Probabilistic Risk Assessment (PRA)

Technology Transfer Program

PRA Technology Transfer Program Brief

The Probabilistic Risk Assessment (PRA) Technology Transfer Program provides classroom instruction designed to train NRC employees in the techniques and uses of PRA. The PRA program is designed to help participants have a better understanding of basic PRA concepts and how they are applied in the regulatory and licensing processes. More advanced courses will allow attendees to independently utilize PRA techniques to evaluate safety issues associated with hardware design, testing, technical specifications, and inspection issues.

The PRA courses are continually updated to incorporate the latest information available, and as needs change, new courses are added to the curriculum. Course instructors are PRA experts employed from private industry and the national laboratories.

The NRC PRA Technology Transfer Program Manager is Lillian W. van Santen, Organizational Development and Training, Office of Personnel. The PRA Technology Transfer Program is administered and managed through a contract with the Idaho National Engineering Laboratory (INEL/EG&G Idaho).

Contents

Registration Procedures

Registration Procedures

Individual course announcements will be sent to each NRC employee approximately eight weeks prior to course date. If one wishes to enroll in a course, complete the registration form, obtain supervisor's approval and return form to Personnel Office/Training Representative who will forward it to the INEL Program Administrator, Joyce L. Nelson, P.O. Box 1625, Idaho Falls, ID 83415. Early registration is encouraged, and forms are accepted any time prior to the course closing date. Space permitting, efforts will be made to accommodate late registrants.

Confirmation/ Cancellation of Courses

The NRC Program Manager will confirm enrollments into PRA courses two weeks prior to course schedule. Should anyone need to cancel an enrollment, please notify the INEL Program Administrator, Joyce Nelson (208–526–9673) or Lillian W. van Santen (301–492–8938), as soon as possible.

Questions About Registration or Specific PRA Courses

Any questions regarding specific PRA courses should be directed to the NRC Project Manager, Lillian W. van Santen, Organizational Development and Training, Office of Personnel (301–492–8938). For additional information regarding PRA course schedules, contact the INEL Program Administrator, Joyce Nelson (208–526–9673).

General PRA Course Information

The INEL Program Administrator will provide participants with specific course information such as location, course hours, instructional materials, lodging, and transportation/parking at the time attendance is confirmed.

PRA TECHNOLOGY TRANSFER PROGRAM
COURSE SCHEDULE FOR FY–93

COURSE TITLE	DATES	LOCATION
IRRAS Basics (0410012)	TBD	Bethesda, MD
Overview of High Level Waste Performance Assessment Techniques (0409345)	Oct 20	Bethesda, MD
PRA Overview (0410001)	Oct 20	Bethesda, MD
Fundamentals of PRA (0410005)	Oct 21–23	Bethesda, MD
Human Reliability Assessment (0413912)	TBD	Bethesda, MD
PWR Technology (R101P)* (0403014)	Nov 17–20	Bethesda, MD
PRA Basics for Licensing Project Managers (0409344)	Dec 1–3	Bethesda, MD
Performance Assessment Techniques for High Level Waste (0410015)	Jan 12–14	Bethesda, MD
PRA Basics for Inspection Applications (0410003)	Jan 19–21	Region I King of Prussia, PA
PRA Basics for Inspection Applications (0410003)	Feb 17–19	Region IV Arlington, TX
Overview of High Level Waste Performance Assessment Techniques (0409345)	Mar 9	Bethesda, MD
PRA Overview (0410001)	Mar 9	Bethesda, MD
Fundamentals of PRA (0410005)	Mar 10–12	Bethesda, MD
BWR Technology (R101B)* (0404001)	Mar 16–19	Bethesda, MD
PRA Basics for Licensing Project Managers (0409344)	Apr 6–8	Bethesda, MD
PWR Technology (R101P)* (0403014)	Apr 12–15	Bethesda, MD
Human Reliability Assessment (0413912)	May 11–13	Bethesda, MD
IRRAS Basics (0410012)	May 11–13	Bethesda, MD
PRA Basics for Inspection Applications (0410003)	June 2-4	Region II Atlanta, GA

PRA TECHNOLOGY TRANSFER PROGRAM
COURSE SCHEDULE FOR FY–93

COURSE TITLE	DATES	LOCATION
Performance Assessment Techniques (0409345) for High Level Waste	June 22–24	Bethesda, MD
PRA Overview (0410001)	July 20	Bethesda, MD
Fundamentals of PRA (0410005)	July 21–23	Bethesda, MD
SARA Basics (0410013)	July 20–23	Bethesda, MD
Overview of High Level Waste Performance Assessment Techniques (0409345)	Aug 10	Bethesda, MD
PRA Basics for Inspection Applications (0410003)	Sept 8-10	Region III Glen Ellyn, IL

*The PWR and BWR Technology courses are taught by instructors from the Technical Training Center in Chattanooga, TN.

