ENSREG
European Nuclear Safety Regulators Group

EU Peer Review Report
Implementation of Armenian Stress Test
National Action Plan

November 2019

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1 INTRODUCTION and BACKGROUND

The purpose of this document is to record the results and conclusions of the peer review of the National Action Plan of Armenia that was produced and is in the process of being implemented, as a result of the application of the EU Stress Test approach in Armenia.

Following the 2011 Fukushima accident, Europe took the lead in carrying out comprehensive risk and safety assessments ("Stress Tests") of Nuclear Power Plants (NPPs) to assess how they can withstand extreme external events.

The final results of the EU Stress Tests provided important technical insights for safety improvements that have been or are well underway to being implemented in all 17 participating countries in order to achieve a higher standard of nuclear safety.

The EU Stress Tests have been carried out in a transparent manner and the results were actively shared, in the interests of our citizens and a stronger global safety culture. In addition, the aim is also to contribute to a more robust and solid nuclear framework worldwide.

At the time of the original EU Stress Tests in 2012 a number of non-EU countries, expressed their interest in following the same peer review process but were not ready to join and immediately submit a report. The European Commission (EC) has always indicated its willingness to support the peer review process in collaboration with ENSREG when a country would be ready.

Armenia confirmed on 23 June 2011 its willingness to undertake on a voluntary basis comprehensive risk and safety assessments ('stress tests'), in accordance with the specifications agreed by the European Commission and the European Nuclear Safety Regulators Group (ENSREG). Armenia stepped into the process in 2015, with the submission of the nuclear operator's report, the review by the national regulator ANRA of this self-assessment and the submission of the national report.

It is emphasised that a stress test exercise remains a targeted exercise reviewing the safety of certain aspects of a nuclear power plant (see stress test specifications). A stress test and the implementation of follow up actions should not be used to justify or authorize the safe operation of a nuclear power plants nor its long-term operation or lifetime extension. Such authorisations have to be in line with the procedures prescribed in the national law and under the full responsibility of the national regulatory authorities.

2 PROCESS OF PEER REVIEW FOR ARMENIA

The peer review of the national report was completed in 2016. The first step was a desktop peer review of the report that led to questions being presented to and answers being received from ANRA. The second step consisted of a visit to Armenia by the team of experts, including a visit to the Armenian nuclear power plant (ANPP) to follow-up their lines of enquiry.

The peer review team issued a report with an assessment of the National Report and Recommendations for the enhancement of safety in the ANPP.

In 2017, ANRA submitted a NAcP, translating the recommendations of their national report and the stress test peer review report into concrete actions for the enhancement of safety together with a timeline for implementation. However the Armenian NAcP was not peer reviewed following its submission in 2017.

2.1 Peer review of the NAcP

Peer review of the Armenian NAcP commenced after receipt of an updated NAcP from ANRA on 3 October 2019. It was the first peer review of a NAcP since the two workshops that took place in 2013 and 2015 for the review of the NAcPs of the 'first wave' of stress tests, i.e. EU Member States, Switzerland and Ukraine.

The objective of the peer review was to considered the way the actions included in the NAcP were developed from the national report, the stress test peer review team's recommendations and other relevant recommendations (e.g. from CNS review). It also considered the adequacy of progress with the implementation of the actions identified.

While having the same objective as the workshop reviews, the review of the Armenian NAcP differed from previous exercises in two main areas:

It was carried out simultaneously on the NAcP, as developed following the National Report and the Stress Test Peer Review Team's recommendations, and on the update of the non-reviewed NAcP, after approximately two years of implementation.

It is the first to be carried out individually on the NAcP of a country and is reported in this document accordingly.

As with the national stress test report, the peer review of the NAcP started with a desktop exercise, with questions prepared by a team of experts. A team of eight experts was established from the experts previously nominated by ENSREG and the European Commission provided a rapporteur to assist the team. Their review led to a total of 67 questions on the content of the NAcP that were submitted to ANRA on 30th October 2019. ANRA subsequently provided written responses to expert's questions on 13th November.

The second stage of the peer review exercise was a visit by the peer review team to Armenia, with follow-up enquiries undertaken at the offices of ANRA and the ANPP site at Metsamor, from 25th to 29th November.

ENSREG also invited the IAEA and the national regulators of Belarus, Iran and the Russian Federation as observers to this peer review who all attended.

2.2 Experience in Armenia

The peer review team had a positive experience in Armenia. The period set aside for the mission was appropriate, allowing adequate time to engage with counterparts and undertake a site visit to resolve any technical queries, enabling an informed judgment to be made on the Armenian NAcP.

ANRA, NRSC and ANPP staffs made themselves available, and were fully supportive and helpful to the team as it sought to get a good understanding of the Armenian NAcP and the country's progress with implementation of the required modifications. There were no issues with interpretation or translation, the majority of the Armenian counterparts spoke good English and were readily able interact with the team and answer their questions. In the small instances where this was not the case excellent interpretation was provided.

The team was grateful for a meeting with Mr Martirosyan, Chairman of ANRA. During the meeting Chairman Martirosyan was open and honest in his appraisal. He advised that the ANPP has 3 improvement programs that it is seeking to implement on the site: lifetime extension (LTE), stress test NAcP and continuous safety upgrade. These require a significant amount of work. The dates for LTE upgrades have been subject to regular deferral and a single integrated program of work to ensure a coordinate approach to implementation of the modifications has been outstanding from the ANPP for over a year.

Chairman Martirosyan indicated that the operating license for the ANPP at Metsamor is due to expire in April 2021. The current requirement, as a result of government decree, is for all LTE safety class 1, 2 and 3 modifications to be implemented by April 2021, to support the licensing decision by ANRA for operations beyond this date.

2.3 Site Visit

The site visit to the ANPP at Metsamor on 27th November was very informative. The peer review team were efficiently transported to and from the NPP site and were able to observe all areas of the plant that they had expressed an interest in seeing, including: the reactor hall, main control room,

back-up control, simulator, main steam and feed water, diesel generators, emergency pumps, battery compartment, and flooding protection and fire brigade. Drawings, procedures and other documentation were also reviewed.

The site visit was an important part of the mission, in addition to visiting the plant areas, it was confirmed that the ANPP was giving significant focus to the delivery of the physical improvements required to support the lifetime extension program for the single operational reactor, which was possible due to funding agreements with Russia. The team was advised that currently there is little funding to deliver the work required by stress test NAcP.

2.4 Peer Review Report Structure

The peer review team sought to follow the reporting template adopted by ENSREG for the workshops of 2013 and 2015 and this report has chapters aligned to the 2012 stress tests template, covering the following topics:

i) Assessment of the Structure of the NAcP

ii) Assessment of the Content of the NAcP

iii) Peer Review Conclusions.

The report contains some additional detail explaining the first of a kind process adopted, as well as a short summary of the findings for each of the 3 topic areas. It also includes a table recording each action and a short evaluation by the peer review team, in line with the format of the NAcP itself. The comprehensive assessment together with further recommendations on how to achieve the safety improvements addressed in the NAcP forms the "Appendix – Table of Actions". This Appendix is an integral part of this report.

3 ASSESSMENT OF THE STRUCTURE OF NATIONAL ACTION PLAN

ANRA produced the NAcP on behalf of Armenia in 2017 to address the findings of the Stress Tests, all possible sources that could highlight improvement measures were used for the preparation of the Armenian NAcP and as result it contains a compilation of all the major conclusions and recommendations contained in:

- National Report - Stress Test for Armenian Nulcear Power Plant (ANPP) – July 2015,
- ENSREG Peer Review of Armenian Stress Tests – June 2016,
- Compilation of Recommendations and Suggestions from the Review European Stress Tests – July 2012,
- Summary Report of the 2nd Extraordinary Meeting of the Contracting Parties to the Convention on Nuclear Safety – August 2012.

Consequently the NAcP contains a broad range of recommendations that required consideration by ANRA and ANPP. It is evident that the NAcP is structured, in accordance with the structure suggested by ENSREG:

- Part I - External hazards, loss of safety systems and severe accident management
- Part II - National organization, emergency preparedness and emergency response, and international cooperation
- Part III gives the list of measures aimed in implementing all the recommendations contained in parts I – II.

An update to the NAcP of Armenia was issued in October 2019, to aid the peer review of the NAcP. In the update the activities have been consolidated in the form of actions and associated tasks. These actions and tasks are listed and evaluated in detail in the Appendix of this report.

4 ASSESSMENT OF THE CONTENT OF NATIONAL ACTION PLAN

4.1 Natural Hazards

General

The NAcP of Armenia comprises 29 actions related to topic 1 (earthquake, flooding, extreme weather and volcanic impacts). The review further identified two recommendations of the "EU Peer Review Report of the Armenian Stress Tests", which are not listed in the NAcP, but addressed by other actions of the Armenian counterpart.

The comprehensive results of the review and recommendations on how to achieve the aims of the 31 actions are listed in the "Annex – Table of Actions". Out of these, the PRT identified 6 actions which have high priority (6.1.1, 6.1.3, and 6.1.6 to 6.1.9).

The NAcP complies with the ENSREG requirements. It describes the actions which are foreseen to improve nuclear safety at ANPP and gives a transparent overview of the actions planned together with their associated schedule of implementation.

The content of the NAcP is largely complete. All major safety improvements recommended in the above mentioned sources, which were appropriate for ANPP, are addressed. Most of the information given in the NAcP is detailed and well understandable.

Overall the team recognizes that significant efforts have been undertaken since 2016 and good progress has been made to protect the installations from external hazards.

Earthquake

It is evident that the seismic robustness of ANPP has been continuously improved in recent years. As a consequence, most but not all of the SSCs of the SSELs can now cope with a PGA_H of at least 0.35 g. However, the PSHA carried out from 2009-2011 already showed that the safety-relevant SSCs of the plant should be designed against a PGA_H of 0.42 g.

A program for seismic safety evaluation of the ANPP on basis of PGA_H = 0.42 g has been developed. The program of seismic improvements will need to include all components of an updated and improved comprehensive SSEL. This should contain, in addition to the existing SSEL, SFP cooling of Unit 1, the fire-fighting system, I&C, and any other safety significant SSCs and those SSCs (including civil structures) which, upon their seismically induced failure, can impair the functionality of SSCs important to safety. It should also include civil structures containing mobile equipment required for accident management (6.1.1, 6.1.3, 6.1.6, 6.1.7, 6.1.8).

The plant visit identified several SSCs which are considered by the PRT to be inadequate to cope with 0.35 g. It is recommended that comprehensive seismic walkdowns are undertaken to identify SSCs important to seismic safety including components, which may impair the function of seismically important SSCs upon their failure. Identified shortfalls should be upgraded as a matter of priority to PGA_H = 0.42 g without an interim step to 0.35 g. Sufficient resource should be applied to ensuring

that this important task is undertaken as soon as possible to eliminate a significant weakness in the plant´s hazard withstand capability.

The future program of seismic improvements, based on PGA_H = 0.42 g, should lead to comprehensive reassessments and as far as necessary backfitting measures in respect to all safety relevant SSCs. In this context it is important that the fire extinguishing system will be reinforced. Currently this system is not seismically resistant.

It is recognized that a program is started for seismic upgrading of the ANPP. However, this has not been undertaken in a comprehensive and coordinated way and the quality of the seismic upgrades shows shortfalls in many details. This was a view also expressed by other members of the PRT dealing with other aspects of the NAcP.

Flooding

In terms of external flooding, most of the PRT report recommendations and actions mentioned in the National Report have been addressed or are planned to be addressed by 2021 at the latest. A number of hardware modifications took place. They focused mostly on the strengthening of barriers against propagation of flooding to safety related areas (volumetric protection) and on improving the DGS building drainage system.

There was a lack of detail on the implementation schedule on some actions in the NAcP but additional information have been provided during the country visit. Generally, the progress of implementation of the NAcP in the area of external flooding is commendable.

The plant has put some additional means in place to reduce likelihood of water accumulation in the DGS basement. However, in line with the ENSREG stress tests generic recommendations, the PRT recommends to ensure that mobile water pumping means are available at the plant in a timely manner as an ultimate and flexible mean to protect the site.

In the meantime, the PRT also recommends to ensure the readiness of the fire brigade means to pump water from flooded areas as necessary (including demonstrating feasibility and conducting drills).

Extreme weather

Concerning extreme weather, only a limited number of measures have been completed to date. An example of measure fully implemented is ensuring the protection of the demineralized water tanks outlet pipes (BZOV) against the plant design extreme cold temperature.

In general for extreme weather, the NAcP provided very little information on the expected completion date of actions not yet implemented. However, the expected implementation schedule was clarified for each action during the country visit.

Most studies that were recommended following the stress tests (PRT recommendations or NR actions) have been significantly delayed and have not started yet. Examples are the studies on combination of external hazards, on updating the meteorological hazard curves and on the screening process for meteorological hazards. The open actions are planned to be addressed by 2021.

During the plant visit, the PRT noted that the diesel fuel tanks with large capacity (emergency diesel fuel tank) are metallic tanks located outside and that they might be vulnerable to cold temperature. Therefore, the PRT recommends that the robustness of these tanks is checked against extreme temperatures.

Volcanism

In respect to volcanism the recommendations of the PRT out of the stress-test of 2016 are currently being implemented. ANPP is on the way to develop response plans to respond to potential volcanic activities and in contact with the relevant ministry, which is responsible for the update of the national civil protection program.

4.2 Loss of Safety Systems

The Topic 2 – Loss of Safety Systems (SBO and Loss of Ultimate Heat Sink) of the National Action Plan contains numerous recommendations that are systematically arranged. The classification is geared mostly to the proposals from Section 6 of the ENSREG Action Plan of 25 July 2012.

The Armenian National Action Plan contains totally 12 recommendations from the Armenian National Stress Test Report of 2015. That means that all the recommendations of the Armenian regulatory authority ANRA have been adopted in the National Action Plan.

In the Peer Review of the National Stress Test Report, which was produced in a peer review mission of 2016, the ENSREG Peer Review Team adopted these suggestions in the Peer Review Mission Report as the suggestions to be considered and additionally, developed four further recommendations for implementation of safety enhancing measures for the topics SBO and LUHS. Also, these four measures were in full integrated into the Armenian National Action Plan.

The National Action Plan drafted totally 20 actions to be employed in order to implement the recommendations from the abovementioned country-specific documents (National Stress Test Report and Peer Review Mission Report) as well as from general documents of ENSREG and the IAEA. The description of specific activities and their correlation to recommendation and suggestions is clear and easily traceable. Due to a frequent overlapping content of recommendations from the country-specific and general documents, an activity can be, at the same time, correlated to several recommendations.

The activities of the National Action Plan are worded only in brief outline. These formulations allow a general understanding of the intentions pursued by the activities. Nevertheless, without additional information, it is impossible to review how a specific activity would help to enhance safety as proposed by the recommendations.

Taking into account that the National Action Plan had been developed after the Peer Review Mission of the National Stress Test Report, which took place in June 2016, in the first version in 2017, the coverage the period from 2017 up to 2020 for implementation of specific measures seems to be comprehensible.

The majority of the actions associated with loss of safety systems are scheduled for completion in 2020 and 2021, only one measure associated with “performance of further studies in areas where there are uncertainties“ is envisaged for implementation during 2022. However, this timeframe is considered acceptable by the peer review team.

The PRT recommends that an overall solution to address SBO events should be developed. This includes the timely deployment and connection of the mobile equipment and the coordination of personnel activities on reactor cooling system (primary and secondary circuits), as well as SFP, in order to ensure a reliable heat removal in case of an SBO.

4.3 Severe Accident Management

There are 22 items included in the topic of Severe Accident Management. Review of implementation of the NAcP is subdivided into several areas, corresponding to different components of accident management.

Organization and arrangements of the licensee to manage accidents, including interrelation between accident management and emergency planning

Peer review of 2016 concluded that there are reasonable human and technical resources for execution of actions of accident management and emergency planning. Initial and periodic refresher training is in place, which include emergency drills with adequate frequency, simulating conditions of potential emergencies caused by external natural hazards and radiologically harsh conditions in case of a severe accident. Operating personnel participates in monthly emergency training as preparation for non-standard situations.

