THE EXPERIENCE IN THE CERNAVODA UNIT 1 OPERATION - A STIMULATING ARGUMENT FOR FUTURE NUCLEAR POWER DEVELOPMENT IN ROMANIA

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ABSTRACT

The Romanian nuclear program has been developed based on the option for CANDU type reactors. At the beginning, this program was unrealistically conceived and its management was inappropriate. The program was reconsidered in 1990 and the management policy and organization structure were also adapted accordingly.

The paper presents, in the first part, the actual organization structure, adapted for the execution of the current and future activities, related to the nuclear power program.

The performance achieved by Cernavoda Unit 1 constitutes the main part of the paper. The performances described demonstrate that the Cernavoda Unit 1 is a success and the Romania's electricity needs are satisfied in a proportion of about 12 % by the nuclear power.

The paper also presents a general view on Cernavoda Unit 2 perspectives.

The essential conclusion of the paper is that the continuation of the nuclear program appears to be a logical option, generally accepted in Romania, limited only by financial restraints.

1. INTRODUCTION

It is well known that the Romanian authorities decided even from the mid 60's that the CANDU-6 nuclear power plant would be the most appropriate plant upon which Romania was to build its nuclear program.

In 1977 the Romanian and the Canadian Governments agreed to co-operate in the field of peaceful use of atomic energy. A license contract for CANDU system was signed in 1978 between the Romanian authorities and Atomic Energy of Canada Limited (AECL).

A large national nuclear power program was launched which envisaged the construction of more than twelve CANDU-6 units. For the beginning, the program started and has been developed around the Cernavoda site, where five units of 700 MWe capacity each were to be constructed.

Construction works for Unit 1 started in 1980 under Romanian management, and in 1991 the completion was of 45%.

After 1990, the Romanian nuclear power program was reconsidered. In 1991, a Project Management Contract (PMC) with AECL - ANSALDO Consortium (AAC) was signed, stipulating that the Consortium would take over the project management activities, including the completion and commissioning of Unit 1. AAC was to operate the plant for the first 18 months.

Cernavoda Unit.1 started the commercial operation on December 1996.

Now, Romania has also two qualified entities, one for nuclear fuel manufacturing and the other one for heavy water production. Both are essential in supporting Cernavoda Unit 1 and are prepared to meet the needs for the future nuclear power units.

The paper presents the performance achieved at Cernavoda Unit 1, the actual organization of the participants in the nuclear power program and gives a general perspective for the future.

2. ORGANIZATION

After 1990, the nuclear power program was assumed by the Romanian Electricity Authority (RENEL). In 1998 RENEL was restructured.

A new company - **CONEL** (National Electric Power Company), was created for energy production (except for nuclear power), transport and distribution activities.

S.N. NUCLEARELECTRICA S.A. is a new company, organized with the objective to produce nuclear power, nuclear fuel, and to administrate the investment activities for Cernavoda units 2 to 5 which are now under different construction phases.

The Company includes three subsidiaries, no legal person:

CNE-PROD Cernavoda (production of nuclear power by Cernavoda Unit 1);

CNE- INVEST Cernavoda (investments activities for Cernavoda units 2 to 5);

FCN Pitesti (CANDU nuclear fuel manufacturing).

The other branches participating in the nuclear program were included in **RAAN** ("Regia Nationala pentru Activitati Nucleare"), a national company for nuclear activities. This Company includes three subsidiaries, no legal person:

ROMAG Drobeta - Turnu Severin (heavy water plant);

CITON Bucuresti - Magurele (nuclear project engineering);

SCN Pitesti (nuclear research).

Uranium mining, concentration and industrial UO_2 powder production are under the management of **National Uranium Company**.

3. CERNAVODA UNIT 1 PERFORMANCE

The major milestones of the Cernavoda Unit 1 are listed below.

