U.S. Department of Energy

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

Preclosure Safety Analysis Overview

Presented to:

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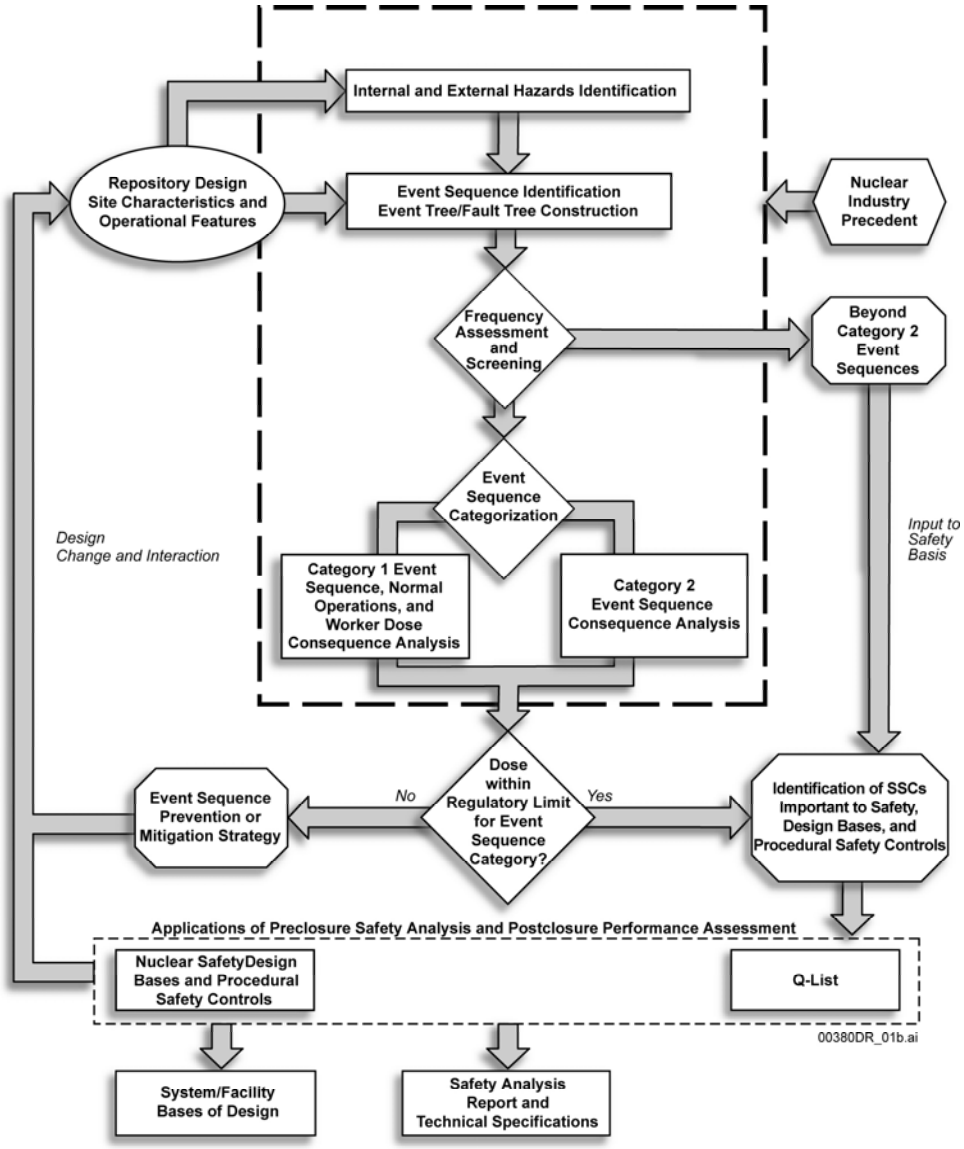
Preclosure Safety Analysis (PCSA) for License Application

- **Process overview**
- **Changes since 2005**

Preclosure Safety Analysis Overview



PCSA Answers the Following:

- **What can happen?**
- **How likely is it?**
- **What are the consequences?**

Risk Management Principles

- **Prevent event sequences**
- **Reduce frequency of event sequences**
- **Mitigate potential consequences**