The actions towards improvement of organization and arrangements of the licensee to manage accidents resulting from the peer review of 2016 were focused on the following:

- Implementation of measures to increase habitability of the rooms with post accident monitoring system and emergency shutdown panel,
- Ensuring quick on-site availability of rescue teams and adequate equipment to provide support in case of emergency,
- Revision of off-site exercise programmes to increase their scope to cover simultaneous occurrence of accidents and serious damage of external infrastructure,
- Performing longer-term exercises to reflect the challenges of extreme external hazards,
- Deployment of early warning system with 20 detectors around the ANPP and JRODOS software,
- Establishment of a new back-up emergency response centre for ANRA with back-up power and communication lines.
- Establishment of a new back-up emergency response centre for ANPP, with back-up power and radiological filtering,
- Reviewing and updating national, regional, provincial, municipal and local emergency plans and conducting exercises to encourage greater coordination among the different organizations.

The present review concluded that the majority of the actions were successfully implemented across many areas associated with severe accident management. It is noted that the ANRA Emergency Response Center is progressing with acceptable time delays. Significant delays (about 3 years) are being encountered in the implementation of a new back-up Emergency Response Center of the ANPP and actions should be taken to accelerate its implementation.

Procedures and guidelines for accident management

Significant progress in the area of EOPs and SAMGs has been made since 2016. The symptom based EOPs and SAMG packages covering the full-power and low-power reactor operating modes as well as accidents in the spent fuel pool have been developed and validated, and the packages for shutdown modes are under development. The scope and format of the EOPs and SAMGs correspond to modern procedures developed for other VVER and PWR reactors. Development is based on relevant accident analysis. According to the current licensing conditions, full implementation of the EOPs and SAMGs should be performed by 2021. The current progress provides a good basis for achieving this goal. The

Peer review team appreciates the progress made in this area and encourages the plant to further accelerate the implementation.

The procedures for open reactor conditions should be developed and implemented. Due to the ongoing process of safety upgrading of the plant, regulatory approval of any relevant change in plant configuration should be reflected by parallel updating the SAMGs in order to ensure consistency of the plant configuration and the procedures.

Hardware provisions for severe accident management

Peer review report of 2016 identified several provisions with potential to be used in accident management, for both prevention and mitigation. At the same time, several new hardware improvements were proposed as essential means for effective prevention and mitigation of severe accidents. Implementation of these measures was scheduled in NAcP for 2019-2020, except for improvement of containment tightness, scheduled for 2022.

Implementation of some hardware provisions is either done (such as enhancement of the containment spray system) or is progressing satisfactorily (such as enhancement of the ECCS). Several other measures are significantly delayed, such as improvement of containment tightness, mitigation of hydrogen risk inside the containment as well as hydrogen propagation outside the containment, measures to provide for molten corium stabilization by external reactor vessel cooling, or emergency gas evacuation from the reactor vessel head.

Implementation of measures to allow for using mobile means for delivery of coolant to the SGs, to the primary circuit and to the containment, should continue as intended. In addition, it is advisable to consider implementation of additional, dedicated means of the reactor coolant system depressurisation under severe accident conditions.

Improvement of containment tightness should be given high priority and implementation of the relevant measures should be accelerated. Every effort should be made to implement measures to ensure effective minimization of radioactive releases, including cooling or flooding of molten corium inside or outside the vessel, and washing out fission products by means of spraying of the containment atmosphere using permanent or mobile means.

Accident management for events in the spent fuel pools

At the time of the peer review of June 2016 the team found the measures to prevent or mitigate accidents in the SFP as inadequate. It was recommended to perform analysis of SFP 1 and 2 cooldown and based on the results to determine additional measures for compensating loss of coolant from the pool. In response to this recommendation, adequate conservative calculations were performed in the frame of development symptom based EOPs for the pool to determine time margins to fuel uncovery in the SFP. Several possibilities were identified for delivery of sufficient flow of coolant using on-site resources to prevent boiling of coolant in the pool. The item of the original action plan is considered as completed. However, the ANPP should be encouraged to implement additional mobile means for compensating loss of coolant from the pool as already planned and to consider further enhancement of instrumentation of the SFP..

5 SCHEDULE FOR IMPLEMENTATION, TRANSPARENCY AND COMMENDABLE ASPECTS

5.1 The schedule of the implementation of the NAcP

The NAcP indicates the status for each activity and the year for implementation. The status of the activities range from planned, to on-going, in progress and completed. The difference between on-going and in progress is unclear.

Measures that only require internal operational planning or organization have been implemented in many cases. However, a number of improvements important to safety are only at an early planning stage, some of these will require a great deal of work to complete. In such instances the NAcP provides little or no information on the expected completion date and it is only stated that the implementation of the measure is planned. However, during the country visit in some instances the schedule for implementation was clarified.

The preparation and approval of concepts can take several years, the implementation of the mostly complex technical improvement actions resulting from these concepts can be expected to take several years.

ANPP is focusing on delivery of the physical improvements required to support the funded LTE program, which government decree is influencing delivery of by April 2021, to support the future licensing decision for the ANPP. ANRA is awaiting a single integrated program of work from the ANPP that covers both LTE and NAcP activities. The peer review team believes that this should be provided as a matter of priority, with safety improvements from the NAcP also classified according to their safety significance to ensure that they are implemented in a timeline commensurate with their classification. This is especially important for complex and time-consuming back-fitting measures such as earthquake strengthening to a PGA_H of 0.42 g.

5.2 Transparency of the NAcP

There are several activities organized by Armenian side which could be considered as demonstration of transparency. First of all, it is their willingness to take part in the stress test exercise and to be subjected to several peer review missions, with various reports being readily available on ANRAs website.

Armenia has invited various international missions, mainly organised by the IAEA. Another sign of ANRA and the ANPP demonstrating awareness in nuclear safety are invitations for various international missions (mostly organized by IAEA) and technical/bilateral co-operations with agencies and national regulatory bodies.

ANRA has developed a communications plan and has sought to engage better with the public and mass media, holding a number of events, but these have had very limited impact, the peer review team was advised that they generated little interest and attendance was limited.

The team found no evidence of work to communicate the content of the NAcP to the public or media, and it is not available on the ANRA or ENSREG websites. The team believes that the NAcP and the subsequent integrated programme should be published on the ANRA website and closely monitored by ANRA to ensure that the relevant milestones and completion dates are achieved.

5.3 Commendable aspects (good practices, experiences, interesting approaches) and challenges

It is clear that enhancing the design of the ANPP is a very challenging task. It is recognised that in spite of limitations, Armenia has made progress in the safety enhancement of the plant and this progress has been made under conditions when, due to peculiarities of the design, the option to utilization of the international experience were quite limited. For the same reason, applicability of lessons learned in Armenia for other designs is limited.

6 PEER-REVIEW CONCLUSIONS

The peer review was undertaken against the NAcP of Armenia, issued in 2017, and the latest NAcP update provided in 2019. A number of other supporting references were also considered to aid the review, including the National Stress Test Report of Armenia (2015) and the subsequent ENSREG Peer Review Report (2016).

The peer review team aligned its work against the 3 topic areas of the ENSREG Stress Test process:

- Natural Hazards
- Loss of Safety Systems
- Severe Accident Management

The peer review team confirmed the adequacy of the structure and content of the NAcP and considered the timeline for implementation of the identified improvements. This was done on a systematic basis, initially focusing on those areas considered by the team to address the more significant higher priority recommendations and actions.

The comments of the peer review team against the specific items in the NAcP of Armenia are contained in Appendix A of this report, with a summary view for each topic area provided in Section 4. The major overall conclusions of the team are:

1. The NAcP of Armenia was developed in accordance with the structure suggested by ENSREG; it identifies all recommendations arising from the Armenian NR, ENSREG Stress Test Peer Review Report and other relevant documents.
2. The review of the NAcP has confirmed that there is a significant amount of work still to be completed at the Metsamor NPP to implement the physical improvements necessary to address the actions emerging from the application of the stress test process.
3. Funding to deliver NAcP safety improvements is limited and needs to be secured to ensure they are implemented in a timely manner.
4. ANRA should ensure that all safety improvements from the NAcP are classified according to their safety significance and implemented in a timeline commensurate with their classification.
5. An integrated plan should be developed to implement the safety improvements required by the stress test NAcP, the continuous safety upgrade program and those associated with the Life Time Extension of the ANPP.
6. Certain improvements are considered by the peer review team as higher priority and should be progressed accordingly:
    - Completing the seismic upgrade of the ANPP to 0.35g and further to 0.42g. In this context the present SSEL has to be extended to include a much more comprehensive list of SSCs as detailed in Section 4.

- Undertaking comprehensive seismic walkdowns to identify and eliminate significant weaknesses in the plant´s hazard withstand capability.
- Developing the overall concept and technical solution to address SBO event.
- Implementing symptom based EOPs and SAMGs, including effective actions to reduce radioactive releases in case of severe accident, in particular improvement of containment tightness, washing out fission products and stabilising the molten core.

7. Overall the team recognizes that significant efforts have been undertaken since 2016 and good progress has been made to protect the installations from external hazards.
8. The NAcP and the subsequent integrated programme should be published on the ANRA website.

The peer review team recommends that ANRA should consider points 1 to 8 above and seek to address them, as well as considering the evaluations of the PRT set out in the Appendix of this report which will support effective implementation of the NAcP.

The ENSREG stress test and associated peer review process encourages national regulators and utilities to undertake a self-assessment of their NPPs and to identify and implement enhancements to secure improvements in nuclear safety performance of the NPP. In accordance with agreed ENSREG principles, Armenia continues to be open and transparent in relation to all matters associated with the ENSREG Peer Review process, including developing and producing the requisite reports and making them publicly available and has also committed to place the National Action Plan on its website.

ANRA, NRSC and ANPP were supportive of the peer review team and sought to aid the team in its understanding of the situation in Armenian. The peer review team is grateful to the Chairman and staff of ANRA and the other support organisations of Armenia for their help and support in facilitating a very constructive and successful peer review of the Armenian NAcP.

• APPENDIX

PRT Assessment of Armenian National Action Plan

1. Earthquake

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
6.1.0 (PRT ch. 5.1.3. p. 23)	The PRT concluded that *"Comprehensive national regulatory requirements for seismic safety (as well as other hazards) are currently [as in 2016] not available and should be developed considering the WENRA (2014) Reference Levels to strengthen the regulatory position and oversight."* **<u>Task:</u>** Develop comprehensive national regulatory requirements for seismic safety considering the WENRA (2014) Reference Levels	This action has a **high priority**. **Implementation:** A new atomic law is currently under development in parallel with Armenia's national activities of harmonization with EU directives. ANRA announces that the new law will take the new Czech regulations as a model, which is in line with EU and WENRA requirements. The action should to be completed 2022-2023. **Evaluation:** The action is not included in the NAcP although it was proposed in the Stress Test County Report (page 23). Seismic safety evaluations so far follow the latest IAEA Safety Standards and advice which ANRA regards as the basis for regulatory activities. The use of these documents widely compensates comprehensive national regulatory requirements for seismic safety (as well as other hazards), which are not available. It is recommended that national regulations should be developed to strengthen the regulatory position and

[1] The brackets indicate the sources of the respective action. Thereby means:

- NR: National Report - Stress Test for Armenian Nuclear Power Plant - July 2015,
- PRT: EU Peer Review Report of the Armenian Stress Tests" - June 2016,
- EU: ENSREG "Compilation of Recommendations and suggestions - Peer review of stress tests performed on European nuclear power plants", 26/07/2012
- CNS: Final Summary Report - 2nd Extraordinary Meeting of the Contracting Parties to the Convention of Nuclear Safety, 27-31 August 2012, Vienna, Austria
- NAcP: Number of Recommendation of the National Action Plan of Armenia (NAcP), Part I and II, 2017
- ch: chapter or number
- p: page

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
		oversight. At the background of the importance of seismic hazards for the overall safety of the ANPP the PRT recommends ANRA to adopt the approach to external hazards including seismic as described by WENRA (2014), which have been implemented in the national regulations of virtually all WENRA countries, and the associated guidance documents (WENRA 2015; 2016). It is also recommended that the legal framework is in line with the Nuclear Safety Directive (NSD, directive 2009/71/EURATOM and its amendments), the Vienna Declaration on Nuclear Safety (VDNS) and the latest versions of relevant IAEA Safety Guidelines and Tecdocs. Where there are no national regulations existing the respective latest WENRA or IAEA documents should be applied. This approach should be made legally binding by the new Atomic Law. WENRA, 2014. Safety Reference Levels for Existing Reactors, Issues E, F and T; WENRA, 2015. Guidance Document Issue T: Natural Hazards. Guidance Head Document; WENRA, 2016. Guidance Documents Issue T (Seismic, External Flooding and Extreme Weather)
6.1.1. (NR p 150, NAcP 2.1.1)	Application of a combination of deterministic and probabilistic safety assessment to continue further seismic enhancement and identification of systems and components that may require further seismic improvement. **Task*:*** ***To determine the probability of the reactor core damage due to seismic effects.*** In 2015, in frame of implementation of the recommendations of the OSART mission (project A1.01/09F), the "Seismic PSA Level 1 based on new seismic hazard curves (with a probability of 10^{-1} to 10^{-7})" was revised. In frame of the revision of the seismic PSA, the human factor	This action has **high priority**. **Implementation:** ANRA, supported by NRSC and representatives of ANPP, declared that presently the ANPP copes in most SSCs important to seismic safety (the entire SSEL) with a PGA_H of 0.35g, except fire-fighting system, and SSCs which, upon their seismically induced failure, can impair the functionality of SSCs important to safety. Based on the PSHA carried out 2009 - 2011, the hazard level PGA_H = 0.42g will be considered as a new RLE(1) in review of the future seismic PSA. ANPP developed a program to upgrade the seismic robustness to PGA_H = 0.42 g and submitted this program to ANRA. ANRA decided to let this program be reviewed by IAEA and received a statement by IAEA in 2019.

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
	was taken into account and the secondary consequences of the earthquake were considered: fires and flooding. The seismic PSA was also reviewed by the IPSART mission, during which a number of recommendations were made. All recommendations were implemented and reflected in the final report. According to the results of the final report, the total frequency of the reactor core damage is $1.39x10^{-5}$ r/year, while there is no seismic interval for which the CDF is greater than $1.0x10^{-5}$ r/year. The measure has been implemented for the existing configuration of the unit systems. After the implementation of the planned measures to improve the NPP safety of in the framework of the LTE, it is planned to revise the PSA in 2022. The measure is planned to be implemented.	An extended SSEL is under preparation by ANPP. This extended SSEL shall contain, besides the old SSEL, among others, SFP cooling of Unit 1, the fire-fighting system, I&C, and SSCs which, upon their seismically induced failure, can impair the functionality of SSCs important to safety. The list shall also include storages for mobile equipment required for crisis management. The extended SSEL shall be completed and submitted to ANRA in 2020. A PSA on the basis of PGA_H = 0.42 g and the updated SSEL will be completed until 2022. PSA results will be used to validate the selection of the SSCs being part of the extended SSEL. The hardware upgrade of the new extended SSEL to PGA_H = 0.42 g is planned to start in 2021. ANRA expects completion of the backfitting in 2024 provided that the updating program is approved early in 2020. **Evaluation:** Earthquake can have a major impact on safety and the risks associated with the plant (CDF). Seismic safety is principally determined by the weakest component within a safety train. It is therefore highly important that **all** SSCs of the SSEL are completely updated to cope at least with a PGA_H = 0.35 g. To save time and money the upgrade of SSCs which are presently not resistant to 0.35 g shall directly be updated to cope with PGA_H = 0.42 g, which result from the latest PSHA. The PSHA carried out from 2009-2011 showed that SSCs important to safety should be designed against PGA_H = 0.42 g. According to ANRA's regulatory decision PGA_H = 0.42 g now is the basis for the reassessment and backfitting. However, this level of seismic robustness is currently not achieved. Seismic robustness of the ANPP significantly improved in the past. However, since the PSHA 2011 has been available at the latest, it has become known that a PGA_H = 0.42 g must be mastered for a seismic design (RLE) considered appropriate today. It is not sufficient to consider this PGAH only as a basis in review of the seismic PSA. It must also be the basis for the reassessment and backfitting of all safety relevant SSCs.

