Nordic nuclear power follow-up in Finland

NKS Seminar on the Fukushima Accident and Perspectives for Nordic Reactor Safety and Emergency Preparedness

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Tomi Routamo

Senior Inspector, Reactor and Safety Systems

Outline

Actions taken in Finland following the Fukushima accident

- National safety review
- European Stress Tests

Safety enhancements

- Loviisa 1&2
- Olkiluoto 1&2
- Olkiluoto 3

Updates to legislation and regulatory guides

Actions taken in Finland following the Fukushima accident – Two parallel activities

National safety review of the operating plants, the plant under construction, new plants, sites

- The formal process for plant safety improvements
- Started a week after the accident
- Ended at the end of 2011 as a separate activity
- Plant enhancements continue as normal safety improvement activities

European Stress Tests

- Started at the beginning of June 2011
- Peer review in 2012

Results of the national review were utilised
in the National Stress Test Report

Legal basis

Finnish Nuclear Energy Act (990/1987)

- **Section 7 a – *Guiding principles***

  The safety of nuclear energy use shall be maintained at as high a level as practically possible. For the further development of safety, measures shall be implemented that can be considered justified considering operating experience and safety research and advances in science and technology.

Government Decree on the Safety of Nuclear Power Plants (733/2008)

- **Section 24, *Operational experience feedback and safety research***

  Nuclear power plant operational experience feedback shall be collected and safety research results monitored, and both assessed for the purpose of enhancing safety. Safety-significant operational events shall be investigated for the purpose of identifying the root causes as well as defining and implementing the corrective measures. Improvements in technical safety, resulting from safety research, shall be taken into account to the extent justified on the basis of the principles laid down in section 7 a of the Nuclear Energy Act.

National Safety Review – Schedule

Date	Action
2011 Mar 17	Ministry of Employment and Economy sent a request to STUK concerning safety of NPPs and their preparedness for impacts of extreme natural phenomena and availability of electricity
2011 Mar 22	STUK sent a request for assessment on the subject to the licensees
2011 Apr 15	STUK received replies from the licensees
2011 May 16	STUK sent the ministry a report on how the Finnish nuclear power plants are prepared for exceptional natural phenomena (http://www.stuk.fi/stuk/tiedotteet/en_GB/news_680)
2011 Aug 4	Based on the answers received in April, STUK sent to Fortum (utility operating two VVERs at Loviisa) a more detailed request for actions
2011 Oct 24	Based on the answers received in April, STUK sent to TVO (utility operating two BWRs and constructing an EPR at Olkiluoto) a more detailed request for actions
2011 Dec 15	Answers from the licensees how safety could be further enhanced
2012 Jul 19	STUK's decisions based on the licensees' proposals (EU Stress Test peer review recommendations taken into account)

National safety review (May 2011)

No such hazards or deficiencies that would require immediate actions were found.

Detailed requests for plant safety assessments were sent to licensees.

The investigations are conducted according to the requirements given in the Finnish Regulatory Guides (YVL Guides)

The utilities were asked to evaluate plant behaviour in accidents concerning multiple units

All important external events should be evaluated
(not only earthquake & flooding)

European Stress Tests – Schedule

Date	Action
2011 Mar 15	Meeting of the Council of The European Union → Initiative to carry out Stress Tests for European Nuclear Power Plants
2011 Mar 24-25	Meeting of the European Council → Decision to initiate the Stress Tests
2011 May 24	Energy Commissioner Oettinger's request to national authorities to start the Stress Tests
2011 Jun 1	STUK's letters to licensees to start the Stress Tests in Finland
2011 Sep 15	National Progress Report
2011 Oct 31	Licensees' final reports to STUK
2011 Dec 30	National Report prepared by STUK submitted to EC (http://www.stuk.fi/ydinturvallisuus/fi_FI/fukushima-selvitykset/_files/86852554565484810/default/EU-StressTests-National_Report-Finland30122011.pdf)
2012 Jan-Apr	International peer review of National Reports
2012 Apr 26	Peer review results published by ENSREG
2012 Sep 9-14	Additional site visits (FR, UK, SE, DE, ES, CZ)
2012 Dec 21	National Action Plan prepared by STUK submitted to ENSREG (http://www.stuk.fi/ydinturvallisuus/fi_FI/fukushima-selvitykset/_files/88872978390137053/default/European_Stress_Test_-_National_Action_Plan_-_Finland.pdf)

