



REPUBLIC OF SLOVENIA
MINISTRY OF THE ENVIRONMENT AND SPATIAL PLANNING
SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

UPDATE OF THE SLOVENIAN POST-FUKUSHIMA ACTION PLAN

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Prepared by the **Slovenian Nuclear Safety Administration**

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Summary

The Slovenian Post-Fukushima National Action Plan (NAcP) is divided into two parts. The first part are the hardware improvements of the Krško NPP (including procedure and safety analysis upgrades), which is the only NPP in Slovenia, comprising the Krško NPP's Safety Upgrade Program (SUP) approved by the Slovenian Nuclear Safety Administration (SNSA) in 2012. The Krško NPP's SUP is divided into three phases.

Phase I was implemented in 2013:

- installation of passive autocatalytic recombiners (PARs) and installation of a containment filtered vent system (SUP action 1.5).

Phase II was to be implemented by the end of 2019, yet some parts of it are delayed. It includes:

- additional flood protection of the nuclear island and all the new systems, structures and components (SUP action 1.9 - implemented in 2015/2016);
- installation of pressuriser bypass relief valves, qualified for severe accidents (part of SUP action 1.4 - implemented in 2018);
- installation of a fixed spray system on the spent fuel pool with provisions to use mobile equipment (SUP action 1.7 - implementation delayed to 2020);
- acquisition of a mobile heat exchanger with provisions for quick connection to the spent fuel pool (SUP action 1.8 - implementation delayed to 2020);
- installation of an additional heat removal pump (ARHR) with a dedicated heat exchanger capable of removing heat from the primary system and the containment. This improvement was to be implemented completely in last year's refuelling outage (October 2019), but the delivery of the main component (the ARHR pump) by the supplier was delayed (part of SUP action 1.4 - delayed to 2021);
- upgrade of the bunkered building 1 (BB1) electrical power supply: provisions to connect mobile diesel generators, seismic requalification, installation of the battery with 24-hour capacity, etc. (SUP action 1.1 - implemented in 2018);
- installation of the emergency control room (ECR) in the BB1 protected against external hazards and severe accident's radiation with capabilities to shut down the reactor and maintain the long-term safe shutdown state. This improvement also includes installation of severe accident instrumentation (SUP action 1.6 - implemented in 2018/2019).
- upgrade of the operational support centre (OSC) and technical support centre (TSC) (emergency centres) to ensure a safe long-term environment for operators even in the event of severe accidents. Both, OSC and TSC are around 90% complete (SUP action 1.10 - implementation delayed to 2020);

Phase III improvements are underway and are to be completed by the end of 2021:

- installation of additional injection systems for the reactor cooling system / containment and steam generators with dedicated reservoirs of cooling water (also borated) capable of being replenished with water from underground wells - the bunkered building 2 (BB2) project (SUP action 1.2 and part of 1.4 - implementation underway);
- construction of a dry spent fuel storage facility (SUP action 12 - implementation underway).

The original deadline for the SUP was 2016 but was delayed. Most delays were caused by the public procurement process due to which most of the projects' biddings had to be repeated. Additional delay was caused by the owners of the plant, which at one point were considering

the financial viability of the plant's life time extension and implementation of the SUP (described in more details in December 2017 NAcP update). By the end of 2019 around 92% of the SUP was implemented. The Krško NPP's SUP is on schedule to be implemented by the end of 2021.

The second part of the Slovenian NAcP are so called soft improvements, such as revising the legislation, enhancing emergency response and cooperation with neighboring countries, performing additional inspections and studies, inviting and hosting peer review missions, and upgrades of PSA analyses. Couple of these actions are still underway, such as the revision of the national emergency response plan, upgrade of spent fuel pool PSA, and invitation of the IAEA RAMP mission (Review of Accident Management Program), which will be the last action to be implemented, expected in 2022 after the completion of the SUP.

The National Action Plan

After the Fukushima Daiichi accident several improvements were implemented in the first several months. The National Action Plan given in table 1 below was comprised of all identified actions that still had to be implemented (see the original National Action Plan from December 2012). It is assessed that up until the end of 2019 around 92% of the Slovenian NAcP has been implemented.