External Hazards Analysis

- **Comprehensive checklists of potential hazards used for identification**
- **Precedents from chemical and nuclear industries**
- **Screened for applicability**
  - **Site conditions**
  - **Ability to impart sufficient energy to damage a waste form**

Internal Hazards Analysis

- **Comprehensive checklists of potential hazards used for identification**
- **Energy method supplements checklists**
- **Precedents from chemical and nuclear industries**
- **Screened for applicability**
  - **Ability to impart sufficient energy to damage a waste form**

Event Sequences Developed

- **Area-by-area hazard evaluation**
- **Initiating events combined with**
  - **Design features**
  - **Operations**
  - **Potential hazards**
  - **Human errors**

Event Sequence Frequency Assessment

- **Accepted analytical methods**
  - **Event trees and fault trees model complex event sequences**
  - **Uses published empirical failure-rate data**
  - **Addresses uncertainties and human error**
  - **Considers common-cause failures**
- **Accepted engineering practice**
- **Uses conservative assumptions**
- **Iterates with engineering to ensure reliability requirements are reasonable and achievable**

Event Sequences are Categorized (10 CFR 63.2)

- **Event sequences are assessed for frequency and probability of occurrence**
- **Event sequence categorization**
  - **Category 1 (expected during preclosure period)**
  - **Category 2 (≥ 1 in 10,000 during preclosure period)**
  - **Beyond Category 2 (< 1 in 10,000 during preclosure period)**

Consequences Evaluated

- **Category 1 [10 CFR 63.111(b)(1)]**
  - **Public (on-site and off-site)**
  - **Worker**
  - **Normal operations plus aggregated event sequences**
- **Category 2 [10 CFR 63.111(b)(2)]**
  - **Public (off-site only)**

Uncertainty Addressed

- **Fault trees are developed using available data and related uncertainty**
- **Margin in event sequence frequency assessment and consequence analyses**
  - **Maximum annual throughput each year + 10%**
  - **Maximum number of handlings for each waste form**
  - **Conservative estimates for crane and fuel handling machine failures**
  - **Canisters breach in drop above lift height limit**
  - **100% fuel cladding breach in drops**
  - **Bounding source terms for waste forms**
  - **Conservative release factors**
  - **95th percentile χ/Q values**

Identification of SSCs Important to Safety

- **Structures, systems or components (SSCs) that ensure credible event sequences do not result in a dose consequence exceeding the limits stated in 10 CFR 63.111 are identified as important to safety (ITS)**
- **Specific safety function(s) relied upon to prevent the occurrence, to reduce the frequency, or to mitigate the consequences of an event sequence are determined**
- **The specific safety function and performance criteria relied upon to prevent, reduce the frequency, or mitigate the consequences of an event sequence are established as nuclear safety design bases requirements for the ITS SSC**

Implementation of PCSA

- **Nuclear safety design bases**
  - **Developed for ITS SSCs per definition in 10 CFR 63.2**
  - **Identify design features and component reliability or availability factors that are credited in event sequence frequency analyses or consequence analyses, or both**
- **Nuclear safety design bases incorporated into**
  - **Design criteria and system and facility basis of design documents**
  - **Procedural safety controls**
  - **Safety Analysis Report**
  - **Technical specifications**

Implementation of PCSA Nuclear Safety Design Bases

- **Design**
  - Nuclear safety design bases
  - Credited safety functions
  - ITS SSCs and Q-List
- **Operations**
  - Nuclear safety design bases
  - Credited safety functions
  - ITS procedural controls
  - Technical specification requirements

Changes Since 2005

- **Design to support License Application (LA)**
  - **Significantly greater development of design**
  - **Greater detail for vendor supplied equipment**
  - **Additional design documentation developed**
  - **More detailed evaluation of design**
  - **Significantly greater design information available for PCSA**

Changes Since 2005 (cont.)

- **PCSA to support LA**
  - **More detailed safety evaluation**
  - **More detailed development of safety functions**
  - **More complete development of reliability requirements**
  - **Additional evaluation of uncertainty and human error**
- **License Application / Safety Analysis Report**
  - **More detailed presentation of design and PCSA**
  - **Enhanced justification of safety case**