L05.- Elements of the Safety Assessment (I)

International Atomic Energy Agency

OBJECTIVE

To identify the key elements in the development of the safety assessment:

- Assessment context. Safety criteria and end points.
- Description of the facility or activity

Introduction

- Safety assessment is the process of evaluating the safety of a facility or activity using radioactive sources, and identifying and quantifying its potential impact on human health and the environment;
- It has to be developed in a systematic manner using a graded approach, proportionate to the hazards, the complexity of facilities or activities;
- Depending upon the point in the lifecycle of the facility or activity, the safety assessment will not necessarily be performed at the same level of detail for all the stages.

Why to do a safety assessment?

- ✓ Means of assessing compliance with safety requirements (and therefore the application of fundamental safety principles)
- ✓ Determine the measures to be taken to ensure safety
- ✓ Develop safe operating envelope to protect workers, the public and the environment in compliance with regulatory requirements
- ✓ Identify safety significant considerations for facility structures, systems and components (SSCs) and waste for normal operations and accidents
- ✓ Reduce likelihood of accidents and mitigate consequences, if accident occurs

About the safety assessment

- ✓ It will be developed and documented by the organization responsible for operating the facility or conducting the activity
- ✓ The safety assessment and documentation process will be independently verified
- ✓ Both will be submitted to the regulatory body as part of the licensing or authorization process
- ✓ It includes both the quantification of the overall level of system performance and the analysis of the associated uncertainties

Safety Assessment

Different assessment approaches

The safety assessment should be performed using an appropriate selection of approaches that, when used in a complementary manner, can increase confidence in the safety of a facility or activity.

Different approaches that can be considered include: reasoned arguments, the use of simple conservative models, probabilistic and deterministic approaches, and the use of more complex and more realistic models

Conservative and realistic assessments

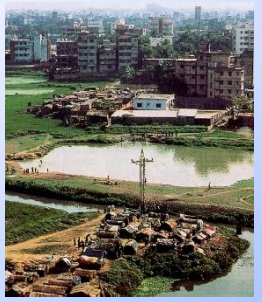
A conservative assessment, aims at simplicity by deliberately overestimating the likelihood and magnitude of exposures and/or underestimating the ability of the engineering and safety measures to provide protection.

A realistic assessment in general requires complex conceptual and mathematical models.