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		Sufficient seismic robustness is only given if **all** seismically important SSCs of the new extended SSEL can cope with a PGA_H = 0.42 g. Among others, also the following components are to be included: SFP cooling of Unit 1, the fire-fighting system, I&C, and SSCs which, upon their seismically induced failure, can impair the functionality of SSCs important to safety. The verification and, if necessary, backfitting for the mastering of a PGA_H = 0.42 g has to be carried out without undue delay as far as this has not yet been done. The measures should be implemented as soon as possible (see also action 6.1.7). However, the PRT believes that the envisaged completion date (2024) is too optimistic as the backfitting of a large number of SSCs to such a high PGA is a complex task. (1) The PRT notes that the term RLE is not used in the WENRA Safety Reference Levels which are expected to set the framework of the future upgrading (WENRA, 2014, Issues E and T; WENRA, 2016).
6.1.2. (NR p. 150, NAcP 2.1.2)	Installation of additional fuel tank with capacity of 50–100 tons or upgrading existing tank to meet relevant seismic requirements to provide an emergency power supply for a period of 72 hours. **Task:** ***To ensure emergency power supply for a period of 72 hours.*** The reserve of diesel fuel in the oil and mazut handling facility of the ANPP makes it possible to ensure the emergency power supply to the diesels for at least 5 days. However, the oil and mazut handling facility was not qualified for RLE (PGA = 0.35g). Taking into account that the reserve tanks in the DGS building have the possibility of adding diesel fuel through the upper hatch (this scheme was used during a fire in 1982), it was decided to increase the seismic stability of the existing diesel	**Implementation:** The upgrade of the existing tanks has been implemented on basis of RLE (PGA = 0.35g). Improvement of the seismic robustness on basis of a PGA=0.42g is open. Completion of the upgrade is part of the general upgrading program to increase seismic resistance of ANPP to 0.42 g (see Action 6.1.1.). **Evaluation:** The safe fuel supply of the plant and the prevention of fuel fires after a severe earthquake are of high safety importance. Therefore the qualification of the oil handling facility for RLE (PGA = 0,35g) represents a considerable improvement in safety. ANRA explained that mazut is not used anymore. Tanks are empty, no actions are required for this issue. Because of their safety importance these facilities should be classified as safety important in respect to earthquake to fulfil their function safely up to a PGA = 0.42g.

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	fuel reserve tanks by 200 and 300 m^3 (B-15, B-16). The following measures have been performed to implement the decision: • The foundations of both B-15, B-16 tanks are reinforced (identical to the fastenings of the foundations of BZOV); • Pipelines are installed on both tanks (B-15, B-16) that open into the road, which make it possible after the earthquake to deliver diesel fuel to the reserve tanks in the compartments of the DGS building; • The platform of the foundations of the tanks was cleaned, the identified deficiencies were eliminated, and the tanks were cleaned of corrosion and painted. After implementation of the above measures, "RESURS" LLC performed the strength calculations of the B-15, B-16 tanks (the verification calculation for strength №P.116.1344 and №P.116.1345). The calculations justified the seismic resistance of B-15 and B-16 tanks at RLE (PGA = 0.35g). In the framework of the LTE, an examination of the tanks was performed and a conclusion was made to extend the service life by 10 years (reports ATE.16.1344 and ATE.116.1345 2017. The measure has been implemented.	
6.1.3 (NR p. 150 PRT ch. 5.1.3, EU 3.1.2,	Seismic margin evaluation of the fire extinguishing system and implementation of measures to reinforce the system. **Task:** To ensure seismic resistance of the fire extinguishing systems. In February 2018 CKTI-Vibroseism performed the following	This action has **high priority.** **Implementation:** Implementation of the measures to upgrade the fire-fighting system to a resistance for PGA_H = 0.42 g is in progress. Calculations for the necessary upgrading have been completed. ANPP declares that the hardware upgrade shall be completed in 2021.

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
NAcP 2.1.3, 2.3.1, 2.2.5)	calculations: • Report on seismic resistance assessment of the fire system. Part 2 (general) №02-02/002. AAEK PU-16; Appendices of the Report №02-02/002. AAEK PU-16: • Appendix №1 SEWS; • Appendix 2a. Analysis of boundary seismic resistance of underground pipelines of water and foam fire extinguishing systems. № 02(1)-02/002. AAEK-PU-7/16; • Appendix 2b. Analysis of the boundary seismic resistance of reinforced concrete tanks of the water and foam fire extinguishing system of the ANPP unit №2. №02 (2)-02/002.AAEK-PU-7/16; • Appendix 2c. Analysis of the boundary seismic stability of the foam fire extinguishing systems pipelines of the pumping station of II lift of the ANPP Unit №2. №02(3)-02/002.AAEK-PU-7/16; • Appendix 2d. Analysis of boundary seismic resistance of the water fire extinguishing pipelines in RDES of the compartments I, II, III of the ANPP unit №2. №02(4)-02/002. AAEK-PU-7/16; • Appendix 2e. Analysis of the boundary seismic resistance of the air collectors B-4 of the foam fire extinguishing systems of the pumping station of the second lift, the ANPP Unit №2. №02(5)-02/002. AAEK-PU-7/16; • Appendix 3. Seismically qualified equipment and pipelines;	**Evaluation:** The fire extinguishing system has a high safety relevance. The fire-fighting system is currently not qualified for seismic loads. Backfitting of the hardware will be made to PGA_H = 0.42 g. It is appreciated that the verifications shall be provided directly for PGA_H = 0.42g.

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
	• Appendix 4. Seismically non-qualified equipment and pipelines; • Appendix 5. Comments and recommendations. Sketches and drawings for seismic reinforcements. The seismic resistance of the fire protection system was assessed for seismic impact with PGA=0,47g. The assessment of the boundary seismic resistance (HCLPF) of 483 elements of equipment and pipelines of the fire system based on operating experience (sheets SEWS and SVDS) and the calculations results of 16 elements was performed. According to the above mentioned analyzes, 451 elements of the fire system received the status of seismic qualification, and 32 elements did not receive the status of seismic qualification. 5 out of 32 elements is a replacement or test of the relays RP-252, the relays RP-256 and RP-352 are already qualified as earthquake-resistant according to the testing results on the ASE-3T vibration stand. For other recommendations, a schedule of measures for seismic strengthening of equipment and pipelines of the fire protection system has been developed, which is in the process of review and approval. According to the above mentioned analyzes, taking into account the implementation of the proposed recommendations, the seismic resistance of the fire extinguishing system at RLE (PGA = 0,42g) is ensured. The implementation of measures is planned for 2019-2020. The measure is in the process of implementation	

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
6.1.4. (NR p. 150, NAcP 2.1.4)	Analysis of impact of explosion of the nitrogen recipients and the hydrogen storage tanks **Task**: To determine the consequences in case of explosion of nitrogen recipients and hydrogen tanks. The analysis of damages in the event of an explosion of nitrogen recipients and hydrogen storage tanks was performed by the NRSC in 2016. According to the analysis performed, there could be a risk of damage to the windows of the DGS compartment 1 on the western side. In the compartment 1 of the DGS (on the western side of the room) DG-1 is located, which is not functional and is not part of the reliable power supply systems. DG-4 is located in the eastern side of the room of the compartment 1, which is involved in the DAR system. Damage to the windows of the western side of the first compartment of the DGS can affect only DG-1. To perform a detailed analysis, a tender will be announced in June 2019. The measure is in the process of implementation.	**Implementation:** To perform a detailed analysis it was originally planned to announce a tender in June 2019. The announcement is now postponed to 2020. The new timeline is to include the financing of the measure in the financing plan for 2020. The completion date of upgrading measures which might become necessary according to the analysis is open. **Evaluation:** Explosions of this type (in particular of hydrogen tanks) must also be carefully investigated if only SSCs with low safety significance are affected, since consequential damage may trigger additional safety risks that are not immediately apparent.
6.1.5. (NR p. 150, NAcP 2.1.5)	Investigation of possible consequences in case of seismic induced flooding in Turbine Hall (TH), impact of safety-related systems in TH and their interaction with adjacent compartments. **Task*:*** To determine the possibility of damage to the safety system	**Implementation:** Deepening of the overflow channel has been implemented. The investigation of possible consequences in case of seismic induced flooding in Turbine Hall is completed and submitted to ANPP. It is under review. The recommendations of the report will be implemented in 2020. **Evaluation:**

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
	in the turbine hall. The analysis of the possible consequences of water entering the turbine hall due to seismic impact was performed in 2015. Based on the analysis results, the measures described in the points 6.1.17-6.1.19 of the National Plan were developed and implemented in 2016. In addition to these events, two more measures were implemented, namely: • To exclude water penetration from the circulating channel to the turbine hall, the southern side of the lower (outlet) channel of the circulating water, in the area between DGS building and TPK, is cut to a depth of 40 cm and a length of 50 m. When the water overflows from the upper channel to the lower, water through the cut-out aperture will flow down a slope in a southerly direction, enters the road and then beyond the NPP industrial site; • An item was added to the operating manual of the ANPP PLK: "when a large amount of water enters the minus mark of the turbine hall (-3.6 m), the PTK operator opens the lid of the sewage system of oiled waters near the TPK building (last hatch)." Since the geodetic level of the cover of the last hatch is 38-40cm above the floor of the minus mark (-3.6) of the turbine hall, water from the sewage of oiled waters will flow out of the hatch and will further leave the ANPP industrial site along the slope in a southern direction. At the same time, the level at the minus level of the turbine room will not exceed 40-50 cm, which cannot lead to equipment failure in the turbine hall. For the final resolution of the problem, a contract was	Seismic induced flooding of the turbine hall endangers adjacent safety-relevant compartments and therefore considerably increases the nuclear risk emanating from earthquakes. Flooding therefore must be prevented by appropriate precautionary measures. The the necessary hardware upgrades resulting from the study should be implemented without undue delay, latest in 2020.

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
	concluded with NRSC to perform justification calculations for the above mentioned.	
6.1.6. (NR p.150, EU 3.1.5 NAcP 2.1.6, 2.3.2)	Completion of the program for seismic upgrading of I&C equipment and seismic monitoring system. **Task:** ***Modernization of seismic monitoring systems.*** A package of documents for the tender has been prepared. Three proposals were received for determining the cost of work. At present the cost of the work clarified to announce the tender. The measure is in the process of implementation.	This action has **high priority**. **Implementation seismic monitoring:** In the frame of the seismic monitoring network the surrounding of ANPP is monitored by six stations in 50 km radius. Data is provided to ANRA and ANPP. ANPP is further equipped with a seismic recording system which includes two independent channels, each consisting of 3 stations. The system automatically generates SCRAM in case ground acceleration exceeds 50 cm/s² (0.05 g). The seismic monitoring system of ANPP is currently out of operation and renewal of the system is planned for 2021. The terms of references are available to ANRA. **Implementation upgrading I&C:** ANRA supported by ANPP declare that currently all parts of I&C are qualified for seismic loads of 0.35 g. In the course of upgrading the seismic resistance of ANPP to PGAH = 0.42 g I&C components are to be upgraded as well. A list of I&C system will be prepared parallel to the development of the extended SSEL list (see Action 6.1.1.). This action and upgrading of the I&C hardware will be completed in accordance with Action 6.1.1. **Evaluation ANPP seismic monitoring system:** ANPP requires sufficient and reliable ground motion data. Such data are important for monitoring local ground acceleration and for developing advanced programs for seismic protection. **Evaluation I&C upgrade:** The seismic robustness of I&C equipment is important for the safe function of the entire plant in case of a seismic event. An appropriate seismic upgrading to cope with a PGA=0.42g is therefore necessary.

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		See also remarks to Action 6.1.1.
6.1.7. (PRT ch. 5.1.2.4, NAcP 2.2.1)	Safety demonstration of adopted hazard value of 0.42 g derived from the PSHA 2011 as an updated DBE for the existing ANPP shall be updated accordingly. **Task:** A "Program for seismic safety evaluation of the ANPP Unit №2 during earthquake at RLE with PGA=0,42g" was developed (UB.ATD.17.OSB-001). The program is submitted to ANRA for review. The implementation of the program is envisaged after ANRA's approval. The implementation of the measure is planned	This action has **high priority**. **Implementation:** The seismic robustness of the plant has been continuously improved in recent years. In particular most of the SSCs of the SSELs now cope with PGA_H of at least 0.35 g (see Action 6.1.1). However, the PSHA 2011 showed that the safety-critical SSCs of the plant should be designed against PGA_H of 0.42 g. According to ANRA's regulatory decision PGA_H = 0.42 g now is the basis for the reassessment and backfitting of SSCs important to safety. ANRA informed that an upgrading program has been prepared by ANPP and submitted to ANRA that an extended SSEL is currently under development. It is expected to be submitted to ANRA for approvement in 2020. This extended SSEL will contain, besides the currently valid SSEL, among others, SFP cooling of Unit 1, the fire-fighting system, I&C, and SSCs which, upon their seismically induced failure, can impair the functionality of SSCs important to safety. ANRA expects completion of the backfitting in 2024 provided that the updating program is approved early in 2020. **Evaluation:** The seismic robustness of ANPP has been continuously improved in recent years. In particular, the SSCs of the currently valid SSEL can now cope with a PGA_H of at least 0.35 g. The PSHA 2011 showed that the safety-relevant SSCs of the plant should be designed against a PGA_H of 0.42 g. This level of seismic robustness is currently not achieved. The PRT appreciates that ANRA required a program for seismic safety evaluation of the ANPP on basis of PGA_H = 0,42 g. Meanwhile ANPP developed this program and submitted it to ANRA for approval. The extended SSEL is currently pending. ANRA has to approve the program and the extended SSEL after receiving the necessary

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		documents from ANPP. ANRA has to approve that the extended SSEL comprises **all** components important to seismic safety as described in Action 6.1.1 and that it will be implemented timely without undue delay (see also Action 6.1.1). However, the PRT believes that the envisaged completion date in 2024 is too optimistic as the backfitting of a large number of SSCs to such a high PGA is a complex task.
6.1.8. (PRT ch. 5.1.3, NAcP 2.2.2)	Verification of seismic protection of the RDGS building and computational analyses taking into account for the current status. **Task*:*** ***Determination of seismic resistance of RDGS.*** A package of documentation has been prepared and a tender has been announced for reevaluation of the seismic resistance of structural elements of RDGS. A tender has taken place. NRSC won the tender. The measures are to be completed in 2019. The measure is in the process of implementation.	This action has **high priority**. **Implementation:** The RDGS building is housing the safety relevant emergency diesel generators. The action shall ensure that the building is capable to withstand seismic events with PGA_H = 0.42 g. Necessary calculations are scheduled to be completed in 2019, upgrading of the building shall be completed in 2020, if necessary. **Evaluation:** The RDGS building is housing the safety relevant emergency diesels. The earthquake-proof design of this building has high safety relevance due to the importance of the emergency diesel in the event of an earthquake. The building must meet high seismic requirements. Basis of the verification must therefore be PGA_H = 0,42 g. The PRT suggests to apply a procedure similar to the one applied to the fire brigade building which is seen as a commendable practice. Analyses should include documentation of the status of the building as-is and quantitative calculations of its seismic resistance. Backfitting measures should be based on this firm database.
6.1.9. (PRT ch. 5.1.3, NAcP	Review the seismic robustness of all SSCs, mobile equipment, and buildings housing such SSCs or used as storages for mobile equipment required for crisis management for DB and BDB events.	This action has **high priority**. **Implementation:** Implementation of stationary SSCs, buildings housing such SSCs or used as storages for

