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Construction of a New LEU Fission Radioisotope Production Plant in Argentina

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ABSTRACT

Molybdenum-99 and Iodine-131 from low enriched uranium-aluminium (LEU) targets are being produced in Argentina, at Ezeiza Atomic Centre, since 2002. Local isotope demand and part of regional markets are supplied by a weekly production.
Before 2002, Argentina produced for more than 15 years fission molybdenum-99 from HEU targets.
In 2010, Argentina initiates a project for constructing a new 30 MW LEU reactor, the RA-10. It is planned to be finished by 2018.
In 2012, a project for constructing a new and bigger LEU Fission Radioisotope Production Plant (PPRF) was approved by the government. The project started in 2013.
The new PPRF will increase production capacity several times compare with the present plant.
A description of the new PPRF, its designed objectives, location, and a brief description of the LEU method will be presented.

Introduction

Molybdenum-99 and Iodine-131 are the radioisotopes most widely employed in nuclear medical practices. For this reason, the production of fission Mo-99 and I-131 has always been an important concern for CNEA.
As part of the "Strategic Plan 2009-2018" approved by the authorities of the CNEA within a themed area called "Applications of Nuclear Technology in Health, Industry and Agriculture", the following strategic objectives are included:

Strategic Objective 1:	Ensure the supply of radioisotopes at national and regional levels, positioning Argentina as an exporter of radioisotopes.
Strategic Objective 2:	CNEA positioning as an exporter of radioisotope production technology.
Strategic Objective 3:	To consolidate technological autonomy in applications of radioisotopes, radiopharmaceuticals and ionizing radiation.

Within these strategic objectives, CNEA has established the following specific objectives:

Specific Objective 1.1	To have the capacity to back up, increase and diversify radioisotopes production by building a new reactor (RA-10) and a new fission radioisotopes production plant (PPRF).
Specific Objective 1.2	To optimize and expand the capacity of existing radioisotopes production and develop new radioisotopes.
Specific Objective 2.1	To build the management capacity to export radioisotopes production technology.
Specific Objective 3.1	To enhance R&D, education and assistance capabilities in the use of radioisotopes and radiopharmaceuticals for applications in medicine and biology.
Specific Objective 3.2	To enhance radioisotopes development and their applications in industry, agriculture and environmental activities.

Because current international policies seek to reduce uranium enrichment in civil uses, Argentina changed its Mo-99 and I-131 production from HEU to LEU in 2002 [1] [2] [3].
Before 2002, Argentina produced for more than 15 years fission Mo-99 from HEU targets, getting most of the experience that later on allowed the change from HEU to LEU.
At present Argentina has a Fission Radioisotopes Production Plant in the Ezeiza Atomic Center, adjacent to the RA-3 reactor. This plant has an extensive operating history (1985) and allows important works as in the fields of radioisotope production and provision of services at local and international levels.
In the last years, the plant has been producing radioisotopes to the limit of its capacity, providing the entire domestic radioisotope demand and exporting to Brazil.
The facility does not have the capacity to increase more the production level. To achieve that, it would be necessary to modify the production hot cell lines and the waste

management systems in the appropriate scale. Those modifications are not possible without a long facility shut down, affecting the national radioisotope supply.

Likewise, the construction and operation of a new reactor were a prerequisite to achieve an expansion of radioisotopes production capacities in Argentina.

In 2010 CNEA began the project design, construction and commissioning of a multi-purpose Argentine nuclear reactor, the RA-10, whose main function is the research and production of radioisotopes for diagnosis of diseases.

The second requirement for increasing the radioisotopes production is to build a new fission radioisotopes production plant.

A project for constructing a new LEU Fission Radioisotopes Production Plant was approved by the government in 2012.

The aim of this work is to show a description of the new facility, location, its designed capacity and a brief description of the LEU method.

Fission Radioisotopes Production Plant (PPRF) Project

Location

The building will be located at Ezeiza Atomic Center, neighbor to the future RA-10 reactor (picture nº1 and nº2).

