

Safety fundamental elements characterizing new build Cernavoda NPP Units 3&4



NUCLEAR 2013

Pitesti, Romania, 25 – 27 May 2011

Introduction

- In 26.11.2010 EC sent to Romanian officials its opinion issued on the basis of Art. 43 Euratom referring to finalization of Units 3 and 4 from CNE Cernavoda, Romania
- In the beginning of the Conclusions section it is mentioned:
“The Commission has taken the view that, on the basis of the foregoing assessment and the intensive discussions with the Investor, the Vendor and the National Regulator and provided that the necessary additional measures recommended in this point of view are implemented, the investment fulfils the objectives of the Euratom Treaty and contributes to develop an energy mix in the region.”
- Safety elements that were considered by EC to issuing its opinion and major enhancements of the safety aspects of the project undertaken by Energonuclear being supported by its investors (SNN, ENEL and Arcelor Mittal) are further presented in brief

Design Safety

EC opinion

- The basic design :
 - Is predetermined by the existing CANDU-related infrastructure
 - Is based on CANDU-6 technology and subsequent feasible and cost-effective improvements
- Risk-informed safety goals in line with international best practices needs to be demonstrated: $CDF < 10^{-5}$ and $LRF < 10^{-6}$
- The impact of all design modifications on overall plant safety will be determined by means of PSA methods.
- Design modifications will significantly increase design safety and bring the overall risk levels sufficiently below the mentioned PSA –based targets.

Pre-Project Achievements

- Licensing Basis Document;
- Definition of the Project
 - Applicable Codes and Standards
 - Safety goals (CDF, LRF, Seism)
 - Basic design: Cernavoda Unit 2 & Design changes
- Safety assessments supporting basic design
- Level 1 and 2 PSA High-level Assessment supporting safety goals

Seismic aspects of design

EC opinion

- Seismic design basis to be established based on site PSHA.
- Regarding *assessment of the seismic capacity of the plant*, intention to apply both a deterministic and a probabilistic approach should be continued in order to increase the reliability of final results.
- The development of plant-specific measures for plant upgrade should take in place in close cooperation with Regulatory Body.

Pre-Project Achievements

- The DBE for Cernavoda 3&4 corresponds to a level with a probability of being exceeded of 1×10^{-4} per year
- New PSHA study was conducted for Units 3 & 4 by Paul Rizzo
- As part of High Level PSA, a Seismic Margin Assessment (SMA) was performed separately for seismic events in order to quantify the seismic capacity of Cernavoda Units 3&4 to withstand an earthquake motion level that is higher than the DBE level
- The SMA demonstrated the intended safety goals for the seismic contribution are met to allow for sufficient margin to account for uncertainties in the analysis (CDF $\sim 1.00 \times 10^{-6}$ event per and LRF $\sim 3.00 \times 10^{-7}$ event per year)
- PSHA which comply with IAEA SSG-9 has been reviewed and confirmed by an IAEA review mission
- All safety related documentation ensured by EN in Pre-project phase was sent to CNCAN

Other safety related aspects- aircraft crash

EC opinion

- International bodies such as IAEA and WENRA do not establish any requirements regarding specifically malevolent aircraft crash.
- The analysis provided to Commission demonstrated compliance with the IAEA for accidental impacts.
- Significant efforts have been demonstrated with regard to vulnerabilities in regard with resistance against aircraft crash and external missiles.

Pre-Project Achievements

- To assess the design against challenges caused by aircraft crash, for Cernavodă Units 3 and 4, a systematic assessment methodology is used.
- The inherent features and the identified design improvements will provide design robustness in front of an aircraft crash.
- As protective measure, the Cernavoda NPP's nearby zone, defined as a cylinder with radius = 10 km and height = 2 km, will continue to be marked as prohibited on the flying route maps in order to reduce the risk for an aircraft crash.

U3&4 Design Safety Performance

- In support of the application for the Letter of Comfort, EN submitted to CNCAN the document “Level 1 and 2 PSA High-level Assessment. Cernavoda Unit 3 and 4” which was elaborated by Candu Energy.
- As a conclusion, *the intended design changes for Units 3 and 4 can achieve the safety goals for new plants with good margin.*

	Design Safety goal	High Level-PSA target	Contribution from internal events, internal fires, internal flooding, full operation
CDF	1E-05/yr	5E-06/yr	1.18E-06/yr
LRF	1E-06/yr	5E-07/yr	7.52E-08/yr

Note: The assessment also took into account contribution of seismic conditions and indirect initiating events: external fires, flooding, severe weather events.

Units 3 and 4 Stress Tests

- Following Fukushima event, additional assessments were engaged to complement the existing studies by evaluating the Cernavoda 3&4 design.
- A document similar with the stress test prepared in accordance with ENSREG specifications was produced with the aim of assessing the plant margins - “Safety assessment of the impact of design changes proposed in the Licensing Basis Documents” - and sent to CNCAN.
- The assessment shows that the systems are designed with sufficient robustness, redundancy and features such that the plant can be operated to prevent the progression of core damage or to mitigate the effects of core damage to protect the public.
- In some cases, improvements to the design have been identified that will further enhance the capability of the plant to cope with the analyzed extreme events.

Units 3&4 - Severe accident related design changes

	Main design changes
Severe accident mitigation systems	<p>Emergency Filtering Containment Venting System</p> <p>Passive Autocatalytic Recombiners</p> <p>Calandria Vault Make-up System</p>
Fukushima related Design changes	<p>Severe Accident Monitoring</p> <ul style="list-style-type: none"> • installation of local water level indicators in spent fuel bays • sample SFB&RB buildings air and monitor hydrogen concentration • extend the range of the RB pressure measurement loops • environmental qualification of the RIH temperature & moderator level & calandria vault water level loops • made indications available in SCA <p>Provide the means to connect the mobile diesel generators to the critical equipment (SCA and EHRS)</p> <p>Spent Fuel Bay Enhancements in case of Severe Accident</p> <ul style="list-style-type: none"> • seismically qualified water addition line to the SFB shall be provided from outside the building • installed local water level indicators in SFBs will be not affected by a power or instrument air loss • evacuation of vapours from the SFB building if the spent fuel cooling is lost.

Recent safety –related achievements in the Pre-project phase



- Letter of Comfort issued by CNCAN –project is licensable
- New INHGA study finalized– considering Bala dam, water requirements are met
- New IAEA review mission finalized- the new seismic hazard analysis for Units 3&4 is in compliance with international safety standards level
- Ministry of Environment and Climate Change informed the public on the decision to issue the Environmental Permit

Conclusions

- In Nov. 2010 Romania obtained EC positive opinion issued on the basis of Art. 43 Euratom referring to finalization of Units 3 and 4 project
- Further activities were undertaken by EN for sustaining the development of safety aspects of the Units 3 and 4 project in agreement with EC opinion. These were confirmed by:
 - May 2011** CNCAN approved Licensing Basis Document” and “Design Safety Guides”
 - May 2012** CNCAN issued Letter of Comfort
 - 2011-2012** New PHSA for Units 3 and 4 site
 - June 2012** IAEA Review Mission Report confirmed PHSA
 - **Sept.2012** Feasibility Study confirms that the project is feasible both from technical and economical point of view.
 - April 2013** Decision to issue the Environmental Permit
- During Pre-Project phase, EN achievements have consolidated the initiating basis for project development.



Thank you for your attention!