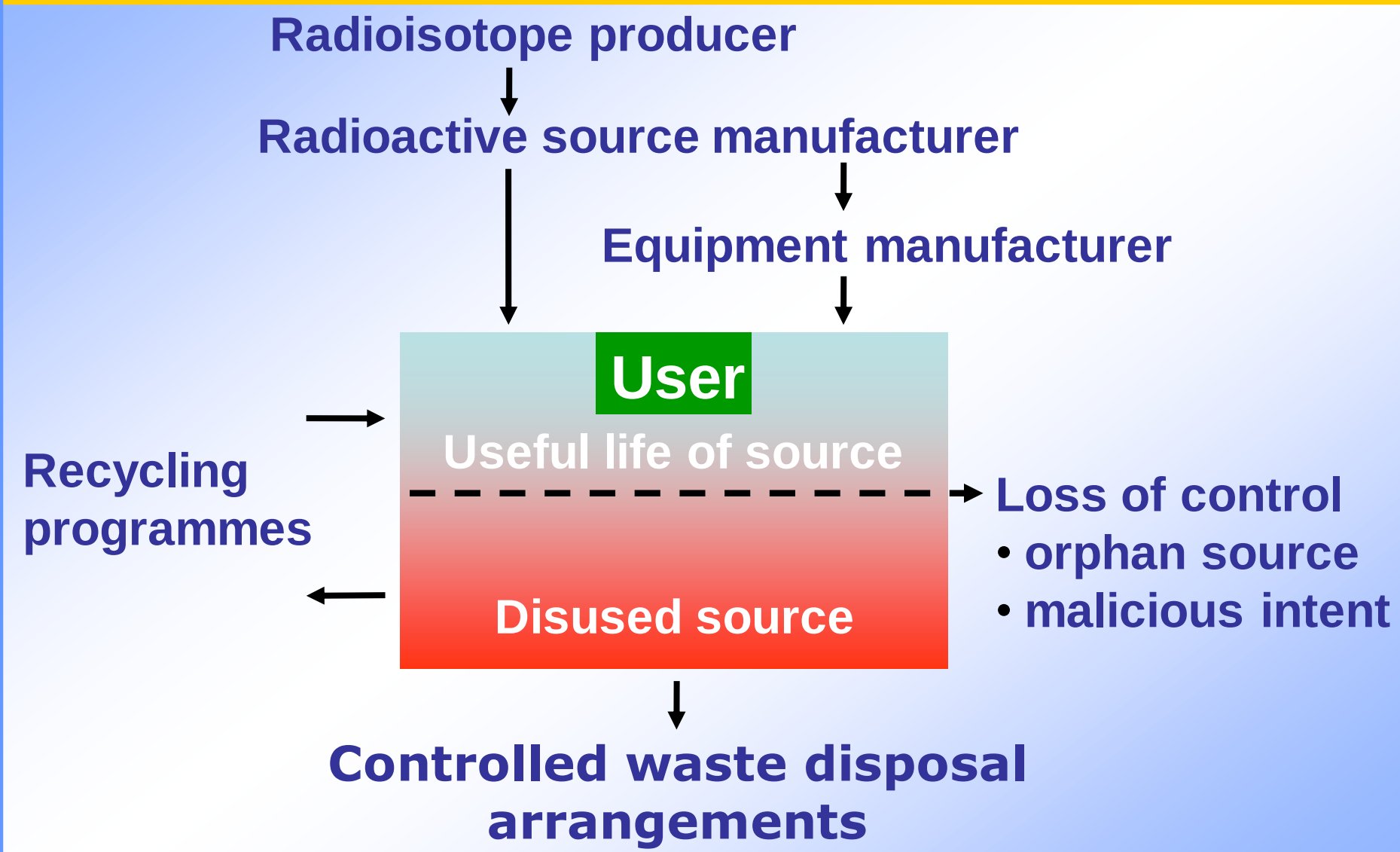
Safety Assessment

Safety Assessment has a role throughout the lifecycle of a facility, for example

- ✓ *Siting – identify suitable locations*
- ✓ *Design – identify necessary barriers and safety features*
- ✓ *Licensing – specify operating conditions*
- ✓ *Operations – procedures developed to avoid initiating events and for response in the event of accidents*
- ✓ *Closure – to assess safety in the case of complex activities*



Cradle to Grave



Main aspects of the Safety Assessment

- The occurrence of events having an impact on safety
- Time-dependent changes in structures, systems and components (SSC) important to safety
- The reaction or response of SSC important to safety, under credible scenarios
- Defence in depth
- The radiological and other consequences that result from operation of the facility or carrying out the activity or in the post closure period
- The quality and extent of the basic data on which the assessment is based
- The use of good engineering practices

