

European Stress Tests for Nuclear Power Plants
Status of activities presented in the Finnish action plan

December 2017



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INTRODUCTION

There are two nuclear power plants operating in Finland: the Loviisa and Olkiluoto plants. The Loviisa plant comprises two VVER units (Soviet type pressurised water reactors) operated by Fortum Power and Heat Oy and the Olkiluoto plant two BWR units (boiling water reactors) operated by Teollisuuden Voima Oyj (TVO). In addition, a new nuclear power plant unit is being constructed by TVO at the Olkiluoto site (EPR type pressurised water reactor). At both sites there are interim storages for spent fuel as well as final repositories for intermediate and low level radioactive waste.

Following the accident at the Fukushima Dai-ichi nuclear power plant on the 11th of March in 2011 (TEPCO Fukushima Dai-ichi accident), safety assessments in Finland were initiated after Radiation and Nuclear Safety Authority (STUK) received a letter from the Ministry of Employment and the Economy (MEE) on 15 March 2011. The Ministry asked STUK to carry out a study on how the Finnish NPPs have prepared against loss of electric power supply and extreme natural phenomena in order to ensure nuclear safety. STUK asked the licensees to carry out assessments and submitted the study report to MEE on 16 May 2011. Although immediate actions were not considered necessary, STUK required the licensees to carry out additional assessments and present action plans for safety improvements. Assessments were conducted and reported by the Finnish licensees to STUK on 15 December 2011. STUK has reviewed the results of national assessments, and made licensee specific decisions on 19 July 2012 on the suggested safety improvements and additional analyses.

Finland also participated in the EU Stress Tests and submitted the national report to European Commission in the end of 2011 and the national action plan in the end of 2012. An EU level peer review on the national report was completed by April 2012 and peer reviews concerning the national action plan were carried out in April 2013 and in April 2015. In addition, Finland participated in the second Extraordinary Meeting of the Convention of Nuclear Safety (CNS) in August 2012. All STUK's related decisions, the national reports to European Commission and the report to the Extraordinary CNS have been published on STUK's website (<http://www.stuk.fi/stuk-valvoo/ydinturvallisuus/fukushima-selvitykset>).

This report presents the current status of activities presented in the Finnish National Action Plan addressing the measures initiated on a national level and at the nuclear power plants as a result of the TEPCO Fukushima Dai-ichi accident.

IMPLEMENTATION OF ACTIVITIES

This Section concludes all activities taken, planned or already implemented on a national level and at the nuclear power plants as a result of the TEPCO Fukushima Dai-ichi accident. Activities are presented in a table format including time schedules. References are given to the Finnish National Action Plan (December 2014) Sections 1-6 regarding more detailed description of the related responses and conclusions. The status of the activities is updated and represents the current situation in December 2017.

Table 1. National level activities.

No.	Action/Activity	Related Section	Status	Schedule
Topics 1-4 – Natural Hazards, Design Issues, Severe Accident Management and National Organisations				
1	Including new issues (extreme external hazards, spent fuel pool issues) in the national research programme	Sections 1 and 4.4	Implemented	2012-2014
2	Implementing the new requirements to Finnish Regulatory Guides (YVL Guides)	Sections 1, 2.1 and 3.5	Implemented	12/2013
3	Preparations to implement rapid support from TSOs to the authority in emergencies	Section 4	Implemented	2013
Topic 5 – Emergency Preparedness and Response and Post-Accident Management (Off-Site)				
4	National Nuclear Power Plant Emergency Preparedness Forum to be launched in order to co-ordinate issues related to: <ul style="list-style-type: none"> –long term accidents of several NPP units, –recovery phase actions, –emergency measures outside the planning zones, –scope of the emergency exercises, –radiation monitoring capability during prolonged emergency situations, –communication capability during prolonged emergency situations, –availability of the emergency centres with respect to power supply, filtration of the intake air and the distance from the NPPs, –public information, information between the authorities, –clearance of the roads, alternative transport ways and means, –decontamination resources and facilities, –supply of contractor staff during the emergencies, –warning the population 	Section 5.1	Canceled *	-
5	Further improvement of arrangements for the coordination of information to the public and media during emergencies is needed. Guidelines for co-operation among authorities have been written in a guidebook	Section 5.3	Implemented	2015

