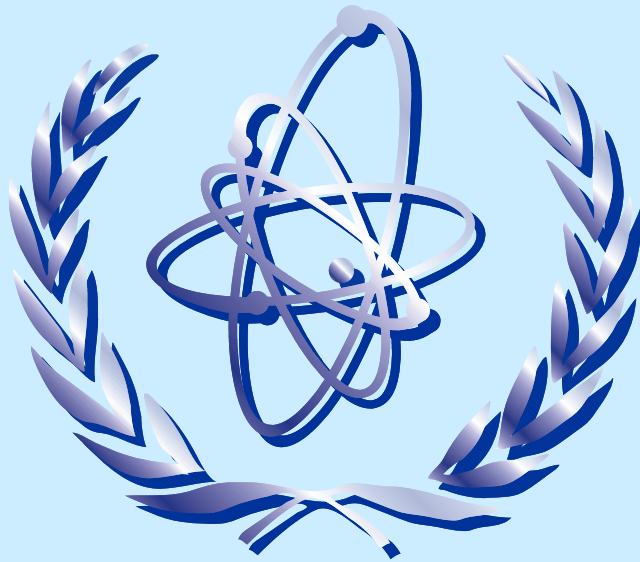


IAEA Training in level 1 PSA and PSA applications

Introduction to risk approach in nuclear safety



The role of PSA in safety management



Introduction

- **The lecture is intended to introduce and explain some important philosophical aspects of the safety management related to Probabilistic Safety Assessment:**
 - **the importance of the complementary application of the deterministic and probabilistic approaches,**
 - **the role of the PSA in safety management**



Content

- **Defence in Depth principle**
 - **The Role of the Barriers**
 - **How does PSA Represent the Barriers?**
- **The Safety Management and the Nuclear Power Plant**
- **The Probabilistic and Deterministic Approaches**
 - **How do they complement each other?**
- **The PSA Applications and the Safety Management**

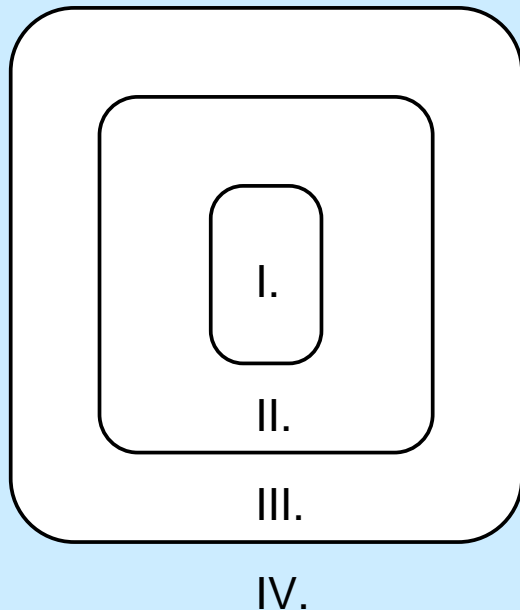


Overview

- The PSA has an important role to complement the deterministic approach to safety design, operation and regulation of nuclear power plants with the risk approach.
 - It is provided by the diversity of the approaches:
 - ◆ Success oriented design with some risk aspects
 - ◆ Failure oriented approach of PSA: answers to questions: What can go wrong?, How likely is it?



The Defence in Depth Principle



- Classical interpretation of the barriers
 - *Physical barriers*
- Abstract interpretation of the barriers
 - *Technological systems*
 - ◆ systems of normal operation
 - ◆ safety systems
 - ◆ accident localisation systems
 - *Administrative barriers*
 - ◆ operating instructions, Tech.Spec.
 - ◆ EOP's
 - ◆ Accident Management Procedures



The Defence in Depth Principle (cont'd)

Properties of the barriers:

- **What is the barrier able to cope with? (height)**

The design basis

- **Is it sure any time? (integrity)**

Reliability

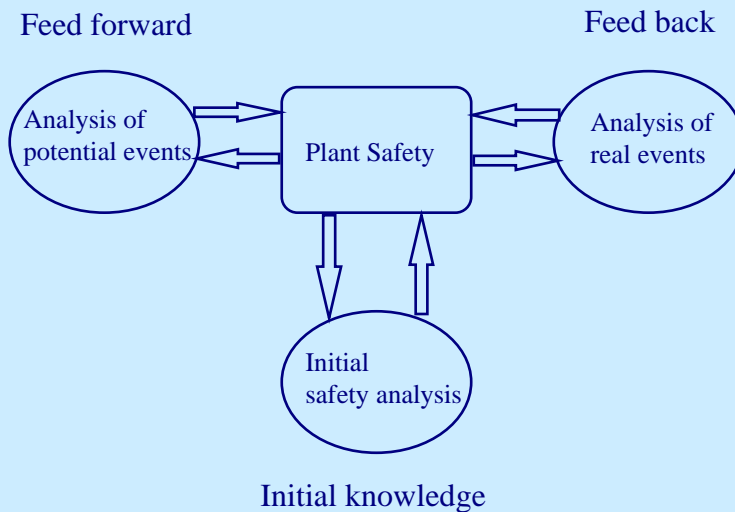
Low frequency of attacks, being able to cope with wide spectrum of events and high barrier reliability give together safety.

⇒ use PSA to evaluate the effectiveness of the protection



The role of PSA in safety management

The Safety Management and the Nuclear Power Plant Safety



after J. Villadóniga, Argonne, 1995

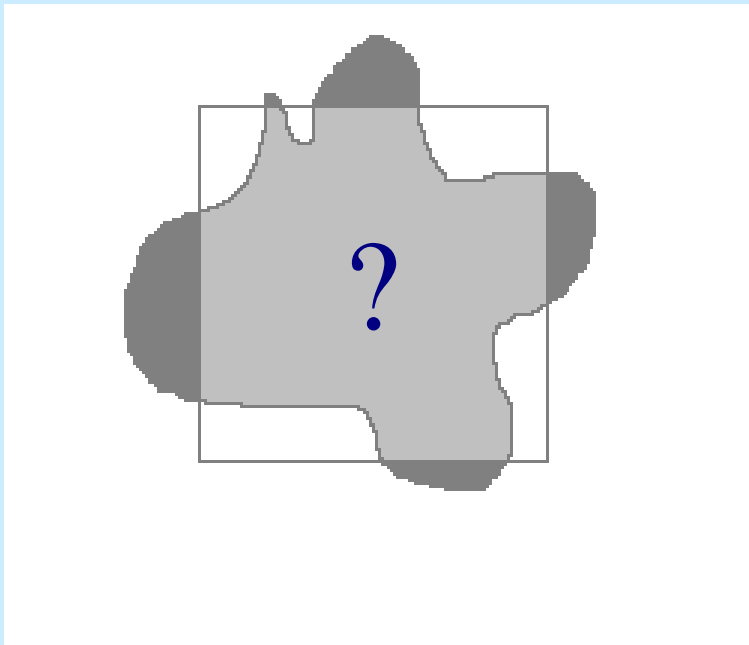
Three group of mechanisms and tools to provide high level of safety:

- initial knowledge
 - ◆ DBA
- feedforward
 - ◆ PSA
 - ◆ experiments
- feedback
 - ◆ event investigation
 - ◆ internal and external experience feedback



The role of PSA in safety management

Probabilistic and Deterministic Approaches



The probabilistic and the deterministic approaches have the same objective: to find the safe region in the space of the possible plant states.

Which is better?

The **complementary use** of both is the best.



