NUCLEARELECTRICA

Approved
Board of Directors,
Chairman
Teodor Minodor
Chirica

NOTE
on approving the issuance of a letter to SNC Lavalin regarding the intention/commitment of Nuclearelectrica S.A. National Company ("SNN"), for retubing the reactor of Unit 1 of Cernavoda NPP, of the set of retubing tools used at the refurbished Embalse

I. General aspects /competence

According to the provisions of art. 13 par. (4) let. a) of the Articles of incorporation of SNN, updated on 27.01.2021, the Extraordinary General Meeting of Shareholders of SNN decides on "a) concluding, by the Company, any contract, **assuming any obligation or commitment which could involve expenses or assuming any other important obligation by the Company,** according to the competence limits provided in Annex no. 1 to these Articles of Incorporation", and according to the provisions of the Annex to the Articles of Incorporation of SNN, position 2 – "Investment decisions", **for investments with a value higher than or equal to EUR 50 million, the approval competence belongs to the shareholders of the company.**

In this context, as shown below in this Note, choosing an optimal version for SNN, regarding the set of retubing tools to be actually used within the project for refurbishing Unit 1 of Cernavoda NPP, represents a strategic investment decision / a strategic commitment, by the major financial implications for the company it involves and by the impact on the refurbishment, overall, mainly based on the costs involved by the two currently possible versions. Specifically, the company must choose, regarding the solution for the retubing tools, between the version consisting of using the retubing tools used for the refurbished Embalse and the version that consists of purchasing a new set of retubing tools, and the set of retubing tools used at the refurbished Embalse has an estimated cost that is USD 89 million less than the estimated cost of a new set of retubing tools. Any of these two versions involves SNN assuming a major financial commitment, whose value, irrespective of the selected version, exceeds the value of EUR 50 million, indicated in the previous paragraph, therefore such a strategic decision belongs to the shareholders of the company, according to the Articles of incorporation of SNN.

II. Presentation

1. Introduction

CANDU power stations were designed to operate for 30 years at a capacity factor of 80%. This is equivalent to an operation of 210,000 hours at a nominal power (EFPH) of the reactor components: fuel channels (PT), calandria tubes (CT), the ducts through which the cooling agent between the fuel channels and the collectors (feeders) and the spacers between the PT and CT. The safe operation of these components, up to 210,000 EFPH, was proven by their forced aging and then by performance testing.

At the beginning of the 2000's, as the first CANDU power stations were getting closer to the end of the first operating cycle, Canadian company CANDU Energy Inc. (the exclusive holder and user, on behalf of the Canadian State, of the license for CANDU nuclear power stations, the equivalent of Cernavoda NPP) developed a technology for their refurbishment, whereby they could operate for another 30-year cycle. The main element of this technology is changing the reactor components: PT, CT, feeders and spacers between the PT and CT, an operation called "retubing". The operating experience shows that the retubing is technically and economically feasible and has already allowed, at several CANDU nuclear power stations, to extend the operation duration with a 30-year cycle.

CANDU reactors which have been successfully retubed are indicated below. The time periods indicated below represent the stoppage duration for refurbishing, during which the reactor components are removed and replaced. Engineering activities, preparing the documentation, purchasing the components and training are not included in this time interval.

Bruce Power 1&2	August 2006 - 2011
Point Lepreau	July 2008 - March 2012
Wolsong 1	April 2009 - July 2011
Embalse	**December 2015 - January 2019**
Darlington Unit 2	October 2016 - April 2020

Currently, such refurbishing projects are implemented at Canadian power stations Darlington 3 and Bruce Power 6.

Specific characteristics of a CANDU reactor, such as expanded joints of PT and CT, positioning bellows and sets, flange joints between feeders and the terminal fitting, and the welded joints between the feeders and the collectors were assessed and, following these assessments, methodologies, complex devices and specific equipment were developed in order to replace them. In developing these methodologies, devices and equipment, the specific configuration of CANDU reactors was considered (including CANDU 6, the subtype that operates at Cernavoda NPP), the available space that exists in the area that is adjacent to the reactor sides, the contamination level, the radiation fields estimated in the work areas and other critical factors, in order to determine the specific screening, location and maneuverability requirements for each type of reactor to be refurbished.

In order to facilitate the PT and CT extraction process and in order to minimize the resulted medium-level volume of radioactive waste, special technology was developed in order to mechanically process, by cutting and flattening, the PT and CT in the reactor chamber and transport them to the radioactive waste storage facility in low-volume containers. The configuration of these waste containers and

the devices for loading/unlaoding them directly impact the design of the installation for storing active medium-level waste resulted from the refurbishment. The qualification trials and tests previously performed by SNC Lavalin (the parent company, which owns Candu Energy Inc., the latter organized as a branch of the SNC Lavalin group) represented the key for determining the specific details of each retubing activity: extracting the existing components, inspection, installing new components and testing them, transporting the dismantled components, in a screened state, to the waste storage facility. After these tests, a set of dedicated complex devices and equipment was developed (hereinafter referred as "set of retubing tools"), which were successfully used for retubing CANDU reactors.

