# ROMANIA

## Presentation on the progress in the implementation of the

# National Action Plan post-Fukushima

## National Commission for Nuclear Activities Control

## CNCAN

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# Presentation Outline

- ❖General overview of nuclear installations under the scope of the NAcP
- ❖Response/clarification on any issues identified in the rapporteur's report from the 2013 workshop.
- ❖Progress on implementation and update of the NAcP and summary of safety improvements implemented after Fukushima
- ❖Main changes in the NAcP since the 2013 workshop with justification, including:

- additional measures

- measures removed or modified

- changes in the schedule.

- ❖Technical basis leading to the main changes identified in the NAcPs.
- ❖Relevant outcomes of studies and analyses identified in the NAcPs, and completed since the 2013 workshop.
- ❖Good practices and challenges identified during implementation.
- ❖Response/clarification on the questions/comments raised on the 2014 version of NAcP.
- ❖Concluding Remarks

# Cernavoda NPP

| Reactor Unit | Type | Gross Capacity MW(e) | Construction Start | First Criticality | Operating Status |
|---|---|---|---|---|---|
| Cernavoda-1 | CANDU-6 (PHWR) | 706.5 | 1980 | 16th of April 1996 | In operation |
| Cemavoda-2 | CANDU-6 (PHWR) | 706.5 | 1980 | 6th of May 2007 | In operation |
| Cemavoda-3 | CANDU-6 (PHWR) | 720 | 1980 | - | Under preservation, plans to restart construction |
| Cemavoda-4 | CANDU-6 (PHWR) | 720 | 1980 | - | Under preservation, plans to restart construction |
| Cemavoda-5 | CANDU-6 (PHWR) | - | 1980 | - | Under preservation, no plans to restart construction |

# Issues identified in the rapporteur's report from the 2013 workshop

**Peer Review Conclusions from the 2013 workshop (as is the Rapporteur's Report for Romania):**

- *The implementation of improvement measures is clearly scheduled, and the ending date of the process (2015) is considered ambitious and commendable.*
- *Romania considers the enhancement of instrumentation and monitoring under severe accident conditions (especially in the long term) as a challenge. (ENSREG Recommendation 3.2.5)*
- *During the workshop several other good practices have been identified in the NAcP (e.g. the construction of a new on-site emergency center, which is seismically robust and protected against external hazards as well as the development of a new off-site emergency control center located away from the site or the prompt implementation of relevant containment protection measures as passive autocatalytic recombiners and seismically qualified filtered venting).*
- **No clarifications are necessary in response to these issues; the following slides present the progress in the implementation of the action plan, the updated information on the way in which the challenge is being solved and the changes in the schedule for some improvements**

# Progress on implementation and update of the NAcP

**As of April 2015, the status of the completion of improvement measures, grouped under 43 items (RO NAcP – Table 1), is as follows:**

- **Implemented: actions 1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 26, 27, 29, 30, 34, 35, 37, 38, 39, 41.**

- **In progress: actions 5, 15, 24, 25, 28, 31, 32, 33, 36, 40, 42, 43; these have the end of 2015 as target date for completion, with the exception of 24 and 31 (explained below) and 42 and 43, which are continuous activities.**

- **Two actions have target dates beyond the original target that was set for the end of 2015: action 24 (regarding instrumentation qualified for severe accident conditions – most modifications have been performed but some will be completed only in 2016) and action 31 (regarding the completion of the new seismically qualified location for the on-site emergency control centre and the fire fighters – delayed until 2017, but alternative measures have been implemented until then)**

- **Planned: action 10 (assessment of "cliff-edge" effects due to external events – at the time of the stress test, no "cliff-edge" effects have been found for seismic and flooding events with frequencies of return > 1E-4/year; no further analysis has been performed); target date: end of 2015**

## Summary of main improvements implemented post - Fukushima

**Actions implemented for increased protection against external events:**

- **Improvement of the seismic robustness of the Class I and II batteries;**
- **Provision of sand bags, on-site, for use as temporary flood barriers, if required;**
- **Revised procedure for response to extreme weather conditions in order to include appropriate proactive actions for plant shutdown;**
- **Replacement of 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;**
- **Routine regulatory inspections of the flood protection design features;**
- **The establishment of a seismic level comparable to the SL-1 of IAEA, leading to plant shutdown and inspections (previously the actions taken by the licensee following an earthquake were based on decision making criteria that include the estimated damage to the plant instead of a pre-defined level). (walkdown using a specific procedure).**