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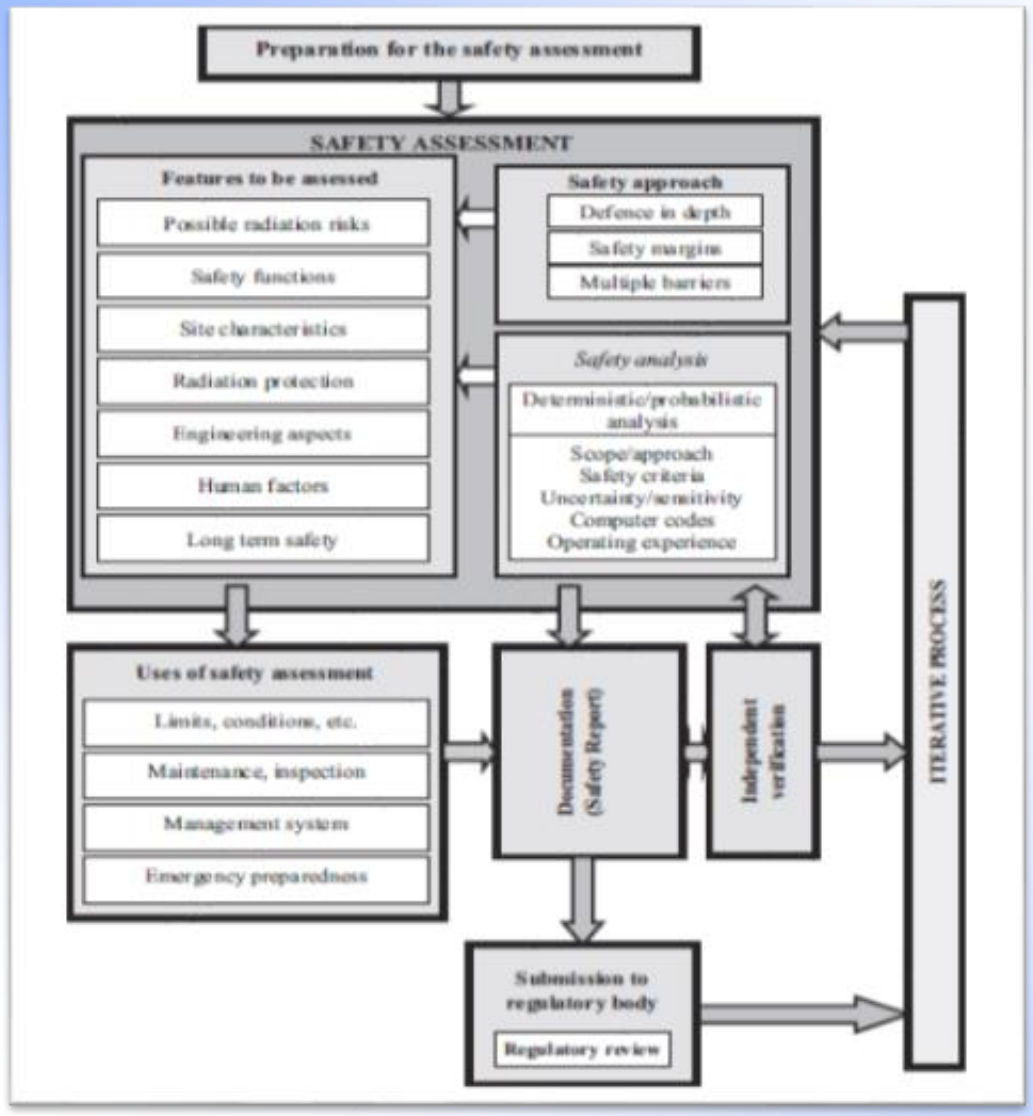
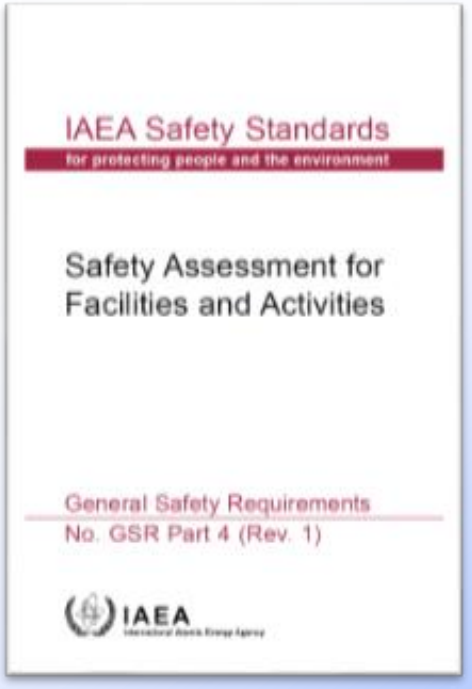
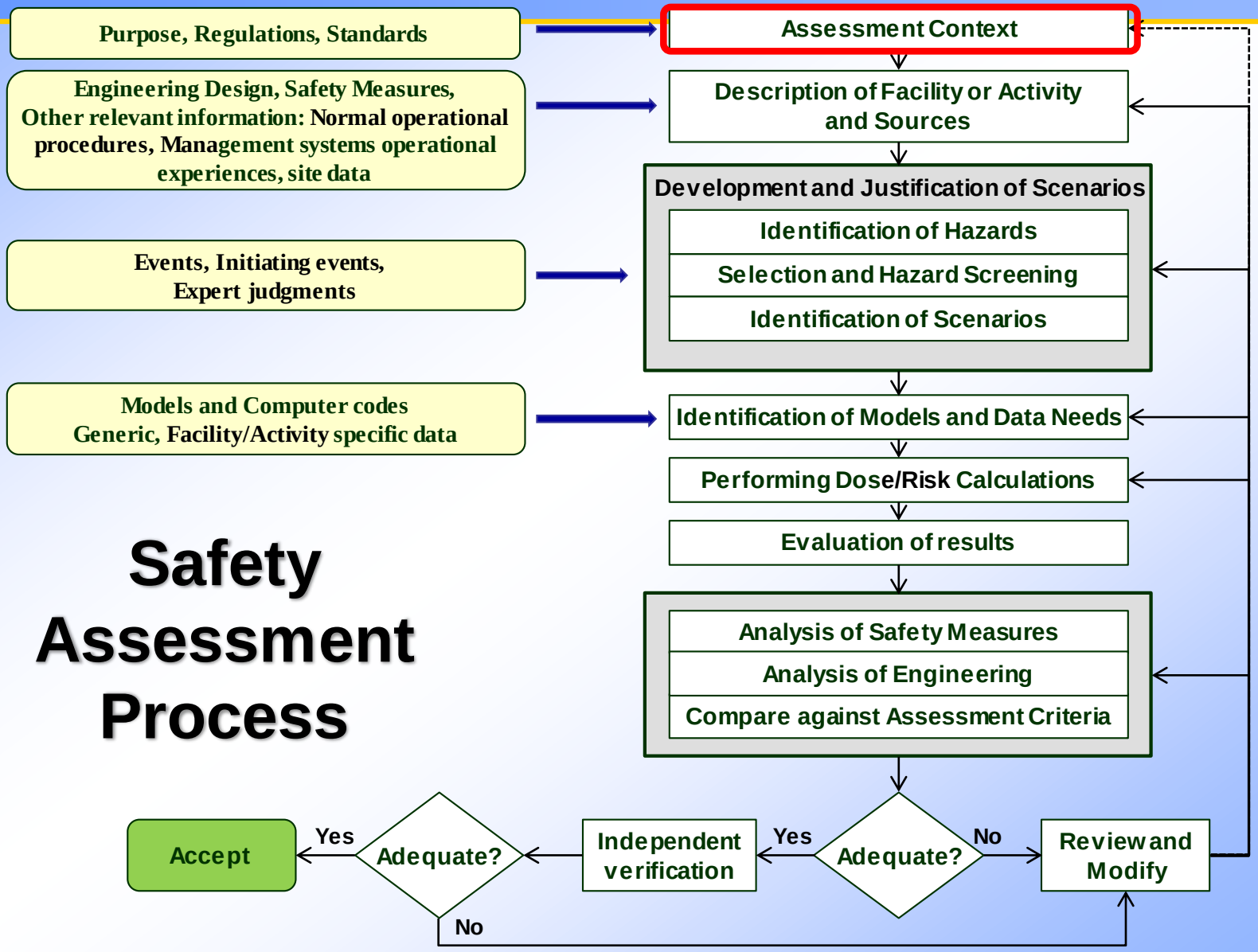
Components of the Safety Assessment