Table 1: Slovenian National Action Plan

No.	Action / activity	Area	Status	Finalization	Level
1	SUP SUP comprises of a set of modifications/ improvements (see numbers 1.1 to 1.10) that will be implemented in steps until the end of 2021.	SUP	in progress 92%	2021	site
1.1	Safety upgrade of AC power supply	SUP, Phase II	implemented	2018	site
1.2	New pump for supplying SGs; in a bunkered building, with a dedicated water supply	SUP, Phase III	in progress 60%	2021	site
1.3	Installation of alternative ultimate heat sink – revised into alternate long-term heat sink using SGs and underground well water (see 1.2 and Chapter 5.2.1)	SUP, Phase III	in progress 60%	2021	site
1.4	Additional pump for injecting into the reactor primary system, in a bunkered building, with a dedicated (borated) water supply	SUP, Phase III	in progress 85%	2021	site
1.5	Containment integrity safety upgrades including containment filtered vent systems and PARs	SUP, Phase I	implemented	2013	site
1.6	Establishment of emergency control room	SUP, Phase II	implemented	2019	site
1.7	Installation of fixed spray system around the SFP with provisions for quick connection from different sources of water.	SUP, Phase II	in progress 98%	2018 → 2020	site
1.8	Mobile heat exchanger with provisions to quick connect to SFP	SUP, Phase II	in progress 98%	2018 → 2020	site
1.9	Flood protection upgrade (additional protection of nuclear island and bunkered buildings)	SUP, Phase II	implemented	2015	site
1.10	Establishment of new technical support center and upgrade of existing operational support center (emergency operating facilities)	SUP, Phase II	in progress 90%	2018 → 2020	site
2.1	SNSA shall amend its legislation to include:	legislation	implemented	2016	national

No.	Action / activity	Area	Status	Finalization	Level
	<ul style="list-style-type: none"> • requirements regarding the use of advanced deteriorating weather warning systems • requirements regarding the use of seismic monitoring systems • PSA Level 3 requirements (at least for new NPPs) • requirements for Beyond Design Basis Accidents I&C for Spent Fuel Pool • emergency planning requirements for prolonged SBO in the areas of communications capability (onsite, e.g., radios for response teams and between facilities, and offsite, e.g., cellular telephones, satellite telephones), ERDS capability, training and exercises, and equipment and facilities 				
2.2	<p>The SNSA shall consider amending its regulation for the design basis by more stringent safety objectives for:</p> <ul style="list-style-type: none"> • Prevention and mitigation of core-melt accident in reactor and in spent fuel storage to avoid off-site long term contamination • Large or early release to be practically eliminated (for new NPPs) • Increase robustness of NPPs to be able to face natural hazards more severe than the ones considered in the design basis (DEC); this should also include requirements for test and maintenance of equipment, training,.... <p>This will be done mainly by following WENRA/ENSREG new initiatives, updated RL...</p> <p>The SNSA shall also examine whether more detailed requirements are needed regarding LOOP, SBO and loss of UHS</p>	legislation	implemented	2016	national
3	<p>In January 2012 SNSA issued the third decision regarding the Fukushima event requiring from the Krško NPP to review the basis and assumptions for the Radiological Emergency Response Plan. This is to be finished by March 2013. The results of the review, possible proposals for improvements of the Radiological Emergency Response Plan, shall be implemented as appropriate.</p> <p>In addition the SNSA (together with other appropriate stakeholders) shall give further consideration to:</p> <ul style="list-style-type: none"> • supplementing the national radiological emergency response plan with provisions for off-site support regarding to the long-term fuel supply and also some additional pieces of mobile equipment in case of widespread disruption of plant's infrastructure • within the supplementing of national radiological emergency response plan further consideration shall be given to: <ul style="list-style-type: none"> - Reference levels for importing food, - Trans-boundary processing of goods and services such as container transport - Approach / philosophy and associated limits and criterion to govern the 'remediation' phase of the event - Return to evacuated area criteria and criteria for return to normal from the emergency state - Establishing contamination monitoring protocols and locations during the recovery phase • preparing national strategy (also amending legislation if needed) regarding solutions for post- 	emergency response	in progress 95%	2018 → 2020	national

