

EMERGENCY PREPAREDNESS AND RESPONSE

COURSE IN ENGLISH

**EXAMPLE
OF TRAINING
PROVIDED**

OUR EXPERTS ENHANCE YOUR SKILLS

National System for Emergency Preparedness and Response



Code: CO1028

Session:
On demand

Registration deadline:
3 months prior to course

Duration: 5 days
Certificate of attendance
will be issued to participants
who attend the full course.

Price: Contact us!

**TO BE DESIGNED ACCORDING
TO YOUR EXPECTATIONS**

Prerequisites

Participants should have a basic knowledge of accidents in nuclear facilities and in the field of applied radiation technologies.

Examination

Knowledge testing (multiple choice exam) will be performed on the full course content and successful candidates will be issued with a Knowledge Certificate.

Teaching methods

Lectures, discussions and practical sessions are included.

Working group exercises and technical visits are supervised by experienced TSO experts.

A USB stick containing the course material will be provided.

Objectives

Helping people and organisations responsible for national emergency response to be ready to manage unexpected situations arising from nuclear or radiation related accidents so as to provide government with the best possible technical support and assistance for managing the crisis

Target Audience

This training is intended for professionals from nuclear regulatory authorities and technical support organisations with responsibilities associated with the implementation of emergency preparedness at a national level.

Learning Outcomes

- **A better understanding of the general principles of EP&R:** basic goals & general requirements, implementation.
- **A view of regulations in force in various European countries** and differences between these countries.
- **A better understanding of emergency response arrangements in different European countries:** goals, emergency response phases, emergency management, roles & responsibilities, assessment methods & tools, on site and off- site plans.
- **A perspective of the importance of communication during a nuclear crisis** and of acquiring its basic principles.
- **A knowledge of resources needed** for an emergency center to function.
- **A practical understanding of emergency preparedness exercises.**
- **A better understanding of the role of mobile teams** in emergency situations.

Program

The 5-day training module will cover the following subjects:

- Introduction to EP&R definitions and generalities, with presentation of related regulations in European countries.
- Emergency response arrangements in Europe in case of accident, including communication and information dissemination in emergency situations.
- The emergency centers of nuclear safety authorities and TSOs, including organization, methods & tools, information exchanges and emergency preparedness.
- Post-accident management and operational management.
- Technical visit with feedback from a radiotherapy accident.

At the end of the module, a roundtable discussion session addresses issues identified by participants.

It is followed by an evaluation during which participants give their impressions of the module, with a review of the degree to which the needs expressed on the first day of training were met.

Contact :
training-tutoring@irsn.fr

Online catalogue
<https://formation.irsn.fr/en/>

NUCLEAR SAFETY

COURSE IN ENGLISH

**EXAMPLE
OF TRAINING
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OUR EXPERTS ENHANCE YOUR SKILLS

Decommissioning Safety

Code: CO1012

Session:
On demand

Registration deadline:
3 months prior to course

Duration: 5 days
Certificate of attendance
will be issued to participants
who attend the full course.

Price: Contact us!

**TO BE DESIGNED ACCORDING
TO YOUR EXPECTATIONS**

Prerequisites

Participants should have work experience and be familiar with fundamentals on different types of nuclear facilities.

Examination

Knowledge testing (multiple choice exam) will be performed on the full course content and successful candidates will be issued with a Knowledge Certificate.

Teaching methods

Lectures, discussions and practical sessions are included.

Working group exercises and technical visits are supervised by experienced TSO experts.

A USB stick containing the course material will be provided.



Objectives

To address topics relevant to the decommissioning of nuclear facilities.

The training will consider aspects of national and international regulations, practical experiences and working-group activities related to the conduct of regulatory review.

Target Audience

This training is intended mainly for professionals from nuclear regulatory authorities and technical safety organizations.

Learning Outcomes

Participants will acquire:

- The fundamentals of decommissioning of nuclear facilities, including, inter alia, aspects of planning, conduct and termination of decommissioning.
- Detailed knowledge on the decommissioning of different types of nuclear facilities and on start points for decommissioning phases.
- Feedback on licensing and supervision experience during decommissioning.
- An introduction to an internationally accepted methodology for conducting decommissioning safety assessments.
- An introduction to an internationally accepted methodology for the regulatory review of decommissioning safety assessment results.
- Information on safety assessment and related reviews from national examples.
- An understanding of how safety assessment results are implemented during decommissioning operations.