2. Description

Retubing is the main activity performed for refurbishing a nuclear power station fitted with CANDU reactors. Retubing requires a complex set of conventional and specialized tools, in order to perform various operations of replacing CT and PT, tools that are especially designed for these activities by AECL/Candu Energy Inc., which is, as the exclusive owner and user of the CANDU technology, on behalf of the Canadian State, the only provider, until now, of retubing services for CANDU reactors. The experience of SNC Lavalin/Candu Energy Inc. in retubing projects is presented in Table 1 below.

TABLE 1

Project	**Project modifications and authorization support**	**Reactor design and technical specifications**	**Reactor component procurement**	**Designing the set of retubing tools**	**Refurbishing/manufacturing the set of retubing tools**	**Procuring the set of retubing tools**	**Retubing**
Bruce 1&2	Bruce Power	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy
Point Lepreau	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy
Wolsong	AECL/ CANDU Energy	AECL/ CANDU Energy	CANDU Energy	CANDU Energy	CANDU Energy	CANDU Energy	CANDU Energy
Gentlly 2	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy	AECL/ CANDU Energy	CANDU Energy	CANDU Energy	CANDU Energy (The project
Embalse	CANDU Energy	CANDU Energy	NASA (1)	CANDU Energy	CANDU Energy	CANDU Energy	CANDU Energy (2)
Darlington (4 units)	OPG	CANDU Energy	CANDU Energy	CANDU Energy	CANDU Energy	CANDU Energy	CANDU Energy (within a
Bruce Units 3÷8	CANDU Energy	CANDU Energy	CANDU Energy	CANDU Energy	CANDU Energy(3)	Bruce Power	CANDU Energy (within a

Notes:

1. *CANDU Energy drafted the design specifications, trained the manufacturers and ensured the supervision during the manufacture.*
2. *Over 30 CANDU Energy specialists, technical advisers for training, replacing and testing activities.*
3. *Manufacturing installation tools and technical support for designing / manufacturing dismantling tools and testing systems.*

The set of retubing tools used for dismantling, inspection and installation is composed of 19 major systems, which include over 450 separate types of tools and 5,000 individual tools. The entire set weighs 1,500 tons and is kept and transported in approximately 100 sea containers of 6 and 12 meters long.

The set of retubing tools is designed in order to perform similar operations, but with specific requirements depending on the configuration and peculiarities of each type of CANDU reactor. Thus, although there are similarities between the tools used for the retubing operations at Bruce Power, Darlington and Embalse, they can only be used for the reactor type for which they were designed. That is why the retubing tools for CANDU 6 represents a single system that is specific to this reactor type.

The set of retubing tools contains complex components and that is why it is included in the category of equipment with long procurement/manufacture time. They must be available before the refurbishing stoppage, as they are used for mock-up training of the personnel who will work with them.

3. Options regarding the set of retubing tools that can be used for refurbishing Unit 1 of Cernavoda NPP.

3.1. Option 1 - Set of retubing tools used for the refurbished Embalse

On December 18, 2018, SNC Lavalin (the sole owner of Candu Energy Inc., the official and exclusive owner of the intellectual property rights over the CANDU technology and the only supplier, until now, of retubing services for CANDU reactors) informed Nuclearelectrica S.A. National Company (“SNN”) about the possibility of using, within the refurbishing project at Unit 1 of Cernavoda NPP, the set of retubing tools that were previously used at Embalse Argentina (the power station fitted with a CANDU 6 reactor, therefore the same type as for Cernavoda NPP), decontaminated and refurbished by Candu Energy, in order to be used at Cernavoda. This set of retubing tools, which was used by Candu Energy at Embalse, was transported in Canada, is currently stored at Mississauga and, following the assessment of Candu Energy, it can be used for retubing Unit 1 at Cernavoda NPP without any modification.

Candu Energy will assess the material state of the existing tools, following which some of them will be refurbished, and those for the decontamination and/or refurbishment is/are not feasible will be replaced with newly manufactured tools, resulting an operational set of tools.

The advantages and disadvantages of using the set of retubing tools used at the refurbished Embalse are presented in Table 2.

3.2. Option 2 - New set of retubing tools

Using a new set of retubing tools represents another option that can be considered. In this case, Candu Energy designs and drafts the procurement specifications, and ensures the procurement, the supervision during the manufacture and the reception of the tools. Most retubing tools have been manufactured by Automation Tooling Systems Inc. (ATS) in Canada. Manufacturing a complete set of retubing tools lasts for approximately 3 years after launching the order and ***the estimated cost of a new set of tools is approximately 89 M $ more than the set of tools used at the refurbished Embalse.***

The advantages and disadvantages of using a new set of retubing tools are presented in Table 2.

