NRC-PWROG Meeting to Discuss Determining the PAM Instrumentation that Satisfies the Criteria of 10CFR50.36

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Agenda

- Background
- Objective of the Topical Report
- Correspondence Chronology
- Methodology to Determine the PAM Instrumentation that Satisfies Criterion 4 of 10CFR50.36
- HRA Evaluation of Operator Actions for PAM Instrumentation Relocated from the Tech Specs
- ERG CSF Status Trees
- Instrumentation Utilized in ERG CSF Status Trees
- Plant Specific HRA Evaluation
- NUREG-1431 Changes
- Summary and Conclusions

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Relocation of PAM Instrumentation from TS

- The existing TS requirements for PAM Instrumentation relocated from the TS will be included in a licensee controlled document (e.g. Technical Requirements Manual (TRM))
  - LCO
  - Applicability
  - Actions
  - Surveillance Requirements
- Therefore, the relocation of PAM Instrumentation from the TS does not, in itself, impact the availability of that instrumentation
- Adoption of this TR does not change any of the above requirements, nor does it supersede any other TS (e.g.. TS 3.3.1 and TS 3.3.2)

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Background

- WCAP-11618, "MERITS Program- Phase II Task 5 Criteria Application," documents the results of the application of the NRC's Interim Policy Statement Criteria to NUREG-0452
- NRC letter from Murley (NRC) to Newton (WOG) dated May 1988 documents the NRC staff review of the application of the NRC's Interim Policy Statement Criteria to NUREG-0452
- WCAP-11618 concluded that only Reg. Guide Type A instrumentation satisfied any of the NRC's Interim Policy Statement Criteria (Criterion 3)
- WCAP-11618 also concluded that Reg. Guide non-Type A, Category 1 instrumentation did not satisfy any of the NRC's Interim Policy Criteria including Criterion 4

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Background (cont.)

- The Staff's review documented in the May 1988 letter agreed that Reg. Guide 1.97 Type A instrumentation satisfied Criterion 3 and concluded that the Staff was unable to confirm the OGs conclusion that Category 1 PAM instrumentation was not of prime importance in limiting risk (Criterion 4)
- The basis for the conclusion regarding Category 1 PAM instrumentation was that "recent" PRAs have shown the risk significance of operator recovery actions required a knowledge of Category 1 variables, and that "recent" severe accident studies showed significant potential for risk reduction from accident management

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Background (cont.)

- The Staff concluded that the OGs should develop further risk-based justification in support of relocating any or all Category 1 variables from the STS
- Tech Spec 3.3.3, "PAM Instrumentation," in NUREG-1431 contains a Reviewer's Note that requires Table 3.3.3-1 to include all Reg. Guide 1.97 Type A instruments, and all Reg. Guide 1.97 Category 1, non-Type A instruments in accordance with the unit's Reg. Guide 1.97 SER

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Objective of the Topical Report (WCAP-15981)

- The objective of the Topical Report is to determine which PAM instrumentation satisfies Criteria 3 and/or 4 of 10CFR50.36
- **Criterion 3:** An SSC that is part of the primary success path and which functions or actuates to mitigate a DBA or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier
- The safety analyses were reviewed to determine which PAM instrumentation provides the primary information that is essential for the direct accomplishment of specified manual actions for which no automatic control is provided and that are required for safety systems to accomplish their safety functions for DBA or transients
- This PAM instrumentation satisfies Criterion 3 of 10CFR50.36

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Objective of the Topical Report (cont.)

