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How to Ensure and Review the Safety of Nuclear Installations

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How to Ensure and Review the Safety of Nuclear Installations



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Objectives

- How may the hazards from the installation, and possible harm to people arise?
- What are the standards and criteria that are relevant to ensure safety?
- What are the processes that are needed to demonstrate safety through safety assessment?



Subject of this presentation: safety assessment

- Why safety assessment is important?
- What is safety assessment?
- Who is responsible for safety assessment?
- What is the purpose and scope of safety assessment?
- When is safety assessment performed?



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The Fundamental Safety Objective:

For operation of facilities or the conduct of activities that give rise to radiation risks the fundamental safety objective is to protect people and the environment from harmful effects of ionizing radiation.

IAEA Safety Standards for protecting people and the environment

Fundamental Safety Principles

Safety Fundamentals No. SF-1

To achieve this measures have to be taken:

- To control the radiation exposure of people and the release of radioactive material to the environment;
- To restrict the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation;
- To mitigate the consequences of such events if they were to occur.



SF-1 Safety Fundamentals



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Why safety assessment is important? What is safety assessment? What is the scope of safety assessment? When is safety assessment performed?



Relevant IAEA Safety Standards





Safety Assessment

- Is a systematic process that is carried out throughout the lifetime of the facility or activity to ensure that all the relevant safety requirements are met by the proposed or actual design
- Safety assessment includes, but is not limited to, the formal safety analysis





SAFETY ASSESSMENT AND SAFETY ANALYSIS



While the assessment of engineering aspects important to safety may not be explicitly addressed in the safety analysis, it constitutes a relevant part of the safety assessment.

Equipment qualification

- Ageing
- Man-machine interface

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Requirement 3: Responsibility for safety assessment

The responsibility for carrying out the safety assessment shall rest with the responsible legal person, i.e. the person or organization responsible for the facility or activity

The IAEA Fundamental Safety Principles state: The licensee retains the prime responsibility for safety throughout the lifetime of facilities and activities, and this responsibility cannot be delegated. Other groups, such as designers, manufacturers and constructors, employers, contractors, and consignors and carriers, also have legal, professional or functional responsibilities with regard to safety.

The regulatory authority: shall review and assess submissions on safety from the operators both prior to authorization and periodically during operation as required.

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- Why safety assessment is important?
- What is safety assessment?
- Who is responsible for safety assessment?

What is the purpose and the scope of safety assessment?

When is safety assessment performed?

Requirement 1: Graded approach

A graded approach shall be used in determining the scope and level of detail of the safety assessment carried out in a particular State for any particular facility or activity, consistent with the magnitude of the potential radiation risks arising from the facility or activity

Requirement 2: Scope of safety assessment

A safety assessment shall be carried out for all applications of technology that give rise to radiation risks — that is, for all types of facilities and activities

Examples of facilities: research reactors, nuclear power plants, fuel cycle facilities, irradiation facilities

Examples of activities: Production, use, import and export of radiation sources, transport of radioactive material, decommissioning and dismantling of facilities



Requirements 4: Purpose of the safety assessment

The primary purposes of the safety assessment shall be to determine whether an adequate level of safety has been achieved for a facility or activity and whether the basic safety objectives and safety criteria established by the designer, the operating organization and the regulatory body, in compliance with the requirements for radiation protection and safety as established in the International Basic Safety Standards for Protection against lonizing Radiation and for the Safety of Radiation Sources, have been fulfilled.

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Requirement 5: Preparation for the safety assessment

The first stage of carrying out the safety assessment shall be to ensure that the necessary resources, information, data, analytical tools as well as safety criteria are identified and are available.