Table 2

	Option 1 **Set of retubing tools used for the refurbished Embalse**	***Option 2*** **New set of retubing tools**
Advantages	- Cost lower by approximately 89 M $ compared to option 2	
	- Most tools are procured and stored, resulting their availability according to the project schedule	
	- Set of tools was successfully used for the Embalse retubing and we are not in a “first of a kind” situation	
	- The tool project is verified in reality	- The tool project is verified in reality
	- The operation experience acquired in previous retubing operations was implemented in the project and tool operation	- The operation experience acquired in previous retubing operations was implemented in the tool project
Disadvantages		- Cost higher by approximately 89 M $ compared to option 1
		- Procurement ad manufacture delays may cause the increase of the duration for the critical path of the project.
Operating experience	Yes - The project was used at Embalse - The tools were verified in reality	Partially - The project was used at Embalse - New tools are not verified in reality
Risk profile	**Low**	**Medium**

4. Improvements

In both retubing versions, refurbished or new, ***improvements can be made based on the acquired experiences and learnt lessons***, resulted from other retubing projects, leading to activity optimizations and reducing their necessary times. The improvements considered by Candu Energy at this moment - and which are prepared to be applied at Unit 3 at Darlington - are:

- Combined extraction of the pressure tube and the Calandria tube;
- The automated inspection of the holes in the tubular plate in which the Calandria tubes are expanded;
- Releasing and removing in one sequence the insertions of the Calandria tubes.

Candu Energy estimates that, by implementing these improvements, the duration of the retubing could be obtained by 35 days, and the total cost (estimated, at this moment) of these improvements is, however, substantial (tens of millions of $). It is worth noting that ***Cernavoda NPP can choose to implement them in the set of tools that will be chosen in the end.*** A decisive role on exercising this option, by SNN, will be that of the results and benefits obtained at Darlington.

5. Assessing options

The assessment of the aforementioned options shows the following sole versions to be considered for the set of retubing tools to be used within the refurbishment project at Unit 1 of Cernavoda NPP:

- Set of retubing tools used for the refurbished Embalse;
- New set of retubing tools.

A comparison between the aforementioned options, with the advantages and disadvantages of each version, was presented in Table 2 above.

6. Recommendations

After analyzing the two options, considering both their advantages and disadvantages, according to the information received by Candu Energy, it results that option 1, by using the set of retubing tools used at refurbished Embalse, represents the optimal version at this moment for retubing Unit 1 Cernavoda NPP, within the Refurbishment Project.

This recommendation is supported by the following:

1. The lowest cost out of the two possible options;
2. The risk for the procurement and operation of the set of retubing tools used at refurbished Embalse to cause delays in the schedule of the refurbishment project is almost 0;
3. In this version also, we can later add improvements, after we obtain the OPEX from their use at Darlington 3.

7. Conclusions

Considering the recommendation under the previous paragraph, SNN needs to issue a letter of intent/commitment, whereby it communicates SNC Lavalin the firm intention of SNN to use, for refurnishing the reactor of Unit 1 at Cernavoda NPP, of the refurbished set of retubing tool, used at Embalse.

The issuance of this letter of intent/commitment is necessary for SNC Lavalin/Candu Energy to keep available the set of retubing tools used at Embalse, as operational (the set is currently stored at premises leased by SNC Lavalin in Misissasauga, Canada), in order to be used for retubing the reactor of Unit 1. This set of retubing tools will be used, however, within the implementation of the retubing contract,

a document which will be signed after approving the feasibility study of the project for refurbishing Unit 1 of Cernavoda NPP, so this set of tools will be contracted by signing the contract for retubing Unit 1 of Cernavoda NPP. Currently, SNN needs only to express its interest / firm commitment to use, in the future, the set of retubing tools used at Embalse, and the actual use of this option is, as aforementioned, conditional upon the actual performance of the subsequent stages for implementing the project for refurbishing Unit 1.

III. Proposals subject to the approval of the Extraordinary General Meeting of Shareholders of SNN

Considering the aforementioned aspects, **we submit for the approval of the Extraordinary General Meeting of Shareholders of SNN the proposal for sending, by the executive managers of SNN, of a letter of intent (letter of commitment) to SNC Lavalin (the parent company of Candu Energy Inc.) notifying this company that Nuclearelectrica SA National Company intends to use for retubing the reactor of Unit 1 at Cernavoda NPP, within the refurbishment project, the refurbished set of retubing tools, used for retubing the Embalse NPP.**

We would like to mention that this proposal has also been approved by the Board of Directors of SNN, in its meeting of 15.03.2021, according to the provisions of art. 20 par. (4) of the articles of incorporation of SNN, updated on 27.01.2021, corroborated with the provisions of the Annex to the articles of incorporation of SNN, position 2 - “Investment decisions”.

Chief Executive Officer,
Cosmin Ghita

Deputy Chief Executive Officer,
Dan Laurentiu Tudor

Chief Financial Officer
Paul Ichim