# Summary of main improvements implemented post - Fukushima

**Actions for increased protection against SBO and LOUHS events :**

➢ **Implemented:**

- **Procurement and testing of mobile equipment (e.g. mobile diesel generators, mobile pumps, connections, etc.);**
- **Provision of a facility to open the MSSVs after a SBO, to allow for depressurization of SGs and gravitational water flow from the dousing tank;**
- **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;**
- **Development, validation and implementation of specific emergency operating procedures to cope with Station Blackout and Loss of Spent Fuel Pool Cooling events.**

➢ **In progress:**

- **The installation of a supplementary independent power supply for the SCA instrumentation panels is under implementation by the licensee – to be completed by the end of 2015.**

# Summary of main improvements implemented post - Fukushima

**Actions for increased protection against severe accidents and for improved emergency preparedness:**

➢ **Implemented:**

- **Validation of the station Severe Accident Management Guidelines (SAMG) through emergency drills and exercises;**
- **Training for severe accident scenarios, including as part of the emergency drills and exercises;**
- **Installation of PARs (passive autocatalytic recombiners) for hydrogen management in both Cernavoda NPP Units;**
- **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);**
- **Special agreements 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;**
- **Improvement of the reliability of the on-site emergency control centre (increased seismic robustness) and of the on-site emergency organization;**
- **Installation of Special Communication Service phones in each Main Control Room and Secondary Control Areas.**

# Summary of main improvements implemented post - Fukushima

**Actions for Increased protection against severe accidents and for improved emergency preparedness:**

- **Implemented:**
  - Design modification for water make-up to the calandria vessel (completed for Unit 1; partially implemented for Unit 2 – to be finalized by mid 2015)
  - Design modification for water make-up to the calandria vault (completed for both units)
  - Installation of dedicated emergency containment filtered venting systems (completed for both units);
  - Verification of the completeness of event-based and symptom-based EOPs for all accident situations;
  - Additional instrumentation for severe accident (SA) management (e.g. hydrogen concentration monitoring in Reactor Building; new RB pressure monitoring loops);
  - Improvement of the existing provisions to facilitate operator actions to prevent a severe accident in the spent fuel pool (water level and temperature monitoring from outside the SFP building);
  - The review of Level 1 PSA and the completion of Level 2 PSA, including SFP accidents;
  - Improvements to the reliability of the communication systems

# Summary of main improvements implemented post - Fukushima

**Actions for increased protection against severe accidents and for improved emergency preparedness:**

➢ **In progress:**

- **MCR habitability analysis is being continued (e.g. assessment of total core melt with voluntary venting): will be completed by mid 2015;**
- **Review of SAMGs taking account of plant modifications and upgrades performed after Fukushima: to be finalized by mid 2015;**
- **Improvements to the reliability of existing instrumentation by qualification to severe accident conditions and extension of the measurement domain: to be completed by the end of 2016;**
- **The development of SAMGs specifically for shutdown states will be finalized by the end of 2015;**
- **Establishment of a new seismically qualified location for the on-site emergency control centre and for 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: to be completed by the end of 2017;**
- **An alternate off-site emergency control centre has been constructed and the installation of equipment is in progress – will be finalized by the end of 2015.**

# Summary of main improvements implemented post - Fukushima

**Actions for improving the national regulatory framework:**

➢ **Implemented:**

- **The regulation on response to transients, accident management and on-site emergency preparedness and response for nuclear power plants was published in January 2014 and came into force in April 2014; takes account of the lessons learned from the Fukushima accident and from the safety reviews performed, the IAEA safety standards and WENRA Reactor Safety Reference Levels.**
- **The National Strategy for Nuclear Safety and Security was officially approved by the Romanian Government and by the Supreme Council of National Defence, has been published and has come into force in July 2014.**
- **The regulation on the protection of nuclear installations against external events of natural origin has been published and has come into force in January 2015; it is based primarily on the new WENRA Reference Levels - Issue T: Natural Hazards.**
- **A regulation on the protection of nuclear installations against cyber threats has been published and came into force in November 2014.**
- **A regulatory guide providing recommendations on the use of industrial codes and standards for nuclear power plants has been published in March 2015.**

