



BWR Application to RG 1.97 Rev. 4

NEDO-33349 Revision 1 Topical Report

NRC-BWROG RG 1.97 RAI Meeting
August 21, 2008
Washington DC

NRC-BWROG Meeting Agenda

- Introduction and Objectives - M. Iannantuono
- BWROG Topical Report - A. Klemptner
- Key Findings and Conclusions - J. Kenny
- Topical Report Methodology - J. Kenny
- NRC RAI Issues and BWROG Responses -
J. Kenny
- Progressing Forward - T. Schiffley

Meeting Objectives

- Promote common understanding of Topical Report methodology and its application
- Discuss NRC RAI issues and BWROG RAI responses
- Work to consensus on key RAI issues

RG 1.97 Topical Report Overview

- BWROG RG 1.97 Committee
- Regulatory Guidance
- NEDO-33349 Topical Report Objectives
- NRC Review of Topical Report and RAI

Regulatory Guidance For Accident Monitoring Instrumentation

RG 1.97, Accident Monitoring Instrumentation evolution

- NUREG-0737, Clarification of TMI Action Plan Requirements results in RG 1.97 revisions
- R2/3 provides prescriptive lists of variable types and defines design and qualification categories of variables
- Plants either complied with requirements or requested deviations

RG 1.97 R4 provides performance-based criteria

- Selecting criteria for variable Types using safety analysis and EPGs
- Consistent design and qualification categories for each variable Type
- Existing plants required to provide complete analysis for use

Topical Report Objectives

- Provide BWR methodology for performing an analysis for PAM modifications meeting RG 1.97 R4 selection criteria
- Identify specific criteria for BWR Type A-D variables utilizing
 - R4 source documents (IEEE 497)
 - BWR safety analysis, EPGs and engineering analysis
- Apply R4 criteria and source documents for selecting radiological release “Type E” variables for BWRs
- Document results for Typical BWR/4 and 6 Accident Monitoring Variables

Topical Report Objectives (continued)

- Provide Guidelines for Plant Specific Application
- Summarize Significant Changes from RG 1.97 R3
 - Compare R4 results to R3 variables list
 - Include plant specific R3 list for information only

Key Findings and Conclusions

Different methodology used for each Type variable

- Type A variables identified for Typical Plants (BWR/4 and 6)
 - RPV Water Level, RPV Pressure, Containment Pressure, Suppression Pool Temperature, Suppression Pool Level
- Type B has same list of variables with addition of Neutron Flux
 - NEDO-31558 addresses requirement
- Type C has same list as Type A
- Type D results in similar list as compared to R3 with NRC approved deviations
- Type E results in similar list of variables as R3 but with different design requirements
 - R4 included as high quality commercial grade
 - NUREG 0737 differences exist

NRC Review of Topical Report and RAI

- Draft LTR forwarded to the NRC in support of a Pre-Submittal Meeting held on November 13, 2006
- NRC provided comments resulting from the Pre-Submittal Meeting in a letter dated March 13, 2007
- NEDO-33349 Rev 1, BWR Application to Regulatory Guide 1.97 Rev 4 was submitted in August 2007
- Pre-acceptance issues were discussed and the LTR was accepted for review in March 2008
- Draft NRC RAI provided in May 2008 and final NRC RAI received in August 2008
 - RAI input from three NRC Branches
 - BWROG response is due in 90 days

Topical Report Methodology- Type A

Type A Variables

Provide Primary Information Required to Permit Operators to:

- 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
- 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

Topical Report Methodology- Type A

Operator Actions Assumed in Plant Safety Analysis (FSAR)

- Safety Analysis Requirements
 - Determine Safety Analysis Events
 - Anticipated Operational Occurrences
 - Accidents
 - Establish Required Actions for safe shutdown
 - Consider Single Failures in Mitigating Systems
- Utilize BWR Nuclear Safety Operational Analysis (NSOA) Methodology
 - Identify All Required Systems
 - Identify Required Operator Actions
 - Identify Specific Parameters in Safety Analysis Used by Operators to Perform Planned Manual Operations

Topical Report Methodology- Type B

Type B Variables

Provide Primary Information to Control Room Operators to Assess Critical Safety Functions (IEEE 497)