	published in November 2012.			
6	Emergency exercises exceeding 24 hours or exercises containing aspects of recovery have not been organised systematically, and should be included in the exercise calendar.	Section 5.3	Implemented	2014
7	Ensuring sufficient amount of radiation protection equipment and radiation monitoring devices for rescue services	Section 5.6	Implemented	2014
Topic 6 – International Co-operation				
8	Participation in the IAEA-ISSC work	Section 6.2	In progress	According to the work of the IAEA-ISSC
9	Participation in the WENRA RHWG work	Section 6.2	In progress	According to the WENRA RHWG
10	Participation in the CNRA and CNRA STG on Fukushima	Section 6.2	Completed	According to the CNRA and STG
11	Participation in the MDEP STC and EPR design specific working group	Section 6.2	In progress	According to the MDEP STC and EPRWG
12	Participation in EU Stress Tests	Introduction	Implemented	06/2012

* After the initial proposals, the Forum's field of responsibility was found to be mostly overlapping with other existing co-operation and co-ordination bodies. Therefore, it has been decided that creation of new group is not the best way to address the issue. Instead, the membership and responsibilities of existing groups have been adjusted. For example, Ministry of the Interior is now also member in both of the regional groups.

Table 2. Measures at the Loviisa NPP units 1 and 2.

No.	Action/Activity	Related recommendation	Status	Schedule
Topic 1 – Natural Hazards				
101	Evaluation of fragility of the spent fuel pools at high temperature and at high pressure	Section 1.1	Implemented	09/2012
102	Updating the seismic fragility analyses of <ul style="list-style-type: none"> - the spent fuel pools - fire fighting systems 	Sections 1.1 and 1.3	Implemented Implemented	09/2012 03/2013
103	Improving preparedness for high seawater level	Sections 1.1 and 1.2	In progress	2018
104	Analysis of consequences of beyond design basis low and high temperature	Section 1.1	Implemented	12/2011
105	Analysis of consequences of tornados and down-bursts on plant structures and systems	Section 1.1	Implemented	12/2011

Topic 2 – Design Issues				
106	Implementation of an alternative ultimate heat sink	Section 2.1	Implemented	2014
107	Securing the availability of the auxiliary emergency feed water system	Section 2.1	Implemented	2013
108	Acquiring a container to transfer diesel fuel at site	Section 2.2	Implemented	2012
109	Enhancing the battery power sources	Section 2.3	Implemented	2014
110	Acquiring mobile power supply and mobile pumps	Section 2.5	Canceled **	-
111	Connecting the additional diesel power engine to the plant switchgears by a dedicated cable	Section 2.3	Implemented	10/2012
112	Evaluation of demineralised water reservoirs	Section 2.1	Implemented	12/2011
113	Evaluation of demineralised water usage in an accident concerning all units and spent fuel pools at the site	Section 2.1	Implemented	5/2013
114	Enhancing the diesel fuel transfer capabilities on-site; acquiring a new diesel fuel storage tank at site	Section 2.2	Implemented	2015
115	Evaluation of suitability of biodiesel for the diesel engines	Section 2.2	Implemented	2012
116	Ensuring the water injection into the spent fuel pools and monitoring the conditions of the pool	Sections 2.4 and 3.3	In progress	2015-2018
Topic 3 – Severe Accident Management				
117	Capability of dealing with multi-unit severe accidents; updating of emergency plans and organisation	Section 3.5	Implemented	2013
118	Improving the containment decay heat removal in case of multi-unit accidents. Alternative means investigated.	Section 3.1	Canceled**	-
119	Plans for restoring the access routes to the site	Section 3.5	Implemented	12/2013
120	Evaluation of suitability of emergency preparedness personnel to their duties	Section 3.5	Implemented	2013
121	Plans for access control and radiation monitoring of the staff and decontamination measures in extreme natural hazards	Section 3.5	Implemented	12/2013

** Using additional mobile power supply and mobile pumps have been evaluated by Fortum and it has been decided that usage of such equipment would not fulfill national regulations. Finnish regulations require fixed installed systems for residual heat removal from the fuel in the reactor for a period of three days independently of the off-site supply of electricity and water in a situation caused by a rare external event or a disruption in the on-site electrical distribution system. Also for severe accident management, there shall be fixed installed systems that are independent of the systems designed for normal operation, anticipated operational occurrences and postulated accidents. Diverse residual heat removal of spent fuel from storage pools can after a grace period rely on mobile equipment with fixed supply connections. Autonomy requirement is the same as in case of residual heat removal from the reactor.