➢ **In progress:**

- **A regulation on the operation of nuclear installations is being developed; it will include all the relevant revised WENRA Reference Levels.**

# Flood resistant doors



# Facilities for opening and keeping MSSVs open in case of SBO

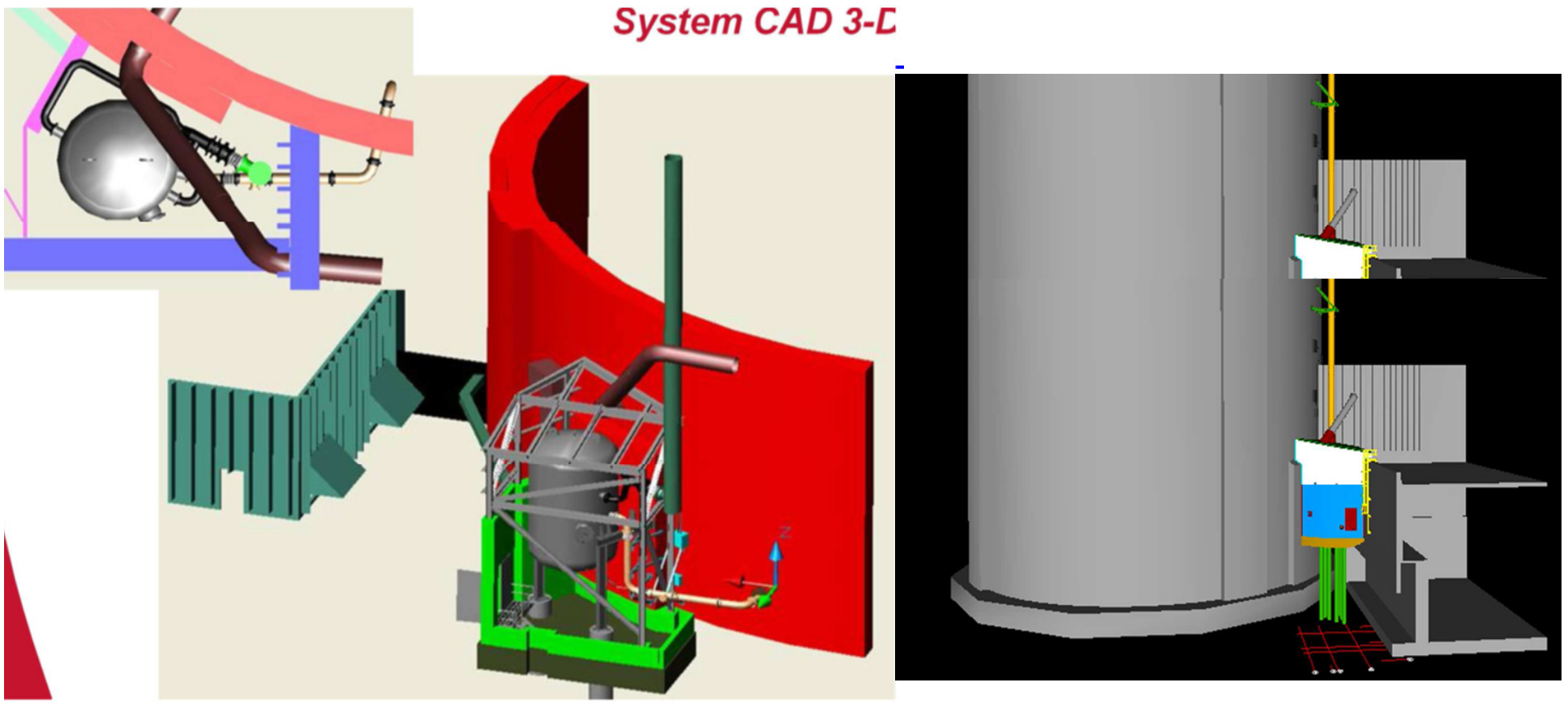


**hydraulic jack**

**N2 supplies for MSSVs pneumatic actuation**

# Mobile Diesel Generators


# Containment Filtered Venting System



# Containment Filtered Venting System

## U1 – Shielding Well set

# Containment Filtered Venting System

## Venturi Vessels (U1/U2) – manufacturing

# Containment Filtered Venting System

## U1 – Vessel Supports Installation

# Containment Filtered Venting System

## U1 – Venturi Vessel Installation

# Containment Filtered Venting System

## U1 – Stack installation


# Passive Autocatalytic Recombiners


# Hydrogen Concentration Monitoring System Panels


## Main changes in the NAcP, justification and technical bases

- **The delays are identified and explained as follows. No actions have been de-prioritised.**

**ACTIONS RELATED TO TOPICS 1- 3**

- **Action 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).**
- **The target date for implementation was initially set for the end of 2014 but has been changed for the end of 2015.**
- **The change of the target date for implementation was due to the complexity of the engineering solutions for penetrations' sealings.**
- **All identified flood resistant doors (around 50) were installed in Unit 1 and Unit 2.**
- **Activities to improve penetrations sealing of selected T/B rooms are in progress, as per an approved Design Modification Package. The remaining activities are introduced in the Work Management System and are monitored.**

## Main changes in the NAcP, justification and technical bases

- **Action 24: Improvements to the reliability of existing instrumentation by qualification to SA conditions and extension of the measurement domain.**
- **The target date for implementation was initially set for the end of 2014 and the status of the action was set as planned.**
- **The target date has been changed due to difficulties in procuring items qualified to the specifications issued by the licensee. These problems were noted in 2013, when it was found that the products available on the market are not generally qualified for long term survivability and functionality under severe accident conditions (e.g. radiation fields, temperatures, etc.). This issue has been highlighted as a challenge on the occasion of the first peer review workshop.**
- **Since 2013, the manufactures/suppliers have adapted to the demand for equipment qualified for severe accidents conditions, as required post-Fukushima, so the licensee could identify suitable suppliers.**