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
2.2.3, 2.2.6)	**Task*:*** ***To ensure seismic resistance of mobile equipment intended for the BDBA management.*** The issue will be resolved after receiving mobile equipment. The implementation of the measure is planned	mobile equipment required for crisis management is covered by Actions 6.1.1 and 6.1.7. Up to now neither mobile equipment nor connection points for quick connections of mobile devices are available. Mobile equipment is foreseen to be available in 2020. The same schedule applies to connection points. **Evaluation:** The PRT recommended in chapter 5.1.3 of the Country Report *"to further strengthen the seismic robustness of the ANPP the PRT recommends to (…):* • *review the seismic robustness of all SSCs, mobile equipment, and buildings housing such SSCs or used as storage for mobile equipment required for crisis management for DB and BDB events,* • *continue seismic walkdowns as a regular conformity check including the inspection of SSCs that may damage other equipment upon their failure during a seismic event."* Particular reference was made to seismic walkdowns which are an effective instrument for quickly identifying larger deficits in the seismic robustness of a plant. It is recommended that ANRA requires that ANPP performs comprehensive seismic walkdowns with respect to every single system and SSCs important to seismic safety including components, which may impair the function of seismically important SSCs upon their failure. Identified deficits should be upgraded without undue delays. Upgrades shall be made directly to PGA_H = 0.42 g. As this is a big and time consuming task the current workforce at the plant should be strengthened in order to eliminate the presently most important weaknesses as soon as possible. The PRT's recommendation was to take a comprehensive approach to the seismic robustness of the entire plant. It should be made clear that all stationary SSCs, mobile equipment and buildings required for emergency management remain operational, including the case of earthquake. The PRT did not intend to limit the review to the

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
		mobile devices. With regard to earthquake all SSCs, mobile equipment, and buildings housing this equipment and SSCs shall be resistant to PGA_H = 0.42 g after implementation of Action 6.1.1 and 6.1.7. Until these actions are fully implemented, seismic walkdowns can help to identify obvious deficits and thus quickly contribute to a balanced seismic design of the entire facility. With regard to BDB (DEC), mobile equipment is more important. Availability, transportation and possibilities to connect equipment must be ensured even in a large-scale emergency situation. This also concerns safe storage, the availability of transport options, access to the plant and the availability of suitable connection points (cooling water, electricity, fuel) accessible from outside. The question of the earthquake resistance of the mobile equipment itself is less important, since a comparatively high earthquake resistance can be assumed for the mobile equipment if it corresponds to elevated industry quality, which is assumed here. The recommendation - as intended by ANRA - to reduce this action only to the seismic robustness of mobile equipment for the mitigation of BDB earthquake impacts therefore falls short. The PRT notes that 8 years after the accident of Fukushima, the use of mobile equipment is still not guaranteed due to a lack of equipment. The procurement of the necessary mobile equipment has not only in respect to earthquake high priority.
6.1.9A (PRT ch. 5.1.1.4. p. 19 PRT ch.	The PRT suggested complementing the PSHA 2011 by reviewing (1) Mmax and (2) assessments of active faults which are located close to the site (Sardarapat, Northwest, Yerevan Fault).	The action is not included in the NAcP although it was proposed in the Stress Test County Report (page 23). **Implementation:** In a written reply to questions raised by the PRT, ANRA stated that it regards this issue solved by the assessment of uncertainties of the main parameters for the mentioned

Action (Source[1]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
5.1.3. p. 24)	**Task:** Review critical input parameters of the PSHA 2011 (maximum magnitude, fault parameters)	faults, developing alternative seismotectonic models, applying logic trees and performing sensitivity analysis. ANRA explains that NORATOM performed additional field investigations on these faults after completing the PSHA 2011. These investigations were initiated upon recommendations by IAEA experts. **Evaluation:** Stress Test County Report (page 23) the PRT explained the importance of the assumed maximum magnitudes (Mmax) and fault parameters for the reliability of hazard assessments. The PRT found these issues satisfactory addressed in studies completed after the PSHA 2011.

2. Volcanism

Action (Source[2]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
6.1.10 (PRT ch. 5.4.2.4, 5.4.3 NAcP 2.2.4, 2.2.8, 2.2.10)	Establish design bases for ballistic projectiles and tephra fallout, i.e., those volcanic phenomena for which protection is possible. Some effects of tephra fallout (loading of structures, effects on ventilation) may be enveloped by protection against other hazards (snow load, protection against dust storms). **Task*:*** ***To determine the negative consequences at ANPP during tephra fall.*** In 2018, a tender was announced for the implementation of this measure. NRSC won the tender. A contract №03/037 dated 19.09.2018 was concluded between ANPP and NRSC. The measure is planned to be completed by 15 December 2019. The measure is in the process of implementation	**Implementation:** ANPP completed a report on the possible impact of volcanic hazards on ANPP. The report is in accordance with IAEA SSG-21 and includes assessments of the contribution of volcanic hazards to CDF. The report will be submitted to ANRA for approval in 2019. As a result filters for the air intake of the EDGs will be installed to prevent blocking by tephra or volcanic ash (see action 6.1.21). **Evaluation:** The PRT regarded it important to determine the existing protection and to further improve protection of the plants against volcanic effects against which protective measures are possible. The implementation of this action is the responsibility of ANPP and must be monitored and evaluated by ANRA. CDFs have been calculated for all possible volcanic hazards showing that the contribution of volcanic hazards to CDF is about 10^{-6} per year.

[2] The brackets indicate the sources of the respective action. Thereby means:

- NR: National Report - Stress Test for Armenian Nuclear Power Plant - Juli 2015,
- PRT: EU Peer Review Report of the Armenian Stress Tests" - June 2016,
- EU: ENSREG “Compilation of Recommendations and suggestions - Peer review of stress tests performed on European nuclear power plants”, 26/07/2012
- CNS: Final Summary Report - 2nd Extraordinary Meeting of the Contracting Parties to the Convention of Nuclear Safety, 27-31 August 2012, Vienna, Austria
- NAcP: Number of Recommendation of the National Action Plan of Armenia (NAcP), Part I and II, 2017
- ch: chapter or number
- p: page

6.1.11 (PRT ch. 5.4.2.4, 5.4.3 NAcP 2.2.4) **6.1.12** (PRT ch. 5.4.2.4, 5.4.3 NAcP 2.2.4)	**6.1.11.** ANPP to develop response plans/procedures to respond to potential volcanic activity at Ararat, Aragats, and the Shamiram plateau **6.1.12.** To develop monitoring measures of these capable volcanoes in the framework of the national civil protection programs **Task*:*** ***Establishment of volcanic hazard monitoring system for ANPP.*** To implement the above mentioned tasks, ANPP with the letter №E/15/1312-18 dated 01 October 2018 turned to the Ministry of Energy Infrastructures and Natural Resources of the Republic of Armenia with a request for the involvement of the Ministry of Emergency Situations in implementation of the measures. A preliminary deadline for the development of the necessary documents is planned for 2020. The implementation of the measure is planned	**Implementation:** Action 6.1.11 will implemented together with action 6.1.10, Action 6.1.12. will be implemented in the context of the development and updating of the national civil protection programs under the responsibility of the Ministry of Emergency Situations of the Republic of Armenia. **Evaluation:** Monitoring measures shall be established to provide sufficient warning time for volcanic hazards and to initiate the timely shutdown of ANPP, if regarded necessary. Response plans shall be developed considering the results of investigations carried out in Action 6.1.10. They are part of the precautionary measures to be taken against volcanic hazards by ANPP. The development and updating of the national civil protection programs are a governmental task. In the case of Armenia these programs should also comprise monitoring measures of the relevant capable volcanoes and the necessary protection measures against volcanic hazards.

3. Flooding

Action (Source[3]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
6.1.13. (NR p. 151, PRT ch. 5.2.3, EU 3.1.3 NAcP 2.1.7, 2.2.7, 2.3.3)	Equip the emergency doors of the staircases of DGS basement areas with a border to ensure that water ingress to the basement can be excluded. **Task*:*** ***To exclude ingress of water in the basement compartments of DGs from the outside.***	**Implementation:** All the stairwells of emergency doors of the DGS basement have been protected with 20 cm-high concrete borders. According to the calculations, in case of heavy rain fall the water level at the DGS site would be maximum 15 cm high. Borders with height of 20 cm would exclude the ingress of rainwater into the DGS basement compartments. This action has been completed in 2016. **Evaluation:** This action is in general in line with the PRT recommendation. Based on the site visit, the PRT concludes that the action can be closed.
6.1.14. (NR p. 151, PRT § 5.2.3, NAcP 2.1.7, 2.2.9)	Foresee mobile equipment devoted to water pumping out from DGS and its basement. **Task*:*** ***To exclude flooding of the DGS basement compartments.*** Equip DGS with alarms indicating occurrence of water level	**Implementation:** According to the original design, only a passive (gravitational) drainage system with not alarm was in place in the DGS building. New fixed GNOM pumps have been installed into each EDG compartment with new water level measurement and corresponding alarm in main control room.

[3] The brackets indicate the sources of the respective action. Thereby means:

- NR: National Report - Stress Test for Armenian Nuclear Power Plant - Juli 2015,
- PRT: EU Peer Review Report of the Armenian Stress Tests" - June 2016,
- EU: ENSREG “Compilation of Recommendations and suggestions - Peer review of stress tests performed on European nuclear power plants”, 26/07/2012
- CNS: Final Summary Report - 2nd Extraordinary Meeting of the Contracting Parties to the Convention of Nuclear Safety, 27-31 August 2012, Vienna, Austria
- NAcP: Number of Recommendation of the National Action Plan of Armenia (NAcP), Part I and II, 2017
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Action (Source[3]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
6.1.15. (NR p. 151, NAcP 2.1.7) **6.1.16.** (NR p. 151, NAcP 2.1.7)	in basement area with output of light signals in MCR, central control panel and DGS operator room. Develop a procedure for operators for the case of water inflow in the DGS basement area.	The plant has put additional fixed means in place to reduce the likelihood of water accumulation in the DGS basement and this improves the situation. However, mobile water pumping means are not yet in place. **Evaluation:** The following was clarified during the plant visit: − The GNOM pumps are fixed pumps, therefore it does not exactly answer to the PRT recommendation "to provide mobile pumping means". − The water level detection uses a non-redundant electrode per EDG compartment and could be easily damaged by inadvertent bumping. − 1 pump installed per EDG compartment. − GNOM pumps have to be manually actuated from the DGS basement, i.e. from the area that the pump is protecting. It is not clear whether the accessibility of this area is guaranteed in case of flooding. − The plant has plans to supply mobile water pumping means. Although the provision of the new fixed GNOM pumps and the associated water level detection are obviously positive, the PRT notes that the robustness of this system could be improved. The PRT concludes that these actions do not allow yet to close its 2016 recommendation. In line with the ENSREG stress tests generic recommendations, the PRT recommends to ensure that adequate mobile water pumping means are available in a timely manner, as an ultimate and flexible mean to protect the site. In the meantime, the PRT recommends to ensure the readiness of the fire brigade means to pump water from flooded areas as necessary (including demonstration of feasibility and drills).

Action (Source[3]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
6.1.17. (NR p. 151, NAcP 2.1.8)	Seal the gaps to the turbine hall (TH) from the surrounding area and barriers on the way of water flow to the turbine hall gates **Task*:*** ***To exclude ingress of water in the turbine hall from the outside.***	**Implementation:** 15-20 cm high borders are made in front of all external doors to prevent ingress of water in the turbine hall. According to a recent study, this border height is sufficient to cope with flooding caused by rainfall corresponding to a 10^{-5}/year non exceedance probability. This action has been completed in 2016. **Evaluation:** During the plant visit it was clarified that one large door has at the moment a lower border due to temporary operational reasons. Water ingress through this TH door was conservatively considered in the study and it was demonstrated that it does not lead to any impact on safety. Another potential pathway was observed without protective border, but as it leads to a large spreading surface the study concluded that due to high absorption potential of the soil, water would penetrate the soil without water ingress to the TH through this pathway. The PRT concludes that this self-identified action is in line with the NR and can be closed.
6.1.18. (NR p. 151, EU 3.1.3, NAcP 2.1.9, 2.3.3)	Replacing doors located between TH and boron unit in order to resolve the issue related to water penetration from TH to boron units **Task*:*** To exclude the ingress of water from the turbine hall into the boron room.	**Implementation:** The doors at "-3.6" elevation have been replaced by a waterproof wall. This action has been completed in 2016. **Evaluation:** This self-identified action is in line with the NR and can be closed.
6.1.19 (NR p. 151, PRT §5.2.3, NAcP	Enhancement of reliability of drainage system in order to prevent water penetration from TH to cable tunnels **Task*:*** ***To prevent the likelihood of water ingress from the turbine***	**Implementation:** In the existing design, the cable tunnels at around "-2.0" elevation are sealed and sewerage pipes from these tunnels in the turbine are equipped with check valves to prevent potential water ingress from the basement of the turbine hall to the tunnels.

Action (Source[3]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
2.1.10, 2.2.8, 2.2.10)	***hall into cable tunnels.***	To complement this, a procedure has been written to solve any unexpected water accumulation in the cable tunnel. This action is completed. **Evaluation:** this self-identified action is in line with the NR.
6.1.20. (NR p. 151, EU 3.1.7 NAcP 2.1.11, 2.3.4)	Safety margin assessment in terms of rainfall flooding of ANPP site and calculations aimed to prove that protection measures are enough to prevent impact of mudflows on ANPP systems **Task*:*** ***To perform analysis of impact of rainfall and mudflows on ANPP systems.***	**Implementation:** The topography of the ANPP area reduce the likelihood of rainfall and mudflows impact on ANPP systems. Based on this, the initial ANPP design did not include a specific analysis of the impact of rainfall or mudflows. The need for a specific analysis was concluded in the frame of the stress tests. A specific analysis was conducted and the final report is available since summer 2019. It concludes that the drainage system will fail for a rainfall corresponding to a 10^{-5}/year non-exceedance probability. For the corresponding rainfall profile, no water would enter buildings that contain safety related equipment. The analysis shows that about 22.6 m^3 of rainwater could enter the TH but without any consequence on safety. A separate analysis of mudflow scenarios has been tendered and is about to start. This study is expected to be concluded in 2021. This action is partly completed. **Evaluation:** This action is in line with the PRT recommendation. The action will be closed once the mudflow analysis will be completed and its potential consequences taken care of.

4. Extreme Weather

Action (Source[4]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
6.1.21 (NR p. 152, PRT ch. 5.3.3 NAcP 2.1.12)	Develop and implement measures aimed to protect DG from dust, including improvement of DG compartments leak-tightness and/or installation of special air filtering at DG air intake system. **Task*:*** ***To protect DG from dust at dust storm***	**Implementation:** To prevent potential dust ingress, windows and doors openings of the DGS compartments have been sealed. After some delay, in the frame of the OSA programme, Krsko NPP specialists visited ANPP to study the issue of installation of special air filters on the DG air intake system and to collect the necessary information. A draft report has been issued with recommendations on installing filters on the DG air intake line. This draft report is under discussion and is expected to be finalised around February 2020. A tender will then be launched for supply of the filter. Full implementation of the corrective actions is expected to be completed by 2021. This action is ongoing. **Evaluation:** This action is in line with the PRT report recommendation. The PRT recommends completing the remaining part of this action in a timely manner.

