# ARGENTINE ACTIVITIES ON FUELS FOR NUCLEAR GENERATION STATIONS.

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## ABSTRAC.

In the last six years, significant changes have taken place in the nuclear activity field in Argentina, therefore all the areas of the nuclear fuel cycle have been strongly influenced by these.

The strategies carried out by CNEA to give an initial answer to the modifications of the domestic and international context of the nuclear fuel cycle were described in the previous Conference.

Three years later, it is possible to appreciate the first results of the application of those strategies, and also that the frame has continued not only evolving and requiring new answers, but adapting and accentuating some strategies as well.

A brief review of those results is presented here , together with a summary of the condition of the current situation and of the proposals to face it.

## INTRODUCTION.

In 1989, CNEA restated its policies and strategies for the nuclear fuel cycle, to adapt to the conditions and requirements that a new context imposed, particularly in the domestic sphere.

CNEA had taken two basic and fundamental decisions in the 70s:

* the generation of nuclear electricity in the country would come from adopting the natural uranium- heavy water line.
* the nuclear fuel cycle would be technologically and operatively self-sufficient.

The former, was a decision arising from the selection of the best technical and economic alternatives based on the characteristics and potentialities of the country.

The latter one, was an imperative course of action, rising from the international restrictions and limitations to which Argentina had been subject in relation with

technology, materials and equipment linked with the nuclear bussiness. Consequently, these conditions did not ensure a good supply of nuclear fuel to the power stations.

At that time, CNEA had to focus its efforts in developing and reaching technological capacity in order to manufacture its nuclear fuels, to obtain the zircaloy components and the uranium dioxide from the very primary raw materials.

By the middle of the 80s, CNEA operated two nuclear power stations, Atucha-I a 300 MW PHWR of German design, Embalse a 600 MW CANDU type and a third one ATUCHA-II also a 600 MW PHWR under construction.

At that time, a plant for manufacturing fuel bundles for both power stations in operation was already running This plant processed uranium dioxide coming from a conversion facility fed with concentrates of domestic origin.

Simultaneously, zircaloy components were begining to be manufactured in a factory designed to obtain them from circonium minerals if necessary .

CNEA had also begun the construction of a plant for heavy water production with a capacity of 200 annual tons.This plant was destined to replace the rented load of the CANDU Power Plant , to provide the first load of Atucha-II and to trade the surpluses.

At that time, CNEA began the setting up of a plant for the enrichement of uranium in order to have autonomy in the commercialization of nuclear fuels for material testing reactors.

Towards the end of the 80s, CNEA:

* carried out basic and applied research;
* went ahead with technological developments;
* operated nuclear power plants whose contribution to the electricity supply represented 15 % of the total offer of electricity in the country;
* managed and operated by itself or through associated companies all the stages of the front end of the nuclear fuel cycle;
* actively participated in the construction of a power plant, Atucha-II.
* was the main authority in regulatory activities.

CNEA had structured policies to give participation to private capitals in all those activities that because of the size could be subject to industrial management. According to this outline, CNEA formed companies of public right, where private groups owned part of the shares and were responsible of the management and CNEA assumed technological support and reserved managerial fundamental decisions. Thus two companies were created, CONUAR for the production of nuclear fuels in 1981, and FAE ( Special Alloys Manufacturing) for the production of zircaloy components and special alloys in 1986.

The dominant characteristics of the national scape were given mainly by the way with which the electric generation activity and the country economic conditions were developed.
The generation of electricity was an activity in the hands of the government.

The generation system was surpassed by the demand and the high inflation rates that dated from some time before deterred the Sector from carrying out investments.

At the beginning of the 90s this situation modifies dramatically, the economy opens up, the rate of inflation decreases abruptly, the government transfers to private sectors the activities in the generation of non nuclear electricity

Two markets of electric power appear, a retail and a wholesaler market. The latter one, structured fundamentally on the competitiveness of prices, and in which the offer begins to surpass the demand.

From this time onwards , the generation of nuclear electricity is to compete with the other kinds of generation, at the risk of receiving a penalty through power reductions or having to leave the grid due to the decrease or lack of demand from the wholesaler. market.

The external context became more favorable and it was possible to reach many foreign suppliers of products associated with the nuclear activity, even, equipment itself.

**PRESENT SITUATION**.

In the last three years the tendencies in the domestic and foreign frame have consolidated and deepened.

The policies of the government to separate the State from the commercial activities, and to incorporate the private sector in conditions of risk, have now reached other sectors of the nuclear field.

The nuclear power stations were separated from CNEA, through the creation of an operation company, where CNEA does not have stock participation. This new company is to be privatized after the approval by the Congress.

Another modification to CNEA's scope was the transfer of all regulatory activities to a new governmental Regulatory Board, dependent directly from the Executive Power.

Consequently, the nuclear power stations that constituted an inner customer in CNEA organization, have now become an external client. This change in the relationships increases the necessity of improving the competitiveness of the nuclear fuel prices.

