

LSNReviews

From: Robert Johnson (NMSS)
Sent: Friday, May 12, 2006 5:52 PM
To: Asadul Chowdhury; Amitava Ghosh; Biswajit Dasgupta; John Stamatkos; Luis Ibarra; Goodluck Ofoegbu; Oleg Povetko; Roland Benke; shgonzalez@cnwra.swri.edu; Simon Hsiung; Sitakanta Mohanty; Thomas Wilt; vjain@cnwra.swri.edu; Abou-Bakr Ibrahim; Albert Wong; Banad Jagannath; Christopher Ryder; Dennis Galvin; David Dancer; Jon Chen; Kien Chang; Michael Waters; Mahendra Shah; Mysore Nataraja; Philip Justus; Rosemary Reeves; Tina Ghosh; Tae Ahn; Thomas Matula; Wilkins Smith; fferrante@swri.org; 'George Adams'; joe.steiber@swri.org; p.a.cox@swri.org; skinkler@swri.org
Cc: Budhi Sagar; Wesley Patrick; Andy Campbell; Brittain Hill; Bret Leslie; C.W. (Bill) Reamer; Dan Rom; Elmo Collins; Frederick Brown; Jack Parrott; Jack Guttmann; James Rubenstone; Lawrence Kokajko; Marissa Bailey; Marian Zabler; King Stablein; RMANTOOTH.CNWRA.Internet@nrc.gov; Timothy McCartin; rkazban@swri.org
Subject: Information for May 16-17, 2006 PCSA TE
Attachments: PCSA TE Presentation.PPT; PCSA TE Meeting Notice.pdf; ML0612306840.pdf

PC Team,

FYI: I have attached the final version of the Staff presentation. There are also copies of the Agenda and Key Messages letter (sent to DOE earlier this week).

Thanks,

Robert K. Johnson

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From: Robert Johnson <RKJ@nrc.gov>

