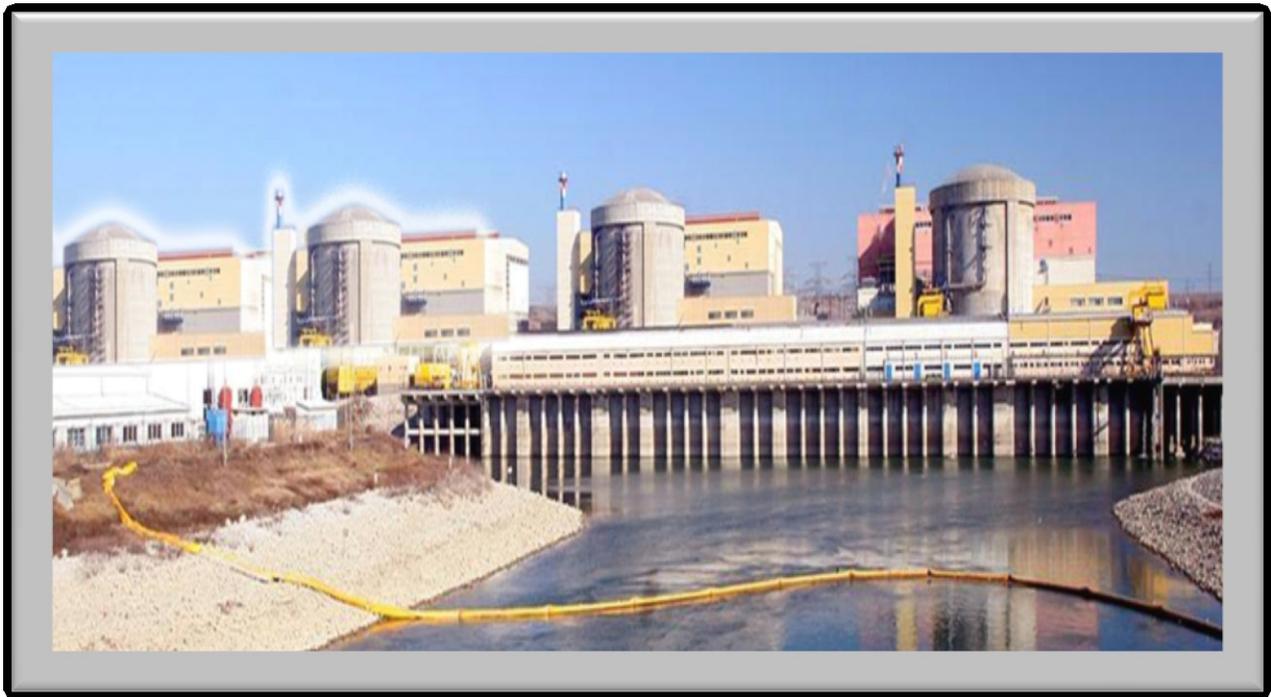


## Cernavoda NPP Units 3 and 4 Project



## **1. Introduction**

Nuclear power in Romania is exclusively used for peaceful purposes. Romania is a founding member of the International Atomic Energy Agency (IAEA). All nuclear activities are subject to safeguard inspections performed by the Romanian Government, as well as by the international authorized bodies. Spent nuclear fuel is stored as radioactive waste in dry storage facilities, following that in the future it will be transferred to final, geological deposits. According to the non-proliferation policy of the Romanian State the nuclear spent fuel reprocessing is considered.

Societatea Nationala Nuclearelectrica SA (“SNN”) is a Romanian registered company, owning and operating Cernavoda NPP (Nuclear Power Plant) Units 1 and 2, having Shareholders the Romanian State (majority shareholder), S.C. Fondul Proprietatea S.A. and other private investors. Since 2013, SNN shares are traded on the Bucharest Stock Exchange.

SNN as part of the international nuclear industry is member of World Association of Nuclear Operators (WANO) and CANDU Owners Group (COG), since 1992.

SNN is committed to finalize the Cernavoda NPP Units 3 and 4 Project, looking for reputable international partners. In this respect, in 2009, SNN set up a project company – EnergoNuclear (“EN”) - in order to develop Units 3 and 4 of the Cernavoda Nuclear Power Plant (“the Project”). The company is organized and operated in accordance with the Romanian Commercial Companies Law. Currently, SNN owns 100% of EN shares.

## **2. Short description of the Cernavoda NPP Site**

The Cernavoda NPP site is located in the Dobrogea region of South-East Romania, near the Danube River and the Danube - Black Sea Channel. The site was designed for five CANDU 6 reactors, using natural uranium as fuel and heavy water as moderator and cooling agent. Initial construction on the site commenced in 1982, with the intention of completing all five units. The current status of development of the site is: Unit 1 - in operation since December 1996, Unit 2 - in operation since October 2007, having 706.5 MW installed capacity each.