This objective is not easy to reach in a system designed to serve three nuclear power stations that represent an equivalent of 280 tons of uranium per year and which should

achieve the equilibrium point with only 150 annual uranium tons, that implies the 900 MW of the capacity installed today

Originaly, the commissioning of Atucha-II was programmed for 1997. In 1994, the production of the first core was started. A quick increase in the nuclear total fuel production capacity was required. It was necessary to overcome a bottle neck localized in the plant of conversion, by importing part of the Embalse consumption. Today, the construction of Atucha II is in a stand by state waiting for the capitals from privatization.

To reduce the cost of the front end of our nuclear fuel cycle is not an easy task, Several factors are responsible for those difficulties. Some of them are structural, like the uranium yield from Argentinean minerals, others depend on temporary circunstances as it is to pass to an economy of scale through the incorporation of Atucha-II to the system and by mining unexploted deposits of higer uranium content.

The uranium cost could be decreased by looking for an appropriate proportion of mixture between the consumption of domestic and foreing concentrates.

Efforts were made in several areas of the fuel bundles manufacturing process to reduce the costs. The aspects involved were mainly related to:

**Product Engineering.**

The emphasis was laid on Atucha-I fuel bundle design, since this course of action promised the higher benefits. The task was centered in three lines of decreasing significance:

- slight enrichment of the fuel up to 0.85% in $^{235}U$.

- increase of the uranium content by replacing a structural rod by a fuel element (the fuel assembly changes from 36 fuel rods to 37).

- decrease of the Zry mass of the spacer, the most important component of the bundle from the structural and economic point of view .

The development of the first of these lines is in an advanced state. Now an irradiation program is underway at the Atucha-I power plant. A set of twelve proptoptypes are in the core. The program will be finished next year, after the irradiation of another set of thirty prototypes that will include inner cladding wall graphite coating. The decision of the massive entrance is foreseen for 1997. That would make it possible for an expected burn-up of 12.000 MWD/ T.U. to be reched and to save about 15 % in the fuel cycle cost.

A final hydrodinamic loop test is now being done to confirm the design that would replace the structural rod.

A less massive spacer is at the designe stage.
Only minor modifications have been practiced in the CANDU bundles to facilitate the production process.

**Process Engineering**

In this aspect it was the production line of Candú bundles which received more attention in order to increase its productivity.

The layout was improved, and different process stages were reviewed in order to diminish or to eleminate preparation steps of components and materials .
As the personnel item plays a very important role in the manufacturing costs, an intensive revision of the processes, to give them a higher degree of automation was carried out.

Studies in the end plugs weld resistance process are under way to correlate characteristic of the welds, operation parameters and different types of mechanisms of welding force.

**Organization.**

To achieve additional reduction of fixed costs, most of the non special production processes constituted by conventional operations were derived outside the Plant to be done by subcontractors.

Then, it was necessary to identify and to develop suppliers of services as subcontractors and to place them under the QC and QA system.

**Materials Procurement.**

The almost disappearance of international limitations for the acquisition of raw materials and equipment related to the nuclear business have opened the possibility of alternating supplying sources, to better prices and to lower stocks levels.

An example is the procurement of zircaloy TREX and strips. Today the domestic production is unprofitable due to scale factors when comparison with the current international prices are made.

To try to reduce the cost of the interface supplier- client joint tasks with the suppliers have been done.The idea was to avoid reiteration of tests and controls on materials and components, to approach delivery conditions to those required for their immediate use in the equipment of the production line, or that the supplier carries out some preliminary operations that otherwise should be made in the customers line. This last methodology may generate an additional benefit in reducing the costs by a higher economic value to the scrap which is tansferred to the client.

**Achievements Of The Period.**

In these last three years it has been possible to reduce the cost of the nuclear fuel cycle in approximately 7 %.

An equivalent to 450 tons of uranium was manufactured as fuel bundles during this period, 200 tons corresponded to Candu fuel. This implies an increase of about 34 % in the total production regarding the period 1.990 - 1.992.

The rate of manufacturing failures for Atucha-I fuels was 0,6% from january 1993 up to the present.

The rate for CANDU bundles was 0,15% for the same period, but the rate falls to 0,1% in the last twelve months.

A goal, which although not directly related with the fuel, but which deserves to stand out was the setting in operation of the heavy water plant.

## CONCLUSIONS.

The strategies and actions taken at the beginning of the 90s in order to reduce the cost of the nuclear fuel and to increase its confidence level have begun to give the expected results.

All the areas involved with the nuclear fuel have been submitted to fine adjustments in the last three years, without leaving aside any aspects though minor they were in their potencial contribution to reach the objectives.

For the short term it is expected , that the enforcement of those policies that were described above will lead to an increase in the favorable effects that have been obtained up to the present.

In the mediate future, the use of slightly enriched fuel in an homogeneous core in Atucha-I, and mainly, the starting in operation of Atucha-II will represent a quantitative technical and economic jump.