First criticality	- April 16, 1996
Grid connection	- July 11, 1996
Reactor at full design rated power	- October 2, 1996
Commercial operation	- December 2, 1996

After the commercial operation began, the warranty tests, stipulated in the Contract between the Romanian Party and AAC were performed. The results obtained during the tests, as certified in the documents signed by both Parties, are better than the ones guaranteed by the Contract.

Most relevant performance indicators, as they are defined by the World Association of Nuclear Operators (WANO), achieved by the Cernavoda Unit 1 during its operation period are presented in the Figures 1 to 6. When looking at these graphs we have to mention that the values reported for the first seven months of 1999 must be considered as no planned outage took place in this period. First planned outage for 1999 is scheduled at the beginning of the last quarter of the year.

The operating performance indicators achieved by the plant have, in most respects, better values than the best quartile ones, especially compared with other PHWR units in operation [1].
(In the WANO terminology, for the best quartile, 25 percent of the unit indicator values are better than this value).

These results prove the high quality of the equipment supplied by well known manufacturers and the operating skill of the Romanian personnel. It is worth mentioning that PMC stipulated AAC responsibilities to provide formal and on-the-job training of the Romanian personnel, who were to operate the unit when AAC's job was done. All the plant operating responsibilities were transferred to the Romanian personnel on June 30, 1997.

A complex and modern training center is also in place on the Cernavoda site, ensuring periodic training for the Romanian personnel according to the most recent requirements.

It should be underlined the important role of the international community support through

PRE-OSART missions from IAEA, training programs and seminars. Co-operation with IAEA, OECD-NEA, WANO and COG have ensured supplementary warranties for safe operation of Cernavoda Power Plant.

Fuel procurement is made by the Cernavoda Unit 1, according to CAN CSA Z299.2.

First fuel supply was made by Zircatec Precision Industries Inc., from Canada. The reactor's first fuel load also included 66 fuel bundles supplied by FCN Pitesti.

The re-loading started in the middle of January 1997 with fuel produced by the Romanian fuel plant.

More details regarding the actual Romanian nuclear fuel manufacturing status are presented in another paper at this conference [2].

Heavy water necessary to compensate the losses is supplied by ROMAG which produces a very high quality product.

4. CERNAVODA UNIT 2

Among the other four reactors under construction on the Cernavoda site, the Unit 2 is in the most advanced state of equipment installation and is more than 40% complete. The most recent activity was the mounting of the fuel channels which is completed by now.

Extent of the construction work is strongly dependent on the possibility to secure financing in order to accelerate the progress in the completion of this project.

The success of the Cernavoda Unit 1 and the possibility to supply energy to neighboring countries as well as the increase of the flexibility of the regional electrical system are considered to be stimulating arguments to provide financial support for Cernavoda Unit 2.

Two units in operation may constitute a solid economical support to help the possible completion of the remaining three units.

For these reasons S.N. NUCLEARELECTRICA S.A. focuses its efforts to promote the completion of the Cernavoda Unit 2 project.

5. CONCLUSIONS

Romania reconsidered its nuclear program after 1990 and chose to gradually take advantage of the previous investments on the Cernavoda site and in other supporting local nuclear industries.

Romania has now in place all the chain of the specific technical and industrial capabilities to support a realistic nuclear power program.

The completion and the operating performance of the Cernavoda Unit 1 provide a great satisfaction inside the Romanian nuclear community.

The economical effect of the operation of this unit is important, the Cernavoda Unit 1 supplying about 12 percent of Romania's electricity needs.

The continuation of the nuclear program appears to be a logical option, generally accepted in Romania, limited only by financial restraints.

REFERENCES

[1] WANO - Performance Indicator Report - PI14, 1998.

[2] A. C. GALERIU, et al., "Five Years of Successful CANDU-6 Fuel Manufacturing in Romania", Sixth International Conference on CANDU Fuel, Niagara Falls, Canada, 1999 September 26-30.