Picture nº1: PPRF and RA-10 location view

Picture nº2: PPRF and RA-10 zoom location view

Design Objectives

The PPRF is being conceived as a facility for routine RI production. Its design capacity will be 3.000 Ci/week of Mo-99 and 400 Ci/week of I-131 (both 6 days calibrated).

Safety Related Objectives

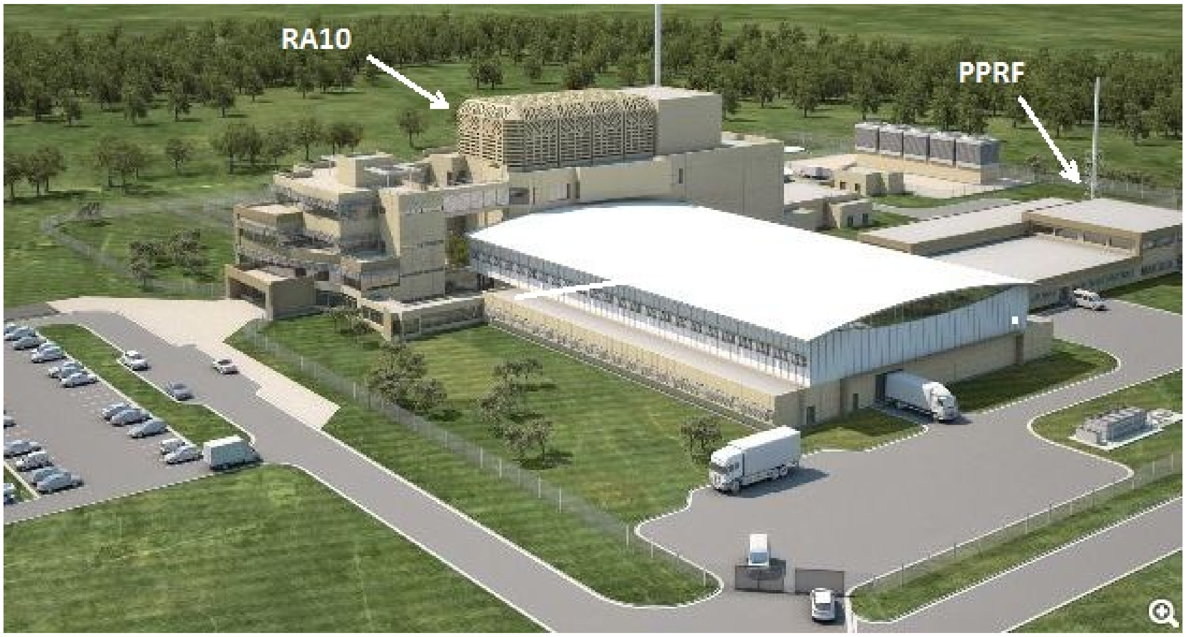
The PPRF shall meet the Argentinian Safety Regulations and International Atomic Energy Agency (IAEA) Standards.

Design Objectives related to RI Production

The facility is being designed to fulfill GMP standards as well as the latest and most modern systems associated with quality and safety, both for workers, as well as the environment.

