

IAEA

TRAINING MATERIALS

SHARING KNOWLEDGE AND EXPERIENCE

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SAFETY ASSESSMENT EDUCATION AND TRAINING

SAFETY OF RESEARCH REACTORS

The objective is to enhance the safety of research reactors (RRs) in Member States. Activities in the research reactor safety area include monitoring and enhancing the safety of research reactors subject to project and supply agreements, and assistance to Member States with such reactors in fulfilling relevant safety obligations.

NS-R-4: Safety of Research Reactors

The use of a Graded Approach in the Application of Safety

Safety Documents

Safety Analysis: Methods and Approaches

Operational Radiation Protection Programme

Core Management and Fuel Handling

Safety of Research Reactors Experiments

Ageing Management

Synergy between Nuclear Safety and Security

Specific Considerations in Different Phases of the Country's First Research Reactor Project

Training and Qualification of Personnel

INSARR: integrated safety assessment for research reactors

SEDO: safety evaluation of fuel cycle facilities during operation

Incident reporting systems for Research Reactors - IRSRR

Incident reporting systems for Fuel Cycle Facilities - FINAS

IAEA safety standards for research reactors



MANAGING THE UNEXPECTED

These training materials consist of lectures and presentations held during the technical meeting on “Managing the Unexpected – From the perspective of the interaction between Individuals, Technology and Organizations”. State of the art research was presented and leading world experts shared their knowledge. The materials address three main parts.

The first part provides an introduction to managing the unexpected, resilience engineering and the systemic perspective of the interaction between Individuals, Technology and Organizations (ITO). This part also consists of presentation on the current approach to nuclear safety related to severe accident management and defence in depth.

The second part provides complementary perspectives on severe accidents such as ITO and Resilience Engineering (RE). This includes Japanese presentations on the Fukushima Daiichi accident from an ITO perspective.

The third part is demonstrating examples on how to implement complementary safety improvement methods such as ITO, RE and how to manage for the unexpected.

Facts and Lessons of the Fukushima Nuclear Accident - The Operator Viewpoints

The Accident at TEPCO's Fukushima Daiichi NPP Station

Managing the Unexpected

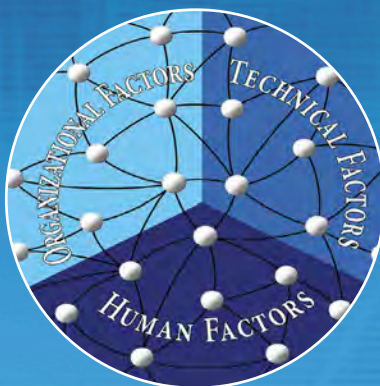
The Accident at TEPCO's Fukushima Daiichi NPP Station

Fukushima from the Perspective of Managing the Unexpected – TEPCO

Resilience Engineering and Crisis Management

Organizing for Mindfulness

Resilience in Aviation: The Challenge of the Unexpected



MANAGING THE UNEXPECTED

Resilience in Aviation: The Challenge of the Unexpected

Defense in Depth towards Managing the Unexpected

Assessing and Managing Severe Accidents in Nuclear Power Plants

MTO - A system View of Safety

Intense Care Units: A Case Study for Resilience

Evaluating Organization's Potential for being able to manage varying conditions

The Deepwater Horizon Disaster from a Systemic and Unexpected Management Perspective

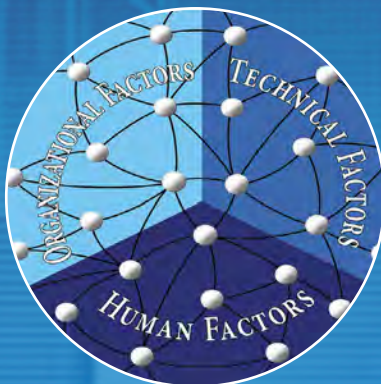
Using Operating Experience to Prevent or Mitigate Nuclear Events