No.	Action / activity	Area	Status	Finalization	Level
	accident contamination and the treatment of potentially large volumes of contaminated water <ul style="list-style-type: none"> • enhancement of intervention personnel training, trans-boundary arrangements and education of the public and media • enhancing cooperation with neighboring countries (especially Croatia), including mutual exercises • enhancing exercises by including all interface points (National, Regional, Municipal...), performing longer term exercises for better reflection of the extreme events challenges, and incorporating failure of communication systems and radiation data availability into drill programs • enhancement of national radiological monitoring system 				
4	SNSA shall assign dedicated inspections to: <ul style="list-style-type: none"> • verify the external hazard protection equipment; • systematically review and inspect SAME equipment, SAMGs, test and maintenance procedures, as well as full scale training events at the Krško NPP with the emphasis on how the limited number of staff are able to cope with equipment deployment and transfer of additional fuel to the users, what are the available and needed times, are there enough resources (human and equipment) available,... • check what are plant's capabilities to power communications equipment needed to communicate onsite (e.g., radios for response teams and between facilities) and offsite (e.g., cellular telephones, satellite telephones) during a prolonged SBO; • additional inspection on radiological protection equipment, procedures for radiological mapping in case of an accident, staff training (added from action #5, additional studies) 	Inspection	implemented	2017	site
5	The SNSA shall consider requiring the plant to perform additional studies regarding: <ul style="list-style-type: none"> • accident timing, including core melt, reactor pressure vessel (RPV) failure, basemat melt-through, SFP fuel uncover, etc., using different computer codes • radiological protection equipment for SA response • analysis and identification of situations that would prevent performance of work for radiological reasons; • the question of stress on staff behavior including emotional, psychological and cultural aspects associated with emergency response and associated training and support 	additional studies	implemented	2017	site
6	Nuclear safety infrastructure in Slovenia needs more political support. Only in such environment the human resource capacity and competence across all organizations in the field of nuclear safety can be further developed. SNSA shall organize a meeting, where this topic shall be brainstormed by all involved parties (the utility, the regulatory body, TSOs...). Special action plan shall be prepared and executed to enhance political support to nuclear safety infrastructure.	nuclear safety infrastructure	implemented	2016	national
7	To enhance its processes SNSA shall: <ul style="list-style-type: none"> • reconsider, which of the international meetings/groups are of utmost importance, since 	SNSA processes	implemented	2017	national

No.	Action / activity	Area	Status	Finalization	Level
	the decreasing number of staff and increasing number of international activities the quality of regular work may start to suffer <ul style="list-style-type: none"> review its capability for evaluating defense-in-depth to see whether and how it could be further enhanced enhance its staff training on severe accidents and SAMGs 				
8	The SNSA shall consider inviting the following peer review missions <ul style="list-style-type: none"> additional RAMP mission (best after completion of SUP) to again properly and independently validate the SAMGs. Likewise consideration shall be given to inviting peer review missions to reassess the external hazards a follow-up IRRS mission in 2014, and next IRRS mission in the next 5-6 years OSART mission to review plant design safety features and related modifications (in next 3 years) EPREV (Emergency Preparedness Review) mission 	peer reviews	in progress 95%	2022	site
9	SA plant parameters are being transferred to regulator premises. Still, this system needs a revision to include all needed SA parameters, increase reliability of the system...	ERDS	implemented	2015	site
10	A full scope PSA (including Level 2) for low power and shutdown modes shall be implemented for the Krško NPP by the end of 2015. SNSA shall consider requiring a PSA for the Krško's Spent Fuel Pool.	PSA	in progress 95%	2018 → 2020	site
11	SNSA shall (together with the operator) analyze how the following topics are taken into account, maintained and improved: <ul style="list-style-type: none"> Transparency; public discussion of safety issues An open and trustful relationship between regulators, operators and the public with keeping in mind their respective roles and functions Define appropriate actions to ensure that the desired safety culture characteristics are achieved in the regulatory and operational organizations Methods to evaluate and detect degraded safety culture 	safety culture	implemented	2014	national
12	The construction of the dry spent fuel storage (within the reassessment of its severe accident management strategy, existing design measures and procedures, the operator has also reassessed its possibilities for alternative spent fuel strategy. The results showed that best strategy would be storing the spent fuel in dry cask storage with a possibility to combine it with later reprocessing)	reviews and NPP improvements	in progress 70%	2020 → 2021	national + site

Comments of the delayed actions

Action No. 1: The SUP

The Krško NPP's SUP is divided into three phases.