Program

The training will start with an overview of decommissioning aspects and the presentation of ongoing decommissioning projects (NPPs and fuel cycle facilities). This will ensure that all participants share the same understanding of decommissioning, and will set the scene for the further lectures.

A presentation of the methodologies used in France to make safety assessments and conduct regulatory reviews of such assessments will be the starting point for lectures by specialists on the following subjects: risk identification; human factors; radiation protection; fire safety; risks linked to handling activities during decommissioning; and radiological characterization vs. waste management.

A test case in radiation protection during decommissioning will be proposed to illustrate how to deal with these issues, and a specific session will be dedicated to innovative techniques for decommissioning, featuring 3D simulation and contaminated site characterization with geostatistical concepts.

At the end of the module, a roundtable discussion session addresses issues identified by participants.

It is followed by an evaluation during which participants give their impressions of the module, with a review of the degree to which the needs expressed on the first day of training were met.

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NUCLEAR SAFETY

COURSE IN ENGLISH

**EXAMPLE
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OUR EXPERTS ENHANCE YOUR SKILLS

ASTEC: Accident Source Term Evaluation Code

Code: CO1020

Session:
On demand

Registration deadline:
3 months prior to course

Duration: 5 days
Certificate of attendance
will be issued to participants
who attend the full course.

Price: Contact us!



ELSA

Fission product release

ICARE

Core degradation, with
corium behaviour
in vessel lower head

RUPICUV

Corium entrainment
in containment

Objectives

To provide a basic understanding of the ASTEC software capabilities and its application in reactor accident source term assessment and severe accident management. It should be noted that participants cannot be expected to acquire an in-depth theoretical knowledge of severe accident phenomena from the brief description of ASTEC physical modeling principles presented in this course.

Learning Outcomes

Participants will acquire:

- An understanding of ASTEC software capabilities.
- Sufficient understanding of the software use to perform first calculations for the purpose of interpreting severe accident experiments and developing NPP accident scenarios.

Target Audience

The training course is intended for the benefit of professional engineers and scientists with university-level degrees involved in NPP safety analysis related especially to severe accidents.

**TO BE DESIGNED ACCORDING
TO YOUR EXPECTATIONS**

Prerequisites

Participants will require knowledge of severe accident phenomenology and an experience in running computer codes.

Examination

Knowledge testing (multiple choice exam) will be performed on the full course content and successful candidates will be issued with a Knowledge Certificate.

Teaching methods

Lectures, discussions and practical sessions are included.

Working group exercises are supervised by experienced TSO experts belonging to the IRSN ASTEC team.

A USB stick containing the course material will be provided.

Program

The Accident Source Term Evaluation Code (ASTEC) has been developed over a number of years for the simulation of severe accident sequences in water-cooled nuclear power plants. The software simulates all severe accident phenomena, except steam explosion and loss-of-containment mechanical integrity, from the initiating event up to the possible release of radioactive products ("source term") from the containment.

The main ASTEC applications include nuclear reactor safety analysis source term evaluations, and development of severe accident management guidelines.

The current V2 version is applicable to water-cooled reactors including PWR, VVER and BWR and to pressurized heavy-water reactors.

The software builds on the European body of knowledge on severe accidents. It has been subjected to an intensive validation through more than 160 experiments, including separate and coupled effect tests, integral tests (e.g. Phébus FP in-pile tests) and, in particular, OECD/NEA ISP exercises. The validation matrix is being continuously expanded based on the results of ongoing international programs (PEARL, STEM2-OECD, CCI-OECD, ThAI-OECD, etc.).

Following a general presentation of the software structure and user tools, the lectures focus on various modules used to simulate severe accident phenomena, each one addressing either NPP zones during the whole scenario or specific parts of the scenarios.

At the end of the module, a roundtable discussion session addresses issues identified by participants. It is followed by an evaluation during which participants give their impressions of the module, with a review of the degree to which the needs expressed on the first day of training were met.

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NUCLEAR SAFETY

COURSE IN ENGLISH

**EXAMPLE
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OUR EXPERTS ENHANCE YOUR SKILLS

SOFIA - Simulating Reactor Functioning during Incident and Accident

Code: CO1023

Session:
On demand

Registration deadline:
3 months prior to course

Duration: 5 days
Certificate of attendance will be issued to participants who attend the full course.

Price: Contact us!



Objectives

To acquire a working knowledge of the SOFIA simulator for observation of functioning under incident and accident conditions.

