



EUCI Presents a Course on:

NUCLEAR POWER PROBABILISTIC RISK ASSESSMENT (PRA)

IMPROVE NUCLEAR PLANT SAFETY THROUGH APPLICATION
OF A HIGHLY STRUCTURED ANALYSIS - PRA

August 25 - 26, 2009 • Hyatt Regency Chicago • Chicago, IL



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OVERVIEW

This course introduces PRA history, development and nuclear risk assessment in nuclear power applications. It is designed for those who use PRA results, need to understand PRA uses, methods, and issues, but who don't directly develop PRA themselves. The course will give attendees a solid understanding of the history behind PRA, reasons for developing PRA, how they are constructed, their assumptions and limits, types of applications, methods of development and issues that remain to be resolved with their use in nuclear power applications. Attendees will look at many aspects of PRA, including event tree families, develop a simple PRA, and look at complete analysis to review the details of complexity and PRA limitations. The course will cover PRA types, various initiating events, event sequences, top events, deterministic reviews and risk-informed analysis, with nuclear industry application formulation of PRA. It will also review the current ANS/ASME joint PRA risk-informed methods positions. Although presentation will be from the perspective of PRA use in designing facilities, the course will discuss operational uses, too. We will discuss new plant applications, developing new plant Reliability Assurance Plans with PRA, and outstanding PRA design issues, including digital controls, equipment upgrades, level of details required and other legacy plant applications.

WHO SHOULD ATTEND

Those who will benefit from the course include plant design engineers new to PRA nuclear application use. Those who need a fast introduction to the licensing framework so they can quickly be effective in a nuclear regulatory framework will also benefit from the course. Additionally, new utility or nuclear industry employees unfamiliar with the nuclear plant design process or its conversion into operational requirements should attend. Employees who are shifting roles from other functional areas to nuclear plant design support, such as license development, marketing, or regulatory compliance will find the course particularly beneficial, as will attorneys (and their employees) representing government and quasi-government agencies who lack in-house training programs. This course focuses on the critical role played by PRA design basis and nuclear safety. Companies considering becoming sole source suppliers or providing nuclear related services under Part 50, Appendix B, and Part 21, particularly for new nuclear construction, should also attend.

TRAINING OBJECTIVES

- Discuss PRA background and deterministic safety analysis
- Recognize deterministic safety analysis limits
- Relate PRA use to events like Three Mile Island
- Identify simple PRA elements relating those to deterministic analysis
- Interpret common PRA elements and standards
- Explain PRA role as a tool assessing nuclear risks
- Describe PRA role in new nuclear plant (10 CFR) Part 52, Combined Licensing
- Analyze PRA limits
- Examine likely directions for future PRA development

IACET



EUCI has been approved as an

Authorized Provider by the International Association for Continuing Education and Training (IACET), 1760 Old Meadow Road, Suite 500, McLean, VA 22102. In obtaining this approval, EUCI has demonstrated that it complies with the ANSI/IACET Standards which are widely recognized as standards of good practice internationally.

As a result of their Authorized Provider membership status, EUCI is authorized to offer IACET CEUs for its programs that qualify under the ANSI/IACET Standards.

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Requirements for Successful Completion of Program

Participants must sign in/out each day and be in attendance for the entire program to be eligible for any continuing education credit.

Instructional Methods

Instruction methods will include PowerPoint presentations and discussion.

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PROGRAM AGENDA

TUESDAY, AUGUST 25, 2009

8:00 – 8:30 a.m. Registration and Continental Breakfast

8:30 – 9:15 a.m. Nuclear Safety Background/Overview

Providing a brief history behind the use of PRA:

- Development: Cold War weapons operations research
- Power applications, including naval reactors
- Wash-1400: The Rasmussen Report
- Three Mile Island accident, Chernobyl
- Nuclear considerations and due diligence
- Deterministic assumptions in nuclear accident risk
- Risk control methods
- Light Water Reactor (LWR) barriers: Fuel, primary and secondary systems
- Redundancy

9:15 – 10:00 a.m. Traditional Nuclear Design

This session will cover traditional deterministic safety design and its limitations and is an introduction to PRA methods.

Deterministic Analysis

- Design Basis & Design Basis Accidents (DBA)
- Safety functions and systems
- Safety Analysis Reports (SAR)
- Significant events

Risk Analysis

- Early ways to perform risk-based analysis
- New basis for design: PRA
- Compliance with administrative controls
 - 50.34: Requirements for Design
 - 50.59: "Changes, tests, and experiments"
 - Part 21: Requirements for commercial grade equipment
 - 50.65: Maintenance Rule

10:00 – 10:15 a.m. Morning Break

10:15 – 11:00 a.m. What is a PRA?

Describing Probability Risk Assessment: Covering basic PRA development safety design traditional use, its evolution from the plants safety design post-licensing, and the types of PRA used. The session will provide a basic understanding of PRA from a safety design event perspective.

