification given in NEDO-33349 is that the NRC approved the elimination of the MSIV leakage control system on a plant specific basis with the approval of NEDC-31858P, Revision 2, “BWROG Report for Increasing MSIV Leakage Limits and Elimination of Leakage Control Systems,” issued August 1993 (Reference 18), with a safety evaluation issued March 3, 1999 (Reference 19). NEDC-31858P, Revision 2, was reissued, as NEDC-31858P-A, issued August 1999 (Reference 20), to incorporate the March 3, 1999 safety evaluation.

The NRC staff agrees with the reclassification of MSIV Leakage Control System Pressure as not being a RG 1.97, Revision 4, Type D variable for the Main Steam System. Each licensee should identify any previous approval of the elimination of MSIV leakage control system, justify the elimination of the MSIV Leakage Control System, or provide instrumentation indicating the MSIV Leakage Control System Pressure.

3.1.D.22 Type D Radwaste System Variables

3.1.D.22.1 High Radioactivity Liquid Tank Level

RG 1.97, Revision 3, recommends that Type D, Category 3 instrumentation be provided to monitor High Radioactivity Liquid Tank Level to check the operation of the Radwaste Systems. NEDO-33349 recommends that High Radioactivity Liquid Tank Level need not be considered as an RG 1.97, Revision 4, Type D variable. The justification given in NEDO-33349 is that BWR radwaste systems are normal operating systems. Liquid radwaste systems are not required for mitigation of accidents.

The NRC staff agrees with the reclassification of High Radioactivity Liquid Tank Level as not being an RG 1.97, Revision 4, Type D variable to provide information on the status of the Radwaste System.

3.1.E Type E Functions

NEDO-33349 recommends that the following functions be monitored by Type E variables: (1) Containment Radiation, (2) Area Radiation, (3) Airborne Radioactive Materials Released from Plant - Noble Gas and Vent Flow Rate, (4) Particulates and Halogens, (5) Environs Radiation and Radioactivity, (6) Meteorological, (7) Grab Samples, (8) Off-gas System Radiation, and (9) Effluent Radioactivity.

3.1.E.1 Type E Containment Radiation Variables

3.1.E.1.1 Containment Area Radiation

RG 1.97, Revision 3, recommends that Type E, Category 1 instrumentation be provided to monitor Containment Area Radiation - High Range for detection of significant releases, release assessment, long-term surveillance, and emergency plan actuation for determining the magnitude of Containment Radiation releases. NEDO-33349 recommends that Containment Area Radiation - High Range instrumentation be classified as an RG 1.97, Revision 4, Type E variable to Monitor Identified Pathway. NEDO-33349 also recommends that this instrumentation should meet the plant specific licensing commitments to Item II.F.1 in NUREG-0737 and RG 1.97, Revision 2 or 3, for Type E variables, instead of the RG 1.97, Revision 4, Type E criteria.

The NRC staff agrees with the classification of Containment Area Radiation - High Range as an RG 1.97, Revision 4, Type E variable to monitor identified pathways provided that the instrumentation meets the plant specific licensing commitments to Item II.F.1 in NUREG-0737 and RG 1.97, Revision 2 or 3, Category 1 criteria, instead of the RG 1.97, Revision 4, Type E criteria. The classification of Containment Area Radiation - High Range as an RG 1.97,

Revision 4, Type E variable does not release licensees from meeting the plant specific licensing commitments related to the requirements of Item II.F.1 of NUREG-0737.

RG 1.97, Revision 3, also recommends that Type C, Category 3 instrumentation be provided to monitor Primary Containment Area Radiation to detect a breach and verify the Reactor Coolant Pressure Boundary function. NEDO-33349 recommends that Primary Containment Area Radiation be reclassified as an RG 1.97, Revision 4, Type E variable. The justification given in NEDO-33349 is that Primary Containment Area Radiation is an indicator of radiation release from fuel cladding failure and reactor coolant pressure boundary breach and thus meets the criteria of an RG 1.97, Revision 4, Type E variable, as it provides the magnitude of release for Containment Area Radiation.

The NRC staff also agrees with the reclassification of RG 1.97, Revision 3, Type C Primary Containment Area Radiation as an RG 1.97, Revision 4, Type E variable. The range of Primary Containment Area Radiation is included in the range of Containment Area Radiation - High Range; therefore, a single instrument could provide information for both Containment Area Radiation - High Range and Primary Containment Area Radiation.

NEDO-33349 also implies that because the design criteria for Containment Area Radiation - High Range instrumentation and the requirements for hydrogen monitoring instrumentation in 10 CFR 50.44 are similar, the requirements of 10 CFR 50.44 could be extended to instrumentation for Containment Area Radiation - High Range. Any relaxations or downgrades from previous design and qualification criteria for instrumentation covered by 10 CFR 50.44 are applicable only to the instrumentation that is specified in the regulation and cannot be extended to other instrumentation. Therefore, relaxations and downgrades in 10 CFR 50.44 cannot be extended to instrumentation for Containment Area Radiation - High Range.

3.1.E.1.2 Reactor Building or Secondary Containment Area Radiation

RG 1.97, Revision 3, recommends that Type E, Category 2 instrumentation for Mark III containments and Category 3 instrumentation for Mark I and II containments be provided to monitor Reactor Building or Secondary Containment Area Radiation for detection of significant releases, release assessment, and long-term surveillance to determine the magnitude of Containment Radiation releases. NEDO-33349 recommends that Reactor Building or Secondary Containment Area Radiation be classified as an RG 1.97, Revision 4, Type E variable to Monitor Identified Pathway.

The NRC staff agrees with the classification of Reactor Building or Secondary Containment Area Radiation as an RG 1.97, Revision 4, Type E variable to Monitor Identified Pathway for determining the magnitude of Containment Radiation releases.

3.1.E.2 Type E Area Radiation Variables

3.1.E.2.1 Radiation Exposure Rate

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Radiation Exposure Rate for detection of significant releases, release assessment, and long-term surveillance for determining the magnitude of Area Radiation releases; RG 1.97, Revision 2, recommends that Type E, Category 2 instrumentation be used for these purposes.

NEDO-33349 recommends that Radiation Exposure Rate (inside buildings or areas where access is required to service equipment important to safety) be classified as an RG 1.97, Revision 4, Type E variable.

The NRC staff agrees with the classification of Radiation Exposure Rate (inside buildings or areas where access is required to service equipment important to safety) as an RG 1.97, Revision 4, Type E variable to Monitor Identified Pathway for determining the magnitude of Area Radiation releases.

3.1.E.2.2 Control Room Area Radiation

NEDO-33349 recommends that Control Room Area Radiation be classified as RG1.97, Revision 4, Type E variable to monitor radiation levels in the control room. The justification given in NEDO-33349 is that Control Room Area Radiation is consistent with the plant recovery access parameters in RG 1.97, Revision 4.

The NRC staff agrees with the classification of Control Room Area Radiation as an RG 1.97, Revision 4, Type E variable to monitor control room radiation.

3.1.E.3 Type E Airborne Radioactive Materials Released From The Plant - Noble Gas and Vent Flow Rate Variables

3.1.E.3.1 Drywell Purge, Standby Gas Treatment System Purge, and Secondary Containment Purge

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Drywell Purge, Standby Gas Treatment System Purge (in Mark I and II plants), and Secondary Containment Purge (in Mark III plants) - Noble Gases and Vent Flow Rate for detection of significant releases and release assessment for determining the magnitude of Airborne Radioactive Materials Released from the Plant. NEDO-33349 recommends that Drywell Purge, Standby Gas Treatment System Purge (Mark I and II plants), and Secondary Containment Purge (Mark III plants) - Noble Gases and Vent Flow Rate be classified as an RG 1.97, Revision 4, Type E variable. The justification given in NEDO-33349 is that these purges should be included as release points if they are included in a plant specific list of potential release points.