Target Audience

This training is intended for engineers who wish to acquire general knowledge in functioning physics and safety of pressurized water reactors (PWR) under normal and accident conditions..

Learning Outcomes

Participants will acquire:

- A better understanding of the physical phenomena that occur in a PWR during normal operation, especially during the startup stage and under accident conditions.
- A global view of the main systems of the nuclear island used in normal and accident conditions, and of how they interact.
- An understanding of the main steps in normal operational procedures as the function of the main automatic controls of the plant unit, for different states of the plant (from cold shutdown state for maintenance to full power operation).
- An understanding of the main operational safety procedures under accident conditions (LOCA, SGTR).
- The ability to assess situations that can lead to severe accidents, such as loss of cooling water, loss of steam generator feedwater supply, or loss of power; demonstration through simulation of the Three Miles Island (TMI) and Fukushima accidents.

**TO BE DESIGNED ACCORDING
TO YOUR EXPECTATIONS**

Prerequisites

Participants will require knowledge of severe accident phenomenology and an experience in running computer codes.

Examination

Knowledge testing (multiple choice exam) will be performed on the full course content and successful candidates will be issued with a Knowledge Certificate.

Teaching methods

Lectures, discussions and practical sessions are included.

Working group exercises and technical visits are supervised by experienced TSO experts.

A USB stick containing the course material will be provided.

Program

The course focuses on lectures and practical work sessions on the SOFIA simulator.

To perform analysis of thermal hydraulics during a reactor accident or safety assessment, the French technical safety organization IRSN uses the CATHARE (Code for Analysis of Thermal Hydraulics during an Accident of Reactor and Safety Evaluation) system code for PWR safety analysis, accident management and definition of plant operating procedures, and for research and development.

The module will cover the following subjects:

- | | | |
|---|--|---|
| <ul style="list-style-type: none">■ Design basis accidents for PWR:<ul style="list-style-type: none">- Description of loss-of-coolant accidents (LOCA).- Large-break LOCA transient (LB LOCA).- Small-break LOCA transient (SB LOCA), fourth sequence: failure of first actions.- Description of steam generator tube rupture (SGTR accidents).- SGTR transient.- Sixth sequence: intervention strategy.- Seventh sequence: decision-making process for assault. | <ul style="list-style-type: none">■ PWR systems and normal reactor operation:<ul style="list-style-type: none">- Introduction to PWR operation.- Main PWR systems.- General information and sequence leading to the hot shutdown state. Description of the CATHARE thermal-hydraulic code.- Basics of core physics, divergence and core control.- Divergence and power increase turbine coupling. | <ul style="list-style-type: none">■ Other PWR accidents:<ul style="list-style-type: none">- TMI and Fukushima accidents. |
|---|--|---|

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NUCLEAR SAFETY

COURSE IN ENGLISH

**EXAMPLE
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OUR EXPERTS ENHANCE YOUR SKILLS

Lessons Learned from the Fukushima Daiichi Accident and the EU Stress Test

Code: CO1032

Session:
On demand

Registration deadline:
3 months prior to course

Duration: 5 days
Certificate of attendance
will be issued to participants
who attend the full course.

Price: Contact us!

**TO BE DESIGNED ACCORDING
TO YOUR EXPECTATIONS**

Prerequisites

Basic knowledge in the area of nuclear and radiation science and technologies.

Examination

Knowledge testing (multiple choice exam) will be performed on the full course content and successful candidates will be issued with a Knowledge Certificate.

Teaching methods

Lectures, round table with experienced experts from European safety organizations.

Practical exercises will take place during the week.

A USB stick containing the course material will be provided.

Objectives

To provide trainees with a thorough background on the accident at the Fukushima Daiichi nuclear power plant, its consequences and all related topics; on the lessons learned from the plant behavior assessment, the severe-accident management and emergency response; and on the insights from post-Fukushima activities like the EU stress tests.

Target Audience

Professionals involved in nuclear safety and radiation protection activities, and who are employed by nuclear regulators or their technical safety organizations.

Learning Outcomes

Trainees will gain important up-to-date information to apply to their activities in the fields of nuclear safety and radiation protection.

Program

The 5-day training module will cover the following subjects:

- General presentations of the accident, its management and consequences.
- Extreme natural hazards.
- Safety systems of the Fukushima Daiichi plant and accident management.
- European stress tests.
- Examples of national approaches in Europe.
- Off-site emergency response and consequences of the Fukushima Daiichi accident – short-term response and long-term management.
- Challenges related to emergency preparedness and post-accident management. • Facility types other than NPP, and R & D related to the Fukushima accident.