- Fault trees
- Cut sets
- Event analysis
- Combinations of risk and determinism: Risk informing and risk-informed analysis
- Events
 - Types
 - Families
 - Sequences
 - Top events
- Safety system roles
 - Safety design
- Internal/External events
- PRA detail
- Traditional weaknesses
 - Electric power disturbances
 - Overemphasis on line break scenarios
 - Importance of operations problems: Common causes

PROGRAM AGENDA

TUESDAY, AUGUST 25, 2009 (CONTINUED)

11:00 a.m. – 12:00 p.m. **Initiating Events**

This session addresses initiating events that lead to various categories of PRA. It will cover the implications of various types of events on basic assumptions such as redundancy and diversity.

Probabilistic Safety Assessment (PSA)

- Internal events
 - Damage/Wearout
 - Indirect failure (wear/continuous events)
 - Operating errors
- External events (Environment: wind, air, fire, earthquake, flood)
 - Static/dynamic
- Uncontrollable, some predictable over a long period but all are real
- Event sequence
- Event-nodes-top event (fault tree)
- Human factors (operators)

12:00 – 1:00 p.m. **Group Luncheon**

1:00 – 2:45 p.m. **Building a Simple PRA**

Discussion includes developing a simple PRA for common types of events. It will give a basic understanding of the development of PRA from basic events and plant design logic.

- Small group exercise: Simple PRA
 - Chain
 - Aggregation
 - Dependence
- Deterministic safety analyses design basis events: Common initiators

2:45 – 3:00 p.m. **Afternoon Break**

3:00 – 3:30 p.m. **Other Industries' Applications**

A discussion of other industry approaches and issues, where they appear headed, and how they can benefit from using PRA. This general discussion intends to view other applications independent of nuclear bias so the group can decide on reasonable actions.

- United Flight 232: Rotor disk failure
- US Navy submarine emergency blow capability failure
- Federal Aviation Administration MSG-3 approach to internal events: Prevent single failure event chains
- Reactor plant design
 - Passive safe
 - New technology
 - Operating plants today
 - Partitions

PROGRAM AGENDA

TUESDAY, AUGUST 25, 2009 (CONTINUED)

3:30 – 4:00 p.m.

PRA Uses

How PRA can be used to develop basic products used in nuclear plant design and construction.

- SSC Categorization, 50.65 Maintenance Rule, 50.69 Systems, Structures, and Components (SSC) Categorization
- Expert judgment
- New designs and technology
- Understanding SARs
- Classify (risk rank) SSC; partition
- Preserve plant design basis
- Perform 50.59 reviews
 - Bounding analysis
 - Non-reviewed safety questions
 - Develop SSC special treatment requirements
- Core Damage Frequency (CDF), Large Early Release Fractions (LERF) and other measures

4:00 – 5:00 p.m.

Consensus Standard: ASME Standard for PRA Draft Discussion

Development of PRA into standards by the ASME and ANS. The discussion will address issues that make developing PRA standards difficult, as well as, the necessity of their use. Areas:

Section 1: Introduction

- 1.3 Graded Requirements for Life-Cycle Stages
- 1.4 PRA Element Requirements
- 1.5 Risk Assessment
- 1.6 Configuration and Control
- 1.8 Interface with other Standards

Section 3: Risk Assessment Applications Process

- 3.1 PRA Application Range
- 3.2 Step-by-Step PRA Applications

Section 4: Technical Risk Assessment

- 4.2 Processes
- 4.3 Expert Judgment
- 4.4 Technical Requirements Basis
- 4.5 PRA Technical Requirements

Section 5: PRA Configuration Management

- 5.2 Configuration Management
- 5.4 PRA Maintenance and Upgrade
- 5.5 Changes
- 5.6 Documentation

Section 6: Peer Review

- 6.2 Peer Review Team Composition and Personnel Qualifications
- 6.3 Review of PRA Elements to Confirm the Methodology and Implementation
- 6.4 Expert Judgment
- 6.5 PRA Configuration Management
- 6.6 Peer Review Documentation

Section 7: References

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WEDNESDAY, AUGUST 26, 2009

8:00 – 8:30 a.m. Continental Breakfast

8:30 – 8:45 a.m. Review of Day 1 Discussion

8:45 – 9:15 a.m. Safety Design Process

A discussion of safety design process that evolved from probabilistic risk applications.

- Top Level Safety and Design Criteria (TLSC) (TLDC)
- Design systems, safety functions and Chapter 15 analysis
- Design Basis Accident (DBA) selection; SSC categorization and partition
- 50.59 Analysis (operating plants)

9:15 – 10:15 a.m.

Problems/Issues

There are actually two aspects of risk-informed operations using PRA. The first is developing the PRA; the second evaluating the results with deterministic analysis perspective. This leads to the informed portion of risk-informed analysis that uses PRA.