Subject: Information for May 16-17, 2006 PCSA TE

To: achowdhury@cnwra.swri.edu, aghosh@cnwra.swri.edu,

bdasgupta@cnwra.swri.edu,

jstam@cnwra.swri.edu, libarra@cnwra.swri.edu, ofoegbu@cnwra.swri.edu,

opovetko@cnwra.swri.edu, rbenke@cnwra.swri.edu, shgonzalez@cnwra.swri.edu,

shsiung@cnwra.swri.edu, smohanty@cnwra.swri.edu, twilt@cnwra.swri.edu,

vjain@cnwra.swri.edu, Abou-Bakr Ibrahim <AKI@nrc.gov>,

Albert Wong <AXW2@nrc.gov>, Banad Jagannath <BNJ@nrc.gov>,

Christopher Ryder <CPR@nrc.gov>, Dennis Galvin <DJG3@nrc.gov>,

David Dancer <DMD@nrc.gov>, Jon Chen <JCC2@nrc.gov>, Kien Chang

<KCC@nrc.gov>,

Michael Waters <MDW1@nrc.gov>, Mahendra Shah <MJS3@nrc.gov>,

Mysore Nataraja <MSN1@nrc.gov>, Philip Justus <PSJ@nrc.gov>,

Rosemary Reeves <RBR@nrc.gov>, Tina Ghosh <STG1@nrc.gov>,

Tae Ahn <TMA@nrc.gov>, Thomas Matula <TOM1@nrc.gov>,

Wilkins Smith <WRS@nrc.gov>, fferrante@swri.org,

'George Adams' <george.adams@swri.org>, joe.steiber@swri.org,

p.a.cox@swri.org, skinkler@swri.org

Cc: bsagar@cnwra.swri.edu, wpatrick@cnwra.swri.edu,

Andy Campbell <ACC@nrc.gov>, Brittain Hill <BEH1@nrc.gov>,

Bret Leslie <BWL@nrc.gov>, "C.W. (Bill) Reamer" <CBR@nrc.gov>,

Dan Rom <DSR@nrc.gov>, Elmo Collins <EEC@nrc.gov>,

Frederick Brown <FDB@nrc.gov>, Jack Parrott <JDP1@nrc.gov>,

Jack Guttman <JXG@nrc.gov>, James Rubenstone <JXR5@nrc.gov>,

Lawrence Kokajko <LEK@nrc.gov>, Marissa Bailey <MGB@nrc.gov>,

Marian Zabler <MLZ@nrc.gov>, N King Stablein <NKS@nrc.gov>,

RMANTOOTH.CNWRA.Internet@nrc.gov, Timothy McCartin <TJM3@nrc.gov>,

rkazban@swri.org

Message-id: <s464cb5f.049@NRNWMS05.NRC.GOV>

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10 CFR Part 63

Preclosure Safety Analysis

Robert Johnson, Christopher Ryder, Rosemary Reeves, and Amitava Ghosh

United States Nuclear Regulatory Commission

NRC/DOE Technical Exchange
May 16-17, 2006



Outline

- Purpose
- Key Messages
- Risk-informed, Performance-based Regulation
- Licensing Approach
- Preclosure Safety Analysis (PCSA)
- Levels of information
- Estimating Reliability
- Addressing Uncertainty
- Examples
- Summary
- Questions and Answers



Purpose

- Clarify the process for performing the PCSA
- Discuss information needed to review the PCSA
- Communicate expectations for estimating reliability of structures, systems, and components (SSCs)
- Identify approaches for developing reliability estimates and provide examples



Key Messages

- 10 CFR Part 63 is a risk-informed and performance-based regulation
- Two levels of information:
 - general information supporting PCSA
 - specific information for SSCs designated as important to safety (ITS)
- More design information may be necessary for unique SSCs
- Reliability estimates are needed to perform PCSA and categorize event sequences
- Several approaches for estimating reliability:
 - Accepted engineering practice
 - Empirical data for similar SSCs
 - Modeling



Key Messages (continued)

- Provide technical bases for reliability estimates and approaches used
- Reliability data needs to be related to the design bases and design criteria of the SSCs credited with prevention or mitigation of an event sequence
- Uncertainties and limitations associated with a particular approach or method of analysis and data, need to be addressed in the PCSA



Risk-informed Performance-Based

- 10 CFR Part 63 is a risk-informed, performance-based regulation
- Risk-informed performance-based approach allows use of risk insights, engineering analysis, and judgment to:
 - Focus attention on most important activities
 - Establish objective criteria for evaluating and monitoring performance
 - Provide flexibility to determine how to meet performance criteria
 - Focus on results as primary basis for regulatory decision making



Licensing Approach

- One license application for geologic repository
- Two fundamental regulatory decisions at different times:
 - 10 CFR 63.31 - Whether to grant a Construction Authorization based on license application
 - 10 CFR 63.41 - Whether to grant a license to Receive and Possess nuclear material



PCSA Level of Information

Chris Ryder



Preclosure Safety Analysis

- Preclosure safety analysis is a systematic examination of the site; the design; and potential hazards, initiating events, and event sequences and their consequences
 - Verify compliance with the performance objectives
 - Identify ITS SSCs



Preclosure Safety Analysis Process

Basis of the PCSA

- Proposed Design
- Site Characteristics

PCSA

Identification of Hazards

Identification of Initiating Events

Identification of Event Sequences

Consequences Analyses

Results of the PCSA

- Event Sequence:
 - Frequencies
 - Consequences



Levels of Information

- Two levels of information
 - General information supporting the PCSA
 - Specific information about SSCs that are determined by analysis to be ITS
- Information on proposed design is influenced by similarity with SSCs or operations at other facilities and is bounded by:
 - Analogous SSCs or operations
 - Unique SSCs or operations



General Information Supporting the PCSA

- Description of the facilities and their functions
- Description of SSCs within the facilities
- Design bases and design criteria
- Basic operations, controls, and monitoring
- Key dimensions
- Relationships and interdependencies of SSCs, as needed
- Application of and exceptions to codes and standards



Specific Information for ITS SSCs

- For ITS SSCs, sufficient information on technical bases is necessary to demonstrate ability of SSCs to perform their intended safety functions at the stated reliability
- PCSA and reliability data for ITS SSCs need to be related to design bases and design criteria, and describe how performance objectives are met
 - Design criteria describe functions to be accomplished
 - Design bases identify specific functions performed by an SSC and specific values chosen for controlling parameters for design
- Examples of specific information for ITS SSCs
 - Specificity in design, particular SSCs, and operations
 - Greater description of data, models, judgments
 - Closer ties of design to reliability



Review of Level of Information

- 10 CFR 63 provides DOE with flexibility in designing the repository to meet specific safety performance objectives
- Two levels of information necessary for the review; general information supporting the PCSA and specific information about SSCs designated as ITS
- Level of information depends on the approach taken for the design (analogous operations versus unique operations)