At the end of the module, a roundtable discussion session addresses issues identified by participants.

It is followed by an evaluation during which participants give their impressions of the module, with a review of the degree to which the needs expressed on the first day of training were met.

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NUCLEAR SAFETY

COURSE IN ENGLISH

**EXAMPLE
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OUR EXPERTS ENHANCE YOUR SKILLS

CRISTAL - Tools for Criticality Safety Calculation

Code: CO1055

Session:
On demand

Registration deadline:
3 months prior to course

Duration: 5 days
Certificate of attendance
will be issued to participants
who attend the full course.

Price: Contact us!

**TO BE DESIGNED ACCORDING
TO YOUR EXPECTATIONS**

Prerequisites

Knowledge in neutronics and main principles on nuclear criticality safety (criticality control parameters, fissile materials, etc).

Examination

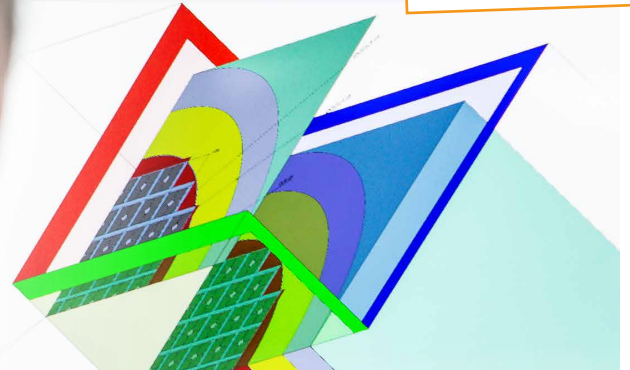
Knowledge testing (multiple choice exam) will be performed on the full course content and successful candidates will be issued with a Knowledge Certificate.

Teaching methods

Lectures, discussions and practical sessions are included.

Practical exercises and software practice on real cases will take place during the week.

A USB stick containing the course material will be provided.



Objectives

The main objective of the training is to use the CRISTAL V2 package for criticality calculations with LATEC graphical front-end and simulation back-end with CRISTAL codes (APOLLO2, MORET 5 et TRIPOLI-4®).

Underlying numerical recipes of simulation and their limitations in the criticality-safety assessment framework are described.

This training is designed to meet the needs of nuclear criticality safety practitioners

Target Audience

A person and organization responsible for design, fabrication, maintenance or review of nuclear criticality safety for a process or transportation.

These persons would be Nuclear criticality safety specialists with the responsibilities of assessment and calculation.

CRISTAL package is used to performed calculations for:

- fissile materials transportations.
- nuclear fuel cycle facilities (fuel processing, reprocessing...).
- laboratories and storage units.
- unloaded nuclear reactor core.
- decommissioning or decommissioned facilities.

Learning Outcomes

After the course, participants will :

- Have a general knowledge of CRISTAL package (structure, simulations tools, libraries, etc).
- Be able to perform criticality calculations with CRISTAL V2 package, relying on state-of-the-art neutronic simulation tools (APOLLO2, TRIPOLI-4®, MORET 5) and international nuclear database.
- Understand the application range of different simulation tools and methods.

Program

Basics

CRISTAL V2 package – Architecture and main components – Calculation routes

Deterministic method

APOLLO2 simulation code, recommended calculation routes, standard calculations, practical cases.

Monte Carlo method

MORET 5 and TRIPOLI-4® simulation codes, features, practical cases.

Modelling environment

LATEC workbench, dilution laws, basics, perform and validate criticality-safety calculations

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NUCLEAR SECURITY

COURSE IN ENGLISH

**EXAMPLE
OF TRAINING
PROVIDED**

OUR EXPERTS ENHANCE YOUR SKILLS

Implementing Nuclear Safeguards in practice

Code: CO1053

Session:
On demand

Registration deadline:
3 months prior to course

Duration: 5 days
Certificate of attendance
will be issued to participants
who attend the full course.

Price: Contact us!



Objectives

Increase the knowledge of the participants:

- On the importance of implementing fully safeguards obligations to facilitate the effective and efficient application of safeguards for the country;
- On the continued evolution of safeguards through modern technology and newly developed concepts.

Target Audience

Professionals involved in nuclear safeguards activities employed in National Regulatory Authorities (NRA) and Technical Support Organizations (TSO).

