Probabilistic Safety Assessments for Nuclear Power Plants

A key responsibility of the Canadian Nuclear Safety Commission (CNSC) is to ensure that the risks arising from the operation of nuclear power plants (NPPs) are taken into account. One of the tools for analyzing risk is a probabilistic safety assessment (PSA).

What is a PSA?

A PSA is a comprehensive and structured analysis tool used to evaluate risk at an NPP and drive safety improvements. It examines the design and operation of an NPP to demonstrate the overall safety of the facility, and helps the CNSC and operators better understand each NPP. The CNSC requires two levels of assessment, Level 1 and Level 2 PSAs.

Did you know?

NPP licensees are required to implement and maintain a PSA program, which must be updated every five years or whenever an NPP undergoes major changes.

PSA levels

What does a Level 1 PSA examine?

A Level 1 PSA analyzes the sequences that could lead to severe reactor core damage, also known as a reactor meltdown. The focus is on the NPP's response to different internal events, which could be initiated by human error or system malfunctions, and to external hazards. Hazards considered may even include very unlikely ones, and are usually categorized as:

- **internal events,** which are caused by random component failures, human error, fires and floods originating from within the plant
- **external natural and human-induced hazards,** such as earthquakes, high winds, floods, freezing rain, meteorites, geomagnetic storms, solar flares and airplane crashes, and accidents at nearby industrial facilities

What does a Level 2 PSA examine?

Building on the results of the Level 1 PSA, a Level 2 PSA examines the containment response to the accident and assesses the likelihood and magnitude of potential radioactive releases to the environment.

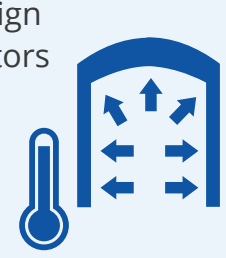
How are PSAs used?

Assist in risk-informed inspections

PSAs are used to provide insights into plant design and operation, including identifying dominant risk contributors. The CNSC uses the results to focus its inspection and oversight efforts, together with other types of assessments.

Complement deterministic analysis

PSAs complement a deterministic safety analysis (DSA) by providing information on the likelihood of accident scenarios (how likely they are), and by identifying design alternatives, dominant contributors to risk of core damage or large radioactive release.



A DSA is used to analyze the behaviour of an NPP's reactor following a hypothetical equipment failure, an internal or external event, or operator error. The purpose of a DSA is to ensure compliance with various criteria, including safety requirements governing the integrity of the NPP's barriers against the release of radioactive material.

Help identify safety improvements

PSAs identify safety improvements that have implications for the day-to-day operations of existing NPPs. They are used, for instance, to optimize testing and maintenance strategies to focus on the components most important to safety.

Did you know?

The CNSC is leading international efforts to produce a PSA methodology for integrating the risks specific to multi-unit NPP stations.