Phase I (installation of PARs and containment filtered vent system) was implemented in 2013.

Phase II was to be implemented by the end of 2019, yet some parts of it are delayed:

- installation of a fixed spray system on the spent fuel pool with provisions to use mobile equipment (SUP action 1.7 - implementation delayed until April 2020 due to needed redesign and implementation of other tasks with higher priority);
- acquisition of a mobile heat exchanger with provisions for quick connection to the spent fuel pool (SUP action 1.8 - implementation delayed until April 2020 due to needed redesign and implementation of other tasks with higher priority);
- installation of an additional heat removal pump (ARHR) with a dedicated heat exchanger capable of removing heat from the primary system and the containment. This improvement was to be implemented completely in last year's refuelling outage (October 2019), but the delivery of the main component (the ARHR pump) by the supplier was delayed (part of SUP action 1.4 - delayed to 2021);
- upgrade of the operational support centre (OSC) and technical support centre (TSC) (emergency centres) to ensure a safe long-term environment for operators even in the event of severe accidents. Both, OSC and TSC are around 90% complete (SUP action 1.10 - implementation delayed to 2020 due to other tasks with higher priority);

Phase III improvements are underway and are on schedule to be completed by the end of 2021.

The original deadline for the SUP was 2016 but was delayed. Most delays were caused by the public procurement process due to which most of the projects' biddings had to be repeated. Additional delay was caused by the owners of the plant, which at one moment were considering the financial viability of the plant's life time extension and implementation of the SUP (described in more details in December 2017 NAcP update). Some delays were caused by needs to redesign improvements and by large component delivery delays. By the end of 2019 around 92% of the SUP was implemented. The Krško NPP's SUP is on schedule to be implemented by the end of 2021.

Action No. 3: Emergency response improvements

Regarding improvements of emergency response one more action is open – the revision of the National Radiation Emergency Plan to include:

- provisions for off-site support regarding to the long-term fuel supply, and
- provisions for providing additional pieces of mobile equipment in case of widespread disruption of plant's infrastructure.

The draft of the new revision has long been prepared, but the new version of the plan has not yet been published due to preparation of some other documents which are inputs to the plan (i.e. protection strategy). A special group will be established in early 2020 to help amend the plan and publish it in 2020.

Action No. 8: Peer reviews

One still open sub-action is to invite the IAEA RAMP (Review of Accident Management Program) mission to the Krško NPP. This mission is postponed to 2022 when all the upgrades from the currently ongoing SUP will be complete.

Action No. 10: PSA

Krško NPP has prepared the PSA for the SFP, but only for internal events. The internal and external hazards (internal fires and floods, seismic hazards) PSA for SFP are still under development. The foreseen deadline is end of 2020.

Action No. 12: The construction of the dry spent fuel storage

This action is now also part of the Krško NPP's SUP. The project is underway and on schedule to be completed in 2021. Major delay in the past was caused by the failed public procurement process, which first had to be repeated and then again was delayed due to appeals of the not chosen supplier.

Conclusion

The implementation of the Slovenian NAcP is underway. It is assessed that in December 2019 around 92% of the NAcP actions have been implemented.

The big part of the Slovenian NAcP is the Krško NPP's SUP, which includes major hardware upgrades that will further increase the plant's safety. The SUP is well underway and even with some delays in specific upgrades it's still to be completed by the end of 2021.

Also a couple of actions from the second part of the Slovenian NAcP are still underway, such as the revision of the national emergency response plan, upgrade of spent fuel pool PSA, and invitation of the IAEA RAMP mission (Review of Accident Management Program), which will be the last action to be implemented, expected in 2022 after the completion of the SUP.