Unit 3 and 4 are currently under preservation, civil structures being completed 52% for Unit 3 and respectively 30% for Unit 4. Neither Unit 3, nor Unit 4 has any major equipment installed.

The General Shareholders Assembly of SNN decided in March 2014 to abandon to the completion of Unit 5 and to use the existing structures to house some specific facilities (the emergency center, mobile intervention devices in case of severe accident etc).

The site of the Cernavoda NPP complies with international standards for nuclear power plants siting, which include:

- Seismic and geological characteristics;
- Flooding and climatic conditions;
- Potential man made events;
- Dispersion in water and air;
- Demographic distribution;

- The emergency response program;
- Land usage;
- Cooling water supply under various conditions;
- Connection to the national power grid; and
- Environmental protection

### **3. Rationale for the Project**

#### **3.1. Energy Sector Strategy**

The main challenges of the energy sector are the security of supply, replacement of the obsolete capacities with expired lifetime, next future increasing of the demand, Grid management with an increasing share of electricity produced by renewable sources and integration into the regional and European market. To meet the above objectives, while old capacities will be retired soon, in conjunction with the expected growth of the demand, is obvious the need of new capacities to be installed and commissioned.

There is a clear commitment of the Romanian Government to promote carbon free electricity production technologies. By increasing nuclear generating capacity through commissioning of the Project, bringing to the Grid an additional annual energy contribution of around 11 TWh, the mix of electricity generated in Romania will be significantly modified, with nuclear power forecast to generate about 30% of Romania's electricity production.

Plans to improve interconnectivity with Serbia, Moldova and Turkey will increase Romania's export capabilities and decrease cross-border congestions.

#### **3.2. Project Features**

The Project has the following features recommending it as a reasonable long-term electricity generation option for Romania:

- Units 3 and 4 would produce yearly around 11 TWh of carbon free electricity at a competitive price;
- CANDU is a proven technology not only worldwide, but also in Romania, which has experience in constructing, licensing and good operating performance to date of CANDU based generation units;
- The Project has been presented to the European Commission in the framework of Art 41 of the EURATOM Treaty and after an extensive review the Government of Romania received a positive opinion for implementation. This opinion recognizes that the Project has adopted safety goals associated with "New Build" projects; the Project also addresses key lessons learned from the events at the Fukushima Daiichi nuclear power plant in March 2011;
- EnergoNuclear prepared together with highly specialized consultants key safety and engineering documentation packages (Probabilistic Seismic Hazard Analysis, Safety Assessments following the Fukushima accident, high level Probabilistic Safety Assessment, Interim Safety Analysis – Chapter 15 of the Preliminary Safety Analysis Report - PSAR, Seismic Assessment of Major Equipment, List of design changes to improve safety and operation features, Preliminary Decommissioning Plan, Radioactive Waste Management

Strategy);

- Licensing Basis Documents and the Safety Design Guides for the two units, defining the regulator's technical licensing requirements, have already been approved by National Commission for Nuclear Activities Control (CNCAN) - the Romanian Regulatory body. The Letter of Comfort, issued by CNCAN in May 2012, indicates the Regulatory Body confidence that the design of the units is licensable in accordance with the existing legal framework;
- The Ministry of Environment and Climate Change granted SNN the Environmental Agreement for the completion of Units 3 and 4 Project;
- The technical status of Units 3 and 4 existing civil structures fit to their final purpose – the completion and long term operation of the units. This was certified by the Atomic Energy of Canada Ltd. (AECL), today CANDU Energy - the design authority and holder of CANDU 6 technology - following a thorough inspection.
- Construction and operation of Units 1 and 2 has contributed to developing the present capabilities for the supply of design, manufacturing, construction and management services existing in Romania today.

### 3.3. The potential involvement of national horizontal industry in Project Units 3 and 4

The performance of Units 1 and 2, as illustrated below by the unit capacity factor evolution, indicates that SNN’s operating personnel is skilled and knowledgeable in the operation of CANDU 6 reactors. The staff training is performed by SNN using its own full scope CANDU 6 simulator. The training programs are fully compliant with international best practices and standards. As a result, SNN has the technical expertise to train operating personnel and staff for Units 3 and 4.