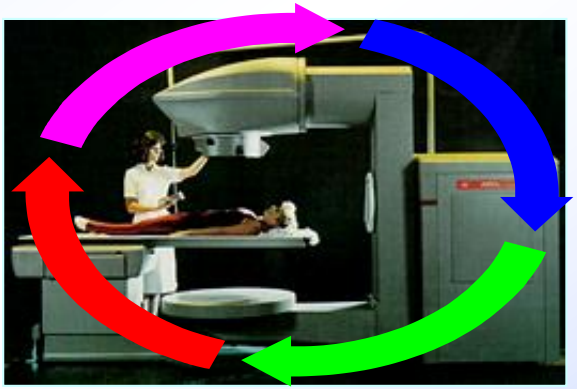


GSR Part 4

Safety Assessment Process



Safety Assessment Context



Assessment context:

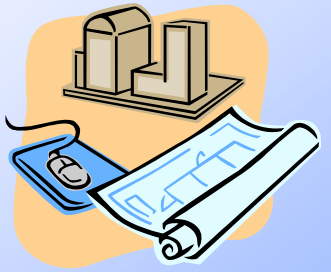
- ✓ *Assessment purpose and scope*
- ✓ *Regulatory framework*
- ✓ *Assessment end points*
- ✓ *Assessment philosophy and approaches*
  - Graded approach
  - Use of different assessment approaches
  - Probabilistic and deterministic approaches
  - Conservative and realistic assessments
- ✓ *Assessment time frame*
- ✓ *Target audience and involvement of interested parties*

Purpose and Scope

- **Assessment purpose**

  To evaluate the safety of a facility or activity, and to identify and quantify its potential impact on human health and the environment to reflect the stage in the life cycle of the facility or activity.

  Safety Assessment will be developed as the project progresses and will be used as a basis for decision making.



- **Assessment scope**

  The scope of the safety assessment should be clearly defined. It should identify whether the assessment considers an entire installation or a single facility or activity. It should also consider site boundaries and interfaces with neighbouring activities and facilities.

