ROMANIA

National Commission for Nuclear Activities Control

Romanian National Action Plan post - Fukushima

Revision 3, January 2020

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GENERAL INFORMATION ABOUT THE ACTION PLAN POST-FUKUSHIMA

Following the Fukushima Daiichi accident occurred in March 2011, the Romanian authorities and the nuclear industry performed reassessments of nuclear safety and emergency preparedness arrangements and implemented improvements, in line with the international efforts in this direction.

There are currently several public reports (listed in the References) which document the actions taken by the National Commission for Nuclear Activities Control (CNCAN) and Cernavoda Nuclear Power Plant (NPP) to take account of the lessons learned from the Fukushima accident.

A national action plan has been developed for bringing together the actions identified from regulatory reviews, self-assessments, peer-reviews and generic recommendations at international level. This action plan, presented in the annex to this report, has been elaborated by CNCAN, based on the safety reviews performed after the Fukushima accident, taking account of the guidance provided by ENSREG. The action plan was issued for the first time in December 2012 and has been reviewed and revised in December 2014, in December 2017 and in January 2020, respectively.

CNCAN has been monitoring the licensee's progress in the implementation of the planned improvements and continues to perform safety reviews and inspections to ensure that all the opportunities for improvement are properly addressed taking account of the lessons learned from the Fukushima accident.

All the most important safety-related upgrades have been implemented.

The revision 3 of the action plan reflects the situation as of December 2019. The action plan is reviewed annually by CNCAN to verify the progress with its implementation and revised, as necessary, to reflect any relevant new information and developments.

On the overall, it can be concluded that Romania has made good progress in the implementation of regulatory framework improvements and design upgrades to take account of the lessons learned from the Fukushima accident and improve the nuclear safety of the Cernavoda NPP.

Other significant updates for the last reporting period, that are worth of being mentioned in relation to the implementation of improvement actions based on lessons learned from the Fukushima accident, are provided as follows.

Follow-up IRRS

In October 2017, CNCAN received a follow-up IRRS. The IRRS team found that Romania had systematically addressed the findings made by the previous mission, implementing most of its recommendations and addressing the lessons learned from the 2011 Fukushima Daiichi accident. The follow-up IRRS report has been made public on the IAEA website: https://www.iaea.org/sites/default/files/documents/review-missions/irrs_follow-up_mission_rep_romania_2017.pdf .

The IRRS team noted that significant progress has been made in many areas. Specifically, 30 out of 34 recommendations and all 18 suggestions were closed. During the follow-up mission, the IRRS team developed 8 new recommendations and 4 new suggestions.

Also, the IRRS team noted that the Romanian Government showed a strong commitment to nuclear safety and improvement of regulatory control of the nuclear sector including;

- Approval of the National Strategy on Nuclear Safety and Security (NSNSS);
- Advanced the revision of the national strategy for radioactive waste and nuclear spent fuel management;
- Significant progress in the amendment of the Law 111/1996 to implement the BSS Directive;
- Commitment to ensuring an appropriate level of human resources to CNCAN when the Law 111 has been amended;
- Plans to significantly increase the CNCAN operational budget starting at the 2018 state fiscal year.

In several areas of regulatory responsibility, CNCAN has made significant progress from the previous IRRS mission. The IRRS team highlighted the following:

- Initiated, led or coordinated many initiatives related to the NSNSS;
- Progressed the implementation of the graded approach throughout its programs;
- Continued to develop regulations and guidance for authorizations, and internal procedures for review, assessment, and inspections;
- Advanced its capabilities to respond to nuclear and radiological emergencies;
- Adequately addressed the TEPCO Fukushima Daiichi response plan.

The IRRS team also noted that in spite of all the improvement work carried out by CNCAN, many tasks were not completed due to resource constraints. It was expected that the actions initiated by the Government to increase resources for CNCAN, will support the prompt completion of these tasks.

As a result, the organizational structure of CNCAN was modified in 2018 to allow for the increase in staffing. Several recruitment campaigns have been conducted and additional staff was hired.