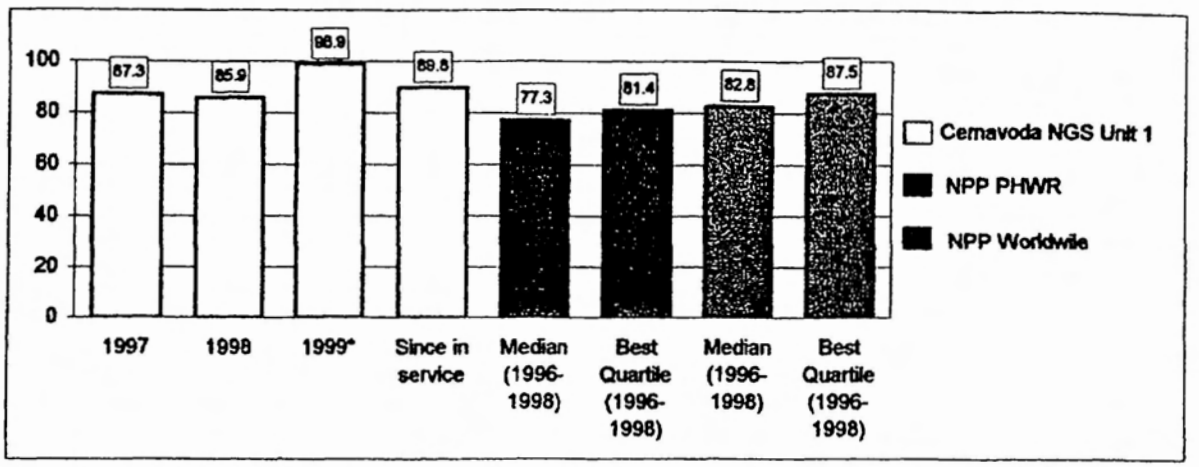

FIG. 1. UNIT CAPABILITY FACTOR (%)

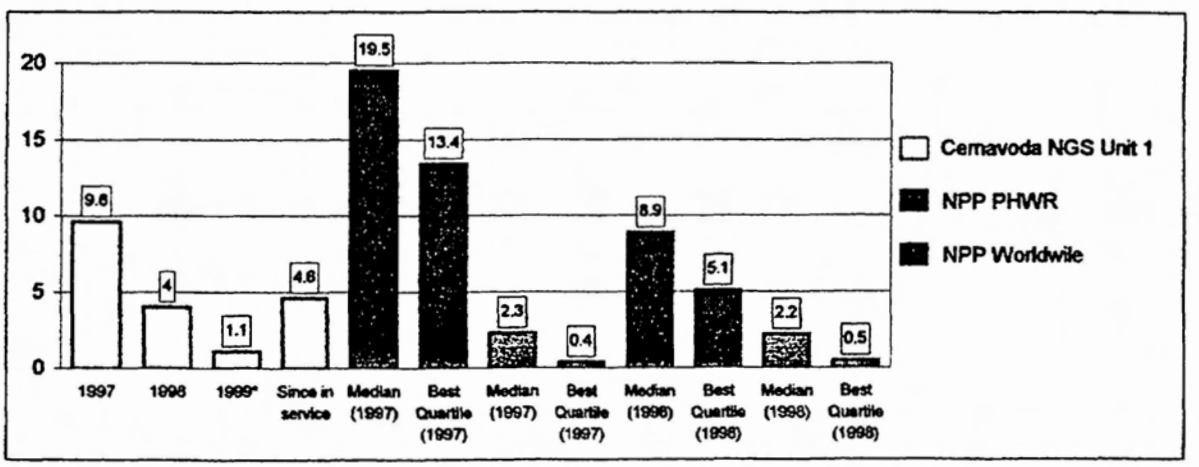

FIG. 2. UNPLANNED CAPACITY LOSS FACTOR (%)