[4] The brackets indicate the sources of the respective action. Thereby means:

- NR: National Report - Stress Test for Armenian Nuclear Power Plant - Juli 2015,
- PRT: EU Peer Review Report of the Armenian Stress Tests" - June 2016,
- EU: ENSREG “Compilation of Recommendations and suggestions - Peer review of stress tests performed on European nuclear power plants”, 26/07/2012
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Action (Source[4]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
6.1.22 (NR p. 152, PRT ch. 5.3.3 NAcP 2.1.13)	Implement measures aimed to remove snow from TH building roof in case of snow accumulation. **Task*:*** ***To exclude the likelihood of collapse of the roof of the turbine compartment during extreme snowfall.***	**Implementation:** As part of the annual autumn-winter order covering ANPP transition to winter conditions, an action to remove snow from the roof in case of heavy snow fall has been included. Relevant plant personnel have been briefed on this topic. This action is completed. **Evaluation:** This self-identified action is in line with the NR.
6.1.23. (NR p. 152, PRT ch. 5.3.3 NAcP 2.1.14, 2.2.11)	Re-evaluation of the air temperature which could lead to freezing of outlet pipes of demineralized water tanks (BZOV). Depending on the results of this, additional measures could be necessary for protection of BZOV pipes against extremely low temperatures **Task*:*** ***To exclude the likelihood of freezing pipe at BZOV exit.***	**Implementation:** An updated assessment of the minimum temperature corresponding to a non-exceedance probability of 10^{-4}/year has been completed in 2019 and it leads to a value of -41°C. Based on this, an assessment of the robustness of the BZOV has been performed and recommendations have been issued. Accordingly, corrective actions (mainly thermal insulation and tightening of the compartment) have been completely implemented during the summer 2019 outage. This action is completed. **Evaluation:** This action in general is line with the PRT recommendation. During the plant visit, some parts of the pipes in the BZOV compartment of unit 2 were found not protected by thermal insulation and this was corrected directly by the plant.
6.1.24. (NR p 152, PRT ch 5.3.3	Check adequacy of SG emergency feed diesel pump exhaust pipe robustness against external hazards. **Task*:*** ***To exclude the likelihood of collapse of the exhaust pipe in case of strong winds.***	**Implementation:** Following the verification performed, a risk of collapse of the exhaust pipe in case of strong wind was identified. As a result, the exhaust pipe was fixed with steel cables. The end of the exhaust pipe has been covered with a fine mesh to prevent penetration of large particles in the pipe. This action has been completed in 2017.

Action (Source[4]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
NAcP 2.1.15, 2.2.12)		**Evaluation:** This action is in line with the NR and can be closed.
6.1.25 (NR p. 152, PRT ch. 5.3.3 NAcP 2.1.16)	Implement measures aimed to protect DG auxiliary systems (e.g. HVAC) against external hazards (e.g. combination of seismic and low temperatures hazards). **Task*:*** ***To protect DG auxiliary systems against external hazards.***	**Implementation:** The task has taken some delay and is scheduled to be completed after completing measures included in action 6.1.28 (FSA-NPP project). The contract for conducting PSA calculations for critical combinations of external hazard factors has been signed in autumn 2019. The report on these calculations is expected to be concluded by end 2020. Following this report, recommendations for corrective actions might be issued and (if any) they would be expected to be implemented in 2021. This action is pending. **Evaluation:** The PRT takes note of the delay and recommends completing this action in a timely manner.
6.1.26 (NR p. 152, PRT ch. 5.3.3 NAcP 2.1.17)	Implement detailed analysis for lightning impact on ANPP. **Task*:*** ***To identify possible consequences of a lightning strike at ANPP.*** This action was decided due to a lack of data to characterize precisely the lightning hazard in the ANPP region.	**Implementation:** The tender covering this detailed analysis will be announced in 2020. The contract will include a reassessment of the lightning hazard and a comparison with the lightning protections included in the design. Following the detailed analysis, corrective actions (if any) would be expected to be implemented in 2021. This action is pending. **Evaluation:** Though this self-identified action is in line with the NR, its implementation has not started yet. The PRT recommends completing this action in a timely manner.
6.1.27	Review external hazards screening process taking into	**Implementation:**

Action (Source[4]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
(NR p. 152, PRT ch. 5.3.3 NAcP 2.1.18)	account information reflected in stress-test report and PSA model for external hazards. **Task*:*** ***To revise the list of external Initiating Events for external hazards.***	Pending. The tendering has been done and the contract has been signed in autumn 2019. The contract covers updating the meteorological hazard selection process considering the info mentioned in the external hazard PSA and stress tests recommendations (10^{-4}/year non exceedance probability, in combination with the updated hazard curves as defined in action 6.1.29). This task is expected to be finalised by end 2020. This action is pending. **Evaluation:** Though this self-identified action is in line with the NR, its implementation has not started yet. The PRT recommends completing this action in a timely manner.
6.1.28 (NR p. 153, PRT ch. 5.3.3 EU 3. 1.8 NAcP 2.1.18, 2.3.5)	To complement PSA by critical combinations of external hazards identified within FSA-ANPP project. **Task*:*** ***To perform PSA calculations for critical combinations of external hazards factors.***	**Implementation:** The tendering has been done and the contract for conducting PSA calculations for critical combinations of external hazard factors has been signed in autumn 2019. This task is expected to be finalised by end 2020. Following this report, recommendations for corrective actions might be issued and they would be expected to be implemented in 2021. This action is pending. **Evaluation:** Though this self-identified action is in line with the NR, its implementation has not started yet. The PRT takes note of the delay.
6.1.29 (NR p. 153,	To review hazard curves for different hazards taking into account updated meteorological data (up to 2018).	**Implementation:** This action has been delayed. The tendering has been done and the contract for conducting PSA calculations for critical combinations of external hazards factors has been signed in autumn 2019. This task is expected to be finalised by end 2020.

Action (Source[4]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
PRT ch. 5.3.3 NAcP 2.1.18, 2.3.5)		Following this report, recommendations for corrective actions might be issued and, if any, they would be expected to be implemented in 2021. Updated hazard curves are already available for minimum temperature and rainfall in the frame of respectively actions 6.1.23 and 6.1.20. This action is pending. **Evaluation:** Though this self-identified action is in line with the NR, its implementation has not started yet. The PRT takes note of the delay and recommends completing this action in a timely manner.

5. Station black out and loss of ultimate heat sink

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
6.2.1 6.2.2 (NR ch. 7.2.4 PRT ch. 6.2.4 NAcP 3.1.1, 3.2.3)	Provision of mobile DGs for charging batteries during SBO. Implement a new electrical scheme for charging batteries from DAR system and/or the portable diesel generator. **Task*:*** ***To provide battery charging during the loss of power to NPP.***	**Implementation:** The final implementation of the activity is still pending. The technical concept and specification have been prepared. Temporary solutions as an alternative safety related measure are installed. **Evaluation:** The intended solution is appropriate to cope with the PRT recommendation. During the Peer Review Mission in 2016 it was discovered that in the case the EDG´s will

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
	In 2016, a temporary scheme for charging batteries from the DG of the physical protection system was implemented. After the acquisition of a mobile DG, the backup battery charging scheme from the DG of the physical protection system will be transferred to a portable DG. Under the EC assistance program, it is planned to provide ANPP with mobile DGs. The technical specifications have been prepared with the aim of further tendering. DG acquisition is scheduled for 2020. There is a temporary solution to the problem.	not operate (SBO) there is no option to recharge the batteries for the uninterruptible power supply consumers. Therefore, an alternative technical measure was recommended by the PRT in order to enhance the ability to recharge the batteries in case of an SBO. The EDG devoted for the physical protection system will be used as a temporary solution to provide a backup power supply to one train of the first category uninterruptible AC power supply. This allows powering the selected AC safety loads as well as charging the battery. The capacity of this EDG is 240kW, the loads needed for physical protection systems is 50 kW and loads of the consumers is 150kW. Connection time to batteries is estimated to 10 minutes. Cables are prepared and manual connection is considered. The ANPP plans to receive two additional mobile EDG (0.4kV, 200kW), two EDG (0.4kV, 800kW), which will be dedicated to feed both trains of the second category of 0.4kV AC power supply, and one EDG (6kV, 2 MW) to provide alternate power supply to a 6kV safety bus to power safety loads in case of SBO event. In order to reduce loads and ensure separation of the safety trains, certain loads (e.g. turbine lubrication pumps and generator hydrogen sealing pumps) is powered from normal battery backup buses. The mobile EDG (0.4kV, 200kW) can also be connected to the 0.4 kV bus to provide for charging the battery. The maximum charging current for battery is 100 A. The 200kW mobile EDG is sufficient power for charging the battery. A breaker to connect a mobile 200kW EDG to the 0.4kV bus is not yet installed. Connecting points and schemes have already been prepared. The technical concept was presented to the peer review team. Activity 6.2.2 has been skipped by the operator because of implementation of activity 6.2.1. Possibility for recharging the batteries by the DAR will not be realized.
6.2.3	Replace all reversible motor generators (ODGs) with modern inverters with less energy losses.	**Implementation:** The implementation of the measure is still pending. The technical concept is already

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
(NR ch. 7.2.4 PRT ch. 6.2.4 NAcP 3.1.1)	**Task*:*** ***To reduce load on the accumulator battery of BSHPT*** The technical specifications for the procurement of a modern inverter have been developed and agreed. The supplier has been determined. Installation and commissioning will be performed during the scheduled annual outage and refueling in 2020. The measure is in the process of implementation.	prepared. **Evaluation:** The measure is in line with the PRT recommendation to enhance the batterie based energy supply system in case of an SBO. In 2020 outage the existing ODGs will be replaced with static charges and inverters (EKRA company). Inverters are the state of the art- technology. This new equipment has been manufactured for the use in the highest safety class of power supply. A mixed technical solution analogue/digital technology will be installed. The inverters have digital control systems. Therefore, it must be assured that the software in the equipment fullfills the highest standards regarding software security since they are devoted to serve for supplying the highest-safety class consumers. Technical qualification has been done according to IEC 60870 (Environmental) and IEC 61850 (Communication protocol), and software qualification according to IEC 60880. This documentation of this qualification is still outstanding and has to be prepared before installing the inverters.
6.2.4 (NR ch 7.2.4 PRT ch 6.2.4 NAcP 3.1.1)	Develop and implement additional measures to extend the operating time of reversible motor generators (ODGs) in an inverter mode that will lead to increase the time to provide I&C AC power supply. ***Task:*** ***To extend ODG operation in the inverter regime to 72 hours.*** In 2012, ANPP performed an assessment of the duration	**Implementation:** The implementation of this measure is still pending. **Evaluation:** The measure is in line with the PRT recommendation to enhance the batterie based energy supply system in case of an SBO. When the technical solution of actions 6.2.1 - 6.2.3. will be implemented, this task will be consequently fulfilled.

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
	of providing consumers with direct and alternating current of the first category of reliability with electricity after a complete blackout of the plant (UB.ETD.06.OYAB-004). According to the assessment results, it was detected that: − After the transfer of AMNU power from 2BSHPPT-1 to OSHPT, the operating time of 2BSHPT-1 increases by 0,6 hours and is 6 hours; − If the loads of sections 28NA and 29NO are distributed equally, then the operation time of 2BSHPT-1 can be increased up to 8 hours. At the same time, 2BSHPT-2 continues to remain operational for more than 14 hours. Based on the performed analysis, the power of AMNU from 2BSHPT-1 is transferred to OSHPT. In 2017, in the framework of the EC funded project "Europe Aid/130412/C/SER/AM", a report was developed titled "Development of additional measures to increase the operating time of reversible engine-generators (ODG) in inverter mode" (ENCO FR (17)16) . In conclusion, it was stated that the measures taken are adequate, but the possibility of providing consumers with supply for 72 hours is not provided, for which it is necessary to implement battery charging schemes from a mobile diesel generator. It should also be noted that since 2016 to date, approximately 70% of incandescent lamps in the emergency lighting systems have been replaced by LED lamps. At the same time, the energy saving for	

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
	emergency lighting is approximately 60%. Taking the above mentioned into account, as well as the degree of implementation of measures according to the paragraphs 6.2.1, 6.2.2 and 6.2.3, the following can be stated that there is a temporary solution to the problem. The measure is in the process of implemented.	
6.2.5 (NR ch. 7.2.4 PRT ch. 6.2.4 NAcP 3.1.2, 3.2.4)	Implement two new separate lines for make-up of the coolant inventory in SFP from a mobile source (e.g. fire pumps or diesel pumps) and external water sources for SFPs emergency cooling. **Task*:*** ***To provide cooling of the spent fuel pool in emergencies.*** A technical decision on this issue was made back in 2011. However, a possible trace of the pipeline for supplying water to the spent fuel pools was found only in 2018. The difficulty was that this pipeline, when entering the spent fuel pool, prevented the installation of plates on the spent fuel pool. In 2018, a solution was found for supplying a dry pipe from the fire machines to the spent fuel pool. The project for the implementation of the Technical Solution has been completed. Currently, applications for the procurement of appropriate equipment are being processed. The measure is in the process of implementation	**Implementation:** The implementation of this measure is still pending. **Evaluation:** The measure is in line with the PRT recommendation to enhance the ability for cooling the spent fuel pool 2 in case of SBO or LUHS. One independent permanent pipe will be installed via penetration from a transport corridor to respective spent fuel. Water supply will be realized by a fire water pump using water either form the fire brigade or service water cooling channels. Due to the geometry of the spent fuel racks the subcriticality is ensured in case of using non borated water. The needed flowrate of a water supply is 6.3 m^3/h in case that the entire core is off-loaded to the spent fuel pool. The PRT underlines that this concept requires a reliable water level measurement.
6.2.6	Increase the reliability of the refuelling process from emergency diesel fuel tank or to foresee measures to	**Implementation:** Operator stated that the activity has been implemented. PRT recommended additional

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
(NR ch. 7.2.4 PRT ch. 6.2.4 NAcP 3.1.4, 3.2.1)	install additional fuel capacity in terms of seismically qualified and reliable fuel tank. The measure was implemented in 2018 (see activity 6.1.2)	actions as described below. **Evaluation:** During the site visit, the operator explained that the additional emergency fuel tanks have been qualified seismically, but the connecting line to the EDG department including the pump has no seismic qualification. As a compensatory measure in case of an earthquake and inoperability of this line, the alternative measure should be the provision of fuel by mobile trucks. The PRT also observed that the tank is not insulated which in winter condition may lead to solidifying of the diesel fuel in the tank. Currently, this level measurement is relalized by manual actions. It has been assured that the diesel fuel level in the tank covers the possible demand at every time.
6.2.7 (NR ch. 7.2.4 PRT ch. 6.2.4 NAcP 3.1.4)	Implement the sequential start-up program of diesels for "cold" shutdown and refueling modes. **Task*:*** ***To enhance the reliability of power supply in "cold shutdown" and "refueling" modes.*** In these modes, it may be necessary to start-up one DG and operate one NR-cooling pump and NSO. At that, the operator has enough time to actuate these pumps. Instruction to the personnel on undertaking appropriate actions is added in Chapter 9 (in the point 9.2, subparagraph 8) of the technological specification for the NPP operation. The measure has been implemented.	**Implementation:** The measure has been implemented. **Evaluation:** This activity originally came from recommendations prepared by ANRA in its National report. During the discussion, it was clarified that there is no urgent need for such EDG load sequence programme during the shutdown mode. During the discussion it was explained that additional analysis conducted after the Peer review mission show enough time to manually connect the necessary loads. NPP has implemented instruction in which order the respective consumers will be uploaded.
6.2.8 (NR ch. 7.2.4 PRT ch. 6.2.4	Perform new analysis and implement appropriate operator action for all emergency states, which may arise in case of loss of the primary ultimate heat sink, combined with station black out.	**Implementation:** The activity has been implemented. **Evaluation:**

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
NAcP 3.1.5, 3.3.4, 3.3.6)	**Task:** ***To specify the operator's actions to recover the loss of water to ECCS in emergency situations.*** In the existing instruction "Abnormal operation regimes of technical water supply system for essential consumers of ANPP unit №2" a new paragraph is added that specifies the actions of operational personnel to recover water losses in ECCS (finite absorber) from the circulation channel. In frame of the assistance of the US Department of Energy in 2015-2016 appropriate analyzes have been performed. Based on the calculations, emergency operating procedures (EOP) and Guidelines for the management of beyond design basis accidents (SAMG) have been developed. These procedures have been verified at ANPP and submitted to ANRA for approval. These procedures also regulate the actions of the operator to recover water in ECCS. The measure has been implemented.	This activity must be addressed in the framework of the Topic 3 Accident management.
6.2.9 (NR ch. 7.2.4 PRT ch. 6.2.4 NAcP 3.1.6, 3.2.2)	Provision of mobile DGs for power supply of safety system. **Task:** ***Provide with power supply to the safety systems in case of failure of standard power supply systems.*** Under the EC assistance program, it is planned to provide ANPP with mobile diesel generators. In 2019, the technical specifications were developed with	**Implementation:** The final implementation of the activity is still pending. The technical concept has been prepared. **Evaluation:** The intended solution is appropriate to cope with the PRT recommendation. During the Peer Review Mission in 2016, the PRT addressed a lack of diversity of the EDGs and DAR DG (same type, same building same age). In order to handle possible failures or disfunctions of the EDG system, the proposed measure seems to be

