# OSART Good Practices
## TECHNICAL SUPPORT
### Use of PSA

## Loviisa, Finland

Mission Date; 5-21 Mar., 2007

Fortum Nuclear Services (FNS) has developed a high quality and comprehensive a Probabilistic Safety Analysis (PSA) with state-of-the-art methods and tools. The model is used by the plant in several areas.

The team noticed some outstanding features in different aspects of the PSA, including:

- Human reliability assessment: usage of an improved state-of-art Human Reliability assessment (HRA) method which allows to include dependencies, procedures and recovery factors in more details; comprehensive collection of site-specific data during simulator training;
- Shutdown modes: very detailed division and modelling of the different outage phases including multiple time windows with state-specific models, initiating events and data;
- Severe weather and industrial hazard PSA: detailed assessment of oil spill impact frequencies from the tanker in the Baltic sea has been performed taking into account hydro-meteorological conditions, oil properties and leakage sizes as well as recent oil spill statistics.
-

The PSA is continuously and extensively developed and being used by the plant in different areas in order to improve operational safety and initial design. Examples of such improvements are:

- Fire PSA
    - Fire protection covers on critical cables,
    - Extension of sprinkler system
    - Covering of high pressure hydraulic oil pipelines
    - New cables routings
    - Support for definition of Fire training programme
- Dilution risks
    - Change in some outage procedures
- Drops of heavy loads
    - New lifting routes
    - Improved lifting procedures
- Improvements of EOPs and Severe Accident Management Guidelines
- Numerous improvements of initial plant design :
    - Frazil ice measures
    - Primary Coolant Pump sealing water modifications
    - Primary to secondary leakage measurements
- Optimisation of surveillance programme for emergency Diesel generators (EDG), based on comprehensive analyze of EDG fault history and diagnostic for Diesel damages.

## Borssele, Netherlands

Mission Date; 23 FJan. – 9 Feb., 2023

The plant has developed an easily applicable ‘Mechanism Matrix’ to visualize ageing management activities in order to ensure effective ageing management of all structures, systems and components (SSCs) in scope of its plant-level ageing management programme.

The purpose of the ‘Mechanism Matrix’ is to verify comprehensiveness of ageing management activities, improve the overview of coordination requirements and traceability of relevant ageing management activities. The plant has introduced the visualization of these aspects in matrices and included them in living ageing management review documents.

**Description**

Visualization of ageing management activities consists of representing Ageing Management Programmes (AMPs) for all relevant ageing mechanisms at every location in the SSC under consideration.

| | Thermal Ageing (CAM 3.1) | Wear/fretting (CAM 3.3) | Relaxation (CAM 3.4.2) | Thermal Fatigue (incl. EAF) (CAM 3.5) | Boric Acid Corrosion (BAC) (CAM 3.6.1.3) | Pitting (CAM 3.6.2.1) | Crevice corrosion (CAM 3.6.3.1) | IGSCC (CAM 3.7.1.1) | PWSCC (CAM 3.7.1) | Underclad cracking (CAM 3.8) |
|---|---|---|---|---|---|---|---|---|---|---|
| Outside area steam generator | | | | | 461 | | | | | |
| Primary chambers and nozzles | | | | 450 | | 403 | | | | TLAA |
| Division sheet | | | | 450 | | 403 | | | 471 | |
| Tube bundle | | 481 | | | | 481 | 481 | | | |
| Tube sheet | | | | 450 | | | 481 | | 471 | |
| Rolled plugs | | 481 | | | | | 481 | | | |
| Explosion welded plugs | | | | | | 403 | 481 | | | |
| Welded plugs | | | | | | | | | 471, 481 | |
| Manhole covers (gasket) | 401 | | | | | | | | | |
| Nozzle dam bolts | | | | | | 403 | | | | |
| Dewatering lines | | | | | | 403 | | 470 | | |
| Closure bolting | | | 440 | | 461 | 440 | | | | |

Visualization of AMPs for the primary side of the steam generators

In the above example, the ageing management review identified relevant ageing mechanisms to be managed for the primary side of the steam generators. Relevant AMPs were identified for each of these mechanisms.

In this example, the following AMPs were identified:

- AMP 401 Maintenance (Preventive replacement of gaskets)
- AMP 403 AMP Water chemistry
- AMP 440 AMP for bolting used in pressure retaining components
- AMP 450 AMP for monitoring of thermal fatigue
- AMP 461 AMP for Boric Acid Corrosion
- AMP 470 AMP for Stress Corrosion Cracking
- AMP 471 AMP for Primary Water Stress Corrosion Cracking (PWSCC)
- AMP 481 AMP for steam generator tube bundle

Underclad cracks in the primary chambers and nozzles are adequately addressed by means of a Time Limited Ageing Analysis (TLAA).

Individual AMPs clearly state what degradation mechanism they are intended to manage. Where different mechanisms require similar ageing management activities, they may be grouped into collective AMPs, as in this case for the steam generator tube bundle.
Visualizing AMPs by means of the mechanism matrix is applicable for both individual structures or components and for commodity groups.

**Benefits**
The use of the 'Mechanism Matrix' enables the plant to easily verify that any degradation mechanism is adequately managed at all relevant locations in the plant, thus contributing to the safe operation during Long Term Operation. The overview of the mechanism matrix provides the following benefits:

- Verification that all relevant AMPs have been identified, ensuring efficient use of available resources for the maintenance of the plant-level ageing management programme;
- Verification that any multidisciplinary ageing management activities are adequately captured in AMPs, coordinated by ageing management working groups from across the organization;
- Possibility of benchmarking against International Generic Ageing Lessons Learned AMPs, ensuring that proven practices in the nuclear industry are considered in the plant's ageing management programme;
- Efficient verification of the application of lessons learned from operating experience or research & development results and introducing them into the plant's own AMPs.

The mechanism matrix contributed to significant improvement in the coordination and traceability of the plant's ageing management activities since implementation of the plant-level ageing management programme.