- Nuclear safety focus (versus all events)
- Cut off limits: Design Basis Events (DBE) and Beyond Design Basis Events (BDBE)
 - Where? (E-09)
- Defense in depth
- Uncertainties
- Interpretations assessing risk
- Common cause failures
- Level of detail
- Consensus codes: What are generally accepted practices, and how do they fit with traditional methods like design, technical specifications and maintenance?
- Future implications
- Full PRA

10:15 – 10:30 a.m. Morning Break

10:30 – 11:00 a.m. Detailed Discussion (New Plants): Reliability Assurance Programs (D-RAP)

This section will include discussion on current PRA details as they relate to new plant construction design license issues. Particularly, how the Design Control Document (DCD) operationally incorporates a Reliability Assurance Program (RAP) based on PRA in design and operational components. NUREG-0800 guidance for the COL (Part 52) tasks designers to develop the Design RAP ("D-RAP"). Although different from past practice, it remains unclear how PRA relates to the traditional Part 21 dedication, Part 50.59 Changes and Tests (Unreviewed Safety Question) and Appendix A & B rules for expert opinion, SSC failure modes and causes, and managing the engineering design basis.

- Full/partial PRA
- Operationalizing PRA
- Design Control Document
- Designers versus operational perspective
- Testing, measurement and replacement (50.59); Partition
- SSC aging (50.49)
- Operational-RAP (50.65)
- Operationalized rule integration: Part 21, 50.34, 50.49, 50.59, 50.65, 50.69
- Commercial codes like ASME's PTC
- Commercial dedication requirements
 - Ex: Palo Verde Nuclear Generating Station heat exchanger (PVNGS HX)
- Understanding statistics: Deterministic assumptions
- Applying technical specifications
- Root cause analysis
- Procurement specifications

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WEDNESDAY, AUGUST 26, 2009 (CONTINUED)

11:00 – 11:45 a.m. Special Topics/Outstanding Issues

During this session, current outstanding PRA issues, where they appear headed, and how they can beneficially be resolved for use will be considered. This is a general discussion for group contributions based upon participation in industry standards setting groups.

- PRA level of detail
- Automated controls
- Special treatment
- Defense in depth
- Standards and references

11:45 a.m. – 12:00 p.m. Questions and Final Remarks

INSTRUCTOR

Jim August, PE, Nuclear Engineer, CORE, Inc.

Jim August is a nuclear engineer with CORE, Inc., a nuclear reliability engineering services firm. He has authored numerous professional papers, maintenance publications, and two books published by Penn-Well Publishing (*Power Engineering magazine*) relating to the design basis: *Applied Reliability Centered Maintenance* and *RCM: How to Build a Reliable Plant Maintenance Program*. He has over 35 years experience in nuclear power generation operations, maintenance, engineering, and management. He holds BS and ME degrees in mechanical engineering, physics, and engineering management. He is a licensed PE, certified SMRP professional, and has managed a variety of interesting projects throughout his career. He worked for Public Service Company of Colorado (now part of Xcel Energy) for 20 years in various power generating stations and capacities – nuclear and fossil, performing and directing plant engineering. He was the Technical Services Manager for the Fort St. Vrain Nuclear Station in the 1980s. Since that time, he has worked for other utilities performing plant engineering. These include PPL, PPL Montana, Nebraska Public Power, Eugene Water Electric Board, Arizona Power, and Luminant (formerly TXU).

PROCEEDINGS

The proceedings of the course will be published and one copy will be distributed to each registrant at the course.

COURSE LOCATION

A room block has been reserved at the Hyatt Regency Chicago, 151 East Wacker Drive, Chicago, Illinois, USA 60601, for the nights of August 24-25, 2009. The rate is US \$169 plus applicable tax. Call (312) 565-1234 for reservations and mention the EUCI course to get the group rate. Make your reservations prior to August 7, 2009. There are a limited number of rooms available at the group rate. **Please make your reservations early.**

REGISTRATION INFORMATION

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All cancellations received on or before July 24, 2009 will be subject to a US \$195 processing fee. Written cancellations received after this date will create a credit of the tuition (less processing fee) good toward any other EUCI conference or publication. This credit will be good for six months. In case of course cancellation, Electric Utility Consultants' liability is limited to refund of the course registration fee only. For more information regarding administrative policies such as complaints and refunds, please contact our offices at (303) 770.8800.

EUCI reserves the right to alter this program without prior notice.

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The Course

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- NUCLEAR POWER PROBABILISTIC RISK ASSESSMENT (PRA)**
Improve Nuclear Plant Safety through Application of a Highly Structured Analysis - PRA, August 25 - 26, 2009, US \$1395
Early Bird on or Before August 14, 2009, US \$1195

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