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
	a view to further tendering. The measure is in the process of implementation	appropriate in general. The operator explained that the new EDG (6kV, 2MW) will be purchased that can be connected to the plant safety buses, in case the standby EDG are unavailable. An additional connection to the bus supplied by the DAR is also intended. Additional two EDGs (0.4kV, 800kW) will be purchased that can be connected to 0.4 bus of second category. This will allow for powering the 0.4 kV AC load as well as for charging the batteries to ensure continuity of uninterruptible power supplies when static battery charges and inverters will be installed as a replacement of ODG. Another two EDGs (0.4kV, 200kW) will be received that can be connected to the first category. This will allow for powering the 0.4 kV AC load as well as for charging the battery to ensure continuity of uninterruptible power supplies (see implementation of activity 6.2.2). The technical concept has been explained to the PRT.
6.2.10 (NR ch. 7.2.4 PRT ch. 6.2.4 NAcP 3.1.7)	Assure MCP seals long-term (more than 24 hours) operation in case of cooling failure. **Task*:*** ***To prevent leaks through the MCP seals.*** ANPP turned to the Central Mechanical Engineering Design Bureau with the purpose of performing this analysis. According to the response of the Central Mechanical Engineering Design Bureau, bench tests are required for such analysis. However, at present there is no removable part of the MCP-317 pump at the enterprise's stand (branch of "TsKBM-2" JSC) with strapping and electric motor, as well as auxiliary equipment. Due to the large scope of work to create the necessary stand and the	**Implementation:** The implementation hasn`t started yet. **Evaluation:** The understanding of PRT is that no technical concept exists to solve this issue. The problem is not plant or VVER type specific but already addressed in ENSREG "Compilation of Recommendations and suggestions" The integrity of RCP seals can be guaranteed for 24 hours only in case that the organizational leakage drainage line is isolated in a timely manner. If this isolation valve remains open in the SBO, there is a continuous flow through the seal. Without providing sealing water which also cools the RCP seals, the hot water from RCS (250°C) will heat up the seal. The water expansion could damage the integrity of the seal. Currently, there is a manual valve installed. One hour closing time may be insufficient to prevent damage and leak through the RCP seals.

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
	workload of the enterprise, the Central Mechanical Engineering Design Bureau can begin to resolve our problem only at the end of 2021 within 18 months. In this regard, ANPP solved the problem with the organizational method. Since leakage through the MCP seals can occur after 24 hours if it is not possible to cool the MCP seals, the operator has enough time to close the valves on the drainage line of the organized leaks and prevent possible leakage from the primary circuit. As a compensatory measure, the instructions for accident mitigation specify the operator's actions to close the valves on the lines of the organized leaks in the primary circuit in one hour from the beginning of the initiating event with complete station blackout. Compensatory measures to solve the task have been implemented	The concept to cope with the station black out (injection to the reactor cooling system) has not been presented to the PRT. The plant has implemented a diesel driven pump which can feed the steam generators. However, in order to ensure heat removal via SG`s injection into the reactor cooling system is necessary to keep sufficient volume and subcooling margin for natural circulation. With this regard, limiting the leakages from the reactor cooling system (e.g. through RCP seal drainage line) is essential as early as possible. PRT recommends that the plant ensures closing manually operated valves in the RCP drainage line as soon as possible after the SBO. Respective procedures are prepared. The PRT recommends that the actions of these procedures should be trained by the personal regularely in order to minimize the time to close the valves . The procedures are part of the prepared EOP`s. During the discussion, it was explained by the operator and confirmed by ANRA that the original intendend concept for solving this issue to be provided by Central Mechanical Engineering Design Bureau will not be pursued. A diverse means injecting into reactor cooling system has been envisaged as a part of activity 6.3.2..
6.2.11 (NR ch. 7.2.4 PRT ch. 6.2.4 NAcP 3.1.8)	Provide for mobile pumps for ESWS make-up from Circulation Water Channel. The measure has been implemented in 2017 (see activity 6.2.8).	**Implementation:** The activity has been already implemented. **Evaluation:** Measures of this activity have been already implemented in 2016. Due to the fact that final documentation was provided by the operator to ANRA in late 2017, this action was implemented in the NAcP by the regulator when it prepared the first version of the NAcP.
6.2.12	Develop and implement additional measures to use a large reserve of service water in the inlet and outlet	**Implementation:**

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
NR ch. 7.2.4 EUPRT ch. **6.2.4** NAcP 3.1.9)	channels, as an alternative heat sink. The measure has been implemented in 2017 (see activity 6.2.8)	The activity has been already implemented. **Evaluation:** Measures of this activity have been already implemented in 2016. Due to the fact that final documentation was provided by the operator to ANRA in late 2017, this action was implemented in the NAcP by the regulator when it prepared the first version of the NAcP.
6.2.13 (NR ch. 7.2.4 PRT ch. 6.2.4 NAcP 3.1.10)	Implement autonomous alternative means for make-up of SGs 1-6 of the Unit 2. **Task*:*** ***To ensure the possibility of SG make-up in case of a failure of standard systems.*** a) In 2014, a technical solution was adopted and implemented for installation of a filling pipeline for BZOV-1,2 by fire machines. Water from BZOV-1,2 with an additional diesel pump can supply SG-1-6. b) In 2016, a technical solution was adopted and implemented for the use of demineralized water reserves in the chemical shop for filling BZOV-1,2 with fire machines. c) In 2017, a technical decision was adopted to create an independent alternative make-up scheme for 2SG-1-6 by fire machines. A project is ongoing for for the implementation of this technical solution. d) Under the EC program, it is planned to provide ANPP with mobile diesel pumps. In 2019, the technical specification will be prepared for their further tendering.	**Implementation:** The implementation of the measure is still pending. The technical concept is already prepared. **Evaluation:** The intended solution is appropriate to cope with the PRT recommendation. The proposed measures are devoted to assure the core cooling via natural convection and fed and bleed operation mode of the steam generators in the case of SBO and/or LUHS. The mobile diesel-driven pump (1000 l/min at 15bars; 2000 l/min at 4 bars) devoted to feed the steam generators in unit 2 will be positioned on the roof of the Boron compartment B001/2. This pump discharge will be connected to the pre-design pipeline that will connect the existing emergency feedwater pipe line located inside the room B001/1. There is permanently installed connection to emergency feedwater collector from Unit 1 to Unit 2. Procurement and the technical specification have already been prepared. The suction to the diesel driven pump will be ensured from either tank of demineralized water (outside of the turbine hall). A depressurization of the SGs will be ensured via BRU-A, motor operated valves that are supplied from the first category of the uninterruptible power supply. Since during the refilling of the SGs and the heat removal is associated with a decrease of

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	The measure is in the process of implementation.	the reactor coolant system volume, also the primary circuit must be refilled. This will be done by a high pressure boron injection pump which will be installed in the room B001/2 and will have a dedicated diesel backup power supply. Procurement and the technical specification have already been prepared. As explained by ANRA a justified technical concept was provided to NRA and is now under assessment.
6.2.14 **6.2.15** (NR ch 7.2.4 PRT ch 6.2.4 NAcP 3.1.12, 3.2.2)	Implement analysis of circuit diagram for consumers power supply (from DAR). Develop and implement activities aimed at minimizing personnel manual actions to activate the DAR system. **Task*:*** ***To minimize the personnel's actions when commissioning DAR.*** In frame of the OSA program the technical specifications were developed for the acquisition of manual power switches for DAR consumers. The measure is in the process of implementation	**Implementation:** The implementation of the measure is still pending. The technical concept is under development. **Evaluation:** The intended solution is appropriate to cope with the PRT recommendation. DAR as the last fixed power source in SBO has to be put in operation manually by the operating personnel. An existing instruction specifies how consumers should be connected. The selection of consumers is dependent from the emergency situation. Usually in first order the ESWS pumps are connected. Tests performed by the operating staff showed that average time to connect consumers is about 30 min. The switching-on of the all respective consumers to the DAR emergency power supply can take up to 60 min. The decision which safety loads are to be supplied should depend on the state of the plant, the priority of the consumer and the information about re-establishing of the emergency power supply by EDGs or by the normal in-house power supply. DAR has been designed and implemented as an ultimate solution in case of CCF event in the second category 6 kV electrical distribution system. DAR provides power supply directly to a specific load by disconnecting original cables from terminal box and connect a cable connection which provides power supply from DAR. Because DAR power capacity is limited to 1500kW, only limited 6kV loads,e.g. one ECCS pump and one ESWS pump which is sufficient for heat removal from the primariry circuit and limited number of 0.4kV loads can be powered. Connection to a dedicated load is

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
		done manually by disconnecting original power cable from equipment terminals and connect new cable which is power from DAR. Operator stated that a training will be implemented to improve skills of the personnel to connect 6 kV cables to the dedicated consumers when using DAR as alternate power AC supply source.
6.2.16 (NAcP 3.3.5, EU 3.2.5)	The enhancement of instrumentation and control. Examples include separate I&C and/or power sources to enable monitoring of essential parameters under any circumstances for accident management and the ability to measure specific important parameters based on passive and simple principles. **Task*:*** ***To ensure monitoring of essential parameters in the accident management conditions.*** The implementation of the measure is scheduled for 2020.	**Implementation:** This action has been already implemented. **Evaluation:** The intended solution is appropriate to cope with the PRT recommendation. Based on a presentation provided by ANRA it was explained that the post accident monitoring system has been installed in a separate room together with remote shut down panel.
6.2.17 (NAcP 3.3.16, EU 3.2.16)	The establishment of regular programs for inspections to ensure that a variety of existing and additional equipment and mobile devices are properly installed and maintained, particularly for temporary and mobile equipment and tools used for mitigation of BDB external events. **Task*:*** ***To ensure conditions for maintaining mobile equipment for elimination of beyond design basis accidents in working condition.*** It will be completed after procurement and installation of	**Implementation:** The implementation of the measure is still pending. **Evaluation:** The measure based on a recommendation addressed in ENSREG “Compilation of Recommendations and suggestions”. Answering the PRT questions, ANRA stated the currently the following is available at the ANPP for mitigation of the beyond-the design-basis accidents: – SG FWDP – for SG make-up; – DAR (secondary emergency cooldown) system – for power supply of safety systems;

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
	additional equipment and mobile devices. The implementation of the measure is planned.	– GNOM-10 type pumps– for pumping out water from the DGS basement These systems are run annually in compliance with corresponding programs. During the mission it was clarified by the operator and ANRA that for new devices periodically performed inspections programmes and schedules will be developed based on design documentation of the equipment. Procedures describing the process for the preparation of such inspections programmes already exist.
6.2.18 (NAcP 3.3.17, EU 3.2.17)	The performance of further studies in areas where there are uncertainties. Uncertainties may exist in the following areas: • The integrity of the SFP and its liner in the event of boiling or external impact. • The functionality of control equipment (feedwater control valves and SG relief valves, main steam safety valves, isolation condenser flow path, containment isolation valves as well as depressurization valves) during the SBO to ensure that cooling using natural circulation would not be interrupted in a SBO (this is partially addressed in recommendation 3.2.10). The performance of additional studies to assess operation in the event of widespread damage, for example, the need different equipment (e.g. bulldozers) to clear the route to the most critical locations or equipment. This includes the logistics of the external support and related arrangements (storage of equipment, use of national defense resources, etc.).	**Implementation:** For this measure neither a concept nor implementation activities have been specified by now. According to the NAcP, the studies should be performed until the end of 2022. **Evaluation:** The measure based on a recommendation addressed in ENSREG “Compilation of Recommendations and suggestions”. An evaluation of this activity isn´t possible at this stage by now. The need for this recommendation should be verified by ANRA using the experiences from other European National Action Plans.

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
6.2.19 (NAcP 3.3.8, EU 3.2.8)	The enhancement of ventilation capacity during SBO to ensure equipment operability. **Task*:*** ***To provide temperature conditions for operability of the safety important systems.*** This year, "ASE" EC JSC performed an analysis of the existing ventilation systems, namely: "Analysis of adequacy of existing ventilation systems in the emergency boron supply room," A-132035pm; "Analysis of adequacy of cooling and ventilation systems in the rooms of modernization of the main building of EETU, the DGS building and the block of structures on the open switchgears" A-135597. The analysis data has been studied by ANPP specialists, and proposals and comments for revising these analyzes have been compiled and submitted to "ASE" EC JSC. The measure is in the process of implementation.	**Implementation:** The implementation of the measure is still pending. **Evaluation:** The measure based on a recommendation addressed in ENSREG "Compilation of Recommendations and suggestions". The PRT emphasized that this activity is not related to ventilation in the boron compartment. If equipment in this compartment runs, energy for the ventilation in this room is available. This activity is related to other critical systems like ventilation in the Main Control Room (habitability), I&C rooms, remote shut down panel and other heat producing systems which are needed for coping with SBO. The critical rooms and systems must be identified and a concept for the ventilation in these rooms must be prepared. The loads must be investigated and the demand to be assured must be assessed. The need for and the scope of this recommendation should be verified by ANRA using the experiences from other European National Action Plans.
6.2.20 (NAcP 3.3.12, EU 3.2.12)	The verification of assured flow paths and access under SBO conditions. Ensure that the state in which isolation valves fail and remain, when motive and control power is lost, is carefully considered to maximize safety. Enhance and extend the availability of DC power and instrument air (e. g. by installing additional or larger accumulators on the valves). Ensure access to critical equipment in all circumstances, specifically when electrically operated turnstiles are interlocked. **Task*:***	**Implementation** As stated in the NAcP update 2019, the implementation of this measure is in the planning phase and the study activities should be finalized until the end of 2020. **Evaluation:** The measure based on a recommendation addressed in ENSREG "Compilation of Recommendations and suggestions". The technical concept for this activity has not been prepared until now; therefore, an evaluation could not be complete.

Action (Source[5]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and evaluation of action
	To provide access to the safety systems equipment in all circumstances, in case of blocking of electrical turnstiles. The implementation of the measure is planned.	The need for this recommendation should be verified by ANRA using the experiences from other European National Action Plans.

6. Severe Accident Management

Action (Source[6]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
6.3.1 NAcP 4.1.1. PRT 7.2.4. 7.3. 8. NR 7.2.5.(1) EU 3.3.2 .-	Development of a full set of severe accidents management guidelines covering also SFP **Task*:*** ***To ensure management of severe accidents.*** The SAMG package, which also includes the spent fuel pool, is developed. After organizing a tender for expertise and obtaining expertise results, the SAMG package will be submitted to the regulatory authority for review. It is planned to complete the measure in 2019.	**Implementation:** The SAMG package covering the full-power and low-power reactor operating modes (including shutdown modes with the reactor sealed) has been developed. The SAMG package for shutdown modes with open reactor as well as accidents in 2 spent fuel pools is under development. The package considers the strategies for prevention of the loss of physical barriers and for mitigation of releases of fission products up to the recovery of the unit to controlled stable conditions. Development of strategies is based on relevant severe accident analysis. Certain hardware improvements aimed at supporting effectiveness of the SAMGs have been implemented (e.g. improvements of the spray system) others (improvements of the ECCS system) are planned for the future. Validation of SAMGs was carried out in October 2016, using discussion method.

