# Cernavoda NPP - Units 3 and 4
# - energy for the future -

NUCLEAR 2011

The 4th Annual International Conference on Sustainable Development through Nuclear Research and Education

Pitesti, Romania, 25 – 27 May 2011

# Cernavoda Units 3 and 4 Project – Current Status

## Description

- 2 Units x 720 MW CANDU 6
- Expected annual electricity 10-11 TWh; 12% from overall country production;
- EnergoNuclear - project company for development, construction and operation;
- ArcelorMittal, Enel and SNN executed the Revised Investment Agreement;
- EPC contract approach is base for negotiations with potential prime contractors;
- Romanian Authorities are looking for new investors.

## Achievements

- EC positive opinion in relation with Project (Euratom Treaty Art. 41);
- Licensing Basis Document;
- Definition of the Project
  - List of Design Changes
  - Applicable Codes and Standards
  - Safety goals (CDF, LRF, Seism)
- Radwaste Management Strategy;
- Preliminary Decommissioning Plan
- Inspection of existing structures.

# What is the current status of the Project?

- EPC procedure in place
- EN prepared a preliminary Bid Invitation Specification
- Updating Process for Site PSHA – in progress;
- Financial Advisor - selected;
- Strategy for Construction License – approved by CNCAN
- Content of support documents for Letter of Comfort – approved by CNCAN
- Content of Stress Test Analysis – in progress

# Units 3&4 Design

- Cernavoda Units 3&4 design is in compliance with the most recent codes and standards requirements issued for new built NPPs;

- Units 3&4 have all of the traditional proven features of the CANDU 6 design supplemented by a number of safety enhancements;

- The integral safety level of these units is equivalent to the world class new build of Generation III and Generation III+ reactors;

# Units 3&4 Safety Requirements

Units 3&4 design comply with:

- CNSC (Canadian Regulator) modern requirements for design in RD-337 “Design of New Nuclear Power Plants” (November 2008), including:
  - Station blackout
  - Mitigation of severe accidents
  - Hydrogen mitigation
  - External events
  - Fire protection

- IAEA NS-R-1 Safety of Nuclear Power Plants: Design (2000)
- WENRA Reactor Safety Reference Levels (January 2008)
- EU Council Directive No. 10667/2009 establishing a Community framework for the nuclear safety of nuclear installations (June 2009)

# Units 3&4 Seismic Qualification

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## Design Basis Earthquake

- The DBE for Cernavoda 3&4 corresponds to a level with a probability of being exceeded of $1x10^{-4}$ per year; the corresponding PGA is under evaluation by Paul Rizzo Probabilistic Seismic Hazard Analysis.
- The objective of the project phase is to demonstrate, both deterministically and probabilistically, the adequacy of the structures, systems, and components to bring the plant to a safe shutdown during and after a seismic event at $1x10^{-4}$ probability level.

## Beyond Design Basis Earthquake

- 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, a Seismic Margin Assessment (SMA) will be prepared.
- The seismic capacity is expressed in terms of a High Confidence (95%) of Low Probability (5%) of Failure (HCLPF) relative to a Checking/Review Level Earthquake (CLE).
- PSA-based SMA will be conducted to demonstrate sufficient seismic margin for a CLE to meet the safety goals on Core Damage Frequency (CDF) and Large Release Frequency (LRF).

# Units 3&4 Safety Objectives of Seismic Design

Units 3&4 safety objective of the seismic design is to have sufficient capability to perform the essential safety functions to ensure that during and/or following a DBE:

1. The reactor can be shut down and maintained in the shutdown state
2. HTS integrity can be maintained for fuel cooling (no LOCA caused by earthquake)
3. The fuel in the reactor can be cooled by thermo-syphoning to the steam generators
4. The containment boundary can be maintained
5. The plant can be controlled and monitored from a seismically qualified area (Secondary Control Area - SCA)
6. The main control room (MCR) remains available to protect the operator
7. A qualified route is provided for safe access from MCR to SCA
8. Critical structures and systems outside containment are maintained so as not to cause radioactivity releases beyond allowable accident limits.

During and after an earthquake the safety functions must be maintained to limit the release of radioactivity below the regulatory dose limits for accidents.

# Units 3&4 – Inspection results for the existing structures

- Inspection of the Existing Structures – AECL confirmed that the existing civil structures are fit for purpose.

- Assessments were performed for:
  - Reactor Building
  - Other Buildings
  - Hydro Circuit

- The fifty (50) year life expectancy of the existing structures is confirmed.

# Units 3&4 – Units 3&4 Safety Improvements

For Units 3&4, to address the response and mitigation of Beyond Design Basis Accidents (including Severe Accidents), several design changes are identified, such as:

- Upgrading the Emergency Water System to Emergency Heat Removal System;
- Moderator and Vault Make-Up and Recovery System;
- Installation of Passive Autocatalytic Recombiners (PARs) inside the containment, to mitigate buildup of hydrogen;
- Increasing capacity of Class I batteries;
- Containment Cooling Feature - to prevent Containment failure in postulated events after a severe core damage;
- Providing an additional (the fifth) EPS DG, common for both Units 3&4 to mitigate the event in which both EPS diesel generators fail.

Optionally, the last two design changes could be replaced by the following ones, with the same benefit:

- External Calandria Vault Water Make-Up Line;
- Emergency Filtered Containment Venting System - to prevent containment failure and subsequent uncontrolled release of radioactivity under severe accident conditions.

# Units 3 & 4 - Next steps

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| ▪ Romanian Authorities are looking for new investors. | February 2011 – March 2012 |
| ▪ Engineering, Procurement, Construction Constract | September 2010– July 2012 |
| Elaboration of the documentation for CNCAN authorization<br>▪ Documentation for Leter of Comfort – which confirms that the Project is licensable<br>▪ Documentation for Nuclear Safety Construction License for Construction Phase | June 2011 – April 2012<br>August 2012 – July 2013 |
| ▪ Defining the financial arrangement | April 2011 –July 2013 |
| Early work agreeement (site organization, procurement engineering) | August 2012 – July 2013 |
| Construction Phase | August 2013 – July 2019 |

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Thank you!