The NRC staff agrees with the classification of Drywell Purge, Standby Gas Treatment System Purge (in Mark I and II plants), and Secondary Containment Purge (in Mark III plants) - Noble Gases and Vent Flow Rate as an RG 1.97, Revision 4, Type E variable for plants that include these purges as release points in a plant specific list of potential release points.

3.1.E.3.2 Secondary Containment Purge

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Secondary Containment Purge (in Mark I, II, and III plants) - Noble Gases and Vent Flow Rate for detection of significant releases and release assessment for determining the magnitude of Airborne Radioactive Materials Released from the Plant. NEDO-33349 recommends that Secondary Containment Purge (in Mark I, II, and III plants) - Noble Gases and Vent Flow Rate be classified as an RG 1.97, Revision 4, Type E variable. The justification given

in NEDO-33349 is that Secondary Containment Purge - Noble Gases and Vent Flow Rate should be included as a release point if included in a plant specific list of potential release points.

The NRC staff agrees with the classification of Secondary Containment Purge (in Mark I, II, and III plants) - Noble Gases and Vent Flow Rate as an RG 1.97, Revision 4, Type E variable for plants that include Secondary Containment Purge (in Mark I, II, and III plants) - Noble Gases and Vent Flow Rate as a release point in a plant specific list of potential release points.

3.1.E.3.3 Secondary Containment

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Secondary Containment (reactor shield building annulus) - Noble Gases and Vent Flow Rate for detection of significant releases and release assessment for determining the magnitude of Airborne Radioactive Materials Released from the Plant, for plants with a reactor shield building annulus. NEDO-33349 recommends that Secondary Containment (reactor shied building annulus) - Noble Gases and Vent Flow Rate be classified as an RG 1.97, Revision 4, Type E variable. The justification given in NEDO-33349 is that Secondary Containment (reactor shield building annulus) - Noble Gases and Vent Flow Rate should be included as a release point if included in a plant specific list of potential release points.

The NRC staff agrees with the classification of Secondary Containment (reactor shield building annulus) - Noble Gases and Vent Flow Rate as an RG 1.97, Revision 4, Type E variable for plants that include Secondary Containment (reactor shield building annulus) as a release point in a plant specific list of potential release points.

3.1.E.3.4 Auxiliary Building

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Auxiliary Building (including any building containing primary system gases) - Noble Gases and Vent Flow Rate for detection of significant releases, release assessment, and long-term surveillance for determining the magnitude of Airborne Radioactive Materials Released from the Plant. NEDO-33349 recommends that Auxiliary Building (including any building containing primary system gases) - Noble Gases and Vent Flow Rate be classified as an RG 1.97, Revision 4, Type E variable. The justification given in NEDO-33349 is that Auxiliary Building (including any building containing primary system gases) - Noble Gases and Vent Flow Rate should be included as a release point if included in a plant specific list of potential release points.

The NRC staff agrees with the classification of Auxiliary Building (including any building containing primary system gases) - Noble Gases and Vent Flow Rate as an RG 1.97, Revision 4, Type E variable for plants that include Auxiliary Building (including any building containing primary gases) - Noble Gases and Vent Flow Rate as a release point in a plant specific list of potential release points.

3.1.E.3.5 Common Plant Vent or Multipurpose Vent Discharge

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Common Plant Vent or Multipurpose Vent Discharge - Noble Gases and Vent Flow

Rate for detection of significant releases, release assessment, and long-term surveillance for determining the magnitude of Airborne Radioactive Materials Released from the Plant. NEDO-33349 recommends that Common Plant Vent or Multipurpose Vent Discharge - Noble Gases and Vent Flow Rate be classified as an RG 1.97, Revision 4, Type E variable. The justification given in NEDO-33349 is that Common Plant Vent or Multipurpose Vent Discharge - Noble Gases and Vent Flow Rate should be included as a release point if included in a plant specific list of potential release points.

The NRC staff agrees with the classification of Common Plant Vent or Multipurpose Vent Discharge - Noble Gases and Vent Flow Rate as an RG 1.97, Revision 4, Type E variable for plants that include Common Plant Vent or Multipurpose Vent Discharge - Noble Gases and Vent Flow Rate as a release point in a plant specific list of potential release points.

3.1.E.3.6 All Other Identified Release Points

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor All Other Identified Release Points - Noble Gases and Vent Flow Rate for detection of significant releases, release assessment, and long-term surveillance for determining the magnitude of Airborne Radioactive Materials Released from the Plant. NEDO-33349 recommends that All Other Identified Release Points - Noble Gases and Vent Flow Rate be classified as an RG 1.97, Revision 4, Type E variable. The justification given in NEDO-33349 is that All Other Identified Release Points - Noble Gases and Vent Flow Rate should be included as a release point if included in a plant specific list of potential release points.

The NRC staff agrees with the classification of All Other Identified Release Points - Noble Gases and Vent Flow Rate as an RG 1.97, Revision 4, Type E variable for plants that include All Other Identified Release Points - Noble Gases and Vent Flow Rate as a release point in a plant specific list of potential release points.

3.1.E.4 Type E Particulates and Halogens Variables

3.1.E.4.1 Particulates and Halogens - All Identified Plant Release Points Sampling with Onsite Analysis Capability

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Particulates and Halogens - All Identified Plant Release Points Sampling with Onsite Analysis Capability for detection of significant releases, release assessment, and long-term surveillance for determining the magnitude of Airborne Radioactive Materials Released from the Plant. NEDO-33349 recommends that Particulates and Halogens - All Identified Plant Release Points Sampling with Onsite Analysis Capability remain classified as an RG 1.97, Revision 4, Type E variable.

The NRC staff agrees with the classification of Particulates and Halogens - All Identified Plant Release Points Sampling with Onsite Analysis Capability as an RG 1.97, Revision 4, Type E variable for determining the magnitude of Particulates and Halogens releases.

3.1.E.5 Type E Environs Radiation and Radioactivity Variables

3.1.E.5.1 Airborne Radiohalogens and Particulates

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Airborne Radiohalogens and Particulates (portable sampling with onsite analysis capability) for release assessment and analysis to determine the magnitude of Environs Radiation and Radioactivity. NEDO-33349 recommends that Airborne Radiohalogens and Particulates (portable sampling with onsite analysis capability) remains classified as an RG 1.97, Revision 4, Type E variable.

The NRC staff agrees with the classification of Airborne Radiohalogens and Particulates (portable sampling with onsite analysis capability) as an RG 1.97, Revision 4, Type E variable for determining the magnitude of Environs Radiation and Radioactivity.

3.1.E.5.2 Plant and Environs Radiation

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Plant and Environs Radiation (portable instrumentation) for release assessment and analysis to determine the magnitude of Environs Radiation and Radioactivity. NEDO-33349 recommends that Plant and Environs Radiation (portable instrumentation) remains classified as an RG 1.97, Revision 4, Type E variable to Monitor Plant Environs.
The NRC staff agrees with the classification of Plant and Environs Radiation (portable instrumentation) as an RG 1.97, Revision 4, Type E variable for Monitoring Plant Environs.

3.1.E.5.3 Plant and Environs Radioactivity

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Plant and Environs Radioactivity (portable instrumentation) for release assessment and analysis to determine the magnitude of Environs Radiation and Radioactivity. NEDO-33349 recommends that Plant and Environs Radioactivity (portable instrumentation) remains classified as an RG 1.97, Revision 4, Type E variable.

The NRC staff agrees with the classification of Plant and Environs Radioactivity (portable instrumentation) as an RG 1.97, Revision 4, Type E variable.

3.1.E.6 Type E Meteorological Variables

3.1.E.6.1 Wind Speed

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Wind Speed for release assessment for Meteorological assessment of releases. NEDO-33349 recommends that Wind Speed remain classified as an RG 1.97, Revision 4, Type E variable to Monitor Environmental Conditions.

The NRC staff agrees with the classification of Wind Speed as an RG 1.97, Revision 4, Type E variable to Monitor Environmental Conditions.