[6] The brackets indicate the sources of the respective action. Thereby means:

- NR: National Report - Stress Test for Armenian Nuclear Power Plant - Juli 2015,
- PRT: EU Peer Review Report of the Armenian Stress Tests" - June 2016,
- EU: ENSREG “Compilation of Recommendations and suggestions - Peer review of stress tests performed on European nuclear power plants”, 26/07/2012
- CNS: Final Summary Report - 2nd Extraordinary Meeting of the Contracting Parties to the Convention of Nuclear Safety, 27-31 August 2012, Vienna, Austria
- NAcP: Number of Recommendation of the National Action Plan of Armenia (NAcP), Part I and II, 2017
- ch: chapter or number
- p: page

Action (Source[6]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
3.3.12. 3.3.16 NAcP 4.3.3. 4.3.4. 4.3.5. 4.3.6. 4.3.7. 4.3.8. 4.3.11. 4.3.12. 4.3.16. 4.4.3.	The measure is in the process of implementation	SAMGs were submitted for independent verification to an expert organization. After verification, the comments will be incorporated, followed by additional validation and staff training. The SAMGs correspond to existing configuration of the plant equipment. In accordance with the current licensing conditions full implementation of SAMGs is planned upon completion of the hardware modifications in 2021. **Evaluation:** SAMGs when implemented in the plant operation will represent a key factor for effective mitigation of progression and consequences of severe accidents. It is noted that significant progress has been made towards implementation of SAMGs in operation of the plant. Necessary steps were initiated for full implementation of SAMGs (SAMGs submitted for verification). Further on, full scope validation and training for all staff potentially involved in accident management will be organized. More advanced tools for training, such as multifunctional simulators, would increase efficiency of training. The schedule established for implementation of SAMGs in plant operation is realistic and there are possibilities for earlier implementation of SAMGs already developed. ANPP is encouraged to accelerate the development of remaining SAMGs and implementation of a full package of SAMGs. Due to ongoing process of safety upgrading of the plant, regulatory approval of any relevant change in plant configuration should be conditioned by parallel updating the SAMGs in order to ensure consistency.
6.3.2 NAcP 4.1.2. 4.2.1. 4.4.1. PRT 7.2.4. 7.3 NR 7.2.5.(2)	Modernization of Emergency Core Cooling System to ensure long time operation and reliable compensation of higher leak rate. Introduction of alternative low-pressure core cooling system with independent power supply and water sources **Task*:*** ***To increase MDBA with primary circuit leak to DN100mm.*** At present, design and survey works are performed out by	**Implementation:** A number of actions towards modernization of the ECCS system have been taken as follows: 1. The ECCS modification basic lay-out was developed and approved. 2. Preliminary safety justification was performed. 3. Hydraulic calculations for the ECCS new lay-out were performed. 4. Detailed working documentation for ECCS pipeline cut-in unit into the main

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	"ASE" EC JSC and OKB Gidropress JSC. ANPP transmitted proposals and comments to the existing documents to the Russian side. Some of the documents have already been corrected and agreed upon, and some are at the stage of correction and approval. The measure is in the process of implementation	circulation pipelines were developed. 5. The design for the system I&C was developed. 6. The detailed documentation for construction and erection activities on equipment and pipelines in boron unit and SG compartment is under development. 7. The low pressure ECCS pumps are manufactured and are on the ANPP site. The modifications will include changing the injection points, and installation of low pressure ECCS pumps. Modernized ECCS is designed to control LOCA up to the diameter 100 mm at any position, and surge line 200 mm LOCA. Full implementation is planned 2020, or 2021 at the latest. **Evaluation:** Modernization of the ECCS system has high safety significance both for prevention, as well as for mitigation of a severe accident in its ex-vessel stage (pouring coolant on molten corium to slow-down concrete attack). The modernization when implemented will significantly enhance the scope of design basis accidents controlled by the system and thus strengthen the prevention of transition into a severe accident. In addition, if maintained operable, the system will also facilitate stabilization of molten corium and reduce the radioactive releases after potential ejection of corium from the vessel to the reactor cavity. For this objective, operability of ECCS following a SBO accident would need to have an independent electric power supply, which could be provided by planned new SBO diesel generator, or diesel pumps can be used. There is also a dedicated hydro plant to provide electricity in case of a need. Other means for coolant injection (like mobile diesel pumps, already planned by the NPP) can be also considered. Possible separation of individual ECCS trains should not be left out of any consideration, although at present it seems to be hardly achievable. The implementation of the action is progressing satisfactorily, and the high attention devoted to the implementation is appreciated.
6.3.3 NAcP	Comprehensive analysis of hydrogen generation and implementation of measures to reduce hydrogen explosion	**Implementation:**

Action (Source[6]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
4.1.3. 4.2.3. 4.3.10. PRT 7.2.4. 7.3 NR 7.2.5.(3) EU 2.3. 3.3.1	probability. Implementation of measurement of hydrogen concentration in containment **TASK*:*** ***To reduce hydrogen exposure probability at BDBA*** The tender for the analysis will be announced 2019. The implementation of the measure is planned.	The analysis of potential hydrogen accumulation in containment is included in the 2020 financial plan. Strategies for hydrogen mitigation using available means are covered in SAMGs. Final decision regarding this issue requires additional analyses. The analyses will be followed by corresponding decisions on measures for monitoring the hydrogen concentration and implementation of countermeasures against hydrogen explosions. The action should be implemented till 2021 PRT notes that reference to hydrogen exposure means hydrogen explosion. **Evaluation:** Hydrogen explosion is one of the challenges potentially endangering containment integrity (in spite of the existing opening flaps) and thus it is of very high safety significance. It is clear that additional analyses are necessary to have more comprehensive inputs for decisions. The implementation of measures to deal with the hydrogen issue is at the early stage and there are contradicting factors for reducing hydrogen concentration and to minimize the releases. The comprehensive analysis of hydrogen related issues is delayed, as well as implementation of monitoring of hydrogen concentration and effective measures to prevent hydrogen explosions. Implementation of these items of the NAcP should be given high priority and should be accelerated.
6.3.4 NAcP 4.1.4. 4.2.4. 4.3.2. PRT 7.2.4. 7.3 NR 7.2.5.(4)	Modernization of the Spray System including implementation of interlocks to reduce the risk of depth sub atmospheric pressure and reduce oxygen inflow from outside. It is recommended to foresee measures to supply spray system components using mobile DG equipment. It is also recommended to implement feasibility study for adding alternative sprays with independent source of energy (using a diesel driven spray pump) and water (borated water storage tank of Unit 1) should be done. **Task*:***	**Implementation:** Significant steps were taken towards modernization of the spray system in order to enhance its performance. The system already installed consists of 2 independent channels with 4 new high capacity seismically resistant pumps. Interlocks were implemented to prevent deep underpressure in the containment. Potential for sump clogging was considered in the design, including replacement of the insulation. Another planned way for enhancement is use of alternative sprays with a diesel driven spray pump. The documentation was developed for cut-in fitting in the discharge pipeline of the spray system for future connection of the pipeline from mobile diesel pump for water supply from B-8/1 to sprinkler nozzles. The fitting has been already manufactured and delivered to the ANPP. The overall solution is subject to future

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	To increase MDBA with the primary circuit leak to DN100mm The main design and survey measures were performed out by "ASE" EC JSC and approved by ANPP. ANRA made comments and proposals to some of the documents which are currently reviewed to resolve the comments. ANPP agreed with ANRA the implementation of the measure in two stages. Stage I - in 2019: − To perform safety justification for modification for initial design basis accident (the primary circuit leak with an equivalent diameter of DN32mm) and the positive effect of an upgraded spray system for leak from the primary circuit with an equivalent diameter of more than DN100mm; − To install new system and commission it. Stage II - in 2020. − To perform safety justification for modification for newly adopted MDBA, taking into account modifications of the emergency core cooling system. The measure is in the process of implementation.	regulatory authorization. **Evaluation:** Modernization of the spray system is a high priority important item, in particular due to its effect for washing out fission products from the containment atmosphere under severe accident conditions. Implementation of the actions scheduled in stage I to 2019 was implemented as intended, therefore is considered as satisfactory. Use of the mobile means for spraying is under implementation. Similarly, as in case of ECCS, ensuring electric power supply from existing SBO diesel-generator (although not fully diverse) provides important enhancement for operability of the system under SBO severe accident conditions. The actions implemented until now are highly appreciated and further enhancements encouraged.
6.3.5 NAcP 4.1.5. PRT 7.2.4. NR	Feasibility study and development of measures aimed at maintaining melting fuel inside RPV via external cooling of the reactor vessel ***Task:*** The tender for the analysis will be announced.	**Implementation:** Besides planned enhancement of the ECCS system no specific actions aimed at maintaining molten corium in the reactor vessel were determined by the plant until now. The Scientific and Technical Center developed a preliminary study to investigate feasibility of such measure. Although not listed as a specific item in the NAcP, importance of the reactor coolant system depressurization is recognized as one of the

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7.2.5.(5) EU 3.3.1	The implementation of the measure is planned.	key measures for severe accident management. Different considerations were given to using existing means for depressurization. In addition to the POSRV there are several primary circuit pressure discharge lines as follows: • Primary circuit coolant discharge to bubbler through the POSRV bypass with diameter of 25mm; • Coolant discharge through the routine primary circuit drainage to primary circuit make-up deaerator or tanks 4,5 or B-3/2 through pipeline with diameter of 50mm; • Pipelines of emergency gas removal from primary circuit through valves 2R-30/1-6. The valves are controlled from the MCR. • Also, for pressure discharge from primary circuit the lines of air removal from 2RCP/1-6 and 2SG/1-6 by primary circuit could be used. **Evaluation:** Implementation of activities on feasibility study and development of activities on melt fuel retention in the reactor vessel through external cooling of the reactor vessel is postponed to 2020, compared to original action plan which assumed the development of measures in 2019. Nevertheless, due to complexity of this issue and priority given to other actions (enhancement of ECCS and the spray system) such difference is justified. Further on, it should be clear that the analytical demonstration alone will not resolve the issue of external vessel cooling, which is associated with serious technological problems. In any case it is advisable to develop a realistic plan of actions to address the issue of molten corium stabilization and minimization of likelihood of large radioactive releases. More importantly it is noted that among the existing depressurization lines there are no depressurization means dedicated for severe accident conditions. It is therefore advisable (in accordance with ENSREG stress test recommendations) to consider implementation of additional, dedicated depressurization means for severe accident

Action (Source[6]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
		conditions.
6.3.6 NAcP 4.1.6. 4.2.2. 4.3.10. PRT 7.2.4. 7.3. NR 7.2.5.(6) EU 2.3. 3.3.1	Further improvement of containment tightness. A detailed analysis of possibility of hydrogen accumulation in rooms outside the containment **Task *:*** ***Minimization of releases from the containment into the environment.*** In frame of the EC assistance program, a project has been planned to seal the SG and RCP unit. A technical specification was developed, which was reviewed and agreed at ANPP. In the future, after approval of the technical specification by the regulatory authority, EC will announce a tender. The measure is in the process of implementation.	**Implementation:** The NPP on-site assistance team prepared preliminary detailed analysis for identification of potential hydrogen accumulation in the rooms outside the containment. The study identified the potential pathways for propagation of hydrogen outside the containment as well as possible measures to mitigate the effects. The study concluded that this issue cannot be ignored, but more detailed investigation is needed. After comments from the plant staff, the current study will be updated. Containment leak rate is still very large. Implementation of measures for further improvements of the containment tightness is ongoing and its continuation is planned for the future. **Evaluation:** Containment tightness is an issue of high safety significance. The activities in the framework of this item are under implementation. In the discussion it was stated by the plant staff that due to the complexity of the issue (improvement of the containment tightness) it is required to extend the implementation time to about 2024. There is a need to put high attention to these activities and to accelerate the implementation of corresponding measures. Further on, it is necessary to make every effort for implementation of other measures towards minimization of radioactive releases, such as prevention of severe accidents, cooling or flooding of molten corium, and washing out fission products by means of spraying of the containment atmosphere.
6.3.7 NAcP 4.3.2. 4.4.1.	Implement possibility to feed primary circuit from additional means (diesel pumps) **Task*:*** ***To provide with the possibility to make-up the primary circuit during beyond design basis initiating events.*** Under the EC assistance program, it is planned to provide	**Implementation:** The required analyses justifying feasibility of the use of additional means to feed the primary circuit were performed, the terms of reference were developed and in November 2019 submitted to ANRA. For injection, mobile diesel pumps (not yet available) delivering borated water from the 800 m^3 borated coolant tank are planned. The technical specification for purchasing the necessary equipment was developed.

Action (Source[6]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
	ANPP with mobile diesel pumps. In 2019, a technical specification was prepared with a view of further tendering. The technical specification is reviewed. The measure is in the process of implementation	**Evaluation:** Mobile diesel pumps can offer additional means for the primary circuit make-up provided that the associated conditions will be fulfilled (sufficient time for implementation, reliable depressurization of the primary circuit, pre-installed fixed connecting points). In general, mobile means are considered as a key contributors to safety enhancement of the plant. From the evaluation of the current status it is expected that the originally established schedule can be achieved.
6.3.8 NAcP 3.1.2. 4.4.2. EU 3.2.10	Perform analysis of SFP 1 and 2 cooldown and based on results implement additional measures. The aim of calculations is the time frame for fuel in case of loss of cooling and possibility of DGSL to ensure startup of 1NRB-1 and NZB pumps. **Task*:*** ***To determine the time of damage to spent nuclear fuel in the spent fuel pool upon loss of the spent fuel pool cooling systems.*** The relevant analysis was performed in frame of the development of symptom-oriented emergency operation procedures (Analytical justification of symptom-oriented EOP. Procedures for spent fuel pools of ANPP unit №2 and unit №1, EOR-MR -1-3-R-A). According to the calculations on loss of heat removal from the spent fuel pool, during complete unloading of the core in the spent fuel pool and without operator intervention, fuel damage occurs in about 39 hours. At that, the flow rate of circulating water to ensure not boiling water in the spent fuel pool (T_{SFP} <95°C) is 83.22 m^3/hour. Such a flow rate is provided by the existing pumps 2NBO-	**Implementation:** The analysis of time margins to fuel uncovery in the SFP has been performed in the frame of development of the symptom based EOPs for spent fuel pool. The calculations included conditions associated with complete core off-loading. In compliance with the "Analytical justification of the symptom-oriented EOPs. Procedures of Units 1,2 SFPs" the flow rate 83.22 m3/h is sufficient to prevent coolant boiling in SFP in a recirculation mode. Each of the pumps 2NBO-1,2; 2,1NZB; 1NBO-1 and NChK separately can provide sufficient flow rate. However, these pumps are not available in case of SBO. For compensation of coolant evaporation, 6 m3/h is sufficient. For next year, there are plans to use mobile diesel pumps (2 pumps to be purchased) with feeding from the circulation channel. Use of fire trucks is also planned. The connection points should be still installed. **Evaluation:** The action as originally intended is considered as implemented. Means for preventing fuel damage in the SFP are available, and after installation of connection points may be considered adequate. Intended measures for compensating loss of coolant from the SFP should be implemented. Further enhancement of measurements of coolant parameters (level, temperature, chemistry, radioactivity) in the SFP need to be considered, in accordance with IAEA Safety Standard (SSR-2/1, Rev. 1) updated after Fukushima Daiichi accident.

Action (Source[6]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
	1,2; 2.1 NZB; 1NBO-1 and NCHK. The measure has been implemented	
6.3.9 NAcP 4.4.3. PRT 7.2.3. 7.2.4. NR 7.2.4.(6)	Develop full set of the Emergency Operating Procedures (EOP). **Task*:*** ***To ensure accident management.*** A set of emergency operation procedures has been developed. After the expertise (the NRSC won the tender) the package of emergency operation procedures will be transmitted to the regulatory authority for review in 2019. The measure is in the process of implementation	**Implementation:** Symptom-based EOPs have been developed and validated in the course of their development, including training as a part of validation process. The EOPs correspond to existing configuration of the plant. Review of the symptom-based EOPs was already performed by the expert organization. Currently the implementation of the comments is ongoing as a condition for the regulatory approval. Consistency between the symptoms and the procedures was verified by the expert review. Operator training and implementation of EOPs will be carried out after review of EOPs by the regulator. **Evaluation:** Symptom-based EOPs when implemented in the plant operation represent a key factor for prevention of severe accidents. The symptom-based EOPs have been developed and validated. In accordance with the regulatory licensing conditions it is planned to implement fully the EOPs in 2021. The schedule is considered realistic, and the plant should continue with implementation as intended. In fact, it is believed that acceleration of the implementation is possible. Similarly as in case of SAMGs, regulatory approval of any relevant change in plant configuration should be conditioned by updating the EOPs.
6.3.10 **6.2.13** NAcP 4.3.2. 4.4.1. 3.1.10.	Implement additional independent means for make-up of SGs 1-6 by diesel pumps. The action is common also for Topic 2. **Task*:*** ***To ensure the possibility of SG make-up in case of a failure of standard systems.*** a) In 2014, a technical solution was adopted and implemented for installation of a filling pipeline for BZOV-	**Implementation:** In case of design extension conditions (BDBA) the heat removal from the primary circuit is performed through one or two SGs. In case of the SG level decrease to 0.7m (from the SG bottom) these SGs are isolated from the primary and secondary circuits and their pressure is controlled by means of the SG SVs. Following the SG pressure reduction, the make-up of the SG may be implemented with fire trucks. In addition, additional option to purchase and use mobile diesel pumps is under preparation under the EC programme.