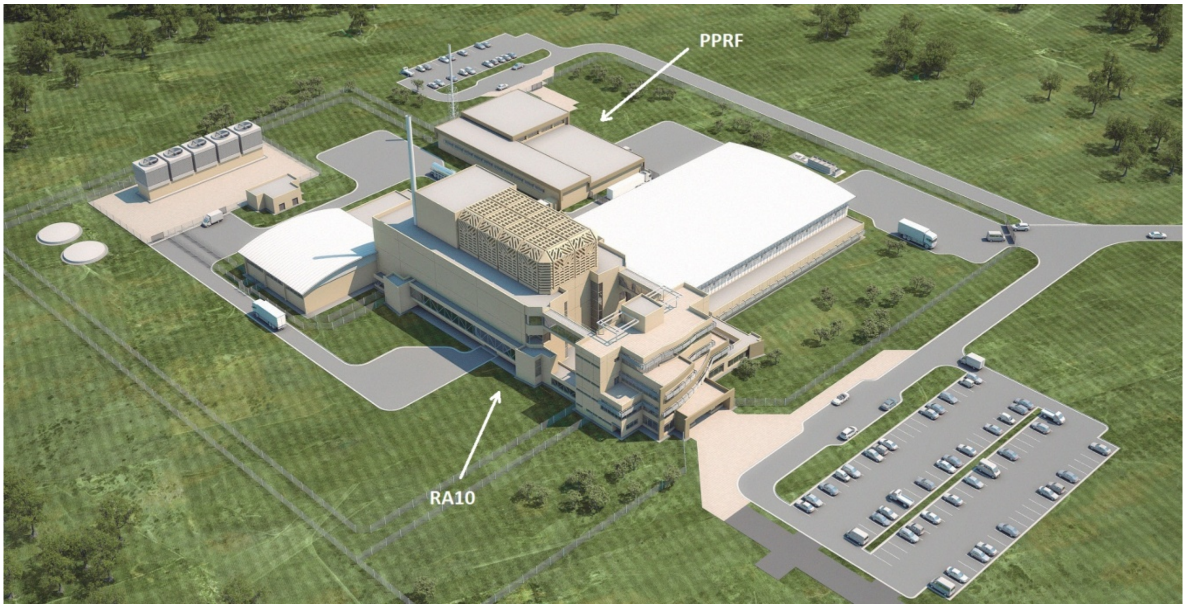
In line with current international policies that seek to reduce uranium enrichment in civil uses, only LEU targets will be used for the RI production

The plant is being designed based on the experience gained over almost 30 years of operation the existing fission plant.



Picture nº3: PPRF and RA-10 lateral view

It is going to be a plant with modular versatility to meet different scales of production according to the demand. It is being conceived with the best production systems associated with systematic and routine production, trying to minimize the chances of flaws or errors in the operation by a safety design.
The production method will be based on the used in the actual production plant [4], that is, alkaline target digestion, filtering and ion exchange purification, but activity produces per batch is going to be increased several times, and it will be possible to produce two batches simultaneously.
It shall have a waste management system that will optimize the management procedures simplicity, minimizing personnel doses as well as the amount of wastes generated. It is going to be an exclusive dedicated cell for solid waste management in order to sort out and segregate different solid wastes.
Regarding the radioactive noble gas emissions, the facility is being conceived to reduce them as much as possible.
The large fraction of radioactive noble gases generated during irradiation and contained in the targets until their dissolution, are going to be stored for several periods, obtaining, in that step, a tending to zero emission. To achieve that, the volume of gases obtained during dissolution, is going to be reduced several times removing hydrogen generated in the alkaline digestion, allowing their easy storage for several weeks.
As a second step in reducing radioactive noble gas emissions, iodine is going to be separated in an earlier process stage through an enclosed system, minimizing the leakage of noble gases generated in iodine decay.
The facility life is being conceived to ensure the supply of radioisotopes for the next 40 years.



Picture nº4: PPRF and RA-10 aerial view

Targets Irradiation: RA-10 Reactor Project

The Ra-10 reactor will be an open pool type. It is going to a 30MW power facility run by low enrichment MTR fuel elements. It will use D_2O as reflector and H_2O as moderator-coolant.
RA-10 will have two independent shutdown systems: hafnium plates and D_2O reflector tank emptying. The reactor shall work in a 26 days continuous operation cycle.
LEU miniplates will be irradiated for 5 days with a neutron flux of $1.0\text{-}1.5x10^{14}$. [5][6][7][8][9].

Picture nº 5: RA-10 front view

Application	Spectrum	Flux	Irradiation Conditions	Section	Length	Positions
Mo-99	Thermal	1.0-1.5x10^{14}	* Continuous loading	5.2 cm (diam.)	30 cm	*10 positions (up to 8 miniplates each one)

Table nº1: RA-10 irradiation conditions and targets characteristics

PPRF Project Development

In Table nº 2 is displayed the expected scope of local participation in project development, that is, all purchases and tasks that are going to be performed and that shall be payable within national borders..

Item	National participation rate	Foreign Participation rate
Basic Engineering	100%	
Detail Engineering	100%	
Civil Work	100%	
Components	50%	50%
Installation	100%	
Cold Test	100%	
Commissioning	100%	
Operation License	100%	

Table nº2: local and international project development

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