



Approved by,

Iulian-Robert Tudorache
Chairperson of the Board of Directors

Note
on the Endorsement/ Approval of the Updated Strategy and Action Plan for the Refurbishment
Project of CNE Cernavoda Unit 1

1. Introduction

Any nuclear facility has a limited lifetime, set by the project. For units with CANDU technology, the projected lifetime is of 210,000 hours of operation at nominal power, which at a capacity factor of 80% translates into an operational lifetime of approximately 30 years. The main life-limiting components and structures are the fuel tubes, the feeders and the nuclear reactor casing.

Unit 1 at CNE Cernavoda was put into commercial operation on December 2, 1996. According to the assessments made so far, due to the fact that it has been exploited at a capacity utilization rate of approximately 90% since commissioning, superior to the projected use (80%), Unit 1 will reach the threshold of 210,000 hours of operation at nominal power at the end of 2023, after approximately 26.6 years of operation since commissioning, approximately 3.4 years before the projected lifetime of 30 years, assuming a capacity factor similar to the one achieved so far for the rest of the period. Operating at a higher capacity factor of about 10 percentage points was possible due to the implemented project improvements over time and to the judicious operation and maintenance mode.

Given the major cost of producing new large-scale production units using nuclear technology, the alternative of refurbishment is attractive to the owner of a nuclear plant. The main advantage of such an option is that, at the end of the retrofit, the owner will be in possession of a nuclear facility capable of operating at project parameters for another life cycle (25-30 years) at costs around the 40% of those that would involve building a similar new objective. In addition, refurbishment is more advantageous than building a new capacity due to the fact that the time required for actual refurbishment works is significantly shorter, based on currently available information, between 24 and 30 months. The process

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of obtaining approvals, authorizations, and permits, including the authorization from the Nuclear Regulatory Authority (CNCAN), is less laborious and less hazardous, given that the site is already authorized, this stage being a difficult one when it comes to new units on new sites.

A number of owners of CANDU nuclear units have already implemented refurbishment projects: Canada – Point Lepreau (with an implementation 55-month period, excessively prolonged due to organizational and commercial problems), Korea – Wolsong (28 months). Unit 2 from Darlington – Canada and Embalse – Argentina began the refurbishment process in 2016, and units in Bruce – Canada are scheduled for refurbishment starting with 2020.

2. Extending the Unit 1's Hours of Operation

In recent years, due to the fact that several CANDU units are approaching the limit of 210,000 hours of operation at rated power, the nuclear industry has researched the behavior of fuel tubes over time and the aging mechanisms that affect them, in order to extend their lifetime beyond the limits estimated at the moment of their design, more than 30 years ago. Based on studies conducted within the group of owners of CANDU nuclear units and after completing the inspection, test and measurement activities of the fuel tubes, including pressure tubes, the regulatory bodies approved the extension of the initial lifetime projected for 210,000 hours, as follows (2014-2016):

- Bruce – Canada, up to 247,000 hours of operation at rated power (+37,000 hours);
- Pickering – Canada, up to 247,000 hours of operation at rated power (+37,000 hours);
- Darlington – Canada, up to 235,000 hours of operation at rated power (+25,000 hours);
- Embalse – Argentina, up to 225,000 hours of operation at rated power (+15,000 hours).

The capitalization of the recent international experience, highlighted above, would allow Unit 1 to function for the entire lifetime set by the project – 30 years, given that the specific studies to be carried out on Unit 1 will conclude that this is also possible in the case of Unit 1, conditional upon obtaining the CNCAN approval – the nuclear regulatory authority.

The periodic studies and inspections of the behavior in time of Unit 1's components and the monitoring of the degradation mechanisms associated with the time-limiting components and the reactor pressure tubes respectively, allowed, at the end of 2015, to estimate towards Candu Energy that their life expectancy within CNE Cernavoda Unit 1 could reach at least 220,000 - 230,000 hours of operation at rated power.

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Current estimates indicate that there are all positive premises to allow Unit 1 to extend the number of hours of operation over 210,000 hours until the 30-year operational lifetime at rated power has been reached. For example – the possible contact between the fuel tubes and the reactor shutdown mechanisms – the results of the 2016 inspections showed that the phenomena with negative effect on the operation of the reactor are not expected to occur before 245,000 hours of operation at rated power.

We mention that 30 years of operation can be reached at approximately 230,000-235,000 hours, also taking into account a slight gradual decrease in the capacity factor achieved for the rest of the life span of up to 30 years due to the aging of the unit.

The impact of such an extension has a strong positive effect on SN Nuclearelectrica S.A. (SNN) for the following main considerations:

- Ensures the operation of Unit 1 for the projected 30-year initial period, in the conditions of higher electricity production than the estimates of the economic model used in the initial (historical) determination of the feasibility of the CANDU project for Romania under nuclear safety conditions and with observance of all the environmental requirements.
- Extends the period of internal financial accumulation from the SNN-generated flows by about 3-4 years, with relatively low costs, leading to a significant reduction in the need for bank financing of the refurbishment (loans).

