Current Issues in Risk Management and Safety

A Personal View

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We are Living in an Interesting Time

- In support of nuclear power
  - PSA standard
    - Level 1 PSA, shutdown and external events
    - Fire PSA
    - Level 2 PSA
    - Level 3 PSA
  - Regulatory measures
- Security applications
- Use in regulatory environment
- Software/methodology advancements/issues
- Widespread applications of PSA

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Commercial Nuclear Power

- Regulatory and Economic Drivers
  - PSA has become key part of communication between utilities and regulators
  - There is movement on "risk-informing" regulations
  - Utilities are expanding internal use to support decision making, supplement training, etc.

Some Current Issues Relating to Commercial Nuclear Power in the US

- Basic Risk-Informed Framework is described in Regulatory Guide 1.174

- USNRC Policy on PSA Quality

- Mitigating System Performance Indicators

- License Extension

- Power Uprate

- Risk-Informed Asset Management

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Evolving Techniques Leading to a New Generation of Risk Workstations

- Binary Decision Diagrams
  - Old mathematic formulation finding new applications
  - Eliminates need to determine cut sets
  - Extremely fast, can support real-time reevaluation of model
  - Will eventually eliminate distinction between large event tree and large fault tree methods
- Dynamic Modeling
- Declarative Techniques

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Barriers

- Need to move forward from simplistic surrogate risk measures like core damage frequency and frequency of large early release

- Difficulties in risk informing certain regulations
  - Coincident large loss of coolant accident and loss of offsite power

- Support for methods development

Programmatic Risk Assessment

- Use of PSA techniques to assist
  - Managing complex programs
  - Developing new products
  - Integration of new technologies

- Output is probabilistic expression of cost, schedule, task importance, critical path, milestone dates, etc.

- Key is recognizing and modeling interdependencies among tasks

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Programmatic Risk Assessment *(continued)*

- Examples:
  - Schedule risk assessment for Yucca Mountain activity
  - Schedule risk assessment for decommissioning of research reactor
  - Schedule risk assessment for testing of new naval propulsion system
  - Basis for ultimate "per unit cost" for defense product
  - Basis to evaluate progress during development of new product

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Barriers

- One barrier – namely, a commercial software product – has been eliminated

- Remaining: acceptance of probabilistic decision support tools by corporate decision makers

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Medical Device Risk Assessment

- Driver: Regulatory Requirements
- ISO 14971 outlines a risk management program that includes
  - Establishing risk acceptance criteria
  - Risk assessment
  - Operational feedback/life cycle history archive
- Mandates a complete life cycle risk management program from its inception

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Barriers

- Training appropriate number of risk professionals in field

- Many companies in field are small - challenge for small companies

Security

- PSA has played a significant role in addressing security and vulnerability issues associated with directed human threats

- Examples:
  - Detailed structural analyses given aircraft crash, explosive, or other threat
  - Response to assumed set of scenarios
  - Target prioritization

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Barriers

- Some methodology development still needed
  - For example, how to address risk management when scenarios are linked in "intelligent" ways

- Resistance to change

Backup

Regulatory Guide 1.174

- Provides guidance on acceptability of changes to plant based on risk

- Limits increase in core damage frequency and frequency of large early releases

- Addresses completeness of PSA including external events and sources of uncertainty

PSA Quality

- USNRC is encouraging increased quality by calling for "completeness" by 2008
  - All initiating events
  - All modes of operation

- Joint regulatory/utility development of standards
  - Level 1, external events, low power and shutdown, fire, Level 2 and Level 3

Mitigating System Performance Index

- MSPI combines unavailability and unreliability data with plant-specific risk importance measures to indicate the performance of key safety systems

- System performance requirements based on PRA system success criteria vs. design basis requirements

- Performance is measured relative to an industry baseline

- Systems
  - EAC, HPI, RHR, AFW/RCIC, Cooling Water (CCW plus SW)

- Monitor the most risk significant components

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License Extension and Power Uprate

- Application to extend license for an additional 20 years
  - PSA to support identification of cost effective "severe accident mitigation alternatives" using ROI and Level 3 results

- Power uprate: few percent for PWRs; up to 20% in BWRs
  - Need to rebaseline PSA

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Risk-Informed Asset Management

- Developed jointly with EPRI and South Texas

- Integrates risk and economic model into utility business model

- Multi-attribute decision support including ROI

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Understanding the Adversary

- The 1979 NUREG 0459 provides a framework to understand adversaries

- Several groups are identified ranging from sophisticated terrorists to common criminals

- Groups differ by goal and means to reach those goals

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Scenario quantification

- Techniques are available to quantify scenarios
  - Large uncertainties
  - Incorporate information from, for example, surveillance detection programs

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