Analysis on Human & Organizational Factors Regarding Initial Responses of Shift

Teams & Field Workers to the Fukushima Daiichi NPP Accident

IAEA's Approach to Leadership & Management of Safety

Managing the Unexpected - The Role of the Regulatory Body



POLICY ON HUMAN RESOURCES DEVELOPMENT FOR SAFETY INFRASTRUCTURE

These training materials consist of lectures and presentations given during the Asian Nuclear Safety Network seminar “Policy on Human Resources Development for Safety Infrastructure”. Nuclear technology, based on nuclear physics and other advanced sciences and technologies, demands high levels of knowledge and experience as priority must be given to safety. Decision makers must be aware that building nuclear safety competence is a multidisciplinary and multi institutional undertaking with a scope, level of effort and cost well beyond that normally required for other industrial developments. This awareness is essential for an informed national commitment, if a decision to embark on a Nuclear Power Program (NPP) is made. It is needed to build institutional knowledge, attract, train and sustain a competent work force capable of conducting a safe and reliable nuclear programme. This includes managerial and subject knowledge with a special focus on nuclear safety matters.

The following aspects should be considered:

- 1) Evolving needs in the various phases of safety infrastructure;*
- 2) Target audience and organizations to receive training;*
- 3) Type of knowledge required;*
- 4) Depth of knowledge required. Building up the necessary education system to underpin the needs for nuclear knowledge is a key activity for countries embarking on a Nuclear Power Program.*

The first part provides an introduction to Human Resource Management related to SSG-16 actions.

The second part provides an overview of IAEA support.

Introduction to Human Resource Management and SSG-16 Actions
M. Ammar Mehdi, IAEA

Human Resource Hiring Strategies
M. Ammar Mehdi, IAEA

Human Resource Sustainability
M. Ammar Mehdi, IAEA



POLICY ON HUMAN RESOURCES DEVELOPMENT FOR SAFETY INFRASTRUCTURE

IAEA's Approach to Safety Culture
M. Haage, IAEA

Self-Assessment of the National Safety Infrastructure for a NPP
Jean-René Jubin, IAEA

Safety Packages of IAEA Assistance for Establishing Safety Infrastructure
Steve Koenick, IAEA

IAEA Global Safety Assessment Network (GSAN)
Steve Koenick, IAEA

NUCLEAR POWER PLANT SIMULATORS FOR EDUCATION

ACR-700
Simulator

CANDU
Simulator, User Manual and Training Material

CTI BWR
Simulator and User Manual

CTI PWR Simulator and User Manual

WWER-1000
Simulator and User Manual



WORKSHOP ON LEVEL-1 PROBABILISTIC SAFETY ASSESSMENT FOR NUCLEAR POWER PLANTS

Target group: Staff of utilities, nuclear power plants, regulatory authorities, and support organizations with little or no experience in PSA development, however some of the PSA application subjects might be interesting even for those that have already basic PSA knowledge.

Media: 9 DVDs with Video-Synchronized Power Point Presentations

Overview of the Agenda and Objectives of the Workshop

Overview of PSA Scope and Tasks

Initiating Events Analysis

Accident Sequence Analysis & Thermal Hydraulic Calculation in Support of PSA

General Overview of Human Reliability Analysis and Human Errors Classification

Pre-Accident Human Errors Analysis

System Analysis & Fault Tree Development

Riskspectrum Computer Code - Overview of the Functions and Interface

Human reliability analysis - general recommendations and examples of application

Data Analysis for PSA



WORKSHOP ON LEVEL-1 PROBABILISTIC SAFETY ASSESSMENT FOR NUCLEAR POWER PLANTS

CCF Data analysis for PSA projects

Analysis of Dependencies

Quantification of the Results

Uncertainty, Sensitivity and importance Analysis

Classification of Hazards, Overview of Approaches, Screening Analysis

Low Power and Shutdown PSA (LSPSA)

Bounding Analysis for External Hazards Detailed Assessment for External Hazards

Overview of Fire and Flood PSA

Overview of IAEA Safety Guides and other Documents on PSA

WORKSHOP ON EXPERIENCE FROM CONSTRUCTION & REGULATORY OVERSIGHT OF NUCLEAR POWER PLANTS

Target group: Trainers in NPP regulation and operations

Media: 6 DVDs with Video-Synchronized Power Point Presentations

The materials below were produced from workshops held on the following subjects:

Opening

Overview of Olkiluoto construction project and its regulatory oversight

Resources for licencing and Regulatory oversight for new Build

Safety principles and requirements for new NPP's



Siting and Environmental Impact Assessment of NPPs

Feasibility Studies for a new NPP before choice of the plant type and vendor

Principles of regulatory oversight of Licensee's use and control of contractors in a Finnish NPP construction

Development of IAEA guidance for NPP construction and its regulation

Activities, preparations and expectations before construction license phase

Licensee's management system for a construction project

Deterministic safety analyses in the licensing process

PRA in the Licensing Process

Detailed design of plant systems

Principles of regulatory oversight for construction and manufacturing

Lessons learned from design, construction, manufacturing and installation of mechanical components

Lessons learned from design, construction, manufacturing - civil structures

Qualification and approval of pressure equipment manufacturers and inspection and testing organisations

Radiation safety aspects in the design of nuclear power plants

Regulatory expectations for plant commissioning and safe operation of the plant

Lessons learned from design, construction, manufacturing and installation of electrical and I&C equipment



SAFETY ASSESSMENT EDUCATION & TRAINING

LEVEL-2 PROBABILISTIC SAFETY ASSESSMENT

Target group: Staff of utilities, nuclear power plants, regulatory authorities, and technical support organizations

Media: 7 DVDs with Video-Synchronized Power Point Presentations

The materials below were produced from workshop on the following subjects:

Overview of Level 2 PSA - Introduction

Level 2 PSA Process - Major Tasks & Interfaces

Role of Level 2 OSA in Risk-Informed Regulations

Level 2 PSA Project Arrangements

Overview of Severe Accident Behavior

Sample Calculation of Severe Accident Progression

LWR Containment Designs

Deterministic Analysis of Containment Structural Capacity

Deterministic Analysis of Fission Product Release

Probabilistic Analysis - Logic Models, Quantification and Uncertainty

Presentation of Results

PSA in IAEA Publications

Review of Level-2 PSA

IRDIM and Level-2 PSA Applications



SAFETY ASSESSMENT EDUCATION & TRAINING SEVERE ACCIDENTS ANALYSIS

Target group: Staff of utilities, nuclear power plants, regulatory authorities, and technical support organizations

Media: 10 DVDs with Video-Synchronized Power Point Presentations

The materials below were produced from workshop on the following subjects:

Introduction to Severe Accidents

Overview In-Vessel Integral and Separate Effects Experiments

Overview Phenomenology of Severe Accidents - In-vessel

Overview - Influence of water addition

Simple Boil off and Quench Transients

Quench-11 Boil off and Quench Experiment and Analysis

Running PWR Station Blackout - Transient Using RELAP/SCDAPSIM

Ex-Vessel Phenomena

In-Vessel Phenomena - CANDU Specific Phenomena

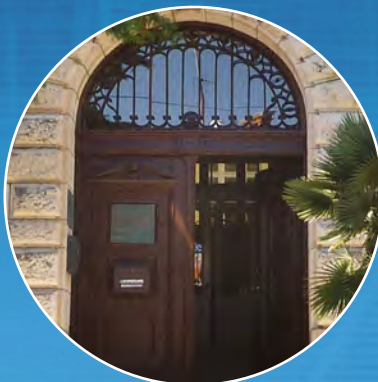
Overview of modeling approach - RELAP/SCDAPSIM

TMI-2

Modeling and Analysis of Severe Accident (II) - Modeling of CANDU specific Phenomena

Overview of Severe Accident Codes

SAMPSON-RELAP/SCDAPSIM



SAFETY ASSESSMENT EDUCATION & TRAINING SEVERE ACCIDENTS ANALYSIS

Overview Uncertainties

Influence of user training and experience on uncertainties

Modeling and Analysis of Severe Accident II

Aerosol and Iodine Behavior

Accident and Source-Term Analysis

Current Status of Safety Guide and Future Activities of SAMP for NPP's

Application of Severe Accident Analysis

Poland - Nuclear Power in Poland

Romania - Romanian Regulatory Requirements on
Severe Accidents Analysis & Severe Accident Management Guidelines