3.1.E.6.2 Wind Direction

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Wind Direction for release assessment for Meteorological assessment of releases. NEDO-33349 recommends that Wind Direction remain classified as an RG 1.97, Revision 4, Type E variable to Monitor Environmental Conditions.

The NRC staff agrees with the classification of Wind Direction as an RG 1.97, Revision 4, Type E variable to Monitor Environmental Conditions.

3.1.E.6.3 Estimation of Atmospheric Stability

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Estimation of Atmospheric Stability for release assessment for Meteorological assessment of releases. NEDO-33349 recommends that Estimation of Atmospheric Stability remain classified as an RG 1.97, Revision 4, Type E variable to Monitor Environmental Conditions.

The NRC staff agrees with the classification of Estimation of Atmospheric Stability as an RG 1.97, Revision 4, Type E variable to Monitor Environmental Conditions.

3.1.E.7 Type E Grab Sample Variables

3.1.E.7.1 Primary Coolant and Sump Grab Sample

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Primary Coolant and Sump Grab Sample for release assessment, verification, and analysis for Accident Sampling Capability. NEDO-33349 recommends that Primary Coolant and Sump Grab Sample remains classified as an RG 1.97, Revision 4, Type E variable within the guidance of NEDO-32991, "Regulatory Relaxation for BWR Post Accident Sampling Stations (PASS)," issued November 30, 2000 (Reference 21). With a safety evaluation dated June 12, 2001 (Reference 22), the NRC staff accepted NEDO-32991. NEDO-32991 was reissued as NEDO-32991-A, dated August 2001 (Reference 23), to incorporate the June 12, 2001 safety evaluation. NEDO-32991-A contains justification for the elimination of PASS, including sampling associated with the primary coolant, suppression pool, and building sumps.

The NRC staff agrees with the classification of Primary Coolant and Sump Grab Sample as an RG 1.97, Revision 4, Type E variable within the guidance of NEDO-32991-A.

3.1.E.7.2 Containment Air Grab Sample

RG 1.97, Revision 3, recommends that Type E, Category 3 instrumentation be provided to monitor Containment Air Grab Sample for release assessment, verification, and analysis for Accident Sampling Capability. NEDO-33349 recommends that Containment Air Grab Sample remains classified as an RG 1.97, Revision 4, Type E variable within the guidance of NEDO-32991. With a safety evaluation dated June 12, 2001, the NRC staff accepted NEDO-32991. NEDO-32991 was reissued as NEDO-32991-A to incorporate the June 12, 2001 safety evaluation. NEDO-32991-A contains justification for elimination of PASS.

The NRC staff agrees with the classification of Containment Air Grab Sample as an RG 1.97, Revision 4, Type E variable within the guidance of NEDO-32991-A.

3.1.E.8 Type E Off-gas System Radiation Variables

3.1.E.8.1 Off-gas System Release Point Radiation

NEDO-33349 recommends that Off-gas System Release Point Radiation be classified as an RG 1.97, Revision 4, Type E variable to Monitor Identified Pathway. The justification given in NEDO-33349 is that Off-gas System Release Point Radiation is consistent with the identified pathways contained in RG 1.97, Revision 4.

The NRC staff agrees with the classification of Off-gas System Release Point Radiation as an RG 1.97, Revision 4, Type E variable to Monitor Identified Pathway for the off-gas system.

3.1.E.9 Type E Effluent Radioactivity Variables

3.1.E.9.1 Containment Effluent Radioactivity - Noble Gases

NEDO-33349 recommends that Containment Effluent Radioactivity - Noble Gases (from identified release points including Standby Gas Treatment) be classified as an RG 1.97, Revision 4, Type E variable. The justification given in NEDO-33349 is that Containment Effluent Radioactivity - Noble Gases (from identified release points including Standby Gas Treatment) provides the magnitude of release for Containment Effluent Radioactivity - Noble Gases.

The NRC staff agrees with the classification of Containment Effluent Radioactivity - Noble Gases (from identified release points including Standby Gas Treatment) as an RG 1.97, Revision 4, Type E variable to monitor Containment Effluent Radioactivity.

3.1.E.9.2 Effluent Radioactivity - Noble Gases

NEDO-33349 recommends that Effluent Radioactivity - Noble Gases (from buildings or areas where penetrations and hatches are located, e.g., auxiliary building, fuel handling building, and secondary containment, that are in direct contact with the primary containment) be classified as an RG 1.97, Revision 4, Type E variable. The justification given in NEDO-33349 is that this variable provides the magnitude of release for Effluent Radioactivity - Noble Gases.

The NRC staff agrees with the classification of Effluent Radioactivity - Noble Gases (from buildings or areas where penetrations and hatches are located, e.g., auxiliary building, fuel handling building, and secondary containment, that are in direct contact with primary containment) as an RG 1.97, Revision 4, Type E variable to monitor Effluent Radioactivity.

3.2 Codes and Standards

RG 1.97, Revision 4, endorses IEEE Std. 497-2002, which references the latest applicable codes and standards at the time of its issue. Regulatory Position 6 of RG 1.97, Revision 4, recommends that if the NRC staff has endorsed a referenced code or standard in a regulatory guide, that code or standard constitutes an acceptable method for use in meeting the related regulatory requirement as described in the regulatory guide(s). Revisions 2 and 3 of RG 1.97

include references to other regulatory guides that endorse codes and standards that are earlier versions of the RG 1.97, Revision 4, codes and standards.

Currently operating BWRs made commitments to either Revision 2 or 3 of RG 1.97, including agreements and deviations to the referenced codes and standards. These agreements and deviations were accepted by the NRC staff and form the current licensing bases for the plant's accident monitoring instrumentation.

NEDO-33349 discusses the application to currently operating BWRs of IEEE Std. 308-1991, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generation Stations," (Reference 24); IEEE Std. 323-1983, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," (Reference 25); IEEE Std. 344-1987, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," (Reference 26); IEEE Std. 384-1992, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," (Reference 27); IEEE Std. 1023-1988, "IEEE Guide for Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations," (Reference 28); IEEE Std. 1289-1998, "IEEE Standard Guide for the Application of Human Factors Engineering in the Design of Computer-Based Monitoring and Control Displays for Nuclear Power Generating Stations," (Reference 29); International Organization for Standardization (ISO) 9241-3-1992, "Visual Display Terminals (VDTs) Used for Office Tasks Ergonomics Design-Part 3: Visual Display Requirements," (Reference 30); and American Society of Mechanical Engineers (ASME) NQA-1-2001, "Quality Assurance Requirements for Nuclear Facility Applications," (Reference 31). NEDO-33349 details the codes and standards that currently operating BWRs meet in lieu of the codes and standards referenced by RG 1.97, Revision 4.

The NRC staff recognizes that no currently operating BWR fully meets the codes and standards that are referenced by RG 1.97, Revision 4. Licensees shall review their RG 1.97, Revision 2 or 3, commitments with respect to codes and standards and shall either comply with the codes and standards referenced by RG 1.97, Revision 4, where practicable, or provide justification for maintaining their existing commitments to the RG 1.97, Revision 2 or 3, referenced codes and standards.

