



## Promoting safety and reliability of nuclear plants

# Services for probabilistic risk assessment – analysis and tool support

Probabilistic risk assessment (PRA) is a systematic and comprehensive methodology to assess the risks of complex systems. In the nuclear domain, PRA is used to continuously find ways to improve safety, justify plant modifications, optimise annual maintenance revisions and fulfil regulations.

### VTT's services for PRA in the nuclear field

VTT supports the safe and efficient use of nuclear power, including nuclear waste management, by developing, validating and applying experimental and theoretical methods and tools. VTT has wide capabilities to support nuclear power plant (NPP) PRA. VTT's PRA services include Level 1, 2, and 3 analyses, human reliability analyses, PRA for non-reactor nuclear facilities, risk-informed applications, PRA reviews, PRA training and dynamic reliability analysis.

VTT also provides a number of PRA supporting deterministic analyses such as severe accident analyses, thermo-hydraulic analyses and fire simulations.

### FinPSA support for PRA needs



Feasibility study

Siting

**DESIGN**

Manufacturing

Construction and installation

**COMMISSIONING**

**OPERATION AND MAINTENANCE**

**PLANT MODIFICATIONS**

Decommissioning

Closure

- ✓ Risk Informed decision making
- ✓ Maintain PRA documentation
- ✓ PRA reviews
- ✓ Level 2 modelling and analysis

- ✓ Risk informed comparison of design alternatives
- ✓ Rapid and effective PRA model building

- ✓ Risk analysis of different plant deviation situations
- ✓ Risk informed planning of outages
- ✓ Easy modification of PRA model
- ✓ Tracking PRA model modifications

### FinPSA tool for professional living PRA

- Efficient computation algorithms and script files
- Versatile numerical analyses; including risk importance measures, sensitivity calculations and uncertainty computations
- Intuitive user interface and model building functions
- Modelling features such as modelling hazards and common cause failures, and digital I&C systems are used
- Results are easily traceable to their origins
- Extensive data exchange and logging functions
- Integrated deterministic and probabilistic safety assessment methodology

## The VTT offering

### PRA

- Modelling and analysis
- Internal events, hazards, external events
- Power operating mode, low power and shutdown
- Human reliability analysis
- Digital I&C analysis
- Training
- PRA method and tool development
- Non-reactor nuclear facilities

### Risk informed applications support

- Allowed outage times
- In-service-inspection
- Safety classification
- Technical specifications

### PRA review

- Review against various national and international requirements and standards
- Development of review guides

### Supporting analyses for PRA

- Wide range of deterministic analyses
- Thermo-hydraulic analyses
- Fire simulations
- Model checking of digital I&C systems

### FinPSA software

- Professional PRA tool for Level 1 and 2
- Training
- Model transfer from other tools
- Integration to external applications

## Reference projects

### Level 1 PRA

We have conducted and participated in several PRA projects. These include, e.g. development of a software reliability analysis method for nuclear power plant's PRA and performing a fire PRA for a NPP.

### PRA for non-reactor nuclear facilities

We have carried out PRA for the final encapsulation and repository facility for spent nuclear fuel, as well as fire and flood PRA for spent fuel pool storage.

### PRA review

We have reviewed human reliability analyses that have been part of NPP PRA against regulations and international guidelines.

### Training

We have given general PRA lectures and special training on FinPSA.

### PRA method development and applications

We develop FinPSA software and PRA methods including human reliability analysis, multi-unit support and Level 3 development.

### FinPSA users

FinPSA is used by utilities and regulators.

Reference users:

Teollisuuden Voima Oyj

STUK - Radiation and Nuclear Safety Authority, Finland

Swiss Federal Nuclear Safety Inspectorate ENSI

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