Assessment philosophy and approaches

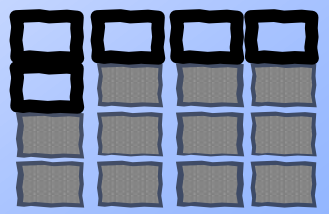
- **Graded approach**

  The scope, extent and level of detail of the SA to be carried out, has to ensure that these are commensurate with the hazards, the complexity of facilities or activities and the characteristics of the sources associated with a facility or activity.

  For example, safety assessment in the practice of industrial gammagraphy should be carried out with a greater level of detail, for the stages of transportation and storage of equipment, for the hazards that bring the loss (theft) of the radioactive sources.

  In the practice of industrial radiography with Rx equipment, safety assessment does not require a high level of detail for transportation. and storage stages, these equipment does not presuppose the direct danger of irradiation of persons, in case of theft.

- **Use of different assessment approaches**



Safety Assessment - Context

- **Regulatory framework**
  - Interaction with license holder
  - Frequency of updating SA
  - Definition of safety criteria
  - Establishment of safety margins

- **Assessment endpoints**

Assessment end points

- **Assessment end points can include:**

✓ **Radiation protection targets such as doses or risk**

  ✓ They usually are related to the relevant regulatory requirements and shall be consistent with assessment context;

✓ **Safety indicators such as**

  ✓ Dose rates,

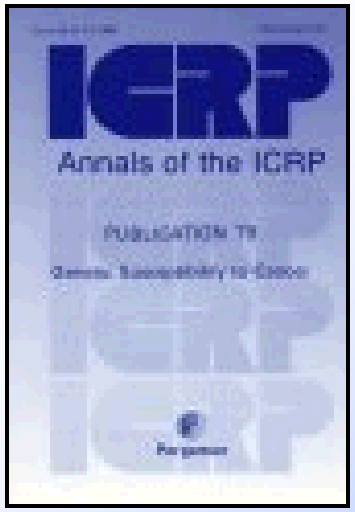
  ✓ Concentrations / releases of radionuclides,

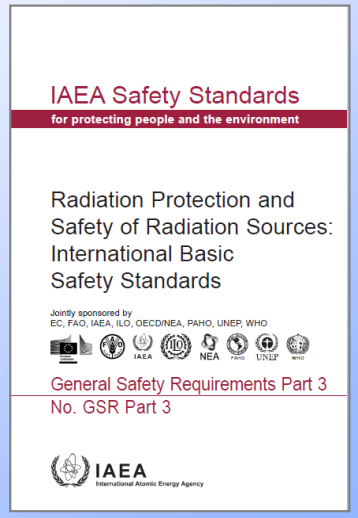
  ✓ Concentrations / releases of non-radiological contaminants.

✓ **Receptors (workers and members of the public, population, non-human species) associated with different end points should be identified and described.**

Assessment criteria

- ✓ **Basic radiation protection principles:**
  - justification
  - dose limitation
  - optimization
- ✓ **National regulatory criteria and BSS**
  - e.g., 1 mSv/y or up to 5 mSv over 5 years (public), 20 mSv/y averaged over 5 years (worker)
- ✓ **Further criteria (e.g. non-radiological effects, conventional safety)**





Assessment criteria (risk)

- Establishment of criteria as prerequisite.
- Example categories of criteria - acceptable risks:

Normal Operation	$< 10^{-2}\ y^{-1}$
Incidents and Accidents	$10^{-2}\ y^{-1} < x > 10^{-5}\ y^{-1}$
Serious Accidents	$< 10^{-5}\ y^{-1}$

Assessment criteria (doses)

Normal Operation	ALARA Defence-in-depth Conservative-bias input parameters	20 mSv/y for worker 1 mSv/y for public
Incidents and Accidents	ALARA Defence-in-depth Conservative-bias input parameters	500 mSv per event for worker 50 mSv per event for public
All Events, Including Serious Accidents	ALARA Defence-in-depth Best Estimate input parameters	Risk targets established