Learning Outcomes

Participants will be able to:

- Understand the international and EURATOM safeguards agreements including the Additional Protocols and the Small Quantity Protocols;
- Contribute to the practical implementation of safeguards in their country in applying the principles of nuclear material accountability and control;
- Understand differences and interfaces between nuclear safeguards and nuclear security;
- Describe safeguards techniques and to practically use some of them.

**TO BE DESIGNED ACCORDING
TO YOUR EXPECTATIONS**

Prerequisites

Participants should have basic knowledge in the fields of nuclear energy and nuclear safeguards.

Examination

Knowledge testing (multiple choice exam) will be performed on the full course content and successful candidates will be issued with a Knowledge Certificate

Teaching methods

Lectures, discussions and practical sessions are included.

Working group exercises are supervised by experienced TSO experts.

A USB stick containing the course material will be provided.

Program

The course focuses on implementing international safeguards in practice. The 5-day training module will cover the following subjects:

1/ Application of safeguards

- Non-proliferation treaty and IAEA verification;
- IAEA safeguards agreements;
- Regional control;
- Small quantity protocol (SQP);
- Additional protocol and declaration.

3/Case study

- Measures taken by country's Nuclear Regulatory Authorities for establishing safeguards infrastructure and providing operational support for verification activities;
- Principles of nuclear material accountability and control.

2/Verification activities

- EURATOM inspections;
- Non Destructive Assay – gamma-ray spectrometry;
- Non Destructive Assay – neutron counting;
- Destructive assay – Containment and surveillance and monitoring; • Hands-on demonstration of the relevant equipment.

4/ Safeguards & Security interface

- Information on the legal framework for nuclear security and on the categorization of nuclear material for nuclear security purposes;
- Principal differences and possible synergies between nuclear safeguards and nuclear security.

5/ At the end of the module, a roundtable discussion session addresses issues identified by participants. It is followed by an evaluation during which participants give their impressions of the module, with a review of the degree to which the needs expressed on the first day of training were met.

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RADIATION PROTECTION

COURSE IN ENGLISH

**EXAMPLE
OF TRAINING
PROVIDED**

OUR EXPERTS ENHANCE YOUR SKILLS

Regulatory Control of the Safety of Spent Fuel & Radioactive Waste Management

Code: C01027

Session:
On demand

Registration deadline:
3 months prior to course

Duration: 5 days
Certificate of attendance
will be issued to participants
who attend the full course.

Price: Contact us!

Objectives

To provide awareness and a transfer of knowledge on the safety related to each step of management, including storage and final disposal.

Target Audience

Professionals employed by nuclear regulatory or nuclear safety technical expertise organizations, with a Master's degree or similar higher- education qualification and who are involved in radioactive-waste safety assessment activities.

Learning Outcomes

Participants will acquire:

- Knowledge of international waste-management standards, including national aspects.
- An overview of pre-disposal radwaste management steps and techniques, with regard to the design of the safe final destination.
- An understanding of the main safety issues involved in near-surface and geological disposal, with practical cases in mind.
- The keys of anticipating the development of knowledge and resources required to assess hazards posed by radwaste repositories.

**TO BE DESIGNED ACCORDING
TO YOUR EXPECTATIONS**

Prerequisites

Participants will require basic knowledge in the fields of nuclear safety and radioactive waste management.

Examination

Knowledge testing (multiple choice exam) will be performed on the full course content and successful candidates will be issued with a Knowledge Certificate.

Teaching methods

Lectures, discussions and practical sessions are included.

Working group exercises are supervised by experienced TSO experts.

A USB stick containing the course material will be provided.

Program

Spent fuel and radioactive waste management is a matter of concern in all nuclear countries. Some countries have already identified final disposal as a sustainable final solution in their national waste management strategy.

The training course covers the following topics:

- Regulatory framework in waste management, international standards, EU countries implementation.
- Pre-disposal requirements (basic steps, waste characterization, acceptance criteria, conditioning, nuclear waste packages).
- The storage of disused radioactive sources and spent fuel, along with the safety assessment aspects. Near-surface disposal (main safety issues, feedback from the French experience, comparison between interim storage and near storage, disposal facilities, natural external hazards).
- The main safety issues implicated in near-surface and geological disposal, with practical cases in mind.
- The main challenges faced in establishing constructive dialogue with the stakeholders involved in a waste disposal project.

At the end of the module, a roundtable discussion session addresses issues identified by participants.

It is followed by an evaluation during which participants give their impressions of the module, with a review of the degree to which the needs expressed on the first day of training were met.

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