Severe Accident Activities In Argentina

Severe Accident Phenomena

Containment Failure Probability

E4. RCS Creep Failure Probability



BASIC PROFESSIONAL TRAINING COURSE (BPTC) - CHAPTER 22

Target group: Trainers in NPP regulation and operations

Media: Two DVDs with Video-Synchronized Power Point Presentations

The materials below were produced from workshops held on the following subjects:

Introduction

Module 1 - Communicating about Nuclear Technology

Module 2 - Best Practices for Communication about Nuclear

Module 2.1 - Understanding Perceptions

Module 3.1 - Q & A with Paul Woodhouse

Module 3.2 - Q & A with Stephane Calpena

Module 3.3 - Q & A with Rejane de Santa Spielberg Planer

Summary

WORKSHOP ON TRANSPARENCY, OPENNESS AND INVOLVMENT OF THE PUBLIC AND STAKEHOLDERS IN THE REGULATORY PROCESS

Target group: Trainers in NPP regulation and operations

The materials below were produced from workshops held on the following subjects:

La Commision Locale D'Information Nucleaire aupres du CNPE du Blayais

French Legislative approach to Transparency and Openness

Transparency, openness and public envolvment -
Expectations of the European Commission in the nuclear field

Nuclear Transparency - A view from the field

Situation in Romania regarding Transparency

Situation in Lithuania regarding Transparnecy

Situation in Slovakia regarding
Transparency

Situation in Slovenia
regarding Transparency



FUTHER NEEDS IN THE AREA OF MANAGEMENT SYSTEMS

Target group: Trainers in NPP regulation and operations

Media: One DVD with Video-Synchronized Power Point Presentations

The materials below were produced from workshops held on the following subjects:

International Wisdom supporting Peaceful Utilisation of Nuclear Energy

IAEA safety Standards on Management Systems - particularly DS349

Human Factors in Design and Construction Regulatory Perspective

Leadership and Culture

Information and Training in Support of the IAEA Safety Standards

Lessons Learned in construction Activities

Added Value of the SCART Mission at SANTA MARIA GARONA NPP

Sellafield Ltd



LICENSING AND REGULATORY OVERSIGHT OF NEW NUCLEAR BUILD

Target group: Trainers in NPP regulation and operations

Media: 10 DVDs with Video-Synchronized Power Point Presentations

The materials below were produced from workshops held on the following subjects:

General Overview of licensing process and regulatory oversight in the design and construction of a nuclear powerplant

Licensing process - framework and roles of stakeholders

On nuclear Installation Safety Training Materials

Safety Principles and requirements for new plants

Siting and Environmental Impact Assessment

Feasibility studies and Decision in Principle phase for Olkiluoto 3 regulators conclusions

Feasibility studies for new NPP key issues for next reactors in Finland

IAEA support available for countries with limited or no experience for nuclear power plant construction

Bidding Phase: Interactions between STUK, TVO and potential vendors, preparations for construction license phase

Construction License phase: requirements for documentation, review and assessment of design

Construction License phase: auditing the vendor and manufacturer

Construction: the role of Technical Support Organisations and experimental research

Construction License phase: the role of probabilistic safety assessment



LICENSING AND REGULATORY OVERSIGHT OF NEW NUCLEAR BUILD

QC and regulatory oversight during manufacturing of mechanical components

Regulatory Inspection of design documentation for structures and components

Licensees QA programme and handling of non conformances

Experience from inspections of civil works and installations on site

Experience from review and assessment of digital I&C systems and electrical systems

Construction Inspection Programme

Preparations for Operating License process

Lessons learned - promotion for safety culture

Regulatory preparations for next NPP project in Finland

SITE SELECTION AND EVALUATION FOR NPPS

Target group: Trainers in NPP regulation and operations

Media: 9 DVDs with Video-Synchronized Power Point Presentations

The materials below were produced from workshops held on the following subjects:

RER/0/026 - Support for Introduction of Nuclear Energy

Global Nuclear Safety Regime

Site Selection Process. IAEA Safety Guide 50-SG-S9, Licensing Process and the Phases