Action (Source[6]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
3.3.1 3.3.6 3.3.11 3.3.13 3.4.1 PRT 6.2.4.(8) NR 7.2.4.(9)	1,2 by fire machines. Water from BZOV-1,2 with an additional diesel pump can be supplied by SG-1-6. b) In 2016, a technical solution was adopted and implemented for the use of demineralized water reserves in the chemical shop for fueling BZOV-1,2 with fire machines. c) In 2017, a technical decision was adopted to create an independent alternative make-up scheme for 2SG-1-6 by fire machines. A project is ongoing for the implementation of this technical solution. d) Under the EC program, it is planned to provide ANPP with mobile diesel pumps. In 2019, the technical specification will be prepared for their further tendering. The measure is in the process of implementation.	**Evaluation:** It should be underlined that flooding the secondary side of the steam generators is essential not only for removal of the residual heat, but in case of a severe accident also to prevent creep rupture of the SG tubes and thus preventing containment by-pass. The actions taken in response to the issues identified in the framework of Topic 2 are adequate also for Topic 3. For implementation of any options mentioned above, connection points for delivery of coolant by mobile means still need to be installed.
6.3.11 NAcP 4.4.1. PRT 5.3.2.2 NR 4.2.1.	Develop and implement measures to prevent window damage of EDG building in case of extreme wind load. **Task*:*** **T*o exclude DG failure in extreme weather conditions*** The glasses of the windows of RDGS are lined with a sticky plastic film, which excludes glass damage under high wind loads. The measure has been completed in 2017. The measure has been implemented.	**Implementation:** The sticky film covering the window glass of EDG building is understood as easy fixing aimed to prevent formation of glass pieces which could injure personnel attending the DG area. It is also noted that the damage of the DG building window glass is not likely because according the wind rose in the ANPP area the wind main direction is from the north-west to south-east, i.e., almost in parallel with the windows surface. **Evaluation:** The action is completed.
6.3.12 NAcP 4.3.9.	Implement measures to increase habitability of the Post accident monitoring system and Emergency Shutdown Panel In the framework of the OSA program, in early 2019, a	**Implementation:** Terms of reference for improvement of habitability of PAMS and emergency shutdown panel rooms, it means for providing normal environmental conditions (ventilation, filtering, heating, air conditioning) in the mentioned room as necessary for actions by

Action (Source[6]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
4.3.12. 4.4.1. PRT 7.2.1. NR 6.2.4. 6.2.5. EU 3.2.9	technical specification was developed for the implementation of measures to increase the habitability of PAMS and ESP. The measure is in the process of implementation.	operating personnel were developed in early 2019. Implementation includes installation of a new ventilation centre. Funding of the action (including hardware) is negotiated assuming EC funding. If the funding through EC fails, internal resources of the plant will be utilized. The issue is expected to be resolved as a condition for the next licence to be issued in 2021. **Evaluation:** Action is very important for accident management in case of non-habitability of the main control room. Completion of the action in originally envisaged timeframe is not feasible, but within the framework of compliance with new licensing condition it is realistic. The plant is encouraged to ensure implementation of the action not later than in 2021.
6.3.13 NR 2.1.2.1. 2.2.4.(2) EU 2.3. 3.3.1	Implement system for gas removal from reactor head. Negotiations are underway with OKB Gidropress to develop a safety justification for the implementation of this modification. The implementation of the measure is planned.	**Implementation:** The OKB Gidropress was given the terms of reference as necessary for development of a justification of the emergency gas removal system (EGRS). The justification of this measure is a condition for the regulatory permit for implementation of the subsequent activities. OKB also received a document with the expertise carried out by Scientific and Technical Center regarding the ANPP suggestions on emergency gas removal from the reactor head. The issue is to decide by the plant in which plant states (design basis accidents or design extension conditions) the system is designated to function. **Evaluation:** Possibility for gas removal from the reactor vessel head is important as one of the means for depressurization of the reactor coolant systems under severe accident conditions and thus for prevention of the high-pressure core melt scenarios. However, implementation of this measure is at the early stage, due to unclear reasons. The issue of intended use of the system should be resolved as soon as possible. Compared to the previously stated deadline the implementation is delayed and should be accelerated.
6.3.14 NAcP	The incorporation of the WENRA reference levels related to severe accident management (SAM) into national legal	**Implementation:** It was discussed and clarified in the discussion that implementation of technical

Action (Source[6]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
4.3.1 PRT 8 EU 3.3.1	frameworks and ensure their implementation in the installations as soon as possible.	measures reflecting the substance of WENRA reference levels (molten corium stabilization, hydrogen mitigation in the containment, hydrogen monitoring system, reliable depressurization of the reactor coolant system and containment overpressure protection) are covered and discussed under other actions of the NAcP and thus not necessarily needs to be repeated separately. Updating of relevant national legislation is covered under the project of harmonization of national legislation with EU directives. **Evaluation:** See the text above.
6.3.15 NAcP 4.3.14 EU 3.3.14	Rescue teams and adequate equipment to be quickly brought on site in order to provide support to local operators in case of a severe situation. **Task*:*** ***To provide assistance to ANPP in the management of beyond design basis accident*** The National Plan for Protection of the Population during a Nuclear and/or Radiological Emergency at ANPP" stipulates that upon notification by the Rescue Service of the Republic of Armenia, assistance is provided to ANPP to perform rescue operations of the NPP personnel. The necessary vehicles, cranes, bulldozer, excavator, grader are available in the ANPP motor transport. According to the agreement №08/87 of 04/19/2013 between ANPP, WANO and Rosenergoatom, at the request of ANPP in the event of a severe accident, the regional crisis center of WANO delivers required special equipment to ANPP with teams of specialists, provides scientific and	**Implementation:** The issue of availability of rescue teams and adequate equipment in due time has been adequately addressed at the national (National Plan for Protection of the Population during a Nuclear and/or Radiological Emergency at ANPP) as well as at international (agreement №08/87 of 04/19/2013 between ANPP, WANO and Rosenergoatom) level. **Evaluation:** It was verified, that duties of different governmental bodies (army, police, Ministry of Health, etc) as well as local municipalities in case of emergency are covered in the National Plan for Protection. The activities are coordinated by the Ministry of Emergency Situations. In the plan the measures for protection of the public and transportation means for evacuation are also covered. The action can be considered as implemented. Improvements need to be considered to purchasing modern heavy vehicles for potential removal of debris and releasing access routes following extreme external event.

Action (Source[6]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
	technical assistance on necessary actions to eliminate accident. The measure has been implemented.	
6.3.16 NAcP 4.3.15. PRT 7.1.3. EU 3.3.15	Development of Level 2 PSA as a tool for the identification of plant vulnerabilities, quantification of potential releases, determination of candidate high-level actions and their effects and prioritizing the order of proposed safety improvements. **Task*:*** ***To develop PSA Level 2*** With the support of the Argonne National Laboratory, the Ukrainian company ETiD in 2018 developed PSA Level 2 for ANPP. When studying this document, ANPP specialists made a lot of comments, which require a radical revision of the document. Currently, ANPP looks for an opportunity to develop a new PSA Level 2. The measure is planned to be implemented.	**Implementation:** PSA Level 2 has been already developed as required but after evaluation considered by ANPP specialists as inadequate due to weaknesses in the plant model and in analyses of severe accidents. **Evaluation:** Although PSA Level 2 study was developed as intended, completion of this action is delayed due to weaknesses of the original study, with the new deadline 2021. Importance of this action is underlined by the fact that some PSA data (e.g. results of analysis of accident progression and radiological consequences) is applicable for other purposes, such as emergency exercises or updating of SAMG.

7. Emergency Preparedness

Action (Source[7]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
6.5.1 NAcP 5.2.1.	Revision of off-site exercise programs to increase the scope and reflect NPP plus external infrastructure simultaneous problems and blending mobile resources into planning and drill programs. **Task*:*** ***Practical development of interconnected actions of external organizations in the event of an accident at ANPP*** Such exercises are organized once every three years. The last exercise was organized in 2016. The next exercise is scheduled for 2019. A two-day exercise is also planned for 2019. The measure has been implemented.	**Implementation:** The off-site emergency exercise programmes have been developed, including coordination between plant and external human and technical resources. For development of external drill programmes, the calculations of severe accidents are used, which were prepared in the process of the PSA Level 2 elaboration, as well as analyses of severe accident consequences presented in the SAR. The programmes drills take into account the consequences of severe accidents. **Evaluation:** The action can be considered as implemented. The plant should be encouraged in future implementation of exercises as established, also utilizing any updated analytical results.
6.5.2 NAcP	Performing of longer term exercises to reflect the	**Implementation:**

[7] The brackets indicate the sources of the respective action. Thereby means:

- NR: National Report - Stress Test for Armenian Nuclear Power Plant - Juli 2015,
- PRT: EU Peer Review Report of the Armenian Stress Tests" - June 2016,
- EU: ENSREG “Compilation of Recommendations and suggestions - Peer review of stress tests performed on European nuclear power plants”, 26/07/2012
- CNS: Final Summary Report - 2nd Extraordinary Meeting of the Contracting Parties to the Convention of Nuclear Safety, 27-31 August 2012, Vienna, Austria
- NAcP: Number of Recommendation of the National Action Plan of Armenia (NAcP), Part I and II, 2017
- ch: chapter or number
- p: page

Action (Source[7]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
5.2.1.	challenges of extreme events **Task*:*** ***Practical development of interconnected actions of external organizations in the event of an accident at ANPP*** Such exercises are organized once every three years. The last exercise was organized in 2016. The next exercise is scheduled for 2019. A two-day exercise is also planned for 2019. The measure has been implemented.	Emergency exercises, including long-term exercises are organized regularly. These exercises reflect the challenges of extreme external events, in particular earthquakes or external flooding. Similarly, harsh radiological consequences of severe accidents are also addressed in the exercises. **Evaluation:** The actions can be considered as implemented. The plant should be encouraged in future implementation as established.
6.5.3 NAcP 5.2.2.	Deployment of early warning system with 20 detectors around ANPP and JRODOS software.	Hardware (server) of the JRODOS system was already delivered to ANRA, now being in the stage of installation. 32 stations with the detectors will be delivered early 2020. At present, the design documents are reviewed and preparation for installation of stations continues. **Evaluation:** The item will be completed with acceptable delay in 2020.
6.5.4 NAcP 5.2.3	Establishment of new back-up Emergency Response Centers for ANRA with back-up power, communication lines.	**Implementation:** Decision about proper location of the centre has been made (location in the main building of Armatom company). JRODOS, as well as NPP safety parameters on-line display will be available there. Communication lines are established. The parameters are already available in the main ANRA emergency centre. **Evaluation:** Implementation is progressing, full implementation is expected in 2021. The issue of back-up power should be addressed for the final implementation.
6.5.5 NAcP	Establishment of new back-up Emergency Response Centers for ANPP, with back-up power, environmental radiological	**Implementation:** Establishment of the Emergency Crisis Center was included in the long-term goals and

Action (Source[7]:)	Text of action in NAcP (Part III) and NAcP update	Implementation and Evaluation of action
5.2.3 PRT 7.2.1 NR 6.1.3.3(b)	filtering, etc. **Task*:*** ***Management of severe BDBA in case of loss of crisis center at ANPP site.*** The procurement plan for 2019 includes a measure on redesigning the building of the "Aknalich" boarding house to a backup Emergency Response Center for ANPP with backup power, a radioactivity filtering system, etc. The implementation of the measure is planned.	objectives of the NPP. The technical requirements to the ANPP Emergency Crisis Center have been developed. The ANPP management plans to establish the Emergency Crisis Center by the end of 2023. **Evaluation:** According the information provided by the plant, the implementation of these measures is delayed by about 3 years.
6.5.6 NAcP 5.2.4	Reviewing and updating national, regional, provincial, municipal and local emergency plans and conducting exercises to encourage greater coordination among the different organizations.	The Ministry of Emergency Situations was contacted to take over the issue. Complete answer from the Ministry to all listed items is still pending. **Evaluation:** Implementation of this action is beyond the control of ANPP as well as ANRA.

• LIST OF ABBREVIATIONS

AC	Alternating Current
AMNU	Emergency oil pump of sealing
ANPP	Armenian Nuclear Power Plant
ANRA	Armenian Nuclear Regulatory Authority
BDB	Beyond Design Basis
BDBA	Beyond Design Basis Accident
BSHPT	Direct Current Panel of Unit
BZOV	Demineralised Water Tank
CDF	Core Damage Frequency
CFF	Common Mode Failure
DAR	Additional Emergency Cooling System
DB	Design Basis
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DC	Direct Current
DG	Diesel Generator
DGS	Diesel Generator Station
DGSL	Diesel Generator Load Sequencer
DN	Diameter Nominal
EC	European Commission
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EETU	Rack of Electrical Devices
EGRS	Emergency Gas Removal System
ENSREG	European Nuclear Safety Regulators Group
EOP	Emergency Operating Procedure
ESP	Emergency Shutdown Panel
ESWS	Essential Service Water System
EU	European Union
g	standard value of the gravitational acceleration (9,81 m/s^2)
HCLPF	High Confidence in Low Probability of Failure
I&C	Instrumentation and Control
IAEA	International Atomic Energy Agency
IPSART	International Probabilistic Safety Assessment Review Team
LOCA	Loss of Coolant Accident
LUHS	Loss of Ultimate Heat Sink
LTE	Life Time Extension
MCP	Main Circulation Pump (= RCP)
MCR	Main Control Room
MDBA	Maximum Design Basis Accident
NAcP	National Action Plan
NBO	Boron Suction Pump
NCHK	Clean Condensate Pump
NPP	Nuclear Power Plant

NR	(Stress Test) National Report
NRSC	Nuclear and Radiation Safety Center
NSO	Cooling System Pump
NZB	Spent Fuel Pool Filling Pump
ODG	Reversible Motor Generator
OSA	On-site Assistance
OSART	Operational Safety Assessment Review Team
OSHPT	Common Direct Current Panel
PAMS	Post Accident Monitoring System
PGA	Peak Ground Acceleration
PGA_H	Horizontal Peak Ground Acceleration
PLK	Stormwater Drainage
POSRV	Pilot Operated Safety Relief Valve
PR	Peer Review
PRT	Peer Review Team
PSA	Probabilistic Safety Assessment (also known as PRA)
PSHA	Probabilistic Seismic Hazard Analysis
PWR	Pressurised Water Reactor
RCP	Reactor Circulation Pump (= MCP)
RCS	Reactor Coolant System
RDGS	Redundant Diesel Generator Station
RLE	Review Level Earthquake
RPV	Reactor Pressure Vessel
SAM	Serious Accident Management
SAMG	Severe Accident Management Guideline
SAR	Safety Analysis Report
SBO	Station Blackout
SFP	Spent Fuel Pool
SG	Steam Generator
SG FWDP	Steam Generator Feed Water Diesel Driven Pump
SSC	Structures, Systems and Components
SSEL	Safe Shutdown Equipment List
SV	Safety Valve
TH	Turbine Hall
TPK	Thermal Underground Duct
US	United States of America
VVER	Water Water Energetic Reactor
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators Association