Requirement 6: Assessment of the potential radiation risks

The possible radiation risks associated with the facility or activity shall be identified and assessed

Requirement 7: Assessment of safety functions

All safety functions associated with a facility or activity shall be specified and assessed



Fundamental safety functions

Control of reactivity

- Control rods
- Boron concentration

Cooling of the core

- Steam generators
- RHR
- Safety injection

Confinement of radioactive materials

- Fuel cladding
- Primary cooling system
- Containment









Requirement 8: Assessment of site characteristics

An assessment of the site characteristics relating to the safety of the facility or activity shall be carried out

Requirement 9: Assessment of the provisions for radiation protection

It shall be determined in the safety assessment for a facility or activity whether adequate measures are in place to protect people and the environment from harmful effects of ionizing radiation

Requirement 10: Assessment of engineering aspects

It shall be determined in the safety assessment whether a facility or activity uses, to the extent reasonable, structures, systems and components of robust and proven design



Requirement 11: Assessment of human factors

Human interactions with the facility or activity shall be addressed in the safety assessment and it shall be determined whether the procedures and safety measures that are provided for all normal operational activities, in particular those that are necessary for implementation of the operational limits and conditions, and those that are required in response to anticipated operational occurrences and accidents, ensure an adequate level of safety

Requirement 12: Assessment of safety over the lifetime of a facility or activity

The safety assessment shall cover all the stages in the lifetime of a facility or activity in which there are possible radiation risks



Requirements 13: Assessment of defence in depth

It shall be determined in the assessment of defence in depth whether adequate provisions have been made at each of the levels of defence in depth

Requirement 14: Scope of the safety analysis

The performance of a facility or activity in all operational states and, as necessary, in the post-operational phase shall be assessed in the safety analysis

Requirement 15: Deterministic and probabilistic approaches

Both deterministic and probabilistic approaches shall be included in the safety analysis



"All safety activities, whether organizational, behavioural or equipment related, are subject to layers of overlapping provisions, so that if a failure should occur it would be compensated for or corrected without causing harm to individuals or the public at large. This idea of multiple levels of protection is the central feature of defence in depth..."



Curtesy Mr. J Misak

International Atomic Energy Agency

INSAG-10



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Defence in depth (INSAG-10)

Levels	Objective	How?
Level 1	Prevention of abnormal operation and failures	Conservative design and high quality in construction and operation
Level 2	Control of abnormal operation and detection of failures	Control, limiting and protection systems and other surveillance features
Level 3	Control of accidents within the design basis	Engineered safety features and accident procedures
Level 4	Control of severe plant conditions including prevention of accident progression and mitigation of severe accidents	Complementary measures and accident management
Level 5	Mitigation of radiological consequences of significant releases of radioactive materials	Off-site emergency response



Requirement 16: Criteria for judging safety

Criteria for judging safety shall be defined for the safety analysis

Requirement 17: Uncertainty and sensitivity analysis

Uncertainty and sensitivity analysis shall be performed and taken into account in the results of the safety analysis and the conclusions drawn from it

Requirement 18: Use of computer codes

Any calculational methods and computer codes used in the safety analysis shall undergo verification and validation

Requirement 19: Use of operating experience data Data on operational safety performance shall be collected and assessed



Requirement 20: Documentation of the safety assessment

The results and findings of the safety assessment shall be documented

Requirement 21: Independent verification

The operating organization shall carry out an independent verification of the safety assessment before it is used by the operating organization or submitted to the regulatory body

Requirement 22: Management of the safety assessment

The processes by which the safety assessment is produced shall be planned, organized, applied, audited and reviewed. The safety assessment shall be periodically reviewed and updated

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Requirement 23: Use of the safety assessment

The results of the safety assessment shall be used to specify the programme for maintenance, surveillance and inspection; to specify the procedures to be put in place for all operational activities significant to safety and for responding to anticipated operational occurrences and accidents; to specify the necessary competences for the staff involved in the facility or activity and to make decisions in an integrated, risk informed approach

Requirement 24: Maintenance of the safety assessment

The safety assessment shall be periodically reviewed and updated

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... Thank you for your attention

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