In order for SNN to be able to demonstrate that Unit 1 can be operated under nuclear safety conditions beyond 210,000 hours of operation at rated power, a set of measures is required to be implemented:

- The development by Candu Energy of the nuclear safety report regarding the extension of the hours of operation at rated power,
- Getting the comfort letter from CNCAN,
- Elaboration and approval of the cost-benefit analysis,
- Contracting of supporting studies, preparing the authorization documentation, obtaining the authorization from CNCAN for the operation of Unit 1 for more than 210,000 hours of operation at rated power.

In detail, the activities and deadlines related to the extension of the number of hours of operation of Unit 1 are presented in Section 1 of the Action Plan of Annex 1, the total cost of these activities/ actions being estimated at about RON 40 million.

We mention that the informative preliminary discussions, which the SNN and Candu Energy experts had with CNCAN, indicate that the Regulatory Authority has shown openness regarding the actions

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aimed at operating Unit 1 beyond the number of hours of its initial design at rated power, before retubing the active area, subject to full compliance with the nuclear safety requirements.

In addition to the aforementioned positive aspects, the extension of the number of hours of operation at rated power over the initially estimated 210,000 has an important contribution and a positive impact on the refurbishment program, and represents an important stage in the Refurbishment Project of CNE Cernavoda Unit 1, in order to obtain an additional period of approximately 3-4 years available for the careful organization and thorough preparation of the actual refurbishment works, as well as for the accumulation of the financial resources needed for the financing of the refurbishment works (SNN's own contribution) and for the support of SNN's activity during the refurbishment under the conditions of operating with a single unit in that time frame (Unit 2).

3. Strategy and Plan for Refurbishment Unit 1

In December 2013, the SNN Extraordinary General Meeting of Shareholders ("EGMS") approved, through Decision no. 27/23.12.2013 (Annex 2), the Strategy and Plan for Refurbishment CNE Cernavoda Unit 1, in order to extend its life, and the contracting and drawing up of technical and economic studies, as well as nuclear safety studies, of the authorization documentation necessary for defining the final purpose (object) of the project, informatively defined with an estimated budget of approximately RON 80 million.

The decision of the EGMS in December 2013 aimed to approve the Strategy and Plan for Refurbishment, including a preliminary list of studies/ documentation, informing the shareholders both of this aspect and of the fact that the finalization of the purpose of this investment project will be achieved by elaborating the Feasibility Study.

Based on the Decision of the Extraordinary General Meeting of Shareholders no. 27/23.12.2013, starting with 2014, SNN has started the implementation of the Strategy and Plan approved by the shareholders, in the sense that it has contracted and finalized a series of documentations, amounting to approximately RON 25.7 million, related to the technical assessments of fuel tubes, reactor buildings, feeders, turbine, electric generator and their auxiliary systems, as well as probable assessments of nuclear safety. The list of studies and their status, including associated costs, are presented in detail in Annex 3.

In parallel with the implementation of the plan approved by the shareholders, SNN analyzed the studies conducted for various nuclear power plants and identified a profitable solution used by the nuclear

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industry, i.e. the extension of the lifetime, for which the additional costs necessary to substantiate it (studies, inspections) are lower than the earned profit. Therefore, taking into account:

- The reasonable possibility of extending the number of hours of initial operation at rated power over the 210,000 hours of the project, based on the operating and international experience for nuclear units with similar technology;
- The need to obtain important information on the planning and implementation of the refurbishment process from other CANDU owners/ operators in other countries (Canada, South Korea, Argentina);
- The need to update the performance chart of the activities related to the assessment of the feasibility of the refurbishment project and the environmental impact assessment,

It is necessary to update the Strategy and Action Plan, as well as the preparation and execution chart of the Unit 1 refurbishment project.

The refurbishment project is structured in the following stages:

- i. Ensuring the operation of Unit 1 for a period of 30 years
- ii. Preparing the organization of the refurbishment project
- iii. Preparing the necessary documentation and approving the project
- iv. Developing pre-project activities
- v. Implementation of the refurbishment project

As far as **Stage i)** is concerned, i.e. ensuring the operation of Unit 1 for a period of 30 years, the main elements are presented in Chapter 2 “Extending the Number of Hours of Operation of Unit 1” above. In this context, we mention that SNN concluded a contract in February (in the amount of CAD 615,280) with CANDU Energy, in its capacity of Design Authority, and by the end of 2017 it is to finalize the report that will indicate the number of hours of operation at rated power, in addition to the estimated 210,000 hours estimated by the project, which can be sustained in operating conditions at high nuclear safety standards, as well as a plan of measures and activities necessary to achieve this goal. Subsequently, it is necessary to discuss this report and obtain agreement in principle of the CNCAN regulatory authority.