However, efforts are still ongoing to staff all the available technical positions with personnel having adequate educational background, experience and qualifications, that is relevant for the nuclear safety regulatory work and to improve staff retention.

<u>Developments of the regulatory framework</u>

New regulations have been issued that take account of the lessons learned from the Fukushima Daiichi accident. The most relevant are:

- NSN-18 - Nuclear safety requirements on event reporting and analysis and on the use of operating experience feedback for nuclear installations (2017);
- NSN-21 - Fundamental nuclear safety requirements for nuclear installations (2017);
- NSN-23 - Regulation on the training, qualification and authorization of nuclear installations personnel with nuclear safety related jobs (2017);
- NSN-24 - Regulation on the deterministic nuclear safety analyses for nuclear installations (2019);

- NSN-26 - Regulation on interfaces between nuclear safety, radiological safety, physical protection, protection against cyber threats, and the control of nuclear safeguards (2019);
- GSN-03 - Guide on fulfilling the overall nuclear safety objective set in the fundamental nuclear safety requirements for nuclear installations (2018);
- GSN-09 - Guide on the development and assessment of nuclear safety culture (2019);
- Basic Requirements on Radiological Safety (BRRS, 2018);
- Regulation on the management of emergency situations specific to nuclear or radiological risk (2018);
- Regulation on the prevention, preparedness and response in case of emergency situations for the emergency preparedness categories I, II and III (2018);
- Regulation on the prevention, preparedness and response in case of emergency situations for the emergency preparedness categories IV and VI (2018).

CNCAN has established new quantitative nuclear safety objectives in the regulation NSN-21 and in the regulatory guide GSN-03.

The regulation NSN-21, issued for transposing the Council Directive 2014/87EURATOM of 8 July 2014 amending Directive 2009/71/EURATOM establishing a Community framework for the nuclear safety of nuclear installations, includes the following requirements:

"*Art. 4. – (1) The general nuclear safety objective that shall be observed in the design, siting, construction, commissioning, operation and decommissioning of a nuclear installation is to reduce at the minimum the risks associated with the exposure to ionizing radiation for the personnel, population and the environment.*

(2) The license holder, respectively the applicant for a license, shall take all the reasonable measures possible from technical point of view and practicable for the prevention of events which may lead to the exposure of the personnel, of the population and of the environment in excess of the limits established in the legislation. Also, all the reasonable measures, possible from technical point of view and practicable shall be taken for the limitation of the consequences of nuclear accidents, for the situations where such events may occur.

(3) For the purpose of fulfilling the general nuclear safety objective, the nuclear installations shall be designed, sited, constructed, commissioned, operated and decommissioned with the objective of preventing accidents and, should an accident occur, mitigating its consequences and avoiding:

a) early radioactive releases that would require off-site emergency measures without sufficient time to implement them;

b) large radioactive releases that would require protective measures that could not be limited in area or time.

(4) The requirements established in paragraph (3) apply to nuclear installations at their first license for the phases of design, siting, construction and installation.

(5) The requirements established in paragraph (3) shall be used as a reference for the timely implementation of reasonably practicable safety improvements to nuclear installations already existing at the time of the entering into force of this regulation, including in the framework of their periodic safety review."

The regulatory guide GSN-03, issued in December 2018 for facilitating the understanding and application of the requirements in article 4 of the regulation NSN-21, recommends the use of the following quantitative nuclear safety objectives:

a) Frequency of releasing into the environment a quantity of radioactive material that would require the temporary evacuation of the population from the vicinity of the nuclear site, quantified as the sum of the frequencies of all accident sequences with the source term higher than 1000 TBq of Iodine-131, to be less than 1E-5 / year. This quantitative objective aims at avoiding early releases of radioactive materials, which would require off-site emergency response measures without sufficient time to implement them. For accident sequences for which the source terms exceed 1000 TBq of Iodine-131, it should be demonstrated that the emission of radioactive material cannot occur in such a short time that it does not allow the population to be evacuated from the vicinity of the site.