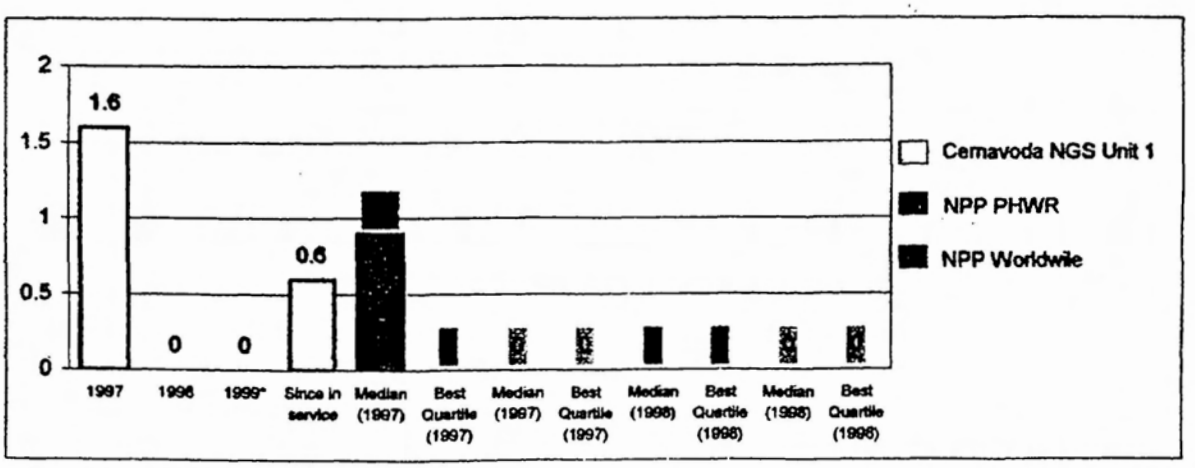

FIG. 3. UNPLANNED AUTOMATIC SCRAMS PER 7,000 HOURS CRITICAL

* First seven months. No planned outage in this period.

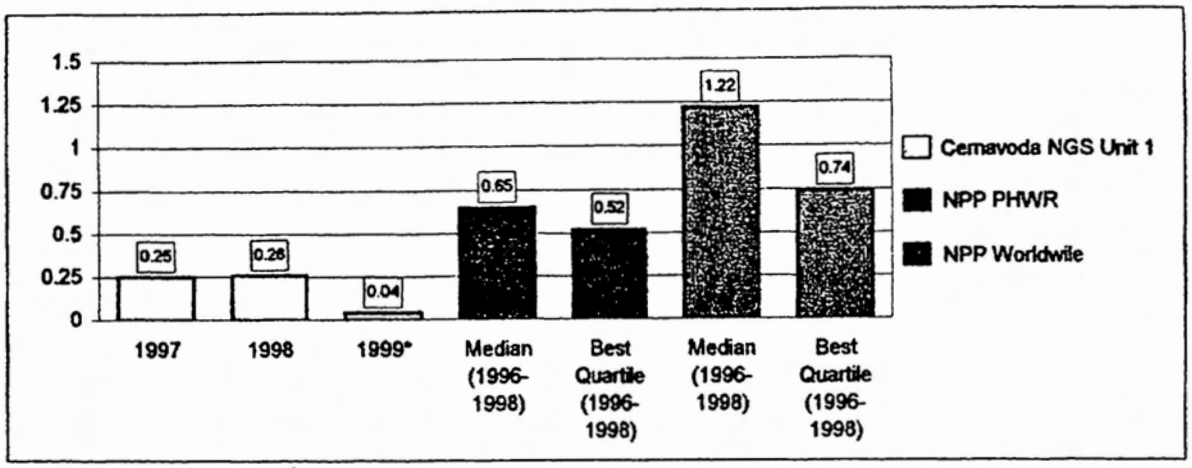

FIG. 4. COLLECTIVE RADIATION EXPOSURE (MAN-Sv/UNIT)