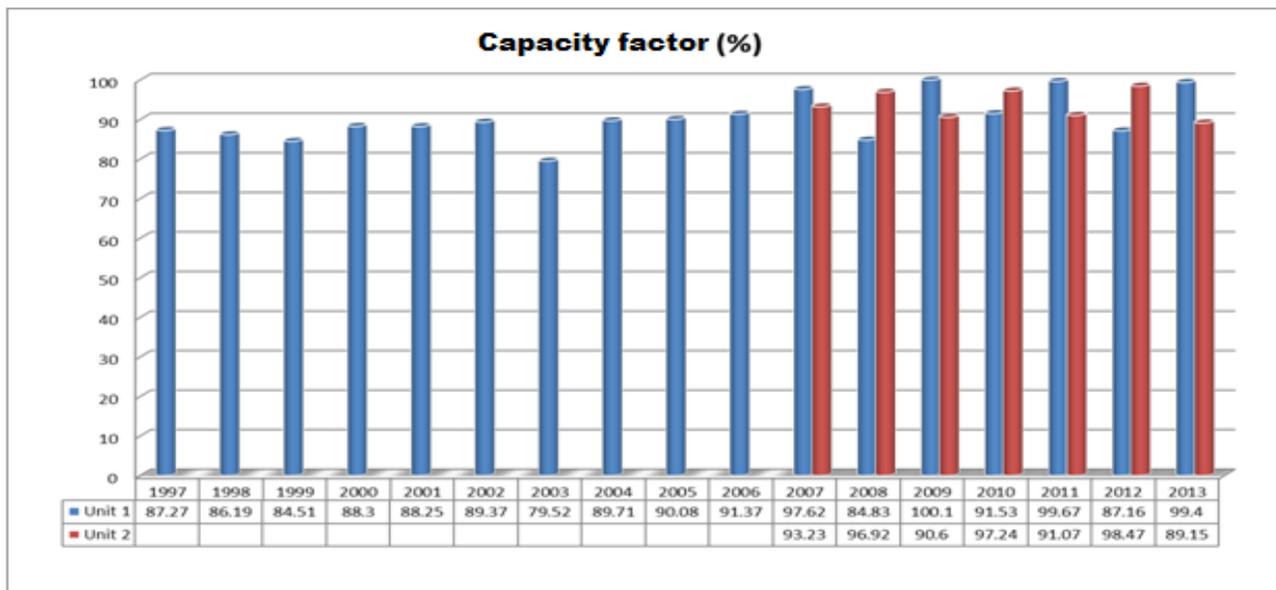


Figure 2. Evolution of the capacity factor at Units 1 and 2 at Cernavoda NPP (source SNN)

Considering the experience achieved during the construction and operation of Units 1 and 2, SNN has the suitably qualified technical and project management staff, able to take key positions in the commissioning and operation of Units 3 and 4, meanwhile providing training for new staff to be hired to supplement operating teams.

Romania has industrial facilities covering the full CANDU 6 nuclear fuel cycle, as well as the technology for heavy water production.

The first load of heavy water necessary to Units 3 and 4 is already made, being currently owned by the Romanian State and SNN.



**Figure 3. View of the nuclear fuel assembly area at FCN Pitesti (source SNN)**

Nuclear Fuel Factory (FCN) Pitesti, a branch of SNN, has been licensed by AECL and Zircatec Precision Industries (ZPI) from Canada (today part of Cameco Group, Canada) in 1994, to manufacture CANDU 6 natural Uranium fuel. The high quality of the nuclear fuel produced in Romania was proven by its excellent behavior and performance during the two existing units' operation. The defect rate recorded was of 0.04% during the two units' operation lifetime at an average burn-up factor of 170 MWh/kgU. By expanding the production capacity, FCN can provide the necessary nuclear fuel for the first load of Units 3 and 4 reactors, as well as during their operation.

Currently, the Romanian nuclear power program uses domestic Uranium as a primary resource. Uranium consumption is about 100 tones / year per unit.

The radioactive waste management strategy implemented at the Cernavoda NPP Units 1 and 2 is in line with IAEA and the European Union requirements and good practices. Radioactive waste is collected, processed (where appropriate) and stored in safe facilities by preventing any negative effects on public health and the environment.

On Cernavoda site, an interim dry spent fuel storage facility (IDSFS) has been in operation since 2003 to collect the spent fuel from Units 1 and 2 for a period of over 50 years. It is taken into account the extension of IDSFS in order to accommodate the spent fuel from Units 3 and 4.

Through involvement in the construction of Units 1 and 2, several Romanian manufacturing and constructing companies have gained the necessary experience and specific authorizations

allowing the fabrication of components and ensuring the construction-erection works for CANDU 6 nuclear units.

Romanian design-engineering companies have developed extensive expertise in the design and assessment of various aspects of CANDU 6 plants.

The Romanian industry involvement in the completion of Units 3 and 4 will maintain and create new jobs, contributing to the national policy of re-industrialization. The analyses performed by the Romanian Atomic Forum, association of the Romanian nuclear industry affiliated to the European similar organization (FORATOM), reveals significant economic and financial potential in companies that candidate in offering services and works for Units 3 and 4, indicating a possible turnover over €500 million.

According to the Project Units 3 and 4 at Cernavoda NPP Completion Strategy, approved by the Romanian Government:

“The documentation of the selection procedure for project investors will contain specific clauses to promote Romanian industry (a volume indicative of 30% but not less than 20% of the works, procurement of equipment, materials and engineering value). Additionally, the initial inventory of heavy water and the first cargo of nuclear fuel will be provided by the Romanian State and SNN.”