b) Frequency of releasing into the environment a quantity of radioactive material that would require relocation of the population near the site, quantified as the sum of the frequencies of all accident sequences with the source term higher than 100 TBq of Cesium-137, to be less than 1E-6 / year. This quantitative objective aims at avoiding large releases of radioactive materials which would require protection measures that cannot be limited in space or time.

c) The cumulative frequency of all accident sequences that can lead to effective doses higher than 100 mSv in the first 7 days, for which the population in the vicinity of the nuclear facility is required to be evacuated in accordance with the generic criteria of the Regulation of Emergency Situations Management for nuclear or radiologic risk, to be less than 1E-5 / year.

d) The cumulative frequency of all accident sequences that can lead to effective doses higher than 100 mSv in the first year, for which temporary relocation of the population located near the site is required according to the generic criteria of the Regulation of Emergency Situations Management for nuclear or radiologic risk, to be less than 1E-6 / year.

In order to assess the fulfillment of the quantitative nuclear safety objectives, deterministic and probabilistic nuclear safety assessments are being further developed and revised, in accordance with the requirements and recommendations in the applicable CNCAN regulations, regulatory guides and internationally recognized standards and best practices. The analyses are required to cover all operational modes of the nuclear installation and to take into account all internal and external initiating events relevant to the installation and to the site. Both design basis accidents as well as the design extension conditions, including severe accidents, are considered in the analyses. Accident scenarios affecting several nuclear installations located on a common site are also considered.

Design improvements

Cernavoda NPP has continued upgrading the safety of its operating units, taking account of the latest standards, available operational experience feedback and the results of research and development activities.

In addition to the design improvements already mentioned in the previous reports post-Fukushima, measures have been taken to enhance the capability for monitoring plant parameters in severe accident conditions. Examples include:

- elevation of the Dousing Level Measurement Loops (belonging to the Emergency Core Cooling System) in order to avoid its unavailability in case of reactor building

flooding due to beyond (extended) design basis accident;

- qualification of the PHT (Primary Heat Transport) Headers Pressure Loops for Earthquake and Severe Accident Conditions and installing Pressure Indicators in SCR (Secondary Control Room); these indications are used for subcooling margin monitoring for SAMG (Severe Accident Monitoring Guidelines).

Improvements of accident management and emergency preparedness and response

CNCAN has continued to perform plant inspections on the procedures, training, equipment and resources available for responding to transients, accidents and emergency situations.

All the licensee's procedures for responding to anticipated operational occurrences and accidents, as well as the severe accident management guidelines, have been systematically reviewed and revalidated during the period 2017 – 2018. The review and revalidation confirmed the adequacy of the procedures and allowed for the identification and subsequent implementation of improvements in the logistics of the response to abnormal events.

To improve the training of operators and other categories of plant personnel, work has started to enhance the full-scope simulator to include severe accident simulation capabilities, augmented with 2D and 3D animated, interactive visualizations of the reactor and containment building to provide trainees with further insights into the behaviour of the plant during severe accident scenarios.

In 2018, CNCAN has revised and updated the regulatory requirements on emergency preparedness and response, in accordance with the international standards and European directives.

In the last 3 years, Cernavoda NPP has revised the On-site Emergency Plan, in order to:

- define the emergency planning zones and distances in accordance with the current IAEA standards;
- introduce information about resources needed to support the on-site emergency response during the first 72 hours of an emergency;
- introduce information regarding the emergency equipment and facilities provided by Cernavoda NPP to support the off-site emergency response;
- introduce events that affect both units on the site;
- update protective actions if the projected dose exceeds the generic criteria.

Other relevant improvements in the area of emergency preparedness and response, implemented by Cernavoda NPP, include the following:

- Development of a software application for dose assessment for the intervention team members in case of severe accident;
- Supplemented the communication groups by the TETRA radio stations with a dedicated group for the monitoring teams;
- Concluded a contract for psychological counseling and psychotherapy services in case of emergency in order to provide psychological support to the intervention team

members;

- Voice recorders in the On-site Emergency Control Center and the Off-site Emergency Control Center are in process of being procured, in order to record phone calls and verbal communication made during the emergency situations;
- Structural improvements to the On-site Emergency Control Center and the Off-site Emergency Control Center have been performed;
- The Diesel Generator for the fridge and cooking equipment in the canteen in the plant Campus is in process of being procured, in order to provide an auxiliary electrical power supply in the emergency food storage area.