Course Descriptions

PRA Overview

Purpose This one–day course is designed to provide NRC personnel with a general overview of the concepts of individual and societal risk, objectives of risk assessment, PRA methodology, and the ways in which PRA technology is currently being used by NRC to fulfill its mission.

Description The course will be supplemented with examples of current PRA applications; a report on technological developments; and a discussion of current PRA research. Also covered in the course will be a discussion of NRC policies, generic issues, and cost benefit analysis using PRA. No examination will be given.

Who Should Attend Recommended for personnel who have no previous PRA training and is not intended to provide practitioner-level skills. The course is highly recommended for new managers who may be interested in the use of PRA technology in the Agency.

Prerequisites There are no prerequisites for this course.

Location/Date 8120 Woodmont Avenue   October 20, 1992
Bethesda, MD   March 9, 1993
                     July 20, 1993

PWR Technology
(R–101P)

Purpose This four-day course describes the functions and flow paths of major systems, instrumentation, terminology, and equipment location. The PWR Technology course will provide the student with a general understanding of the mechanical and instrumentation systems of the Westinghouse design. Emphasis is placed on the Nuclear Steam Supply System including the engineered safety features. The PWR Technology course is taught by the Technical Training Center instructors.

Description Instruction is reinforced by a daily review. Specific topics will include an introduction to PWR systems, reactor coolant systems, chemical and volume control systems, and secondary plant systems. Other topics will include nuclear instrumentation, rod control systems, reactor protection systems, engineered safety features, and plant operations.

Who Should Attend Any employee who plans to attend other PRA training courses should first complete either the PWR or BWR Technology course which will provide a sound background in nuclear power plant systems.

Please note, this PWR Technology course is cross-listed in the Technical Training Center course syllabus as the Westinghouse Technology Course (R–101P).

Prerequisites There are no prerequisites for this course.

Location/Date 8120 Woodmont Avenue November 17–20, 1992
Bethesda, MD April 12-15, 1993

BWR Technology
(R-101B)

Purpose This four-day introductory course is designed to provide an overview of BWR fluid and control systems, explain the functions and operations of BWR safety systems, and describe the normal operation and decay heat removal modes for a BWR, as well as BWR systems response to emergency conditions. The BWR Technology course is taught by instructors from the Technical Training Center.

Description Instruction is reinforced by a daily review. Specific topics will include an introduction to BWR systems, reactor coolant systems, BWR secondary systems, and nuclear instrumentation systems. Other topics will include control rod drive systems, reactor protection systems, engineered safety features, and plant operations.

Who Should Attend Any employee who plans to attend other PRA training courses should first complete either the BWR or PWR Technology course, which will provide a sound background in nuclear power plant systems.

Please note, this BWR Technology course is cross-listed with the Technical Training Center course syllabus as the GE Technology Course (R-101B).

Prerequisites There are no prerequisites for this course.

Location/Date 8120 Woodmont Avenue   March 16-19, 1993
Bethesda, MD

Fundamentals of PRA

Purpose This three-day course is designed for those personnel seeking to acquire introductory practitioner-level skills in probabilistic risk assessment (PRA) and includes a broad introduction to PRA and its applications. This course serves as an introduction to PRA including the methods used in systems modeling, accident process analysis, and accident consequence analysis. The course includes a discussion of PRA strengths, limitations, and results.

Description The course format will emphasize plant systems modeling and PRA applications, and provide an overview of a full range of PRA subject matter in abbreviated form. Specific topics include: risk assessment concepts; elements of nuclear plant risk; accident initiators; event tree and fault tree analysis and quantification; data development and common cause failures; human reliability analysis; external events analysis; accident process analysis; fission product transport and release; fundamentals of consequence evaluation; and PRA programs and requirements. In-class instruction will be supplemented with workshops and problem sessions.

A **short final examination will be given** to reinforce concepts taught in the course.