- **Criterion 4:** An SSC which operating experience or probabilistic risk assessment has shown to be significant to public health and safety
- A methodology was developed to address the Staff request contained in the 1988 NRC letter to develop a risk-based justification to support relocating Category 1 variables that do not satisfy Criterion 4 of 10CFR50.36 out of the STS
- This PAM instrumentation satisfies Criterion 4 of 10CFR50.36
- This Topical Report will support the addition of an additional Reviewer's Note to Tech Spec 3.3.3 of NUREG-1431 that will provide licensees with an option of revising their plant specific PAM Table to reflect the PAM instrumentation that satisfies Criteria 3 and/or 4 of 10CFR50.36 based on the methodology contained in WCAP-15981

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Correspondence Chronology

- The Topical Report was submitted for NRC review and approval on September 17, 2004 (WOG-04-474)
- Responses provided to the first set of RAIs on March 20, 2006 (WOG-06-104)
- WCAP revisions provided in response to a teleconference on August 10, 2006 (OG-06-259)
- Responses provided to the second set of RAIs on June 28, 2007 (OG-07-292)
- Responses provided to the third set of RAIs on August 22, 2007 (OG-07-376)

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Methodology to Determine the PAM Instrumentation that Satisfies Criterion 4 of 10CFR50.36

- Identification of variables that show significant potential for risk reduction from accident management comes from three sources
  - PRAs to date focus on prevention of core damage and therefore are useful in identifying variables that reduce risk by preventing core damage
  - SAMG is useful in identifying variables that reduce risk by preventing fission product releases to the environment following core damage
  - EPIP is useful in identifying variables that reduce risk by timely implementation of offsite emergency preparedness activities
- The focus of the remainder of this presentation is on the PRA and the prevention of core damage

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Methodology to Determine the PAM Instrumentation that Satisfies Criterion 4 of 10CFR50.36 (Continued)

- The relationship of the PRA and PAM instrumentation must be understood to determine the risk significance
  - The PRA models all design basis and beyond design basis initiating events
  - The PRA accident scenarios go beyond design basis single failures and assumptions
  - The PRA models operator actions to mitigate the accident scenarios to determine a realistic CDF

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Methodology to Determine the PAM Instrumentation that Satisfies Criterion 4 of 10CFR50.36 (Continued)

- Operator actions modeled in the PRA are typically based only on Emergency Operating Procedure (EOP) or Abnormal Operating Procedure (AOP) steps
  - Actions assumed in the DBA analyses, and
  - Actions to respond to beyond design basis events
- Not all EOP or AOP steps are modeled in the PRA
  - Highly reliable operator actions, e.g., control AFW to maintain SG level
  - Second and third level recovery actions based on their impact on risk
- All operator actions that have an impact on risk are modeled in the PRA
  - Owners Group Peer Reviews ensure the technical adequacy of the HRA

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Methodology to Determine the PAM Instrumentation that Satisfies Criterion 4 of 10CFR50.36 (Continued)

- The human reliability analysis (HRA) in the PRA assumes that instrumentation is available to cue the operator to take prescribed actions
  - The HRA typically does not assign an instrumentation failure rate
  - The HRA assumes that the instrumentation is available and accurate when required, whether it is included in the Tech Specs or not
    - The instrumentation is monitored once per shift by the operator viewing the control board, e.g., Channel Checks, etc.
    - Important instrumentation has multiple channels
    - The operators are aware of instrumentation out-of-service and the methods to compensate if an event occurs
    - Operator training stresses that instrumentation readings need to be validated by correlations with other instrumentation before any major actions are performed

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Methodology to Determine the PAM Instrumentation that Satisfies Criterion 4 of 10CFR50.36 (Continued)

- The availability of instrumentation, in regards to relocation from PAM Tech Specs, to support operator actions modeled in the PRA is inherent in the PRA risk importance determination
  - The RAW value assumes that the operator actions always fail and measures the impact on risk
  - Therefore RAW provides an indication of the impact of instrument unavailability on risk
- If an operator action has a low RAW value then the instrumentation to support that action has low risk significance
- If an operator action is modeled in the PRA, then the RAW value can be used to determine the impact on risk of degraded availability

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HRA Evaluation of Operator Actions for PAM Instrumentation Relocated from the Tech Specs