- **The action is now in progress, as described in the updated national action plan.**
- **The date for completion has been set for the end of 2016.**

## Main changes in the NAcP, justification and technical bases

- **Action 25: Implementation of a design modification for water make-up to the calandria vessel and the calandria vault (completed for Unit 2 calandria vessel).**
- **The target date for the completion of all the associated design changes was initially set for the end of 2013, based on the conceptual design modification packages.**
- **At Unit 1 of Cernavoda NPP, all the necessary permanent modifications have been implemented.**
- **At Unit 2, the modification for water make-up to the calandria vessel is partially implemented; it will be finalized during the planned outage of Unit 2, in May - June 2015. This modification was delayed because the installation of a certain valve requires plant shutdown state.**
- **Compensatory actions were / are in place to ensure the function of water make-up to the Calandria vessel can be performed, if required, even before the completion of the permanent modification.**
- **The target date for completion of the permanent design modification has thus been changed for mid 2015.**

## Main changes in the NAcP, justification and technical bases

- **Action 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).**
- **The initial target date for the completion of the action, with regard to the analysis, was set for the end of 2014, with the status set to planned. The target date was changed due to delays in the procedure for contracting the necessary studies from external companies.**
- **The new target date for completion of this action has been set for mid 2015.**
- **The preliminary results of the analysis have been made available to CNCAN for information in December 2014. The licensee is currently working on revising the ALARA plans for the actions that would have to be performed from areas in which high radiation levels would be expected.**
- **Note: Unit 2 has already a close ventilation circuit with oxygen supply, implemented as part of the original design. The implementation of such a system in Unit 1 is being considered.**

## Main changes in the NAcP, justification and technical bases

- **Action 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.**
- **The target date was initially set for the end of 2015. It was changed for the end of 2017 due to legal and administrative issues, related to transfer of property of the physical location.**
- **Until the completion of the action, equivalent measures have been implemented to ensure that all intervention equipment (mobile Diesels, Diesel fire pump, fire trucks) are protected from external hazards (e.g. the equipment have been relocated so that they would not be impaired by external events).**