Who Should Attend All NRC personnel with a general interest in learning basic PRA terminology, techniques, and concepts should attend this course.

Prerequisites This course requires previous knowledge of nuclear power plant systems as provided in either the BWR or PWR Technology courses. This course is intended for degreed engineers and scientists who have had a college level course in statistics or probability theory.

Location/Date 8120 Woodmont Avenue   October 21-23, 1992
Bethesda, MD   March 10-12, 1993
                            July 21-23, 1993

PRA Basics for
Inspection Applications

Purpose

This three–day course has been designed to address the special needs of Regional and Resident Inspectors who need to have knowledge of PRA issues and insights to be better able to evaluate the effects of design, testing, maintenance, and operating strategies on system reliability.

Description

The full range of PRA topics will be presented in abbreviated form with the goal of introducing the Resident and Regional Inspection staffs to the basic concepts and terminology of Probabilistic Risk Assessment (PRA) as applied to the inspection process. The course will describe the contents of actual plant PRAs and Risk–Based Inspection Guides (RIGs), and will stress the uses and applications of these publications in planning audits and inspections and evaluating plant safety issues, as opposed to reviewing or actually performing a PRA. A large portion of the course is devoted to teaching students how to extract and apply the information developed in PRAs for their own plant inspection and review activities.

On the final day of the course, **an examination will be given**. The examination will consist of material covered during class and will be composed of short true/false and multiple choice questions. **Upon completion of the exam, the instructors will review all exam questions with the participants.**

Who Should Attend

Regional and Resident Inspectors and others involved in the plant inspection process.

Prerequisites

This course requires previous knowledge of nuclear power plant systems as provided in either the BWR or PWR Technology courses or their equivalent. The course is intended for degreed engineers and scientists who have had a college level course in statistics or probability theory.

Location/Date

R I, King of Prussia, PA	January 19–21, 1993
R II, Atlanta, GA	June 2–4, 1993
R III, Glen Ellyn, IL	September 8–10, 1993
R IV, Arlington, TX	February 17–19, 1993

PRA Basics for Licensing Project Managers

Purpose
This three–day course has been designed to address the special needs of Project Managers, Project Engineers, and Project Directors and related personnel who require a knowledge of PRA issues and insights to be better able to evaluate the aspects of design, testing, maintenance, and operation that most impact plant risk.

Description
The course will focus on developing concepts and skills necessary to interpret and apply PRA insights rather than developing PRA analysis skills. Lectures will focus on elements of PRA, PRA terminology, generic PRA results, dominant PWR and BWR accident sequences, accident sequence interpretation, PRA importance measures, PRA data base issues, and event significance and trending. The course will rely heavily on workshops and case studies to reinforce important concepts presented in the lectures and to provide practical experience in applying those concepts. Current and potential applications of PRA information in evaluating Temporary Waivers of Compliance (TWOCs), event response, regulatory issues, escalated enforcement, integrated scheduling and related licensing issues will be discussed and illustrated.

Who Should Attend
Project Managers, Project Engineers, and Project Directors. It is also open to others involved in the licensing and regulation of nuclear power plants who require a basic understanding of PRA and its applications as a decisionmaking tool.

Prerequisites
This course requires previous knowledge of nuclear power plant systems as provided in either the BWR or PWR Technology courses or their equivalent. The course is intended for degreed engineers and scientists who have had a college level course in statistics or probability theory. No previous PRA training is required or assumed.

Location/Date
8120 Woodmont Avenue   December 1–3, 1992
Bethesda, MD   April 6–8, 1993

Integrated Reliability and Risk Analysis System (IRRAS) Basics

Purpose — This four-day course is designed to provide hands-on training in the use of IRRAS (Integrated Reliability and Risk Analysis System) to perform probabilistic risk assessment analysis on the PC. IRRAS allows the user to build and evaluate the models used in PRA. IRRAS can provide the base models to be used in sensitivity analyses using SARA.

Description — Through the use of example problems, the participant will be led through the various analysis and sensitivity features available in IRRAS. To facilitate the learning process, the course will be restricted to no more than two participants per PC. When the course is completed, the participant will be able to: build fault tree models on the PC; assign reliability data; analyze the fault trees and determine minimal cut sets, calculate various importance measures, perform uncertainty analysis; analyze accident sequences, create and quantify accident sequences; and generate reports.