- Relocation of PAM Instrumentation from the TS does not, in itself, impact the availability of that instrumentation
- For the operator actions modeled in the PRA, the impact of potentially reduced availability is inherent in the risk importance determination
- For operator actions not explicitly modeled in the PRA but are considered to be highly reliable actions, an assessment would be required to determine that the operator action remains highly reliable, even in the event of reduced instrumentation availability
  - e.g., SG level is a multi-channel function as well as having narrow and wide range indication for each SG
- For operator actions screened from the PRA based on contribution to risk, an increase if the instrumentation unavailability would not impact CDF

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Critical Safety Function (CSF) Status Trees

- CSF Status Trees provide a second level of defense for a transient or an accident by protecting barriers that prevent the release of radioactivity
  - The Optimal Recovery Procedures (the E-Series, including ES and ECA procedures for Westinghouse plants) provide the expected operator actions for design basis accidents and many beyond design basis events
  - The CSF Status Trees would typically only be important for beyond design basis events
  - There are four levels of priority in the CSF Status Trees based on the severity of a challenge to fission product barriers
    - Red paths are most severe and require immediate attention
    - Orange paths require immediate attention when no Red paths are "active"
    - Yellow paths are to be are addressed as time is available
  - Therefore, only Red and Orange CSF paths need to be considered

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Instrumentation Utilized in Critical Safety Function (CSF) Status Trees

- Subcriticality CSF Status Tree
  - PR neutron flux is used to indicate a Red Path to FR-S.1
    - PR neutron flux is risk significant in the generic PRA and will be retained in PAM TS 3.3.3
  - IR SUR is used to indicate a Orange Path to FR-S.1
    - IR SUR is not risk significant in the generic PRA (Appendix A) and will not be included in TS 3.3.3
    - The COTs and Channel Calibrations (SR 3.3.1.7, SR 3.3.1.8, and SR 3.3.1.11) in TS 3.3.1 verify that IR and SR indications are available
  - SR can be relocated from TS 3.3.3 but will remain in TS 3.3.1

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Instrumentation Utilized in Critical Safety Function (CSF) Status Trees

- Core Cooling CSF Status Tree
  - No actions are modeled in the PRA to use Core Cooling CSF to prevent core damage; definition of core damage precludes use of Core Cooling CSF
  - Core Exit Temperature (CET) is used to indicate a Red Path to FR-C.1 and Orange Path to FR-C.2
    - CET is risk significant in the generic PRA (but not for Core Cooling CSF Status Tree) and will be retained in TS 3.3.3
  - Reactor Vessel Level (RVLIS) is used to indicate a Red Path to FR-C.1 and an orange path to FR-C.2 when the CET is less than the setpoint value
    - RVLIS is not risk significant in the generic PRA (Appendix A) and will not be retained in TS 3.3.3
    - RVLIS is not needed to effectively use the Core Cooling CSF Status Tree

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Instrumentation Utilized in Critical Safety Function (CSF) Status Trees

- Heat Sink CSF Status Tree
  - AFW Flow and SG Narrow Range are used to indicate a Red Path to FR-H.1
    - AFW Flow is risk significant in the generic PRA and will be retained in TS 3.3.3
  - Heat Sink CSF Status Tree uses SG Narrow Range level as a primary indicator
  - FR-H.1 procedure uses SG Wide Range level to initiate Bleed and Feed which is also risk significant in the generic PRA
    - The COTs and Channel Calibrations (TS 3.3.1 and TS 3.3.2) and TS 3.4.5 verify that SG Narrow Range Level indications are available
    - Plants typically have a figure that correlates Narrow Range and Wide Range SG level indications
    - Therefore only the SG Wide Range level indication needs to be included in TS 3.3.3

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Instrumentation Utilized in Critical Safety Function (CSF) Status Trees

- Integrity CSF Status Tree
  - RCS Cold Leg Temperature and RCS Pressure are used to indicate a Red Path and an Orange path to FR-P.1
    - Pressurized Thermal Shock (PTS) is not risk significant in the generic PRA (Appendix A)
    - Additional PTS analyses performed for the PTS rulemaking conclude that PTS is not risk significant
    - The Cold Leg Temperature indication will not be retained in TS 3.3.3
    - The COTs and Channel Calibrations for OTDT and OPDT (SR 3.3.1.7, SR 3.3.1.10) verify that the Tavg and ΔT indications are available