Stage ii), i.e. preparing for the organization of the refurbishment project, scheduled for March 2017-2018, aims mainly to elaborate the study regarding the optimal organization of the project and the implementation of the resulting organizational and logistic changes. For this purpose, in May 2017, a consulting contract was concluded by tender with the Association consisting of SC AMEC Foster

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Wheeler Nuclear RO SRL and AMEC NSS Limited, in order to carry out a study on the optimal organization of the refurbishment project, the value of the contract being of RON 660,950.

Subsequently, in **Stage iii**), in the period 2018-2021, the necessary supporting documentation will be prepared for the preparation of the Feasibility Study, the stage including the elaboration and submission for approval by the shareholders in 2021. Details regarding the studies and the estimated costs for each of them are presented in Annex 4. The total amount is estimated at RON 150 million (approximately EUR 33 million), of which RON 40 million represents the costs associated with the extension of the number of hours of operation at rated power, as shown above (point 2).

The increase by about RON 70 million of the amount stipulated previously, according to the EGMS Decision no. 27/23.12.2013 for carrying out the documentation preparation and project approval activities, is mainly due to the changes in the strategy, as follows:

- The inclusion in the preparation stage of the refurbishment project of the amount of RON 40 million estimated for extending the number of hours of operation of Unit 1 to over 210,000 hours until reaching an operational life of 30 years;
- Taking into account additional costs, estimated at RON 30 million, due to the fact that by extending the initial operating period by approximately 3.5 years, a number of the activities initially foreseen - the assessment of the status of the fuel tubes, etc. – are to be similarly extended.

We mention that these costs should be detailed/ updated in the investment plans/ budgets.

Stage iv (2021-2026), following the approval of the Feasibility Study, will mainly target:

- Development of engineering packages related to project modifications
- Procurement equipment and components with a long cycle of manufacture
- Award of the engineering, procurement and construction (EPC) contract
- Obtaining the authorization for the start of the refurbishment works from CNCAN.

The last stage, **Stage v**), is the actual implementation of the refurbishment project, scheduled to take place between December 2026 and December 2028, in the conditions in which the project is implemented within the minimum duration currently estimated at 24 months.

A Gantt Level 1 chart for the whole refurbishment project is presented in Appendix 5, as detailed above.

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We specify that the deadlines and allocated budgets are indicative, and are likely to undergo changes depending on the further development of the refurbishment project.

The investment effort of SNN must be understood within the overall objectives of the company, namely the extension of the number of hours of initial operation of Unit 1, the building of the detritiation facility, and the refurbishment of Unit 1. The debts associated with long-term credits in foreign currency contracted for the construction of Unit 2 should also be considered, as these will continue to be reimbursed gradually until 2024 (inclusively).

4. Proposals

Taking into account all of the above and the following:

- (i) The Refurbishment Project of CNE Cernavoda Unit 1 represents a strategic investment for SNN, whose estimated total value exceeds half of the Company's accounting assets;
- (ii) The fact that, from the perspective of the estimated costs of the Refurbishment Project of CNE Cernavoda Unit 1, the shareholders must express their agreement for the strategy and plan related to this project, including the costs associated with the implementation of this plan, which are included in the estimated total project value;
- (iii) The fact that according to the provisions of Art. 153 item 22 of Law no. 31/1990 on trading companies, the conclusion of legal documents whose value exceeds half of the accounting value of the company's assets falls under the purview of the Extraordinary General Meeting of Shareholders;
- (iv) The fact that according to Art. 17 par. (3) let. n of the SNN Articles of incorporation, the Extraordinary General Meeting of Shareholders approves any other decision for which the approval of the Extraordinary General Meeting of Shareholders is required;
- (v) The fact that according to Art. 13 par. (4) let. a and to the Annex within the SNN Articles of incorporation, the Extraordinary General Meeting of Shareholders approves commitments/legal documents that involve important obligations on the part of the Company regarding investment projects if such commitments exceed the amount of EUR 50,000,000;
- (vi) The fact that the implementation of the revised Strategy and Action Plan for the Refurbishment of CNE Cernavoda Unit 1 investment project implies the implementation of an investment project with an estimated value of approximately EUR 1.5 billion; we mention that this value is an indicative-budgetary one, based on the information available from similar projects that have been completed or are under implementation for CANDU type plants, for which the necessary investment value will only be known after the

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completion of all the necessary studies (including the Feasibility Study), according to the assumed timetable (Annex 5).

We submit for the approval of the Extraordinary General Meeting of Shareholders the Updated Strategy and Action Plan for the Refurbishment Project of CNE Cernavoda Unit 1.

Annexes:

Annex 1 – Action Plan for the Refurbishment Project of CNE Cernavoda Unit 1;

Annex 2 – EGMS Decision no. 27/23.12.2013;

Annex 3 – List of studies and their status, including the amounts spent up to December 31, 2016;

Annex 4 – Anticipated activities and budgets for the period 2017-2021;

Annex 5 – Level 1 Chart for the Refurbishment Project of CNE Cernavoda Unit 1.

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