3.3 Summary

The NRC staff agrees with the NEDO-33349 recommendation that the following types, functions, and variables should be monitored in accordance with RG 1.97, Revision 4:

Rev 4 Type	Function	Variable	Safety Evaluation Section
A	Design Basis Event	RPV Water Level	3.1.A
A	Design Basis Event	RPV Pressure	3.1.A
A	Design Basis Event	Drywell Pressure	3.1.A
A	Design Basis Event	Suppression Pool Temperature	3.1.A
A	Design Basis Event	Suppression Pool Water Level	3.1.A
B	Reactivity Control	Neutron Flux	3.1.B.1.1

Rev 4 Type	Function	Variable	Safety Evaluation Section
B	Level Control	RPV Water Level	3.1.B.2.1
B	Pressure Control	RPV Pressure	3.1.B.3.1
B	Primary Containment Control	Drywell Pressure/ Containment Pressure	3.1.B.4.1
B	Primary Containment Control	Suppression Pool Temperature	3.1.B.4.2
B	Primary Containment Control	Suppression Pool Water Level	3.1.B.4.3
C	Fuel Cladding	RPV Water Level	3.1.C.1.1
C	Reactor Coolant Pressure Boundary	RPV Water Level	3.1.C.2.1
C	Reactor Coolant Pressure Boundary	RPV Pressure	3.1.C.2.2
C	Reactor Coolant Pressure Boundary	Drywell Pressure/ Containment Pressure	3.1.C.2.3
C	Reactor Coolant Pressure Boundary	Suppression Pool Water Level	3.1.C.2.4
C	Reactor Coolant Pressure Boundary	Suppression Pool Temperature	3.1.C.2.5
C	Primary Containment	Drywell Pressure/ Containment Pressure	3.1.C.3.1
C	Primary Containment	Suppression Pool Temperature	3.1.C.3.2
C	Primary Containment	Suppression Pool Water Level	3.1.C.3.3
D	Containment System	Drywell Pressure/ Containment Pressure	3.1.D.1.1
D	Containment System	Suppression Pool Temperature	3.1.D.1.2
D	Containment System	Suppression Pool Water Level	3.1.D.1.3
D	Containment System	Drywell Temperature	3.1.D.1.4
D	RPS and CRD System	Neutron Flux	3.1.D.2.1
D	RPS and CRD System	Control Rod Position	3.1.D.2.2
D	SRV System	SRV Position	3.1.D.3.1
D	RCIC System	RCIC System Flow	3.1.D.4.1
D	RCIC System	Condensate Storage Tank Water Level	3.1.D.4.2
D	HPCI or HPCS System	HPCI or HPCS System Flow	3.1.D.5.1
D	HPCI or HPCS System	Condensate Storage Tank Water Level	3.1.D.5.2
D	RHR System	RHR System Flow	3.1.D.6.1
D	RHR System	RHR System Valve Position	3.1.D.6.2
D	RHR System	Suppression Chamber Spray Flow	3.1.D.6.3
D	RHR System	Drywell Spray Flow	3.1.D.6.4

Rev 4 Type	Function	Variable	Safety Evaluation Section
D	RHR System	RHR System Heat Exchanger Outlet Temperature	3.1.D.6.5
D	LPCS System	LPCS System Flow	3.1.D.7.1
D	LPCS System	Core Spray Flow	3.1.D.7.2
D	Cooling Water System	Cooling Water Temperature to ESF System Components	3.1.D.8.1
D	RHR Service Water System	RHR Service Water System Flow	3.1.D.9.1
D	Essential Service Water System	Essential Service Water System Flow	3.1.D.10.1
D	RPV Isolation System	MSIV Position	3.1.D.11.1
D	RPV Isolation System	Cleanup System Isolation Valve Position	3.1.D.11.2
D	RPV Isolation System	Shutdown Cooling System Isolation Valve Position	3.1.D.11.3
D	RPV Isolation System	Other RPV Normally Open Isolation Valve Position Inside Containment	3.1.D.11.4
D	RPV Isolation System	Other RPV Normally Closed Isolation Valve Position Inside Containment That Require Opening for LOCA	3.1.D.11.5
D	RPV Isolation System	Other RPV Normally Open Isolation Valve Position Outside Containment	3.1.D.11.6
D	RPV Isolation System	Other RPV Normally Closed Isolation Valve Position Outside Containment That Require Opening for Pipe Breaks Outside Containment	3.1.D.11.7
D	RPV Isolation System	Other RPV Normally Closed Isolation Valve Position Outside Containment That Do Not Require Opening for Either LOCA or Pipe Breaks Outside Containment	3.1.D.11.8
D	Containment Isolation System	Normally Open CIV Position Inside Containment	3.1.D.12.1
D	Containment Isolation System	Normally Closed CIV Position Inside Containment That Require Opening for LOCA	3.1.D.12.2
D	Containment Isolation System	CIV Position Outside Containment Require Opening for LOCA	3.1.D.12.3

Rev 4 Type	Function	Variable	Safety Evaluation Section
D	Containment Isolation System	Normally Closed CIV Position Inside or Outside Containment That Do Not Require Opening for LOCA	3.1.D.12.4
D	Secondary Containment System	Secondary Containment Isolation Damper Position	3.1.D.13.1
D	Secondary Containment System	Standby Gas Treatment Flow	3.1.D.13.2
D	Control Room Environment System	Control Room Isolation Damper Position	3.1.D.14.1
D	Control Room Environment System	Emergency Ventilation Damper Position	3.1.D.14.2
D	SLCS	SLCS Flow or Pumps Running	3.1.D.15.1
D	SLCS	SLCS Storage Tank Level	3.1.D.15.2
D	Power System	AC and DC Power Status	3.1.D.16.1
D	Equipment Area Cooling Water System	Equipment Area Cooling System Cooling Water Temperature	3.1.D.17.1
D	Essential Pneumatic Gas Supply System	Essential Pneumatic Gas Supply Pressure	3.1.D.18.1
D	Isolation Condenser System	Isolation Condenser System Shell-Side Water Level	3.1.D.19.1
D	Isolation Condenser System	Isolation Condenser System Valve Position	3.1.D.19.2
E	Containment Radiation	Containment Area Radiation	3.1.E.1.1
E	Containment Radiation	Reactor Building or Secondary Containment Area Radiation	3.1.E.1.2
E	Area Radiation	Radiation Exposure Rate	3.1.E.2.1
E	Area Radiation	Control Room Area Radiation	3.1.E.2.2
E	Airborne Radioactive Materials Released From Plant - Noble Gas and Vent Flow Rate	Drywell Purge, Standby Gas Treatment System Purge, and Secondary Containment Purge	3.1.E.3.1
E	Airborne Radioactive Materials Released From Plant - Noble Gas and Vent Flow Rate	Secondary Containment Purge	3.1.E.3.2
E	Airborne Radioactive Materials Released From Plant - Noble Gas and Vent Flow Rate	Secondary Containment	3.1.E.3.3
E	Airborne Radioactive Materials Released From Plant - Noble Gas and Vent Flow Rate	Auxiliary Building	3.1.E.3.4

Rev 4 Type	Function	Variable	Safety Evaluation Section
E	Airborne Radioactive Materials Released From Plant - Noble Gas and Vent Flow Rate	Common Plant Vent or Multipurpose Vent Discharge	3.1.E.3.5
E	Airborne Radioactive Materials Released From Plant - Noble Gas and Vent Flow Rate	All Other Identified Release Points	3.1.E.3.6
E	Particulates and Halogens	Particulates and Halogens	3.1.E.4.1
E	Environs Radiation and Radioactivity	Airborne Radiohalogens and Particulates	3.1.E.5.1
E	Environs Radiation and Radioactivity	Plant and Environs Radiation	3.1.E.5.2
E	Environs Radiation and Radioactivity	Plant and Environs Radioactivity	3.1.E.5.3
E	Meteorological	Wind Speed	3.1.E.6.1
E	Meteorological	Wind Direction	3.1.E.6.2
E	Meteorological	Estimation of Atmospheric Stability	3.1.E.6.3
E	Grab Sample	Primary Coolant and Sump Grab Sample	3.1.E.7.1
E	Grab Sample	Containment Air Grab Sample	3.1.E.7.2
E	Off-gas System Radiation	Off-gas System Release Point Radiation	3.1.E.8.1
E	Effluent Radioactivity	Containment Effluent Radioactivity - Noble Gases	3.1.E.9.1
E	Effluent Radioactivity	Effluent Radioactivity - Noble Gases	3.1.E.9.2

The NRC staff agrees with the NEDO-33349 recommendation that the following RG 1.97, Revision 3, variables do not need to be monitored under RG 1.97, Revision 4:

Rev 3 Type	Rev 3 Category	Revision 3 Function	Variable	Safety Evaluation Section
B	3	Reactivity Control	Control Rod Position	3.1.B.1.2
B	3	Reactivity Control	RCS Soluble Boron Concentration	3.1.B.1.3
B	N/A	Core Cooling	BWR Core Temperature	3.1.B.2.2
B	1	Maintaining Reactor Coolant System Integrity	Drywell Pressure	3.1.B.3.2
B	1	Maintaining Reactor Coolant System Integrity	Drywell Sump Level	3.1.B.3.3

Rev 3 Type	Rev 3 Category	Revision 3 Function	Variable	Safety Evaluation Section
B	1	Maintaining Containment Integrity	Primary Containment Isolation Valve Position	3.1.B.4.4
C	1	Fuel Cladding	Radioactivity Concentration or Radiation Level in Circulating Primary Coolant	3.1.C.1.2
C	3	Fuel Cladding	Analysis of Primary Coolant	3.1.C.1.3
C	N/A	Fuel Cladding	BWR Core Temperature	3.1.C.1.4
C	3	Reactor Coolant Pressure Boundary	Primary Containment Area Radiation	3.1.C.2.6
C	1	Reactor Coolant Pressure Boundary	Drywell Drain Sump Level	3.1.C.2.7
C	1	Primary Containment	RPV Pressure	3.1.C.3.4
C	1	Primary Containment	Containment and Drywell Hydrogen	3.1.C.3.5
C	1	Primary Containment	Containment and Drywell Oxygen	3.1.C.3.6
C	3	Primary Containment	Containment Effluent Radioactivity - Noble Gases	3.1.C.3.7
C	2	Primary Containment	Effluent Radioactivity - Noble Gases	3.1.C.3.8
C	2 (Rev. 2)	Primary Containment	Radiation Exposure Rate	3.1.C.3.9
D	2	Primary Containment Related Systems	Suppression Chamber Spray Flow	3.1.D.1.5
D	2	Primary Containment Related Systems	Drywell Spray Flow	3.1.D.1.6
D	3	Condensate and Feedwater System	Main Feedwater Flow	3.1.D.20.1
D	2	Main Steam System	MSIV Leakage Control System Pressure	3.1.D.21.1
D	3	Radwaste System	High Radioactivity Liquid Tank Level	3.1.D.22.1

4.0 LIMITATIONS AND CONDITIONS

4.1 Type A Variables

Each licensee that uses NEDO-33349 should review its plant design against NEDO-33349 for the selection of Type A variables. For some plants, the NEDO-33349 recommendation for Type A variables may not be applicable. Some plants may have additional Type A variables. Other plants may need to justify not including individual Type A variables recommended by NEDO-33349.

4.2 Relaxations or Downgrades

Any relaxation or downgrade in design and qualification criteria for RG 1.97, Revision 4, instrumentation from the recommendations in RG 1.97, Revision 3, does not affect the design and qualification criteria for instrumentation required by 10 CFR 50.34, 10 CFR 50.44, or NUREG-0737. The requirements of 10 CFR 50.34, 10 CFR 50.44, and NUREG-0737 take precedence over RG 1.97. Even though RG 1.97, Revision 4, may allow relaxations or downgrades from the recommendations of RG 1.97, Revision 3, the recommendations of RG 1.97, Revision 4, cannot replace the requirements of 10 CFR 50.34, 10 CFR 50.44, and NUREG-0737.

Any relaxations or downgrades from previous design and qualification criteria for instrumentation covered by 10 CFR 50.44 are applicable only to the instrumentation that is specified in that section of the regulations, and cannot be extended to other instrumentation.

4.3 Reactor Coolant System Soluble Boron Concentration

The NRC staff agrees that RCS Soluble Boron Concentration (Grab Sample) is not a key variable for providing information on the accomplishment of the Reactivity Control function, and, therefore, may be reclassified as not being a RG1.97, Revision 4, Type B variable. However, this does not release licensees from meeting the requirements of 10 CFR 50.34(f)(1)(viii) and Item II.B.3 of NUREG-0737.

4.4 Reactor Pressure Vessel Water Level

The NRC agrees with the classification of RPV Water Level as an RG 1.97, Revision 4, Type C key variable to provide information about the integrity of the Fuel Cladding fission product barrier. However, since a decrease in RPV Water Level is only a precursor to fuel damage, each licensee should identify plant specific backup instrumentation to provide information to determine if core damage has occurred. This plant specific backup instrumentation does not need to meet the RG 1.97, Revision 4, Type C design and qualification criteria.

4.5 Analysis of Primary Coolant

The NRC staff agrees that Analysis of Primary Coolant is not a key variable for providing information on the integrity of the Fuel Cladding fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Fuel Cladding fission product barrier. However, this does not release licensees from meeting the requirements of 10 CFR 50.34(f)(1)(viii) and Item II.B.3 of NUREG-0737.

4.6 Containment and Drywell Hydrogen

The NRC staff agrees that Containment and Drywell Hydrogen is not a key variable for providing information on the integrity of the Primary Containment fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Primary Containment fission product barrier. However, this does not release licensees from meeting the requirements of 10 CFR 50.44.

4.7 Containment and Drywell Oxygen

The NRC staff agrees that Containment and Drywell Oxygen is not a key variable for providing information on the integrity of the Primary Containment fission product barrier and, therefore, may be reclassified as not being an RG 1.97, Revision 4, Type C variable for the Primary Containment fission product barrier. However, this does not release licensees from meeting the requirements of 10 CFR 50.44.

4.8 Safety Relief Valve Position

The NRC staff agrees with the classification of SRV Position as an RG 1.97, Revision 4, Type D variable, without environmental or seismic qualification, to provide information on the SRV System performance. However, this does not release licensees from meeting the requirements of 10 CFR 50.34(f) or Item II.D.3 of NUREG-0737.

4.9 Isolation Condenser System Shell-Side Water Level and Isolation Condenser System Valve Position

The NRC staff agrees with the classification of Isolation Condenser System Shell-Side Water Level and Isolation Condenser System Valve Position as being RG 1.97, Revision 4, Type D variables to provide information on the status of Isolation Condenser System performance, for plants with isolation condensers. Plants with isolation condensers should review their plant design and propose plant specific Type B variables to provide information on the accomplishment of the Isolation Condenser function and Type D variables to provide information on the status of the Isolation Condenser System performance.

4.10 Main Steam Isolation Valve Leakage Control System Pressure

The NRC staff agrees with the reclassification of MSIV Leakage Control System Pressure as not being an RG 1.97, Revision 4, Type D variable for the Main Steam System. Each licensee should identify previous approval of the elimination of MSIV leakage control system, justify the elimination of the MSIV leakage control system, or provide instrumentation for MSIV Leakage Control System Pressure.

4.11 Containment Area Radiation

The NRC staff agrees with the classification of Containment Area Radiation - High Range as an RG 1.97, Revision 4, Type E variable to monitor identified pathways, provided that the instrumentation meets the plant specific licensing commitments to Item II.F.1 of NUREG-0737

and RG 1.97, Revision 2 or 3, Category 1 criteria, instead of the RG 1.97, Revision 4, Type E criteria. However, the classification of Containment Area Radiation - High Range as an RG 1.97, Type E variable does not release licensees from meeting the plant specific licensing commitments related to the requirements of Item II.F.1 of NUREG-0737. Relaxations and downgrades in 10 CFR 50.44 cannot be extended to instrumentation for Containment Area Radiation - High Range.

4.12 Codes and Standards

The NRC staff recognizes that no currently operating BWR fully meets the codes and standards that are referenced by RG 1.97, Revision 4. Licensees should review their RG 1.97, Revision 2 or 3, commitments with respect to codes and standards and should either comply with the codes and standards referenced by RG 1.97, Revision 4, where practicable, or provide justification for maintaining their existing commitments to the RG 1.97, Revision 2 or 3, referenced codes and standards.

