Combined Use of Information from Ageing Management and Paks Plant Specific PSA Models to Support Task 3 in APSA Network

A. Bareith
VEIKI Institute for Electric Power Research

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Contents

- Scope of PSA for NPP Paks
- SSCs represented in PSA models
- Approach to selection of components to be considered in ageing PSA

Scope of PSA for NPP Paks - 1/2

- Level 1
  - Full power
    - Internal events and internal hazards: unit specific
    - External hazards (seismic): reference analysis
  - Low power and shutdown
    - Internal events: reference analysis generalised to all units
    - Internal and external hazards: reference analyses
- Level 2
    - All level 1 but internal and external hazards at low power and shutdown

Scope of PSA for NPP Paks - 2/2

			Unit 1	Unit 2	Unit 3	Unit 3
Reactor	Full Power	Internal Events	+	+	+	+
		Internal Fires	+	+	+	+
		Internal Flooding	+	+	+	+
		Seismic	-	-	+	-
		Other External Events	-	-	-	-
	Low Power and Shutdown	Internal Events	+	+	+	+
		Internal Fires	-	+	-	-
		Internal Flooding	-	+	-	-
		Seismic	-	-	+	-
		Other External Events	-	-	-	-
Spent fuel pool	All Modes	Internal Events	+	+	+	+
		Internal Fires	+	+	+	+
		Internal Flooding	+	+	+	+
		Seismic	-	-	-	-
		Other External Events	-	-	-	-

SSCs Represented in PSA Models - 1/3

- Generally
  - Subset of SCCs that are subject to lifetime / ageing management
- Specifically
  - All plant systems considered important to prevent a severe accident or mitigate its consequences
  - Reasonably detailed breakdown of systems into components
  - Structures represented only in seismic PSA models explicitly

SSCs Represented in PSA Models - 2/3

- Active and passive components are both modelled as required by system success criteria
  - Component definitions and boundaries often differ from that of ageing management programme.
- Ageing related information not included in component / basic event attributes and descriptions

SSCs Represented in PSA Models - 3/3

- Typical mechanical components
  - pumps (incl. driver)
  - valves of various types
  - heat exchangers
  - piping
  - tanks
  - mechanical filters
  - ...
- Typical electrical and I&C components
  - bus-bars
  - accumulators
  - diesel generators
  - transformers
  - circuit breakers
  - cables
  - cable terminals
  - relays
  - transmitters
  - switches
  - ...

Selection of Components for Ageing PSA - 1/5

- Goal
  - Identification of SSCs and groups of SSCs as candidates for ageing PSA modelling
  - Extension of PSA models with information useful for potential future ageing PSA applications
- Important conditions
  - Lifetime / ageing management activities are aimed at preventing decline in SSC reliability!
  - Past efforts on indicating and forecasting changes in safety performance did not lead to conclusive results based on operational experience.

Selection of Components for Ageing PSA - 2/5

- Approach
  - Collaboration of PSA, ageing management and plant experts
- Main steps

1 Expert panel to
   - Review scope and level of detail necessary for a useful selection of SSCs
   - Define ageing related information to be considered in the selection process
     - SSCs and SSC groups based on age dependent commodity group attributes
     - Ageing mechanisms for individual SSCs and commodity groups
     - Operating conditions
     - Environmental conditions (for normal operation and for plant transients), etc.

Selection of Components for Ageing PSA - 3/5

- Main steps (cont.)
  2 PSA modelling using input from step 1
    - Scope
    - Failure mode decomposition
    - Commodity group attributes
    - Attributes on ageing mechanisms
    - Attributes on operating and environmental conditions
  3 Risk importance calculations
    - For both individual components and pre-defined component groups
    - Two types of importance measures as a minimum (e.g. FV importance and RAW)
    - Sensitivity analysis: under consideration
    - Risk ranking based on usual criteria

Selection of Components for Ageing PSA - 4/5

- Main steps (cont.)
  4 Expert panel to evaluate results of risk ranking
    - Comparisons with ageing forecast
    - Representation of components and component groups considered most susceptible to ageing effects
    - Representation of key degradation mechanisms
    - Recommendations for analysis refinement, if necessary

Selection of Components for Ageing PSA - 5/5

- Results expected
  - Definition of SSCs and groups of SSCs that need to be looked at in ageing PSA
  - An improved PSA model prepared for incorporating ageing into risk quantification, if seen feasible
- Quantification of ageing effects on risk is not seen helpful at present
  - Ageing reliability models need support from plant evidence to decide on their acceptance or rejection.
  - Past data records are not fully applicable due to deficiencies in level of detail.