Also, the emergency exercises carried out in the last 5 years at Cernavoda NPP have systematically included severe accident scenarios initiated by extreme external events, using lessons learned from the Fukushima accident.

ANNEX

Romanian Action Plan post-Fukushima - Summary of improvement activities

The latest status of the Romanian National Action Plan is summarized in the table below, which provides an outline of the main improvement activities resulting from the post-Fukushima safety reviews performed to date. The table identifies, for each action, the organization(s) responsible for implementation (SNN - the licensee, CNCAN, or both), the status of the action (implemented, in progress, planned or under evaluation) and the target date for completion. The status of the actions reflects the situation as of December 2019.

CNCAN monitors the licensee's progress in the implementation of the planned improvements and continues to perform safety reviews and inspections to ensure that all the opportunities for improvement are properly addressed taking account of the lessons learned from the Fukushima accident.

Action	Responsible for implementation	Status	Target date for implementation
Topic 1 – External events (earthquakes, floods and extreme weather conditions)			
1. Review the specific procedure which is in place for extreme weather conditions in order to include the appropriate proactive actions for plant shutdown.	SNN	Implemented	-
2. Identification of potential measures to improve protection against flooding.	SNN	Implemented	-
3. Provision of on-site of sand bags to be used as temporary flood barriers, if required.	SNN	Implemented	-
4. Improvement of the seismic robustness of the existing Class I and II batteries.	SNN	Implemented	-

Action	Responsible for implementation	Status	Target date for implementation
5. Design modifications to replace selected doors with flood resistant doors and penetrations sealing (for improving the volumetric protection of the buildings containing safety related equipment located in rooms below plant platform level).	SNN	In progress	July 2020 The target date for implementation was initially the end of 2014, but the scope of work has been extended. All identified flood resistant doors (around 50) were installed in Unit 1 and Unit 2. All design changes identified in rev. 0 of the MPA#1094 (flood doors and penetration sealing) are implemented. Still in progress are the activities to improve penetrations sealing of selected T/B rooms as per rev. 2 of MPA#1094. The change of the target date for implementation was due to the complexity of the engineering solutions for penetrations' sealing. The remaining activities are introduced in the Work Management System and are monitored.
6. The seismic walk-downs and subsequent seismic robustness analyses done as part of the seismic margin assessment have not revealed a need for any safety significant design change. However, several recommendations resulted from these inspections, which have been included in the regular plant seismic housekeeping program. These do not impact on the seismic margin assessment.	SNN	Implemented	-
7. The regulator to consider routine inspections of the flood protection design features.	CNCAN	Implemented	-

Action	Responsible for implementation	Status	Target date for implementation
8. The peer review recommended that a seismic level comparable to the SL-1 of IAEA leading to plant shutdown and inspection is established. It was suggested to the regulator to consider implementing adequate regulations. Currently the actions taken by the licensee following an earthquake are based on decision making criteria that include the estimated damage to the plant (walkdowns using a specific procedure) rather than on pre-defined level.	CNCAN	Implemented	Cernavoda NPP has established the SL-1 level. The regulation NSN-06 on the protection of nuclear installations against external events of natural origin has been published in January 2015.
9. Elaboration of more detailed regulatory requirements on the protection of NPPs against extreme external events, taking account of the lessons learned from the Fukushima accident and of the results of the "stress tests" peer reviews.	CNCAN	Implemented	The regulation NSN-06 on the protection of nuclear installations against external events of natural origin has been published in January 2015.
10. The peer review concluded that there is only little information about margins to cliff edges due to external events and weak points. Further work is proposed in this area and it is recommended that CNCAN obtains good quality programs from licensees and ensures that the work is appropriately followed up.	CNCAN	Implemented	The regulation of NSN-06 includes requirements on the assessment of cliff-edge effects due to external events of natural events. Based on the assessments implemented so far, it was concluded that the existing safety margins are sufficient to prevent cliff-edge effects.