5.0 CONCLUSION

Based on the above evaluation, the NRC staff concludes that the proposed application of RG 1.97, Revision 4, to currently licensed BWR plants, as detailed in NEDO-33349 and modified as stated above, is acceptable for currently licensed BWR plants. Licensees electing to adopt NEDO-33349 should perform a plant specific review to determine its applicability. Licensees should also address the limitations and conditions of this safety evaluation. Licensees should submit a plant specific change to their commitments to RG 1.97 for NRC staff review.

The licensee's submittal should include a table that compares each RG 1.97, Revision 2 or 3, variable and the resultant RG 1.97, Revision 4 variable. This information should also include, for each Type A, B, C, D, or E variable under RG 1.97, Revision 4, in a table format: instrument range, environmental qualification, seismic qualification, quality assurance, redundancy, location of sensors, power supply, and location of display.

The attachment to this safety evaluation provides a detailed list of each RG 1.97, Revision 3, variable and NEDO-33349 proposed changes that have been reviewed and accepted by the NRC staff.

6.0 REFERENCES

1. Letter from R. C. Bunt Boiling Water Reactor Owners Group (BWROG), submitting Licensing Topical Report (LTR) NEDO-33349, Revision 1, "BWR Application to Regulatory Guide 1.97, Revision 4," August 31, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML072470741).

2. Regulatory Guide 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," NRC Office of Nuclear Regulatory Research, June 2006 (ADAMS Accession No. ML061580448).

3. Letter from D. W. Coleman, BWROG, "Responses to Requests for Additional Information (RAIs) Regarding the Submittal of BWROG LTR NEDO-33349, Revision 1, 'BWR

Application to Regulatory Guide 1.97, Revision 4'," October 31, 2008 (ADAMS Accession No. ML083090576).

4. Letter from D. W. Coleman, BWROG, "Responses to Supplemental Request for Additional Information (RAIs) dated June 16, 2009, Regarding Boiling Water Reactor Owners' Group Licensing Topical Report (LTR) NEDO-33349, Revision 1, 'BWR Application to Regulatory Guide 1.97, Revision 4,'" September 14, 2009 (ADAMS Accession No. ML092600272).

5. Letter from F. P. Schiffley, BWROG, "Draft Safety Evaluation (SE) for Boiling Water Reactors Owners' Group Topical Report (TR) NEDO-33349, Revision 1, 'Boiling Water Reactor Application to Regulatory Guide 1.97, Revision 4,'" September 10, 2010 (ADAMS Accession No. ML102570064).

6. Regulatory Guide 1.97, Revision 2, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," NRC Office of Nuclear Regulatory Research, December 1980 (ADAMS Accession No. ML060750525).

7. Regulatory Guide 1.97, Revision 3, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," NRC Office of Nuclear Regulatory Research, May 1983 (ADAMS Accession No. ML003740282).

8. IEEE Std. 497-2002, "IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers.

9. Title 10, of the Code of Federal Regulations, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10. NUREG-0737, "Clarification of TMI Action Plan Requirements," NRC Office of Nuclear Reactor Regulation, November 30, 1980 (ADAMS Accession No. ML051400209).

11. Supplement No. 1 to NUREG-0737, "Requirements for Emergency Response Capability" (Generic Letter No. 82-33), December 17, 1982 (ADAMS Accession No. ML031080548).

12. NEDO-31558, "Position on NRC Regulatory Guide 1.97, Revision 3, Requirements for Post-Accident Neutron Monitoring System," April 1, 1988.

13. Safety Evaluation "Boiling Water Reactors, Regulatory Guide 1.97, Post-Accident Neutron Flux Monitoring Instrumentation," NRC Office of Nuclear Reactor Regulation, January 13, 1993.

14. NEDO-31558-A, "Position on NRC Regulatory Guide 1.97, Revision 3, Requirements for Post-Accident Neutron Monitoring System," March 1993.

15. NEDO-33160, "Regulatory Relaxation for the Post Accident SRV Position Indication System," December 13, 2004 (ADAMS Accession No. ML043510165).

16. Safety Evaluation, “Final Safety Evaluation for Boiling Water Reactor Owners’ Group (BWROG) Topical Report (TR) NEDO-33160, Regulatory Relaxation for the Post Accident SRV [Safety Relief Valve] Position Indication System,” NRC Office of Nuclear Reactor Regulation, September 25, 2006 (ADAMS Accession No. ML062210067).

17. NEDO-33160-A, “Regulatory Relaxation for the Post Accident SRV Position Indication System,” October 2006 (ADAMS Accession No. ML062910165).

18. NEDC-31858P, Revision 2, “BWROG Report for Increasing MSIV Leakage Limits and Elimination of Leakage Control Systems,” September 1993.

19. Safety Evaluation, “Safety Evaluation of GE Topical Report NEDC-31858P, Revision 2, BWROG Report for Increasing MSIV Leakage Limits and Elimination of Leakage Control Systems, September 1993,” NRC Office of Nuclear Reactor Regulation, March 3, 1999 (ADAMS Accession No. ML010640286).

20. NEDC-31858P-A, Revision 2, “BWROG Report for Increasing MSIV Leakage Limits and Elimination of Leakage Control Systems,” August 1999.

21. NEDO-32991, “Regulatory Relaxation for BWR Post Accident Sampling Stations (PASS),” November 30, 2000 (ADAMS Accession No. ML012260048).

22. Safety Evaluation, “Safety Evaluation Related to Topical Report NEDO-32991, ‘Regulatory Relaxation for BWR Post Accident Sampling Stations (PASS)’,” NRC Office of Nuclear Reactor Regulation, June 12, 2001 (ADAMS Accession No. ML011630016).

23. NEDO-32991-A, “Regulatory Relaxation for BWR Post Accident Sampling Stations (PASS),” August 2001 (ADAMS Accession No. ML012260048).

24. IEEE Std. 308-1991, “IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generation Stations,” Institute of Electrical and Electronics Engineers.

25. IEEE Std. 323-1983, “IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers.

26. IEEE Std. 344-1987, “IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers.

27. IEEE Std. 384-1992, “IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits,” Institute of Electrical and Electronics Engineers.

28. IEEE Std. 1023-1988, “IEEE Guide for Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers.

29. IEEE Std. 1289-1998, “IEEE Standard Guide for the Application of Human Factors Engineering in the Design of Computer-Based Monitoring and Control Displays for Nuclear Power Generating Stations,” Institute of Electrical and Electronics Engineers.

30. ISO 9241-3-1992, “Visual Display Terminals (VDTs) Used for Office Tasks Ergonomics Design-Part 3: Visual Display Requirements,” International Organization for Standardization.

31. ASME NQA-1-2001, “Quality Assurance Requirements for Nuclear Facility Applications,” American Society of Mechanical Engineers.