On the final day, **a short examination will be given** to reinforce concepts taught in the course.

Who Should Attend — **PRA practitioners** who have a need to be able to independently develop and quantify fault tree models. Class size is limited to 16 registrants.

Prerequisites — This course **does not** teach basic PRA techniques and is open only to PRA practitioners or personnel who have attended the Fundamentals of PRA course. The course is intended for degreed engineers and scientists who have had a college level course in statistics or probability theory.

Location/Date — 8120 Woodmont Ave.
Bethesda, MD

TBD
May 11–13, 1993

System Analysis and Risk Assessment System (SARA) Basics

Purpose This four-day course is designed to provide hands-on training in the use of SARA (System Analysis and Risk Assessment System) to perform data extraction, editing and sensitivity analysis of probabilistic risk assessment (PRA) results on the PC. SARA allows the user to conduct sensitivity and "what if" studies using the PRA models supplied by IRRAS (Integrated Reliability and Risk Analysis System).

Description SARA is designed to provide the user with the capability to simulate plant modifications and output a new risk analysis. Through the use of example problems, the participant will be led through the various analysis and sensitivity features available in SARA. When the course is completed, the participant will be able to: edit the PRA data bases stored in SARA; perform sensitivity analyses, modify basic event reliability data, calculate sequence and core melt frequencies for changed plant state, generate importance measures for changed plant state, generate reports of the stored PRA information and/or the sensitivity analysis; and become familiar with the limitations of SARA sensitivity analyses. Class size is limited to 16 registrants.

Who Should Attend PRA practitioners who have a need to be able to independently perform sensitivity studies using existing PRA studies.

Prerequisites This course does not teach basic PRA techniques and is intended for PRA practitioners or personnel who have attended the Fundamentals of PRA course. The course is intended for degreed engineers and scientists who have had a college level course in calculus and statistics or probability theory.

Location/Date 8120 Woodmont Ave.   July 20–23, 1993
Bethesda, MD

Overview of Performance Assessment
Techniques for High Level Waste

Purpose This one-day course provides a general overview of the regulatory bases, analytical techniques, and programmatic objectives of performance assessment (PA) of high level waste (HLW) repositories. The course will focus on the general major topics of the relationship between H'.W regulations and PA; the essential steps in completing a PA; and management and policy issues such as licensee–regulator interaction, reviewing a PA, the role of PA in systematic regulatory analysis, and the establishment of research priorities related to PA.

Description Consistent with the purpose of this overview, this presentation will consist primarily of lecture material. The course will emphasize the integrated, probabilistic character of PA and the relationship between PA and relevant HLW regulations. The technical areas of scenario identification, development of conceptual and mathematical models, basic probability concepts, the development of complementary cumulative distribution function (CCDF) curves, and uncertainty and sensitivity analysis will all be briefly discussed. The PA-related roles of the NRC, DOE, and EPA, as well as the necessary interaction between these agencies in licensing and regulating a HLW repository will be addressed. No examination will be given.

Who Should Attend The course is intended for managers and others who require a general understanding of the methods and objectives of HLW PA as well as the programmatic issues related to PA. The course may also provide a useful introduction to PA for technical personnel who may go on   ete more detailed PA training.

Prerequisites There are no prerequisites for this course.

Location/Date 8120 Woodmont Avenue   October 20, 1992
Bethesda, MD   March 9, 1993
                               August 10, 1993

Performance Assessment Techniques for High Level Waste

Purpose This three-day course is designed to provide practitioner level skills for individuals engaged in research and regulatory activities associated with high level waste repository siting, licensing, and regulation.

Description This course covers PRA applications to a high level waste repository. It begins with a review of basic probability theory and theory of random variables from both the frequentist and Bayesian viewpoints. The basic probability distributions used in modeling the uncertainties in physical processes associated with geochemistry, ground water transport, material corrosion, and radionuclide attenuation and transport will be reviewed. Techniques for scenario development and screening will be presented. Uncertainty propagation techniques via Taylor Series Expansions and Monte Carlo simulations will be discussed. The process of decision making, using probabilistic vs. deterministic models, will also be covered.

Who Should Attend Performance assessment practitioners who are engaged in research and regulatory activities associated with siting, licensing, and regulation of high level waste repositories.

Prerequisites This course is intended for degreed engineers and scientists who have had college level courses in calculus and statistics (or probability theory).