Site Survey - Site Selection / Technical, Economic, Environmental & Risk Aspects

Global Nuclear Safety Regime

Overview & Integrated approach of siting as part of the milestone in the development of a national Infrastructure for Nuclear Power



Public Acceptance, Public Engagement

IAEA Safety Requirements on Site Evaluation

Licensing Process for Site Evaluation

Dispersion in water

IAEA Safety Guide on the Evaluation of Seismic Hazards

Collection and Interpretation of geological and seismicity data

Geotechnical Aspects of NPP Site Evaluation and Foundations

Population Distribution

Dispersion in Air

Evaluation of extreme meteorological events

IAEA Safety Standards of Flooding Hazards - Site Evaluation and Design Aspects

Demonstration of feasibility of the Emergency Plan

Extreme Human Induced Events in Site Evaluation for Nuclear Power Plants

Siting a new NPP in Romania

Proposes Egyptian Criteria and Regulatory Guides for NPP Seismic Design

Visaginas Nuclear Power Plant Project

Power Plant Siting in Poland

Siting and Site Evaluation for NPPs in Turkey

Seismic / Natural hazards in Georgia: A tool for Risk Management at NPPs

Nuclear Power Plant Siting in Croatia

Nuclear Power Plant Site Selection

Site Selection in Ukraine



TRAINING COURSE ON MANAGEMENT SYSTEMS BASED ON GS-R-3

The objective of this training course on management systems is to help high level managers understand:

- *The structure and content of the IAEA Safety Standards, guides and safety publications*
 - *Why it is beneficial to have a coherent management system that addresses all requirements in a structured way using processes*
 - *The appropriateness of the management system standards to a nuclear utility*
 - *The roles and responsibilities of senior managers and how leadership supports the development and implementation of the management system*
 - *How to align the management system to the goals and objectives of the utility and transition the current management system to the IAEA Safety Standard GS-R-3*
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Introduction - Management System Training

Module 1 - IAEA Safety Standards on Management Systems

Module 2 - Why have an Integrated Management System?

Module 3 - Role of IAEA Safety Requirement GS-R-3 among other Management System Standards

Module 4 - Responsibilities of Senior Management

Module 5 – Developing and Integrated Management System

EFFECTIVE MANAGEMENT OF ORGANIZATIONAL CHANGES IN NUCLEAR FACILITIES

Target group: Trainers in NPP regulation and operations

Media: One DVD with Video-Synchronized Power Point Presentations

The materials below were produced from workshops held on the following subjects:

Orientation to Process Mapping

Case Study Overview

Regulatory Oversight Activities
for Organizational Change



OVERVIEW OF NUCLEAR SAFETY STANDARDS TOKYO COURSE

Target group: Trainers in NPP regulation and operations

Media: One DVD with Video-Synchronized Power Point Presentations

This course is based on lectures from the Regional Workshop on the IAEA Nuclear Safety Standards:

The Safety Standards Programme Overview

Legal and Governmental Infrastructure for Nuclear Radiation, Radioactive Waste and Transport Safety Requirements

Safety Guides for Legal and Governmental Infrastructure

Safety Requirements for Site Evaluation of NPPs-Part 1

Safety Requirements for Site Evaluation of NPPs-Part 2

Safety Guides for Site Evaluation of NPPs

Safety Requirements for Design of NPPs

Safety Guides for Design of NPPs

Requirements for Safe Operation of NPPs with Comparison to OSART

Safety Guides for Operation of NPPs



LECTURES ON SPECIFIC SAFETY STANDARDS

This course contains Lectures on specific IAEA Safety Standards.