Attachment: NEDO-33349 Variables and RG 1.97, Revision 3 Variables

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Tai Huang
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Date: June 3, 2011

ATTACHMENT - NEDO-33349 Variables and RG 1.97, Revision 3 Variables

NEDO-33349			RG 1.97, Revision 3				Safety Evaluation Section / Remarks
Type	Function	Variable	Type	Category	Function	Variable	
A	Design Basis Event	RPV Water Level	A	1	Design Basis Event	Plant Specific	3.1.A List of Type A variables may vary for specific plants
A	Design Basis Event	RPV Pressure	A	1	Design Basis Event	Plant Specific	3.1.A List of Type A variables may vary for specific plants
A	Design Basis Event	Drywell Pressure	A	1	Design Basis Event	Plant Specific	3.1.A List of Type A variables may vary for specific plants
A	Design Basis Event	Suppression Pool Temperature	A	1	Design Basis Event	Plant Specific	3.1.A List of Type A variables may vary for specific plants
A	Design Basis Event	Suppression Pool Water Level	A	1	Design Basis Event	Plant Specific	3.1.A List of Type A variables may vary for specific plants
B	Reactivity Control	Neutron Flux	B	1	Reactivity Control	Neutron Flux	3.1.B.1.1 NEDO-31558 (see 3.1.D.2.1)
			B	3	Reactivity Control	Control Rod Position	3.1.B.1.2 Type D (see 3.1.D.2.2)
			B	3	Reactivity Control	RCS Soluble Boron Concentration	3.1.B.1.3
B	Level Control	RPV Water Level	B	1	Core Cooling	Coolant Level in Reactor Vessel	3.1.B.2.1
			B	N/A	Core Cooling	BWR Core Temperature	3.1.B.2.2
B	Pressure Control	RPV Pressure	B	1	Maintaining Reactor Coolant System Integrity	RPV Pressure	3.1.B.3.1

NEDO-33349			RG 1.97, Revision 3				Safety Evaluation Section / Remarks
Type	Function	Variable	Type	Category	Function	Variable	
			B	1	Maintaining Reactor Coolant System Integrity	Drywell Pressure	3.1.B.3.2
			B	1	Maintaining Reactor Coolant System Integrity	Drywell Sump Level	3.1.B.3.3
B	Primary Containment Control	Drywell Pressure/Containment Pressure	B	1	Maintaining Containment Integrity	Primary Containment Pressure	3.1.B.4.1
B	Primary Containment Control	Suppression Pool Temperature					3.1.B.4.2
B	Primary Containment Control	Suppression Pool Water Level					3.1.B.4.3
			B	1	Maintaining Containment Integrity	Primary Containment Isolation Valve Position	3.1.B.4.4 Type D (see 3.1.D.12)
C	Fuel Cladding	RPV Water Level					3.1.C.1.1
			C	1	Fuel Cladding	Radioactivity Concentration or Radiation Level in Circulating Primary Coolant	3.1.C.1.2
			C	3	Fuel Cladding	Analysis of Primary Coolant	3.1.C.1.3
			C	N/A	Fuel Cladding	BWR Core Temperature	3.1.C.1.4
C	Reactor Coolant Pressure Boundary	RPV Water Level					3.1.C.2.1
C	Reactor Coolant Pressure Boundary	RPV Pressure	C	1	Reactor Coolant Pressure Boundary	RPV Pressure	3.1.C.2.2
C	Reactor Coolant Pressure Boundary	Drywell Pressure/Containment Pressure	C	1	Reactor Coolant Pressure Boundary	Drywell Pressure	3.1.C.2.3

NEDO-33349			RG 1.97, Revision 3				Safety Evaluation Section / Remarks
Type	Function	Variable	Type	Category	Function	Variable	
C	Reactor Coolant Pressure Boundary	Suppression Pool Water Level	C	1	Reactor Coolant Pressure Boundary	Suppression Pool Water Level	3.1.C.2.4
C	Reactor Coolant Pressure Boundary	Suppression Pool Temperature					3.1.C.2.5
			C	3	Reactor Coolant Pressure Boundary	Primary Containment Area Radiation	3.1.C.2.6 Type E (see 3.1.E.1.1)
			C	1	Reactor Coolant Pressure Boundary	Drywell Drain Sump Level	3.1.C.2.7
C	Primary Containment	Drywell Pressure/Containment Pressure					3.1.C.3.1
C	Primary Containment	Suppression Pool Temperature					3.1.C.3.2
C	Primary Containment	Suppression Pool Water Level					3.1.C.3.3
			C	1	Containment	RPV Pressure	3.1.C.3.4
			C	1	Containment	Containment and Drywell Hydrogen	3.1.C.3.5 10 CFR 50.44
			C	1	Containment	Containment and Drywell Oxygen	3.1.C.3.6 10 CFR 50.44
			C	3	Containment	Containment Effluent Radioactivity - Noble Gases	3.1.C.3.7 Type E (see 3.1.E.9.1)
			C	2	Containment	Effluent Radioactivity - Noble Gases	3.1.C.3.8 Type E (see 3.1.E.9.2)
			C	2 (Rev. 2)	Containment	Radiation Exposure Rate	3.1.C.3.9 Type E (see 3.1.E.2.1)
D	Containment System	Drywell Pressure/Containment Pressure	D	2	Primary Containment Related Systems	Drywell Pressure	3.1.D.1.1

NEDO-33349			RG 1.97, Revision 3				Safety Evaluation Section / Remarks
Type	Function	Variable	Type	Category	Function	Variable	
D	Containment System	Suppression Pool Temperature	D	2	Primary Containment Related Systems	Suppression Pool Temperature	3.1.D.1.2
D	Containment System	Suppression Pool Water Level	D	2	Primary Containment Related Systems	Suppression Pool Water Level	3.1.D.1.3
D	Containment System	Drywell Temperature	D	2	Primary Containment Related Systems	Drywell Atmosphere Temperature	3.1.D.1.4
			D	2	Primary Containment Related Systems	Suppression Chamber Spray Flow	3.1.D.1.5
			D	2	Primary Containment Related Systems	Drywell Spray Flow	3.1.D.1.6
D	Reactor Protection System and Control Rod Drive System	Neutron Flux	B	1	Reactivity Control	Neutron Flux	3.1.D.2.1 NEDO-31558
D	Reactor Protection System and Control Rod Drive System	Control Rod Position	B	3	Reactivity Control	Control Rod Position	3.1.D.2.2 No EQ or Seismic
D	SRV System	SRV Position	D	2	Main Steam System	Primary SRV Position	3.1.D.3.1 NEDO-33160 10 CFR 50.34(f) NUREG-0737 No EQ or Seismic
D	RCIC System	RCIC System Flow	D	2	Safety Systems	RCIC Flow	3.1.D.4.1 No EQ or Seismic
D	RCIC System	Condensate Storage Tank Water Level	D	3	Condensate and Feedwater System	Condensate Storage Tank Level	3.1.D.4.2 No EQ or Seismic
D	HPCI or HPCS System	HPCI or HPCS System Flow	D	2	Safety Systems	HPCI Flow	3.1.D.5.1
D	HPCI or HPCS System	Condensate Storage Tank Water Level	D	3	Condensate and Feedwater System	Condensate Storage Tank Level	3.1.D.5.2 No EQ or Seismic
D	RHR System	RHR System Flow	D	2	Residual Heat Removal Systems	RHR System Flow	3.1.D.6.1
D	RHR System	RHR System Valve Position					3.1.D.6.2

NEDO-33349			RG 1.97, Revision 3				Safety Evaluation Section / Remarks
Type	Function	Variable	Type	Category	Function	Variable	
D	RHR System	Suppression Chamber Spray Flow	D	2	Primary Containment Related Systems	Suppression Chamber Spray Flow	3.1.D.6.3 Alternate Instrument
D	RHR System	Drywell Spray Flow	D	2	Primary Containment Related Systems	Drywell Spray Flow	3.1.D.6.4 Alternate Instrument
D	RHR System	RHR System Heat Exchanger Outlet Temperature	D	2	Residual Heat Removal Systems	RHR Heat Exchanger Outlet Temperature	3.1.D.6.5
D	LPCS System	LPCS System Flow	D	2	Safety Systems	LPCI System Flow	3.1.D.7.1
D	LPCS System	Core Spray Flow	D	2	Safety System	Core Spray System Flow	3.1.D.7.2
D	Cooling Water System	Cooling Water Temperature to ESF System Components	D	2	Cooling Water System	Cooling Water Temperature to ESF System Components	3.1.D.8.1 Alternate instrument
D	RHR Service Water System	RHR Service Water System Flow	D	2	Cooling Water System	Cooling Water Flow to ESF System Components	3.1.D.9.1 Alternate instrument
D	Essential Service Water System	Essential Service Water System Flow					3.1.D.10.1 Alternate Instrument
D	RPV Isolation System	MSIV Position					3.1.D.11.1
D	RPV Isolation System	Cleanup System Isolation Valve Position					3.1.D.11.2
D	RPV Isolation System	Shutdown Cooling System Isolation Valve Position					3.1.D.11.3
D	RPV Isolation System	Other RPV Normally Open Isolation Valve Position Inside Containment					3.1.D.11.4