## Main changes in the NAcP, justification and technical bases

- **Action 32: Review of SAMGs taking account of plant modifications and upgrades performed after Fukushima.**
- **The SAMGs have been reviewed and revised and in December 2014 they are in process of internal evaluation and approval by the licensee.**
- **The target date was initially set for the end of 2014, but it was moved to mid 2015, because the revised SAMGs need to be submitted to the regulator for review.**

# Main changes in the NAcP, justification and technical bases

## ACTIONS RELATED TO TOPICS 4 - 6

- **Action 36:** Implementation of recommendations from the 2011 IRRS mission.
- The initial target date was set for the end of 2013.
- Most of the nuclear safety related technical recommendations have been implemented.

- **Action 40:** An alternative off-site emergency control centre is being developed.
- The construction phase has been finalized. The installation of the communication and data systems is scheduled for 2015.
- The initial target date had been set for the end of 2014. It was changed due to legal and administrative issues, related to transfer of property of the physical location.

## Relevant outcomes of studies and analyses identified in the NAcPs, and completed since the 2013 workshop

- **Action 29:** Revision of Level 1 PSA & completion of Level 2 PSA (to include SFB accidents) was finalized
- The Level 2 PSAs credited safety upgrades performed post-Fukushima: PARs (passive autocatalytic recombiners), EFCVS (Emergency Filtered Containment Venting Systems) and water make-up to the calandria vault (for in-vessel retention).
- Based on the current PSA results, several potential improvements are being analyzed for deciding on their implementation.

## Good practices and challenges identified during implementation

- **Good practices:**
  - Romania has implemented promptly a significant number of important safety improvements.
  - CNCAN has requested the licensee to include topics related to SAMGs in the examinable objectives for control room operators and shift supervisors' authorization and this work is currently ongoing. CNCAN will use these objectives to test the operators' and shift supervisors' knowledge of SAMG application, as part of the licensing process.
  - CNCAN performs annual inspections on the status of the implementation of the safety improvements resulted from the stress tests; these include verifications of the periodic inspection, testing and maintenance performed by the licensee on the systems and equipment credited to support accident management.
  - In addition to the initial review of the licensee's resources for emergency response organization, performed in the framework of the stress tests, on the assumption of severe accidents affecting multiple installations on site, CNCAN has requested the licensee to review also the shift staffing adequacy, taking into consideration various scenarios that could affect multiple installations on the same site. This review is ongoing.

## Good practices and challenges identified during implementation

- **Challenges:**
  - **A potential challenge would be to devise a methodology for the assessment of cliff-edge effects resulting from external events, for identifying the ultimate-load capacity of SSCs / the ultimate failure point and quantifying the probability that this is reached.**

    **This would represent a particular challenge if no EU-level guidance is available, including a common agreement on what should be the reference value for the probability of failure of a SSC considered in a cliff-edge analysis (e.g. 1 or 0.95 or 0.5 probability of failure?) and on the confidence level for this value.**

## Response to questions received in writing before the 2015 workshop

- We would like to thank to all those who contributed to the peer review process for Romania.
- During the peer review process we received 41 questions, from:
  - Austria (2)
  - Spain (15)
  - France (2)
  - Netherlands (2)
  - Slovenia (1)
  - UK (18)
  - EC-JRC (1).
- The answers have been provided in writing and have been made available to all national contact points.
- The issues of particular interest, judging based on the questions received, are addressed in the following slides.

## Response to questions received in writing before the 2015 workshop

- **Several questions related to the review of safety margins for all types of external events of natural origin with frequencies of occurrence of ≤ 1E-4/yr.**
- **The answers make reference to the stress test reviews and to the new regulation issued by CNCAN in January 2015, on the protection of nuclear installations against external events of natural origin, based on Issue T of the 2014 WENRA RHWG Safety Reference Levels for existing reactors.**
- **During the stress tests, margins for extreme external events with frequencies lower than1E-4/yr have been assessed only for seismic and flooding events.**
- **For severe weather conditions, the safety margin review during the stress tests has been less detailed, mainly due to the lack of data and to the large uncertainties associated with data extrapolations.**
- **The licensee is in process of implementing the new regulation.**
- **A guidance document on extreme weather is under preparation by WENRA/RHWG and will be used as an aid in the implementation of the new regulation. CNCAN will review compliance with the new regulation, making use also of the referenced IAEA safety standards and of the applicable guidance produced by WENRA/RHWG.**