Action	Responsible for implementation	Status	Target date for implementation
Topic 2 – Design Issues			
11. Procurement and testing of mobile equipment (e.g. mobile diesel generators, mobile pumps, connections, etc.).	SNN	Implemented	-
12. Provision of a facility to open the MSSVs after a SBO.	SNN	Implemented	-
13. Provision of connection facilities required to add water using fire fighters trucks and flexible conduits to supply the primary side of the RSW/RCW heat exchangers and SGs under emergency conditions.	SNN	Implemented	-
14. Specific emergency operating procedures to cope with Station Blackout and Loss of Spent Fuel Pool Cooling events.	SNN	Implemented	-
15. The option of charging the batteries or the installation of a supplementary uninterruptible power supply for the SCA is being considered by the licensee as a potential improvement.	SNN	Implemented	A few options to supply plants critical parameters from SCA, during severe accident (SBO), from a seismically qualified power supply, were analyzed and documented. These options are in addition to existing modification for supplying SCA panels from the large mobile Diesel generators, which is implemented. The solution selected for implementation, documented in MPA#EC1973, was to add a new power supply to SCA instrumentation panels from 100 kV mobile Diesels, which are already procured. The design modification package (MWP) also included new, seismically qualified, electrical panels that needed to be installed.

Action	Responsible for implementation	Status	Target date for implementation
Topic 3 – Severe Accident Management and Recovery (On-Site)			
16. Validation of the station Severe Accident Management Guidelines (SAMG) through emergency exercises.	SNN	Implemented	-
17. Training for severe accident scenarios, including as part of the emergency drills.	SNN	Implemented (Refreshment training is performed periodically)	-
18. Special agreements were established with the local and national authorities involved in the emergency response in order to ensure that in case of a SBO coincident with loss of primary UHS the plant has absolute priority to grid re-connection and supply of light and heavy equipment and the necessary diesel fuel.	SNN	Implemented	-
19. Accident management provisions for events in the spent fuel pools (natural ventilation for vapours and steam evacuation, seismically qualified fire-water pipe for water make-up).	SNN	Implemented	-
20. Improvement of the existing provisions to facilitate operator actions to prevent a severe accident in SFB (water level and temperature monitoring from outside the SFB building).	SNN	Implemented	Design improvements have been implemented at both units. Water level gauges were installed to allow operators SFB level measurement in case of severe accident from an accessible location, outside the SFB building. Portable devices will be used for water temperature measurement.

Action	Responsible for implementation	Status	Target date for implementation
21. Installation of PARs for hydrogen management.	SNN	Implemented	-
22. Installation of dedicated emergency containment filtered venting system for each NPP unit.	SNN	Implemented	-
23. Additional instrumentation for SA management e.g. hydrogen concentration monitoring in different areas of the reactor building.	SNN	Implemented	-
24. Improvements to the reliability of existing instrumentation by qualification to SA conditions and extension of the measurement domain.	SNN	Implemented	The design changes implemented at both Cernavoda Units to improve survivability to SA addressed the following parameters: - R/B pressure, - Calandria Vault level, - moderator level, - Heat Transport temperature.
25. Implementation of a design modification for water make-up to the calandria vessel and the calandria vault	SNN	Implemented	-
26. Verification of the completeness of event-based and symptom-based EOPs for all accident situations.	SNN CNCAN	Implemented	-
27. Severe accident management requirements to be included in a regulation.	CNCAN	Implemented	The regulation with requirements on severe accident management was issued in January 2014.