NEDO-33349			RG 1.97, Revision 3				Safety Evaluation Section / Remarks
Type	Function	Variable	Type	Category	Function	Variable	
D	RPV Isolation System	Other RPV Normally Closed Isolation Valve Position Inside Containment Require Opening for LOCA					3.1.D.11.5
D	RPV Isolation System	Other RPV Normally Open Isolation Valve Position Outside Containment					3.1.D.11.6
D	RPV Isolation System	Other RPV Normally Closed Isolation Valve Position Outside Containment Require Opening for Pipe Breaks Outside Containment					3.1.D.11.7
D	RPV Isolation System	Other RPV Normally Closed Isolation Valve Position Outside Containment Do Not Require Opening for either LOCA or Pipe Breaks Outside Containment					3.1.D.11.8 No EQ or Seismic
D	Containment Isolation System	Normally Open CIV Position Inside Containment	B	1	Maintaining Containment Integrity	Primary Containment Isolation Valve Position	3.1.D.12.1
D	Containment Isolation System	Normally Closed CIV Position Inside Containment Require Opening for LOCA	B	1	Maintaining Containment Integrity	Primary Containment Isolation Valve Position	3.1.D.12.2
D	Containment Isolation System	CIV Position Outside Containment Require Opening for LOCA	B	1	Maintaining Containment Integrity	Primary Containment Isolation Valve Position	3.1.D.12.3

NEDO-33349			RG 1.97, Revision 3				Safety Evaluation Section / Remarks
Type	Function	Variable	Type	Category	Function	Variable	
D	Containment Isolation System	Normally Closed CIV Position Inside or Outside Containment Do Not Require Opening for LOCA	B	1	Maintaining Containment Integrity	Primary Containment Isolation Valve Position	3.1.D.12.4 No EQ or Seismic
D	Secondary Containment System	Secondary Containment Isolation Damper Position					3.1.D.13.1
D	Secondary Containment System	Standby Gas Treatment Flow					3.1.D.13.2
D	Control Room Environment System	Control Room Isolation Damper Position					3.1.D.14.1
D	Control Room Environment System	Emergency Ventilation Damper Position	D	2	Ventilation Systems	Emergency Ventilation Damper Position	3.1.D.14.2 Alternate Instrument
D	SLCS System	SLCS Flow or Pumps Running	D	2	Safety Systems	SLCS Flow	3.1.D.15.1 No EQ or Seismic
D	SLCS System	SLCS Storage Tank Level	D	2	Safety Systems	SLCS Storage Tank Level	3.1.D.15.2 No EQ or Seismic
D	Power Systems	AC and DC Power Status	D	2	Power Supplies	Status of Standby Power	3.1.D.16.1
D	Equipment Area Cooling Water System	Equipment Area Cooling System Cooling Water Temperature					3.1.D.17.1
D	Essential Pneumatic Gas Supply System	Essential Pneumatic Gas Supply Pressure					3.1.D.18.1
D	Isolation Condenser System	Isolation Condenser System Shell-Side Water Level	D	2	Isolation Condenser System	Isolation Condenser System Shell-Side Water Level	3.1.D.19.1
D	Isolation Condenser System	Isolation Condenser System Valve Position	D	2	Isolation Condenser System	Isolation Condenser System Valve Position	3.1.D.19.2

NEDO-33349			RG 1.97, Revision 3				Safety Evaluation Section / Remarks
Type	Function	Variable	Type	Category	Function	Variable	
			D	3	Condensate and Feedwater System	Main Feedwater Flow	3.1.D.20.1
			D	2	Main Steam System	MSIV Leakage Control System Pressure	3.1.D.21.1
			D	3	Radwaste System	High Radioactivity Liquid Tank Level	3.1.D.22.1
E	Containment Radiation	Containment Area Radiation	E	1	Containment Radiation	Primary Containment Area Radiation - High Range	3.1.E.1.1 NUREG-0737 & RG 1.97 Rev 2 or 3
E	Containment Radiation	Reactor Building or Secondary Containment Area Radiation	E	2 (Mark III) 3 (Mark 1 & 2)	Containment Radiation	Reactor Building or Secondary Containment Area Radiation	3.1.E.1.2
E	Area Radiation	Radiation Exposure Rate	E	3	Area Radiation	Radiation Exposure Rate	3.1.E.2.1
E	Area Radiation	Control Room Area Radiation					3.1.E.2.2
E	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	Drywell Purge, Standby Gas Treatment System Purge, and Secondary Containment Purge	E	3	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	Drywell Purge and Standby Gas Treatment System Purge	3.1.E.3.1 Plant Specific
E	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	Secondary Containment Purge	E	3	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	Secondary Containment Purge	3.1.E.3.2 Plant Specific
E	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	Secondary Containment	E	3	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	Secondary Containment	3.1.E.3.3 Plant Specific

NEDO-33349			RG 1.97, Revision 3				Safety Evaluation Section / Remarks
Type	Function	Variable	Type	Category	Function	Variable	
E	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	Auxiliary Building	E	3	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	Auxiliary Building	3.1.E.3.4 Plant Specific
E	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	Common Plant Vent or Multipurpose Vent Discharge	E	3	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	Common Plant Vent or Multipurpose Vent Discharge	3.1.E.3.5 Plant Specific
E	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	All Other Identified Release Points	E	3	Airborne Radioactive Materials Released From Plant - Noble Gases and Vent Flow Rate	All Other Identified Release Points	3.1.E.3.6 Plant Specific
E	Particulates and Halogens	Particulates and Halogens - All Identified Plant Release Points Sampling With Onsite Analysis Capability	E	3	Airborne Radioactive Materials Released From Plant – Particulates and Halogens	Particulates and Halogens - All Identified Plant Release Points Sampling With Onsite Analysis Capability	3.1.E.4.1
E	Environs Radiation and Radioactivity	Airborne Radiohalogens and Particulates	E	3	Environs Radiation and Radioactivity	Airborne Radiohalogens and Particulates	3.1.E.5.1 Portable Instruments Acceptable
E	Environs Radiation and Radioactivity	Plant and Environs Radiation	E	3	Environs Radiation and Radioactivity	Plant and Environs Radiation	3.1.E.5.2 Portable Instruments Acceptable
E	Environs Radiation and Radioactivity	Plant and Environs Radioactivity	E	3	Environs Radiation and Radioactivity	Plant and Environs Radioactivity	3.1.E.5.3 Portable Instruments Acceptable
E	Meteorological	Wind Speed	E	3	Meteorological	Wind Speed	3.1.E.6.1
E	Meteorological	Wind Direction	E	3	Meteorological	Wind Direction	3.1.E.6.2
E	Meteorological	Estimation of Atmospheric Stability	E	3	Meteorological	Estimation of Atmospheric Stability	3.1.E.6.3

NEDO-33349			RG 1.97, Revision 3				Safety Evaluation Section / Remarks
Type	Function	Variable	Type	Category	Function	Variable	
E	Grab Sample	Primary Containment and Sump Grab Sample	E	3	Accident Sampling Capability	Primary Coolant and Sump Grab Sample	3.1.E.7.1 NEDO-32991
E	Grab Sample	Containment Air Grab Sample	E	3	Accident Sampling Capability	Containment Air Grab Sample	3.1.E.7.2 NEDO-32991
E	Off-gas System Radiation	Off-gas System Release Point Radiation					3.1.E.8.1
E	Effluent Radioactivity	Containment Effluent Radioactivity - Noble Gases	C	3	Containment	Containment Effluent Radioactivity - Noble Gases	3.1.E.9.1
E	Effluent Radioactivity	Effluent Radioactivity - Noble Gases	C	3	Containment	Effluent Radioactivity - Noble Gases	3.1.E.9.2