



# **Summary of Issues from the NRC Review of the US-APWR Level 1 PRA for Operation at Power**

Meeting with Mitsubishi Heavy Industries

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## Background

- The staff appreciates the continuing efforts of MHI in revising the PRA and DCD to resolve staff concerns
- The staff completed its initial review of the US-APWR Level 1 PRA in December 2008 and requested additional information
- Responses to all but 2 questions have been received
- The responses are, in general, satisfactory but there are issues that still remain to be addressed

## Issues Related to Modeling of I&C Systems in the PRA (RAI Questions 19-28 to 19-43)

- Questions regarding PRA Modeling of
  - Functional diversity (separate digital controllers)
  - Power Interface (I/F) module
  - Manual actuation
  - Diversity of AAC signal
  - Failure of sensors for the “other” signals
  - Hardware (modules) CCF
  - Digital I&C room cooling & failure detection
- Basis for the assumed component unavailability
- Support and application software failure probabilities
- Software diversity in separate digital controllers
- Input to D-RAP in terms of “failure of signal”
- Dependency between DAS and PSMS (e.g., sensors)

## Issues Related to Lack of Modeling of Potential Failures

- Examples:
  - Failure of MSIV and MFIV for ruptured SG to close
  - Operator failure to equalize primary-to-secondary pressure following a SGTR event
  - Failure to open of manual valves connecting the EFW pits
  - Failure to control of EFW line throttle valve during standby
  - CCF and miscalibration of EFW pit water level sensors
  - Failure to open of the motor-operated MSRVs
  - Failure of manual actuation
  - Failure of the T-D pumps due to loss of HVAC
- The lack of modeling of such potential failures can be significant in sensitivity studies and risk-informed applications.



## Issues Related to Methodology and Calculations

- Validity of Assumptions and data used in estimating the frequency of total loss of CCW/ESW initiating event
- Thermal-hydraulic analyses used to support PRA success criteria credit more than the minimum set of equipment
- Validity of assumptions made in addressing human error dependencies

## Issues Related to Failure Probabilities

- Demand failure rates not always consistent with testing intervals
- Failure probability of one or more TBV to re-close to isolate a failed SG
- Failure probability of the non-safety GTGs
- CCF parameters for normally operating pumps
- Reliability of non-safety digital I&C software

## Issues Related to Uncertainty/Sensitivity

- Uncertainty of initiating events (e.g., loss of CCW)
- Treatment of high knowledge uncertainty (digital I&C software, reactor trip failure and adverse MTC probabilities) in same sequences of the ATWS event tree
- Treatment of uncertainty associated with maintenance unavailability (No LCO for one train outage)
- Sensitivity of PRA results to the assumed GTG CCF parameters



## Issues Related to PRA Insights/Assumptions

- A COL action item is needed to ensure specific operator actions are incorporated into the accident management program
- Assumptions about design and operational features are not always verified by reference to other DCD chapters or Chapter 19 analyses. Examples are:
  - capability of fast depressurization to allow alternate core cooling
  - early detection of failures due to control room indication
- Implied assumptions about design and operational features must be clearly stated. Examples are:
  - diversity between the M-G set and reactor trip breakers
  - diverse configuration of inter-system injection line check valves





## Major Issues

- Incomplete list of PRA assumptions and associated requirements regarding design and operational features
- Incomplete list of COL action items
- Lack of a systematic search to identify and discuss key areas of uncertainty
- Taking credit of more than the minimum set of equipment in T-H calculations used to support PRA success criteria
- Many not modeled failures have the potential to be significant in risk informed applications