Table 3. Measures at the Olkiluoto NPP units 1 and 2.

No.	Action/Activity	Related recommendation	Status	Schedule
Topic 1 – Natural Hazards				
201	Updating the seismic fragility analyses of the spent fuel pools and fire fighting systems	Sections 1.1 and 1.3	Implemented	2/2013
202	Improvement against exceptionally high seawater level on the cooling systems of the spent fuel interim storage	Section 1.2	Implemented	2013
203	Analysis of consequences of beyond design basis low and high temperature	Section 1.1	Implemented	12/2011
204	Analysis of consequences of tornados and downbursts on plant structures and systems	Section 1.1	Implemented	12/2011
Topic 2 – Design Issues				
205	Implementation of independent way of pumping water into the RPV	Section 2.1	In progress	2017-2018
206	Implementation of modification to prevent overheating of the auxiliary feed water system (independent of sea water cooling)	Section 2.1	In progress	2016-2018***
207	Evaluation of suitability of biodiesel for the diesel engines	Section 2.2	Implemented	2012
208	Implementation of mobile power supply (including re-charge of DC batteries)	Section 2.5	Implemented	2014
209	Evaluation of demineralised water reservoirs	Section 2.1	Implemented	12/2011
210	Evaluation of demineralised water usage in an accident concerning all units and spent fuel pools at the site	Section 2.1	Implemented	2012
211	Ensuring the water injection into the spent fuel pools (Implemented) and monitoring the conditions of the pool (Implemented)	Sections 2.4 and 3.3	Implemented	2017
Topic 3 – Severe Accident Management				
212	Capability of dealing with multi-unit severe accidents; updating the emergency plans and organisation	Section 3.5	Implemented	10/2013
213	Reactor building top venting for steam escape; hydrogen possibly formed could be exhausted through this route as well	Sections 2.4 and 3.1	In progress	2018
214	Plans for restoring the access routes to the site	Section 3.5	Implemented	12/2013
215	Enhancement of the emergency plan on radiation measurement patrols	Section 3.5	Implemented	03/2013
216	Enhancement of adequacy of the maintenance personnel in case of emergency	Section 3.5	Implemented	3/2013
217	Evaluation of suitability of emergency preparedness personnel to their duties	Section 3.5	Implemented	03/2013
218	Plans for access control and radiation monitoring of the staff and decontamination measures in extreme natural hazards	Section 3.5	Implemented	12/2013
219	Improvement of communication capabilities	Section 3.5	Implemented	12/2012

*** The new recirculation line modification was implemented at Olkiluoto 1 in 2014. Abnormal vibration and pressure oscillations have been observed during the testing of one subsystem. This did not influence operation of the pump, however, and the fault would not have prevented the supply of water to the reactor in case of need. The reasons are under investigation and the modification will not be implemented at Olkiluoto 2 until the issue has been resolved. Design of the recirculation line has been revised based on the investigations and current estimated schedule is for the plant modifications to be completed by the end of 2018.

Table 4. Measures at the Olkiluoto NPP unit 3.

No.	Action/Activity	Related recommendation	Status	Schedule
Topic 1 – Natural Hazards				
301	Analysis of consequences of beyond design basis low and high temperature	Section 1.1	Implemented	12/2011
302	Analysis of consequences of tornados and downbursts on plant structures and systems	Section 1.1	Implemented	12/2011
Topic 2 – Design Issues				
303	Evaluating modifications required for independent decay heat removal system	Section 2.1	In progress	12/2019
304	Ensuring the water injection into the spent fuel pools with mobile pumps	Section 2.4	In progress	Before start of operation
Topic 3 – Severe Accident Management				
305	Capability of dealing with multi-unit severe accidents; updating the emergency plans and organisation (in connection with Olkiluoto units 1 and 2)	Section 3.5	In progress	Before start of operation