Status of the Nuclear Fuel Cycle in Argentina

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Abstract. In this work a panorama of the existing nuclear fuel cycle in Argentina is presented. Nowadays Argentina is considering the opportunity to install new nuclear power plants, PWR concept based. Consequently, the impact on existing nuclear fuel cycle is considered.

Besides R&D initiatives in INPRO or G IV reactors are being studied and a decision on the preferable effort to be done in this matter will be taken afterwards. To this end, special care is taken to enhance the development of nuclear materials able to face high temperatures and neutron fluxes than those associated to former reactors and cycles. A brief depiction of this initiative will be presented.

1. Introduction

Argentina has two PHWR nuclear power plants (NPP) and a third one under construction. Atucha I is a pressure vessel type 357 MW(e) imported from Germany and Embalse, a pressure tube reactor CANDU type 648MW(e), imported from Canada. Both NPP are operated by Nucleoeléctrica Argentina SA (NA-SA). The third one is Atucha II imported also from Germany, scheduled to start operating on 10/10/2010, which will generate 745 MW(e). Up to date, nuclear installed capacity represents about the 5% of all national power, being 45% of fossile origin (natural gas, mainly) and 40% of hydraulic origin. Due to characteristics of the Argentine electric market and seasonal reasons, the nuclear share use to reach the 10% delivered to the national grid.

Present plans of the Ministry of Federal Planning and Public Investment and its Energy Secretary[1] (government agency from which both CNEA and NA-SA depends) includes the proposal to refurbish Embalse NPP by replacing all pressure tubes and other internals, to install a fourth NPP CANDU concept in the near future (2013 -) and to make a decision about the convenience to install in the mediate future a pair of PWR NPP (2015 -)

The present policy regarding the nuclear fuel cycle in Argentina has been not to make a decision yet about it . However, the projected future increase of NPP and particularly the possible incorporation of new PWR NPP, as well as the considerable environmental and financial impact that would represent to manage increasing inventories (as detailed in Table 2, below) for final disposition, put over the table the obligation to consider this new future scenario to make a technical, environmental, financial and social well posed nuclear fuel cycle policy.

2. Present status of the Nuclear Fuel Cycle

2.1. Mining and Milling

The status of the Sierra Pintada open pit mine is the same as included in former document on "Country Fuel Cycle Profile" released in 2005. The mine has reserves of 5000 t U and yellow cake production capacity of 120 t HM/a. At present, several ore sites in different Provinces (States) are being prospected to constitute an strategic reserve on uranium stock (yellow cake), This is a joint initiative between the Minery Secretary and the Energy Secretary (through CNEA).

2.2. Conversion

The purification of the yellow cake and the production of UO2 take place at Cordoba mill complex, operated by DIOXITEK SA and located at Cordoba city. This plant will move close to Sierra Pintado or to a new uranium mine once the decision is taken. A study to evaluate benefits / disadvantages for using RepU as raw material for SEU production is undergoing. Main drawbacks are the ocupational dose in aged RepU, generated by U232 decayment daughters[2].

The Pilcaniyeu conversion plant from UO2 to UF6 belongs to CNEA. It is located at 65 kms of Bariloche City in Rio Negro Province and has a capacity of 62 t HM/a.

This is a joint initiative between the Minery Secretary and the Energy Secretary (through CNEA).

2.3. Enrichment

CNEA's gaseous diffusion pilot plant in Pilcaniyeu has a capacity of 20.000 SWU/a. Due to the new impulse given to nuclear activities in Argentina (see ref. 1) the plant is now undergoing a major refurbishing to expand its capacity to provide SEU to Atucha I and II, and eventually to Embalse NPP and the fourth NPP (PHWR concept).

2.4. Fabrication

CONUAR SA UO2 pellet fabrication plant is located at 35 kms from Buenos Aires city, at Ezeiza Atomic Center. Close to it is FAE SA zircalloy tubes fabrication plant. They provide regularly Atucha I and Embalse fuel assemblies (150 t HM/a). CNEA is developing a new unifying fuel assembly, CARA CVN[3] fuel. This fuel will undergo next year several irradiation tests at Halden Reactor Project. Major advantages are negative void coefficient (NVC), lower central temperature due to the diameter reduction (52 fuel rods in 4 rings) and cost reduction.

	Base case bundle	Low void reactivity bundle
1st ring (inner)	0.9 SEU	Nat U + Dy (7 to 8%)
2nd ring	0.9 SEU	1,2 to 1.7 % SEU
3rd ring	0.9 SEU	1.6 to 2 SEU
4th ring (outer)	0.9 SEU	1.3 to 1.6 SEU
Bundle max. power peak factor	1.15	1.15 to 1.34
Extraction Burn up	15000 MWd/TonU	17000 to 24000 MWd/TonU
Average Void coefficient	6.6 mk	-1 to -2 mk

Table 1: Comparison between current Atucha I NPP FA and CARA (NVC) concept

2.5. Spent Fuel Management

The PHWR NPP where commissioned in 1973 (Atucha I), and 1983 (Embalse). Along all these years have generated the following inventory[4] of spent nuclear fuels and heavy metals:

PROJECTED INVENTORY TO 12/31/2008					
	STORING SYSTEM	FA QUANTITY	Nat U t	SEU t	Pu t
ATUCHA I	POOLS	9709	1231	254	5.75
EMBALSE	POOLS & SILOS	115229	2330	-	8.40

Table 2 Projected Inventory of Spent Nuclear Fuels and Heavy Metals to 12/31/2008

Atucha I NPP: the decision to build dry silos for long term storage of SNF was recently taken.

2.6. Heavy Water Production

The Arroyito Heavy Water Production Plant is based on ammonia – hydrogen process and its production capacity is 200 t HW/a. It is owned by CNEA and operated by Empresa Neuquina de Servicios Industriales (ENSI SA).

3. Impact of the "Reactivation of Nuclear Activities in Argentina" policy (see ref. 1)

The new scenario brought by the Reactivation policy introduce several consequences to take into account:

- New and refurbished NPP demand the expansion of domestic isotopic separation capacity (SEU and 4% U235, heavy water) and/or reliable agreements with foreign providers

- The increasing amount of SNF due to the Reactivation policy will impact on the decision to defer to 2030 the adoption of a nuclear fuel cycle and final disposal policy: it should be re-evaluated and shortened. U and Pu contained in SNF are valuable assets to recycle in NPP, e.g. MOX spiking would extend the fuel cycle length on PHWR NPP and a way to reduce waste inventory for final disposal.

- As long as PWR spent fuel is a kind of SEU fuel for PHWR, a strategy to state a TANDEM cycle should be evaluated

4. Impact of the international trends on future NPP and associated fuel cycle

- Main impact is on the national strategy. Decisions on how and when dedicate financial and human resources to improve appropiate well suited research and development for national and regional requirements have to be taken.

- Up to date, CNEA is facing new development on high temperature fuels and materials because the present expertise resources allow us to move in this direction. Materials for both Advanced Gas Reactors and Ligh Water Reactor, new fuel cycles like Thorium for PHWR are under study at laboratory and pilot plant scale.

- Regional and international alliances to improve enrichment and recycling capacities in the frame of peaceful uses of nuclear energy and non proliferant activities are being and will be deployed by Argentina.

5. Conclusions

From the point of view of the author, national and international trends will prompt in the near future several changes to the status quo situation regarding nuclear fuel cycle and waste final disposal. These changes will be most probably towards the adoption of policies about recycling fissile material, separating interesting radioisotopes for Nuclear Medicine and Industrial applications and confining radioactive wastes for final disposal.

REFERENCES

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