Estimating Reliability and Addressing Uncertainty

Rosemary Reeves



Need for Estimating Reliability

- An estimate of reliability is needed to determine the probability of occurrence of an event sequence
- Reliability of SSCs (active and passive), analyzed in event sequences, is needed to perform the PCSA and categorize event sequences [63.112(b)]
- Reliability provides a measure of the ability of SSCs to perform their intended safety functions, assuming the occurrence of event sequence [63.112(e)]



Reliability Estimation

- Approaches that may be used to develop reliability estimates, include:
 - Accepted Engineering Practice: expert judgment and good engineering practice (e.g. applicability of consensus codes and standards)
 - Empirical: using data from similar SSCs in other applications
 - Modeling: constructing reliability model
- Regardless of the approach, a technical basis for the reliability estimate and the approach chosen must be provided



Reliability Estimation (continued)

- When determining reliability, use SSC analogs at the highest level possible (typically system level)
- If insufficient data, or unique SSC, build reliability from analogs at next level down (component level)
- Other attributes may provide confidence in reliability estimates (e.g., QA, testing, maintenance, inspection, training programs, etc.)



Addressing Uncertainty

- Reliability estimates should address the uncertainties and limitations associated with a particular method of analysis and data
- Defend and support selected approach, accounting for uncertainties
 - Traceability of supporting information
 - Include qualitative and quantitative information
- Review the range of uncertainty and variability considering:
 - Proximity to category limit
 - Severity of consequence (radiological release)
 - Reliance on SSC to prevent or mitigate a potential occurrence



Examples of Estimating Reliability

Amitava Ghosh



Example: Crane

- **Description**
 - Handle welded canisters (e.g., bridge crane inside a facility)
 - Designed to ASME NOG-1 Type 1
- **Event sequence**
 - Credited with reducing the likelihood of occurrence of a drop
- **Estimation of reliability**
 - Empirical data for reliability of cranes may be used (e.g., NUREG-1774, 2003)
 - Data used may be in the form of “n drops in m lifts”
- **Technical basis supporting selected reliability value**
 - Use of design codes and standards (e.g., ASME NOG-1 Type 1)
 - Justification for data being applicable to this crane (e.g., operating environments, training levels, maintenance, quality assurance)



Example: Canister

- Description
 - Handled by lifting devices inside the facility
- Event sequence
 - Potential drops from within its design basis lift height
 - Canister is credited to withstand a drop from within its design basis lift height and reduces the likelihood of occurrence of the event sequence
- Estimation of reliability
 - Engineering judgment applied to the capability for the canister to avoid breaching
- Technical basis supporting estimated reliability value
 - Use of design codes and standards (e.g., ASME Boiler and Pressure Vessel code, conservatism in codes and standards)
 - Justification of estimated reliability
 - Industry data on similar items
 - Manufacture (e.g., quality assurance requirements)
 - Testing (e.g., nondestructive testing)



Example: HVAC

- Description
 - Remove airborne radioactive particulates
 - Maintain negative differential pressure
 - Designed to ASME AG-1
- Event sequence
 - Credited with preventing release of radioactive particulates
 - Reduces the likelihood of occurrence of the event sequence
- Estimation of reliability
 - Empirical data of HVAC systems from existing facilities
 - Modeling to reflect the configuration, design, and components using empirical data for reliability of HVAC components within the system (e.g., IEEE Standard 500)
- Technical basis supporting calculated reliability value
 - Use of design codes and standards (e.g., ASME AG-1)
 - Justification for assumptions (e.g., applicability of data)



Summary

- Two levels of design information for the PCSA
 - General information for the PCSA
 - Specific design information for SSCs designated as ITS
- Design information depends on the approach taken to design the facility
 - Analogous to an existing facility
 - Completely novel facility
- Reliability information for SSCs (active and passive) is needed to demonstrate compliance with Part 63 performance requirements and conduct the preclosure safety analysis.



Summary (continued)

- Reliability can be estimated by using any combination of accepted engineering practice, empirical data for similar SSCs, or modeling
- Regardless of the method used, a technical basis should be included
- Reliability data should be related to design bases and design criteria of SSC credited with prevention or mitigation of an event sequence
- Uncertainties and limitations associated with a particular method of analysis and data should be addressed