Peer review of National Reports

2012 Jan 1–20

Desktop studies of the National Reports and submitting additional questions

Preparing for the Topical Review

2012 Feb 6–17

Topical Review

~25 persons in each team (mainly national authorities)

1 – External events

2 – Loss of safety functions

3 – Severe accident management

Drafting the country review reports

- Country review team 1
- Country review team 2
- Country review team 3
- Country review team 4
- Country review team 5
- Country review team 6

2012 Mar 12–30

Country Visits (17)

8 persons in each team (from the topical review teams)

2012 Apr 26

Publication of the results

European Stress Tests Peer review results

European level recommendations

- WENRA to develop guidance on natural hazards assessments, as well as corresponding guidance on the assessment of margins beyond the design basis and cliff-edge effects.
- ENSREG to underline the importance of periodic safety review. In particular, highlight the necessity to re-evaluate natural hazards and relevant plant provisions regularly. → Task given to WENRA/RHWG
- Urgent implementation of the recognised measures to protect containment integrity.
- Necessary implementation of measures allowing prevention of accidents and limitation of their consequences in case of extreme natural hazards.

→ No significant changes to the planned updates of the national guidance in Finland

Peer review results

Findings in country peer review report of Finland:

- The initiated actions were considered as good improvements.
- Some additional analyses were recommended on safety significant systems.
- Accident management in multi-unit accidents has to be ensured with proper emergency preparedness arrangements.
- Availability of equipment in accidents of long duration should be investigated.
- There are good severe accident management arrangements in Finnish plants (both existing units and Olkiluoto 3 under construction)

The recommendations from the peer review included in decisions that STUK made based on licensees' proposals

Enhancement plan for Loviisa 1&2 (VVER-440)

Based on the request to Fortum (Loviisa 1 and 2) in August 2011

Earthquakes:

- Seismic fragilities of pool structures (capacity of the structures on and beyond current DBE level combined with possible boiling of pool water)
- Also seismic fragility of fire water systems is under study.

Flooding:

- Enhancing local protection of important areas vs. general plant protection (plan due Dec 2013)

Loss of safety functions:

- Air-cooled cooling towers as an alternative ultimate heat sink (independent of sea water cooling; preliminary design ongoing)
- Further improvements on the diesel driven auxiliary emergency feed water pumps (to be finalised early 2013)

Enhancement plan for Loviisa 1&2 (cont'd):

Fuel pools:

- Resistance of the fuel pool structures against heat-up during boiling (cf. earthquakes)
- Instrumentation to monitor the water level and temperature
- Additional water injection capabilities by mobile pumps

Severe accident management (plant modifications already in 90's):

- To take in consideration in the emergency instructions a case where an accident is considering both units and all fuel pools. (due Jun 2013)

→ No need for updates of the SAM strategy

Emergency preparedness arrangements:

- Plan for ensuring and restoring access routes at and to the site. (due Jun 2013)
- Plans for alternative plant access control arrangements. (plans due Mar 2013, training due Dec 2013)

Enhancement plan for Olkiluoto 1&2 (BWRs)

Based on the request to TVO in October 2011

Earthquakes:

- Seismic fragilities of pool structures of fuel storages in reactor buildings (due Feb 2013)
- Seismic capacity evaluation of fire water system (due Feb 2013)

Flooding (probability of exceeding the DBF is very low)

- Some improvements along with other modifications

Loss of safety functions:

- An independent way of pumping water to the reactor pressure vessel is being considered. (planning ongoing)
  - Through the fire fighting water system; additional booster pump is needed with a dedicated power supply

  → An independent way to supply water to the reactor, and it would be available irrespective of the operation of the present backup power systems.
- Modifications to cool the auxiliary feed water system pumps independently from the sea water systems are planned (recirculation of water through the demineralised water tank acting as the heat sink). (planned 2013…2014)

Enhancement plan for Olkiluoto 1&2 (cont'd):

Fuel pools in the reactor building and in the spent fuel interim storage:

- Implementation of external junctions (possibility to use fire-fighting vehicles)
- Improving measurement to monitor the water level and temperature
- Modifications to the spent fuel interim storage during the extension project

Severe accident management:

- Reactor building top-venting to exhaust steam and possibly hydrogen. (in 2013)
- Improving capabilities of managing multi-unit accidents. (due Mar 2013)

→ No need for updates of the SAM strategy

Emergency preparedness arrangements:

- Plan for ensuring and restoring access routes at and to the site.
  (plans due Dec 2012, training due Dec 2013)
- Plans for alternative plant access control arrangements.
  (plans due Mar 2013, training due Dec 2013)
- Satellite telephones to the emergency centre and control rooms

Olkiluoto 3 – EPR under construction

In national safety review, no such design deficiencies have been identified regarding provisions against natural hazards and disturbances in power supply that would lead to significant changes in the plant design.

Possible enhancements in Olkiluoto 3 (EPR under constr.)

Based on the request to TVO in October 2011

The following items have been investigated:

- Evaluation of the robustness of EDG building doors against flooding indicate no threat to loss of EDGs due to flooding (leak tight up to over 10 m of water)
- However, the licensee has evaluated possibilities to implement external feed water connections to the SG secondary side, connections to external AC power supply and external make-up water injection into the RCS during refuelling outages have been under consideration.
- For the decay heat removal from the fuel pools in the fuel building of OL3 the possibility to use fire water systems and boiling of the pool water has been evaluated. Additional mobile pumps to provide water injection into the fire water system are to be acquired before the start of operation of OL3. The needed external connection points, as well as temperature and level measurements are included in the design of the fuel building systems.

→ No need for major changes
(in general, OL3 is well protected against external events)

Summary of the safety enhancements

No major modifications required due to the Fukushima accident

- Low seismicity in Finland
- Moderate sea level changes
- Natural events (excl. seismic for existing plants) taken into account in the design (especially Olkiluoto 3)

Further improvements

- Protection against extremely high sea level in (Loviisa 1&2)
- Reducing the heat removal dependency of sea water systems (Loviisa 1&2 and Olkiluoto 1&2)
- Reducing the reactor cooling dependency of AC power (Olkiluoto 1&2)
- Improving fuel pool cooling capabilities (water injection, monitoring)
- Emergency preparedness in case of multi-unit events

Updates to the national requirements

Government Decrees to include taking into account

- multi-unit accidents at the same site (emergency preparedness)
- off-site centre to support on-site actions (emergency preparedness)
- extended autonomy of the plant to ensure the safety functions (safety)

More specific requirements in YVL Guides on DEC situations:

- managing the situations during extreme weather conditions required already; storms, earthquakes, flooding, extreme temperatures, etc. (extreme conditions further studied in the national research programme)
- 72 h autonomy without material support from off-site facilities
- additional arrangement for decay heat removal independently of the on-site AC grid
- Application of seismic safety margin assessment
  - Details still under discussion

Off-site emergency preparedness

Activities dealt at the national level (i.e. not required from licensees):

- Support of the rescue services to ensure NPP site access
- Ensuring sufficient amount of radiation protection equipment and radiation monitoring capabilities for rescue services
- Specific group to coordinate development of the emergency preparedness planning in the emergency planning zone

Improving STUK's emergency preparedness plans and activities

Thank you