Methodology

- Critical Safety Functions are Derived from EPG/EOPs entry conditions
- Critical Safety Functions are Defined in Topical as
 - Reactor Pressure Vessel Control which includes Reactivity Control, Pressure Control, and Level Control
 - Primary Containment Control
- Symptom based BWR EPGs were utilized to identify variables as defined in the Topical

Topical Report Methodology- Type C

Type C Variables

Provide Extended Range Primary Information to Operators to Indicate Performance of Fission Product Barriers

Fission Product Barriers Defined as

- Fuel Cladding
- Reactor Coolant Pressure Boundary
- Primary Containment Pressure Boundary

Identify Minimum Set of Parameters that Provide the Most Direct Indication of Fission Product Barrier Integrity

Topical Report Methodology- Type C

Type C Methodology

Identify Minimum Set of Parameters that Provide the Most Direct Indication of Fission Product Barrier Integrity based on:

- Safety Analysis
- EPGs
- Engineering Analysis
 - Required for fuel cladding integrity determination

Topical Report Methodology- Type D

Type D Variables

Variables Required in Procedures and Licensing Design Basis

- Indicate Performance of Safety and Auxiliary Systems Necessary for Mitigation of Design Basis Events
- Indicate Performance of Other Systems Necessary to Achieve and Maintain a Safe Shutdown Condition
- Verify Safety System Status

Topical Report Methodology- Type D

Type D Methodology

Use Safety Analysis and EPGs to identify:

- Systems assumed in the safety analysis
 - Based on events and required actions
- Identify Required Systems – remain functional for accidents and AOOs
- Identify Shutdown Systems
 - Derived from EOPs to supplement Required Systems
- Identify Auxiliary Support Systems

Type D will be more plant specific due to system differences

Topical Report Methodology- Type E

Type E Variables

Required for Determining Magnitude and Continually Assessing Release of Radioactive Material

Selection of Variables

- Monitor Magnitude of Releases through the Identified Pathways
- Monitor Environmental Conditions used to Determine the Impact of Releases
- Monitor Radiation Levels and Radioactivity in Plant Environs
- Monitor Radiation Levels and Radioactivity in Control Room and Selected Plant Areas Required for Plant Recovery

Similar variables as R3 with deviations included

NRC RAI Received

Key Issues

- Type C – Fuel Cladding Integrity
- Type E – CHARMS Design Requirements

Key RG 1.97 Topical Report RAI Issues

Type C Variable

- BWR safety analysis, EPGs, and engineering analysis determine RPV water level is appropriate as Type C variable for BWR Fuel Cladding barrier
 - BWR fuel cladding barrier integrity can be directly related to water level
 - EOPs base post accident operator actions to protect fuel barrier on RPV water level
 - Fuel barrier assumed breached if RPV water level lowers to a predefined value
- Confirmation of extent of damage by multitude of parameters: effluent monitors, hydrogen monitors, radioactivity concentration sampling, and CHARM

Key RG 1.97 Topical Report RAI Issues

Qualification Requirements

- RG 1.97 R2/3 – Qualification requirements specified for each instrument
 - NUREG 0737 CHARM requirements specified as Type E Cat 1
- RG 1.97 R4 - Qualification is based on variable type
 - Type A, B, & C variables are full qualification
 - Type E are commercial grade

Key RG 1.97 Topical Report RAI Issues

Containment High-Range Radiation Monitor (CHARM)

- Per RG 1.97 R4, A, B, & C variables derived from safety analysis and EPGs (entry conditions)
- Per RG 1.97 R4, E variables are required to determine magnitude and continual assessment of release of radioactive material
- CHARM
 - Not specified by safety analysis or EPG entry conditions
 - Meets the definition of a Type E variable in RG 1.97 R4
 - Used for confirmation of core damage and assist in EAL determination
- Therefore, Topical Report concludes CHARM is Type E variable of high quality, commercial grade
- Consistent with the precedent of PASS, differences between NUREG 0737 and Topical need to be addressed

NRC RAI Status

- Key Issues to be addressed
- Reconcile with RG 1.97 Rev 3
- Application of Topical Report Methodology
- Markup of Topical to be provided with RAI response (clean typed revision at draft SE)
- RAI Response due in October 2008

Progressing Forward

- Updated BWROG Topical Report will reflect positions discussed today
- BWROG encourages future meetings and review of NRC draft Safety Evaluation during 2009
- Will pursue revision to PAM Technical Specification based on Topical results
- Need to address BWR CHARM classification versus NUREG 0737 (similar to PASS precedent)