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Instrumentation Utilized in Critical Safety Function (CSF) Status Trees

- Containment CSF Status Tree
  - Containment Pressure is used to indicate a Red Path and an Orange path to FR-Z.1
    - Containment Pressure is risk significant in the generic SAMG and EPIP and will be retained in TS 3.3.3
  - Containment Sump Level Wide Range is used to indicate an Orange Path to FR-Z.2
    - This path was included in the containment CSF Status Tree to address non-mechanistic failure (completeness)
    - Prevention of Containment Flooding is not risk significant in the generic PRA (Appendix A)
    - Containment Sump Level Wide Range indication will not be retained in TS 3.3.3

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Instrumentation Utilized in Critical Safety Function (CSF) Status Trees

- Inventory CSF Status Tree
  - All Paths are Yellow and therefore do not need to be addressed immediately
  - Pressurizer Level and RVLIS are used to indicate Yellow Paths
    - RCS Inventory using FR-I.1 through FR-I.3 is not risk significant in the generic PRA (Appendix A)
    - Pressurizer Level is retained in PAM TS 3.3.3 for other risk significant operator actions
    - RVLIS is not needed to effectively use the Inventory CSF Status Tree; RVLIS indication will not be retained in TS 3.3.3
    - Based on PRA modeling, RVLIS does not need to be addressed in the plant specific implementation to determine its risk significance

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Plant Specific HRA Evaluation

- Refer to handout

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NUREG-1431 Changes

- NUREG-1431 contains a Reviewer's Note that requires Table 3.3.3-1 to include all Reg. Guide 1.97 Type A instruments, and all Reg. Guide 1.97 Category 1, non-Type A instruments in accordance with the unit's Reg. Guide 1.97 SER
  - This is a generic list of instruments that must be implemented on a plant specific basis
  - The plant specific lists of instruments varies from the generic list
- An additional Reviewer's Note to Tech Spec 3.3.3 of NUREG-1431 will be added that will provide licensees with an option of revising their plant specific PAM Table to reflect the PAM instrumentation that satisfies Criteria 3 and/or 4 of 10CFR50.36 based on the methodology contained in WCAP-15981
  - The plant specific lists determined with the methodology in WCAP-15981 will also vary from the generic list

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Summary and Conclusions

- The Traveler will include a change to the number of CETs and pre-planned alternate instrumentation
- The methodology in WCAP-15981 will be applied on a plant specific basis to determine the plant specific list of instrumentation to be included in Table 3.3.3-1 based on determining whether the instrumentation satisfies Criteria 3 and/or 4 of 10CFR50.36
- Applying the methodology in WCAP-15981 does not remove any PAM instrumentation from the plant design
- Applying the methodology in WCAP-15981 does not impact the requirements for the instrumentation contained in other TS (e.g., 3.3.1 and 3.3.2)
- Relocation of PAM Instrumentation from the TS does not, in itself, impact the availability of that instrumentation

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Summary and Conclusions

- Applying the methodology in WCAP-15981 does not impact the plant specific Reg. Guide 1.97 analysis and SER
- The plant specific list of PAM instrumentation may be different from the generic list based on applying the methodology on a plant specific basis

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Summary and Conclusions (cont.)

- For operator actions modeled in the PRA the RAW risk importance measure of that operator action is the appropriate metric for determining whether a particular instrument satisfies Criterion 4 of 10CFR50.36
- For all other instrumentation, a qualitative assessment needs to be completed based on the methodology in WCAP-15981 to determine whether other factors can impact the risk importance and therefore satisfy Criterion 4 of 10CFR50.36
  - Impact of the unavailability of the instrumentation on risk (PRA)
  - Post core damage operator actions to mitigate radiological releases (SAMG)
  - Implementation of offsite emergency preparedness activities (EPIPs)

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