# Response to questions received in writing before the 2015 workshop

- **Several questions related to the assessment of cliff-edge effects for external events, in particular for seismic events.**
- **The answers made reference to the seismic margin assessment performed for Cernavoda NPP, which showed that all SSCs which are part of the safe shutdown path after an earthquake would continue to perform their safety function for a PGA of up to 0.4g, which has a frequency of 5E-5 events/year. This margin is considered adequate as it meets the safety goals applied internationally for new NPPs.**
- **Additional margins exist beyond the value of 0.4g, but they have not been quantified. A cliff-edge assessment in line with the intention of the stress test has not been performed, due to lack of technical guidance.**
- **The specifications for the EU stress-tests focused on finding "cliff-edge effects" regardless of their probability of occurrence. Such an approach is aimed at identifying the ultimate-load capacity of SSCs / the ultimate failure point and quantifying the probability that this is reached.**
- **CNCAN has included the requirement on the cliff-edge assessment in the regulation on protection of nuclear installations against external events of natural origin. CNCAN will consider producing guidance for the licensee on the quantitative assessment of cliff-edge effects before the end of 2015. However, it would have been helpful to have a common, agreed, guidance at EU-level.**

# Response to questions received in writing before the 2015 workshop

❖ **Several questions related to the qualification and availability of instrumentation to support the implementation of SAMGs**

❖ **The following instrumentation loops have been identified as critical in order to provide the information required by the SAMGs:**

- **Moderator (Calandria Vessel) level measurement,**
- **Primary heat transport system RIH (reactor inlet header) temperature measurement,**
- **Calandria Vault level and**
- **Reactor building (R/B) pressure measurement (implemented in both Units).**

❖ **The instrumentation needed for measuring these parameters is located inside the R/B, except for R/B pressure measurement. Where necessary, the whole loops (instrumentation, cables and connectors) will be replaced with new ones, qualified including for severe accidents (see conditions listed below).**

❖ **The SSCs located inside the reactor building that are involved in maintaining the core cooling during a S.A. are mainly passive. However, they are qualified, by design, to LOCA conditions.**

❖ **The severe accident conditions are:**

- **Temperature: 137°C**
- **Pressure: 310 kPa(a)**
- **Dose (SA conditions): 7.6E7 rads (7.6E5 Sv)**
- **Humidity: 100% R.H.**

## Response to questions received in writing before the 2015 workshop

❖ **Several questions related to specific technical aspects of the implementation of EOPs and SAMGs, including design features and operational strategies**

❖ **The answers provided details related to:**

- ❖ **seismic qualification of SSCs credited in the response to SBO (Station Black-Out) and LOUHS (Loss of Ultimate Heat Sinks) scenarios**
- ❖ **implementation of EOPs (emergency operating procedures) from the SCA (secondary control area)**
- ❖ **mobile equipment used in various scenarios (e.g. diesels for powering the SCA instrumentation for the case in which batteries would be depleted; mobile diesel engine pump that can be used to fill fire fighters' trucks to provide for water make-up to boilers or for SFB make-up; time frames, etc.)**
- ❖ **diverse facilities / means provided for the depressurization of secondary side (boilers) in case of SBO by opening and maintaining MSSVs (Main Steam Safety Valves) open;**
- ❖ **validation of SAMGs through on-site emergency exercises.**

## Concluding Remarks

- Many important safety improvements have been already implemented in Romania following the post-Fukushima safety reviews, while others are in progress; only two actions are scheduled for completion beyond 2015.
- The monitoring of the progress made by the licensee on the implementation of the National Action Plan is part of the routine regulatory review, inspection and licensing processes.
- We have a strong commitment to improve also our regulatory framework and the assessment and inspection processes.
- We are particularly interested in further exchanging experience on issues such as:
  - assessment of cliff-edge effects in case of external hazards,
  - use of simulators for severe accident management;
  - extent of regulatory review of emergency operating procedures and severe accident management measures.

# Thank you for your attention!