Action	Responsible for implementation	Status	Target date for implementation
28. MCR habitability analysis to be continued (e.g. assessment of total core melt with voluntary venting, implementation of close ventilation circuit with oxygen supply).	SNN	Implemented	-
29. Review of Level 1 PSA & completion of Level 2 PSA (to include SFB accidents).	SNN	Implemented	-
30. Measures have been identified (and will be implemented) that aim to improve the reliability of the: (i) communication system and (ii) on-site emergency control centre.	SNN	Implemented	-
31. Cernavoda NPP will establish a new seismically qualified location for the on-site emergency control centre and the fire fighters. This location will include important intervention equipment (mobile DGs, mobile diesel engine pumps, fire-fighter engines, radiological emergency vehicles, heavy equipment to unblock roads, etc.) and will be protected against all external hazards.	SNN	In progress	End of 2020 The target date was initially set for the end of 2015. It was changed several times due to legal and administrative issues related to transfer of property of the physical location. Until the completion of this action, equivalent measures have been implemented to ensure that all intervention equipment (mobile Diesels, Diesel fire pump, fire trucks, and so) are protected from external hazards (e.g. the equipment have been relocated so that they would not be impaired by external events).
32. Review of SAMGs taking account of plant modifications and upgrades performed after Fukushima.	SNN CNCAN	Implemented	-
33. The development of SAMGs specifically for shutdown states is under consideration.	SNN	Implemented	-

Action	Responsible for implementation	Status	Target date for implementation
Topic 4 – National Organizations			
34. Improvement of on-site emergency organization.	SNN	Implemented	-
35. Review of lessons learned from the Fukushima accident with regard to organizational factors and applicability to national organizations in the nuclear sector.	CNCAN SNN	Implemented	-
36. Implementation of recommendations from the 2011 IRRS mission.	CNCAN	Implemented	The recommendations from the 2011 IRRS mission with regard to regulation and oversight of nuclear installations have been implemented. New recommendations and suggestions have been issued by the follow-up mission received by CNCAN in October 2017.
37. Review of the national regulatory framework for nuclear safety to identify and implement actions for improvement.	CNCAN	Implemented	All the main regulations relevant for nuclear safety and emergency preparedness and response have been revised. Nevertheless the improvement of the regulatory framework is considered a continuous activity.
Topic 5 – Emergency Preparedness and Response and Post-Accident Management (Off-Site)			
38. Review the existing protocol with Public Authorities in order to ensure the necessary support for the Cernavoda NPP personnel in case of severe accident, when the roads are blocked due to extreme meteorological conditions, natural disasters (earthquakes, flooding, etc.) or other traffic restrictions.	SNN	Implemented	-

Action	Responsible for implementation	Status	Target date for implementation
39. Installation of Special Communication Service phones in each Main Control Room (Intervention Support Centre) and Secondary Control Area.	SNN	Implemented	-
40. An alternative off-site emergency control centre is being developed.	SNN	Implemented	The new offsite emergency control center was tested during a drill, in December 2015.
41. A review of the national off-site response is in progress to take account of the lessons learned from the Fukushima accident.	CNCAN + other national authorities	Implemented	The regulations and the national plan for emergency preparedness and response have been revised.
Topic 6 – International Cooperation			
42. Identification and consideration of additional relevant peer-review services.	CNCAN SNN	Implemented	This is a continuous activity, controlled by the operational experience processes. Several OSART and WANO-PEER Review Missions have been conducted at Cernavoda NPP. An IRRS follow-up was conducted in 2017. Several relevant benchmarking activities have been conducted by both regulator and licensee.
43. Participation in international activities for sharing experience on lessons learned from the Fukushima accident and on actions taken to improve safety.	CNCAN SNN	Implemented	Both CNCAN and the licensee have participated and continue to participate in all relevant international activities.

REFERENCES

1) Romanian National Action Plan post-Fukushima – rev.1 – December 2017, http://www.ensreg.eu/sites/default/files/attachments/stress_test_nacp_romania_2017.pdf ;

2) Romanian National Report for the Convention on Nuclear Safety, 8th edition, August 2019, https://www.iaea.org/sites/default/files/romania_nr-8th-rm.pdf ;

3) National Report of Romania for the 2nd Extraordinary Meeting under the Convention on Nuclear Safety (May 2012) http://www.cncan.ro/assets/Informatii-Publice/06-Rapoarte/RO-National-Report-for-2nd-Extraordinary-Meeting-under-CNS-May2012-doc.pdf ;

4) Reports on the implementation of the European "stress tests" by Romania: http://www.ensreg.eu/EU-Stress-Tests/Country-Specific-Reports/EU-Member-States/Romania .