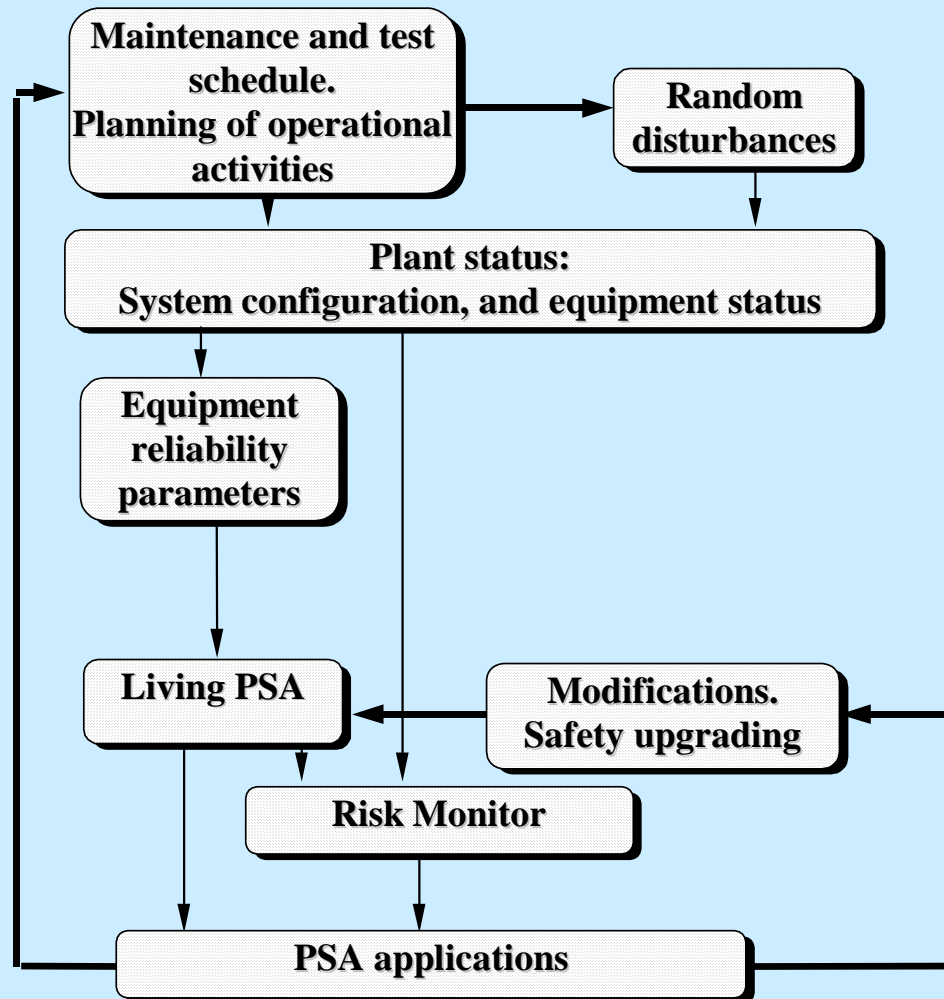
The role of PSA in safety management

Probabilistic and Deterministic Approaches (cont'd)

- Which approach is better, the probabilistic, or the deterministic?
- Both approaches look for the region in the possible plant states, where the operation of the nuclear power plant is thought to be safe enough
- The objective of both approaches is the same. Thus, it is expected that both approaches find the same region
- However, being different approaches, there are regions covered by one and not covered by the other one
- Which, does not mean, that one is more strict or better, than the other
- From the point of view of the safety the right answer is to use both approaches in order to optimize the region found safe enough by both methods i.e. the region with low risk fulfilling the deterministic requirements
- That should be the principle of a modern risk based safety regulation



How does PSA fit into plant safety?





How does PSA fit into plant safety?

- **The Living PSA can be used for direct applications. Additionally the LPSA can be used to develop a model for use in real time on-line (risk monitor)**
- **The results of some LPSA applications can significantly contribute to support the plant maintenance and test scheduling activities**
- **NPP maintenance affects the random equipment behaviour, and therefore, the use of LPSA to support maintenance planning has an impact on the random disturbances**
- **Other LPSA applications are focused towards supporting plant modifications and safety upgrading. These plant modifications have a feedback effect in the whole system.**
- **Thus, in this way a closed control system is defined, which, providing the whole system is used in an efficient manner, will enhance the safety management of the plant**



Summary

- **The PSA and the PSA applications are very useful tools to maintain high safety, if the user understands the basic safety philosophy, and regards the nuclear power plant safety consisting of many components, not underestimating anyone of them.**
- **The risk approach complements the deterministic approach to safety and they together assure safe operation for the whole lifetime of the nuclear power plants.**