Target group: Trainers in NPP regulation and operations

Media: 2 DVDs with Video-Synchronized Power Point Presentations

Legal and Governmental Infrastructure for Nuclear Radiation, Radioactive Waste and Transport Safety, GS-R-1B

Organization and Staffing of the Regulatory Body for Nuclear Facilities, GS-G-1.1

Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body, GS-G-1.3

Documentation for Use in Regulating NPPs GS-G-1.4

Site Evaluation for Nuclear Installations, NS-R-3

External Human Induced Events in Site Evaluation for NPPs, NS-G-3.1

Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for NPPs, NS-G-3.2

Meteorological Events in Site Evaluation for NPPs, NS-G-3.4

Flood Hazards for NPPs on Coastal and River Sites, NS-G-3.5

Software for Computer Based Systems Important to Safety in NPPs, NS-G-1.1

Instrumentation and Control Systems Important to Safety in Npps, NS-G-1.3

Design of Fuel Handling and Storage Systems for NPPs, NS-G-1.4

External Events Excluding Earthquakes in the Design of NPPs, NS-G-1.5

Seismic Design and Qualification for NPPs, NS-G-1.6



Protection Against Internal Fires and Explosions in the Design of NPPs, NS-G-1.8

Design of Emergency Power Systems for NPPs, NS-G-1.8

Design of the Reactor Coolant System and Associated System in NPPs, NS-G-1.9

Design of the Reactor Containment System for NPPs, NS-G-1.10

Modifications to NPPs, NS-G-2.3

Periodic Safety Review of NPPs, NS-G-2.10

Safety of NPPs: Operation, NS-R-2

Fire Safety in the Operation of NPPs, NS-G-2.1

Operational Limits and Conditions and Operating Procedures for NPPs, NS-G-2.2

The Operating Organization for NPPs, NS-G-2.4

Core Management and Fuel Handling for NPPs, NS-G-2.5

Recruitment, Qualification and Training of Personnel for NPPs, NS-G-2.8

The Code Conduct on the Safety of Research Reactors



BASIC PROFESSIONAL TRAINING COURSE ON NS (BPTC)

Target group: Trainers in NPP regulation and operations

Media: Two DVDs with Video-Synchronized Power Point Presentations

The materials below were produced from workshops held on the following subjects:

Safety-Related Characteristics of Nuclear Reactors-Introduction

Safety-Related Characteristics of Nuclear Reactors:
Radioactive Materials Inventory, Fission Product Decay Heat

SCR of NR - RC, SS & PS

Safety Fundamentals of Nuclear Installations

Basic Safety Principles for NPPs - INSAG-12

Defence in Depth - INSAG-10

Defence in Depth - Implementation Spanish Experience

IAEA Sitting Standards - Code on the Safety of NPP Sitting

Safety Evaluation - Safety Guides

IAEA Design Safety Standards

Basic Concepts of DAA

DAA - Classification of Events

DBA - Methods and Codes - RELAP5

Methods for Beyond DBAA [Part1]

PSA Utilization - Risk Management

PSA Utilization - Design, Inspection, Regulatory Applications

IAEA Requirements For Safe Operation of NPPs



Excellence in Operational Safety - The Vision

Challenging Operational Safety - Example & Consequences

Assessing Operational Safety

Configuration Control

Operational Safety - Maintenance & Surveillance Programs

Operating Organization - U.S.

Conduct of Operation - U.S.

Enforcement to Safety Culture - Basic Concepts & Principles

Introduction to Safety Culture - Basic Concepts & Principles

Management of Safety & Safety Culture at NPPs

Structure and Development of Safety Culture

Safety Culture in an Operating Organization

Reducing Human Error



SAFETY ASSESSMENT EDUCATION AND TRAINING

Target group: a wide range of personnel, from those with little or no experience in safety assessment to those seeking to gain specialized expertise in certain areas of safety assessments. The modules are intended for representatives of regulatory authorities, TSOs and plant operators from countries developing new or expanding existing nuclear power programmes seeking to enhance their knowledge of safety assessment.

Media: on-line video presentations covering the following areas:

I.Fundamentals of Safety Assessment

II.Assessment of Engineering Aspects Important to Safety

III.Deterministic Safety Assessment

IV.Probabilistic Safety Assessment

The presentations can be found on the following link:

<http://nucleus.iaea.org/sites/gsan/multimedia/saetmultimedia/Pages/Essential-Knowledge.aspx>

Following is a brief outline of each of the four areas listed above:

I.Fundamentals of Safety Assessment

Introduction to Safety Assessment

Fundamental Safety Principles and overview of IAEA Safety Standards

Safety Requirements: Safety Assessment GSR Part 4 and Design Safety SSR-2/1

Basic Safety Concepts

Scope of Safety Assessment

Fundamentals of Safety Analysis

Scope of safety analysis

Preparing for safety analysis

Criteria for Judging Safety and Acceptance Criteria

Overview of Deterministic Safety Analysis Methods

Overview of Probabilistic Safety Analysis Methods

Use of Computer Codes

Uncertainty and Sensitivity Analysis

Use of Data from Operating Experience

Interpretation of Results

Quality Assurance

Integrate Risk Informed Decision Making



II.Assessment of Engineering Aspects Important to Safety

Overview of Engineering Aspects

Implementation of defence in depth
Operational experience
Radiation protection
Classification of structures systems and components
Equipment qualification
Aging and wear-out mechanisms
Human factors in NPP design and operation
Protection against internal fire and explosions
Protection against internal hazards other than fire and explosions
Protection against earthquakes
Protection against external events excluding earthquakes

Safety Assessment of the Design of the Main Systems

Reactor Core
Reactor coolant system and associated systems
Reactor containment systems
Emergency power systems
Fuel handling and storage systems
Supporting and auxiliary systems
Instrumentation and control systems
Safety Systems

III.Deterministic Safety Assessment

Overview of Deterministic Safety Assessment (DSA)

Deterministic Safety Assessment
Scope of Deterministic Analysis
Overview of DSA Applications
Licensing Analyses
Development of EOPs and SAMGs
Safety Analyses in Support of Periodic Safety Reviews
Shut-down and Low Power Analyses
Analyses in Support of Modifications and Life Extension



SAFETY ASSESSMENT EDUCATION AND TRAINING

III.Deterministic Safety Assessment

Design Basis Analysis – System

Introduction to Design Basis Analysis: Scope, Objectives, Methodology
Identification and Grouping of Initiating Events
Acceptance Criteria
Basic Code Modelling
Code Verification and Validation
Separate Effects Tests Modelling
Integral Effects Tests Modelling
Nuclear Power Plant Modelling
Conservative approach
Best Estimate plus Uncertainty
Sensitivity Analysis
Fundamentals of Conservative vs. Best Estimate Analysis
Uncertainty Evaluation
Applications

Design Basis Analysis - Fuel Behaviour

Under development

Design Extension Conditions

Intro to Design Extension Conditions – overview of severe accidents
In vessel severe accident progression and phenomena
Core degradation experimental programmes
Modelling of in vessel accident progression with computer codes
Lower head behaviour and failure
High pressure accidents – phenomena and analyses
Hydrogen release and behaviour – generation, distribution, mixing and combustion
Direct containment heating
Steam explosions – phenomena, and modelling
Ex vessel debris formation and coolability
Corium spreading
Corium concrete interaction
Fission Product Release and transport
Fission Product modelling
Determination of the Source Term
Severe accident management
Applications



IV. Probabilistic Safety Assessment

Probabilistic Safety Assessment (PSA)

Basic Risk Concepts and Techniques
General Objectives and Scope of PSA
Overview of Level 1, 2, and 3 PSAs
Level-1 PSA organization, management and tasks outline
Level 2 PSA Process - Major Tasks & Interfaces and Project Arrangements
Role of PSA concepts in Risk Informed Regulations
Safety Assessment and Verification with Level 1 PSAs
Overview of PSA Applications and Regulatory Use of PSAs
Living PSAs and Risk Monitors

Level 1 PSA

Analysis of Initiating Events
Accident Sequence Modelling
System Analysis and Fault Tree Development
Reliability and Statistical Data Analyses
Analyses of Dependencies including Common Cause Failures
PSA Quantification and Analysis of Results
Overview of PSA Software
Human Reliability Analysis
Fire Risk Analysis
Flood Risk Analysis
PSA of Internal Hazards
Overview of PSA for External Hazards Including Introduction to Seismic PSA Applications

Level 2 PSA

Overview of Severe Accident Phenomena
Sample Calculations of Severe Accident Progression
Containment Designs and Structural Performance
Probabilistic Event Progression Modelling
Probabilistic Analysis Interfaces
Format and Content of Typical Level 2 PSA Results.
Applications

Level 3 PSA

Under development



Disclaimer

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