PROBABILISTIC SAFETY ASSESSMENT

A Probabilistic Safety Assessment (*PSA*) complements the Deterministic Safety Analysis (*DSA*) of credible accident scenarios and enables an assessment against numerical risk criteria. It should, as far as practicable, provide a best estimate understanding of the design and operation of the plant. The effect of any uncertainty in underlying assumptions should be recognised and should be assessed within targeted sensitivity analyses, whereas the deterministic approach addresses uncertainty by ensuring that the analysis is conservative.

The scope and boundaries of the PSA need to be defined to suit the needs of the particular project. PSAs can be used for a number of purposes e.g. during the design process and also during the plant operation. Examples of when PSA can be used for each of these purposes include:

- During the design process:
    - Calculation of the overall risk to target populations for comparison with relevant probabilistic safety criteria.
    - Identification and resolution of plant vulnerabilities.
    - Identification of important system interdependencies and potential dependent failures.
    - Examination of risk benefits from different design options.
    - Identification of accident sequences and operator actions with a high sensitivity to human error.
    - Support to development of emergency operating procedures.
- During plant operation:
    - Support to maintenance planning e.g. prioritisation of maintenance on critical equipment.
    - Risk informed in-service inspection and testing.
    - Evaluation of operational events and safety issues.
    - Support to Periodic Review of Safety.
    - Support to emergency arrangement definition and planning.
    - Support during accidents and incidents.

The key features that should be considered when developing a PSA in support of the safety case are to:

- Provide a numerical evaluation and understanding of risks compared to identified safety criteria. This can be achieved by:
    - Identification of applicable safety criteria.
    - Creating a summarised description of the plant and its operation.
    - A Level 1 PSA that provides a probabilistic treatment of all credible faults, and fault sequences that could lead to the release of radioactive material.

  - A Level 2 PSA that covers the probabilistic treatment of events within the containment boundaries (e.g. primary circuit, reactor compartment, building structure) from the onset of plant damage to the release of radioactive material (such as core damage) to the environment.
  - A Level 3 PSA which covers the treatment of releases from the containment, the dispersion of radioactive materials and the evaluation of risk in terms of frequency and consequences to people and the environment.
- Provide an input into the design process through:
  - The identification of any Safety Functional Requirements (*SFRs*) that require substantiation such as reliability targets.
  - The identification of the system failures, component failures and operator errors that contribute most of the risks of the plant.
  - The identification of potential As Low As Reasonably Practicable (*ALARP*) improvements.
  - The assessment of the impact on risk of proposed design and operational changes.
- Provide an input into:
  - Operating and emergency instructions.
  - Accident management and contingency planning.

International Atomic Energy Agency (*IAEA*) guidance specific to PSA can be found in IAEA-TECDOC-1200 and IAEA-TECDOC-1511.

Additional Information & Guidance

- IAEA, Application of Probabilistic Safety Assessment (PSA) for Nuclear Power Plants, IAEA-TECDOC-1200, IAEA: Vienna, February 2001.
- IAEA-TECDOC-1804, Attributes of Full Scope Level 1 Probabilistic Safety Assessment (PSA) for Applications in Nuclear Power Plants. Vienna 2016