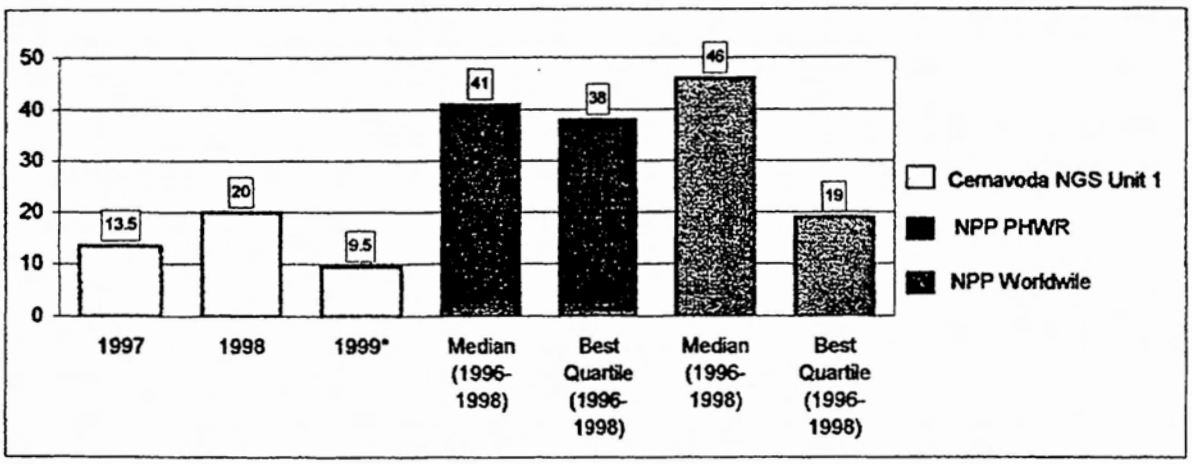

FIG. 5. VOLUME OF SOLIDE RADIOACTIVE WASTE (m^3/UNIT)

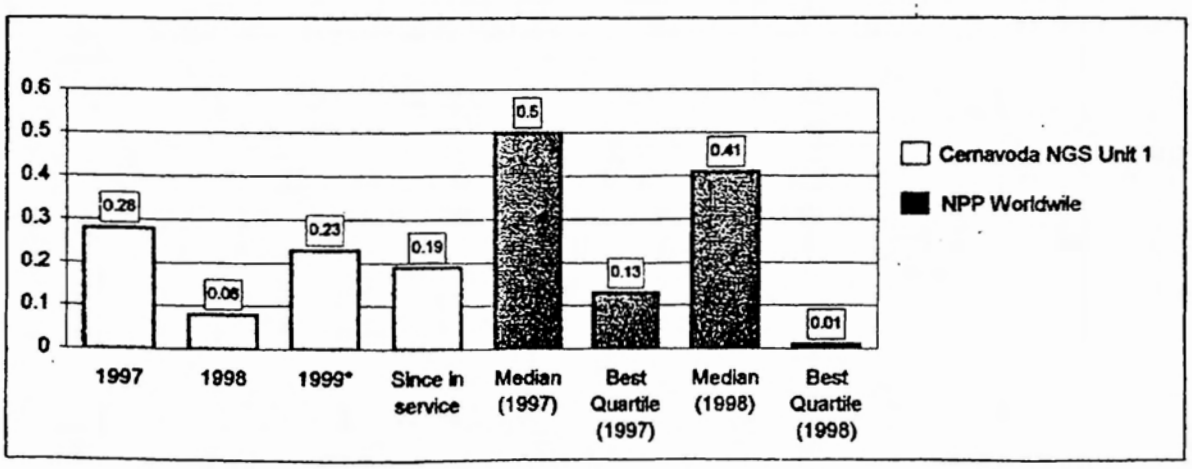

FIG. 6. INDUSTRIAL SAFETY ACCIDENT RATE (NUMBER PER 200,000 MAN-HOURS WORKED)

* First seven months. No planned outage in this period.