Location/Date 8120 Woodmont Avenue January 12-14, 1993
Bethesda, MD June 22-24, 1993

Human Reliability Assessment

Purpose This three–day course serves as an introduction to Human Reliability Assessment (HRA) including the methods used in modeling of human errors and various methods of estimating their probabilities. This course is designed for participants seeking to acquire introductory level skills in HRA and includes a broad introduction to HRA and its applications. It includes a discussion of HRA strengths, limitations, and results.

Description The course will emphasize human error identification, modeling, and quantification. The course will cover specific techniques and models to include: task analysis techniques, SHARP, TALENT, THERP, HCR, SLIM–MAUD, and simulation techniques including MAPPs, CES, and NUCLARR. In–class instruction will be supplemented with workshops and problem sessions. A calculator is needed for this course.

Who Should Attend All NRC personnel with a general interest in learning basic Human Reliability Assessment (HRA) techniques and concepts should attend this course.

Prerequisites There are no prerequisites for this course.

Location/Date 8120 Woodmont Ave.
Bethesda, MD

TBD
May 11–13, 1993

How to Enroll

Complete the registration form, obtain Supervisor's approval, and send the form to the appropriate Personnel Office/Training Representative.

PERSONNEL TRAINING REPRESENTATIVES

Name	Room	Mail Stop	Phone
ACRS, ADM, AEOD, ASLBP, IRM, LSS, OC, SDBU/CR: Christine Alexander	MNBB 2101	MNBB 2104	492–4241
CA, COMMISSION, CONS, EDO, IP, OCAA, OE, OGC, OI, PA, SECY, SP: Janice Hunter	OWFN 15–H–17	OWFN 15–G–21	504–1522
NRR: Jude V. Himmelberg/ Ira Radden	OWFN 13–B–15	OWFN 13–H–17	504–3022
OIG: Martie Lopez-Nagle	EW/W-554	EW/W-542	492–4660
OP: Sheryl Dunn	W456	W450	492–8232
NMSS: Bella A. Carter/ Sally Cornell	OWFN 6–F–7	OWFN 6–E–4	504–0677
RES: Pam Easson/ Carolyn Stabler	NLS–036	NLS–007	492–3636
REGION I: Leonard H. Carsley/ Chris O'Rourke			215–337–5352 215–337–5386
REGION II: Buffy Harper/ Gloria Barber			404–331–5609 404–331–0333
REGION III: Cynthia Marcy/ Dawn Smith			708–790–5751 708–790–5533
REGION IV: Karen E. League/ Connie Parker			817–860–8281 817–860–8255
REGION V: Pam Gallagher			415–448–0320

REGISTRATION FORM

STUDENT INFORMATION: (Please Print)

Name: _____
          Last   First   MI

Job Title: _____

Office/Division/Branch: _____

Mail Stop: _____   Telephone: _____

> *Obtaining Supervisor's approval, send completed form to Personnel Office/Training Representative.*
> *Completed form will be forwarded to the INEL Program Administrator,*
> *Joyce Nelson, P. O. Box 1625, Idaho Falls, Idaho 83415.*

Contact: Joyce L. Nelson (208-526-9673)   or Lillian W. van Santen (301-492-8938)

COURSE TITLE	DATE	LOCATION
_____	_____	_____

_____   _____   _____
Employee Signature   Supervisor Signature   Personnel Office/Trng. Rep.
                                                                                    Signature

In order to better structure the PRA courses to meet your needs, please provide the following information:

1. *Education*

   [ ] Doctorate   [ ] Masters   [ ] Bachelors   [ ] Associate   [ ]

2. *Subject Matter Specialty*

   [ ] Nuclear   [ ] Civil   [ ] Mathematics   [ ] Geology
   [ ] Chemical   [ ] Physics   [ ] Psychology   [ ] _____
   [ ] Mechanical [ ] Chemistry   [ ] Computer Science   [ ] _____
   [ ] Electrical [ ] Health Physics [ ] Statistics   [ ] _____

3. *Years in Present Job*

   [ ] >20   [ ] 16-20   [ ] 10-15   [ ] 1-9   [ ] <1

4. *Which category best describes you:*

   [ ] a. My current position places me in a role of   [ ] b. My future responsibilities may place me
          supervision and dealing with PRA results   in a role of dealing with PRA results and
          and findings.   findings.

5. *Are you a PRA Practitioner?*   Yes _____   No _____