Risk Informed GSI-191 Project Overview

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South Texas Project
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Deterministic Evaluation Attributes	Probabilistic Evaluation Attributes
Predetermined scenarios are analyzed assumed to be "worst case".	Full spectrum of scenarios is analyzed that covers wider range of possibilities. There is solid evidence in the scientific literature that probability is the best measure of uncertainty.
Decision-making is "absolute" - no uncertainty in the decision-making process.	Uncertainty is integral to decision-making. Risk-based methods quantify both the uncertainty of the state of our knowledge and the variability in physical phenomena.
Need for detailed analysis and full phenomenology understanding is avoided by assuming "conservative" values for parameters.	Detailed modeling and analysis is needed to properly characterize uncertainty.

Primary Project Objectives

- Obtain core damage frequency distribution for hypothesized LOCAs that require ECCS recirculation.
- Compare core damage frequency & large, early release frequency results for Potentially Sump Blocking Insulation & Non-Sump Blocking Insulation designs against the criteria of RG1.174
- Employ RG 1.174 strategy to provide risk informed closure of GSI-191
- Finalize plan for GSI-191 closure by mid 2012 for STP
- Develop a repeatable risk informed GSI-191 Closure Method

PRA Perspective

LOCA → ECCS Response → CDF

Injection + *Recirculation* → CDF

Accums + SI + RWST

SI + Sump

Debris + Transport + NPSH

Documented probabilistic basis for risk quantifications

Area of uncertainty, need probabilistic distributions and commensurate technical basis

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Technical Approach

- Modify the methodology summarized in NUREG/CR-6771:
  - Multiple initiators for different break characteristics;
  - Fold into plant-specific analysis (STP PRA);
  - Add downstream effects.
- Current focus areas:
  - Break characterization (probabilistic fracture mechanics, jet characteristics - ZOI)
  - CAD drawings (description of targets and locations)
  - RCS thermal-hydraulics

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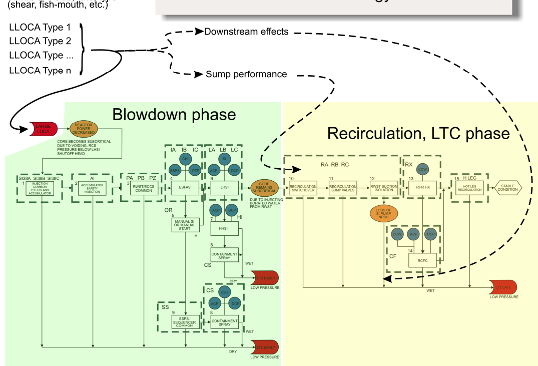
LLOCA Example for Implementation of the NUREG/CR-6771 Methodology in STP PRA



Technical Overview

- The risk-informed approach to GSI-191 closure requires development and integration of five major elements. Each of these elements has one or more technically challenging subtasks.
  - **DTSB**: generation and transport of debris to the sump. Resulting sump strainer differential pressure
  - **TH**: RCS thermal-hydraulic response.
  - **DEM**: Downstream effects of debris getting through the sump strainer screens and into the core, SI components.
  - **PRA**: A logic model that develops and quantifies the scenarios leading to core damage.
  - **Uncertainty**: The development and subsequent reduction of the multivariate probability distributions needed by the PRA for quantification.

Multiple Physics Models

Reactor TH
Plant State Point
Internal Obstructions
Transient Blow Down
EOP Response

ZOI Formation
Probability of Break
Fracture Mechanics
Jet Expansion
Jet Reflection
Break Location

Containment
Blow Down Transport
Spray Actuation
Environment P&T
Wash Down Transport

Sump Pool
Debris Transport
Debris Degradation
Chemical Product Formation
Temperature History

Sump Screen
Debris Accumulation
Thin-Bed Formation
Screen Penetration
Face Velocity
Porous Media Head Loss
$NPSH_{Margin}$

Injection Systems
Recirculation Demand
$NPSH_{reqd}$
Degraded Pump Performance
Valve Wear
Operability

Plant PRA
LOCA Probability by Size/System
Probable Loss of Recirculation
CDF and LERF

2011 Milestone Plan

- **January – February**
  - *NRC Public Meeting January 27th at NRC HQ*
  - *Formal Kick-Off Meeting with NRC to communicate risk-based approach plan, February 22nd*
- **March – April**
  - Best estimate of pipe failure distribution (opening rate, size, geometry)
- **May - June**
  - CAD Model
  - Containment response (primarily sump fluid temperature).
- **May - August**
  - Preliminary uncertainty distributions
  - Preliminary TH/DEM calculations
  - Revise LOCA break frequencies based on the above
- **September – November**
  - **INITIAL QUANTIFICATION**
- **December**
  - Executive report for Regulator/Industry review.

*Italics indicates actual completion

2012 - 2013 Milestone Plan

- Will be based on 2011 initial quantification results and interactions with NRC
- Emphasis and scope will be on areas where highest uncertainties remain
- May require additional testing and/or experiments

SUMMARY

- A risk informed approach for closing GSI-191 has been planned which will employ robust probabilistic methods
- A highly qualified and specialized team has been assembled to undertake this project
- A project plan has been developed with milestones for regulatory/industry communication and project completion
- The intent of the project will be to develop a risk informed GSI-191 closure process that can be repeated by others