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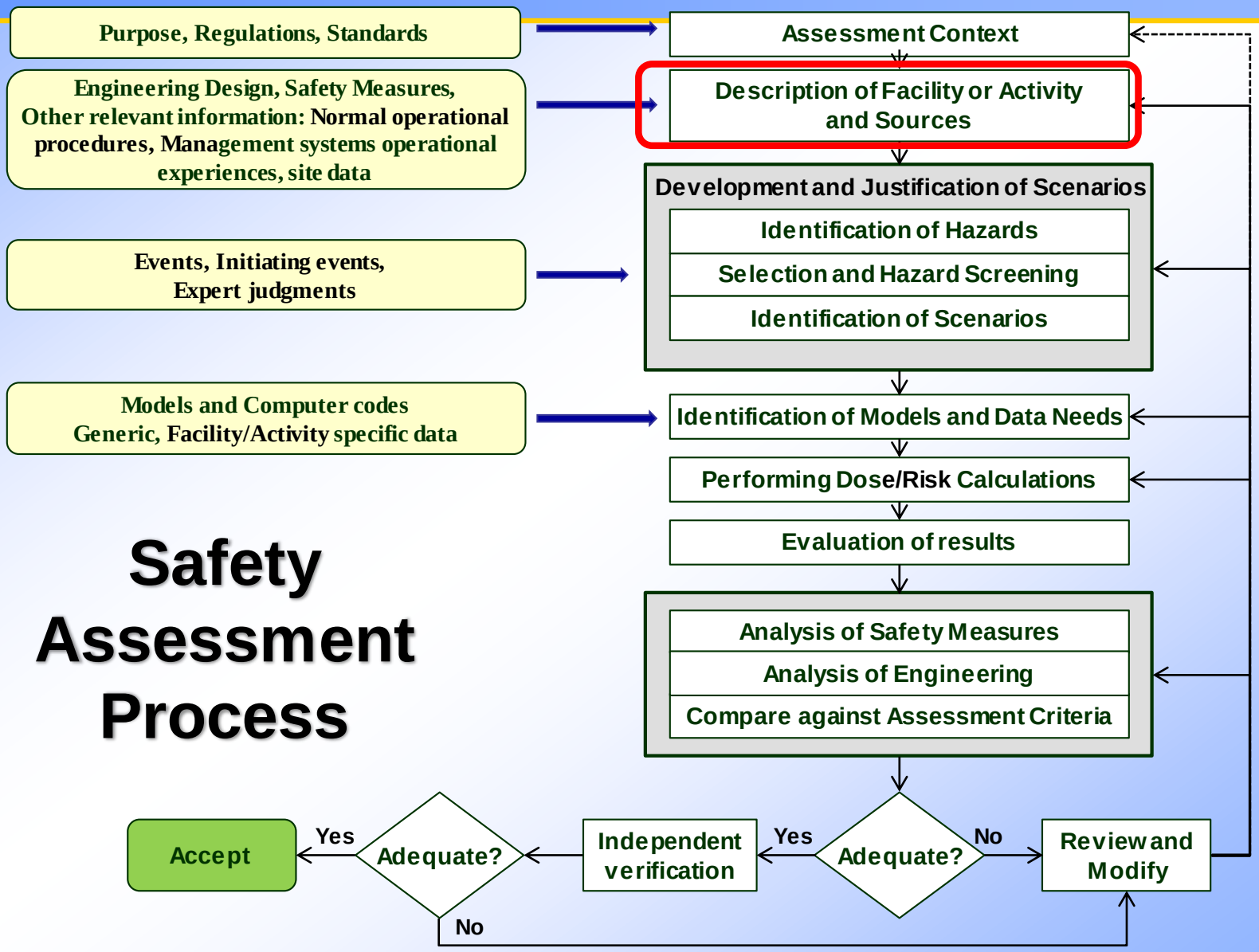
Safety Assessment Process



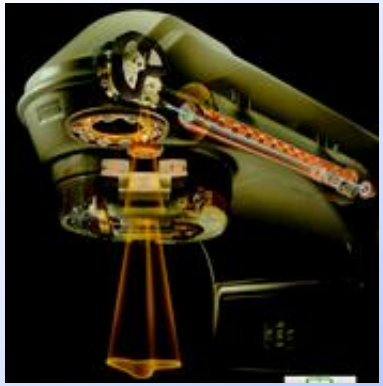
Safety Assessment Process

Description of facility or activity and sources

- Site conditions
- Facilities and activities
- Radioactive sources and waste
- Safety measures
- Engineering design
- Operational experience
- Management systems

Description of facility or activity and sources

- Needed, to a certain extent, for all elements of the safety assessment
- The quantitative analysis of impacts may pose additional data requirements. These are determined by the scenarios considered and models used
- Collection of additional data usually is an iterative process proceeding in parallel to the development and refinement of scenarios and models



Summary

This lecture assist you to understand:

- Why to do a safety assessment. Overall approach. Safety assessment objectives.
- To identify key elements in the development of the safety assessment:
  - ✓ Assessment context. Safety criteria and end points.
  - ✓ Description of the facility or activity and sources

Thank you!