Description of the PIE Facility for Research Reactors Irradiated Fuels in CNEA

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The PIE Facility (LAPEP), located at the Ezeiza Atomic Center (CAE), was designed to carry out destructive and non-destructive post-irradiation examinations (PIE) on research and power reactor spent fuels, reactor internals and other irradiated materials, and to perform studies related with:

- Station lifetime extension
- Fuel performance
- Development of new fuels
- Failures and determination of their causes

LAPEP is a relevant facility where research and development can be carried out. It is worth mentioning that in this facility the PIE corresponding to the Surveillance Program for the Atucha I Nuclear Power Plant (CNA-1) were successfully performed. Materials testing during the CNA-1 repair and the study of failures in fuel element plugs of the Embalse Nuclear Power Plant (CNE) were also performed.

CAPACITIES:

The laboratory allows carrying out the following destructive and non-destructive tests of irradiated materials and components:
a. - Metallography and ceramography
b. - Determination of defects in fuel rods
c. - Gamma Scanning
d. - Measurement of the oxide layer by induced currents
e. - Analysis of fission gases, composition and internal pressure in rods
f. - Mechanical traction and explosion tests
g. - Absolute burnup measurement by chemical methods
h. - Dimensional determinations

FACILITIES

LAPEP has the following facilities:

- **Two cells with heavy concrete shielding**, 1 m thick, high activity cells, with the following characteristics:

➢ **Access Cell** (Fig. I and II):
Dimensions: 3.3 m wide x 5 m high x 7.7 m long
Volume: 127 m3
Surface: 25.41 m2

Equipped with the following:

- one bridge crane of 1 ton
- two leaded glass windows, 1 m thick
- four HWM A –100-type master-slave manipulators
- two working posts
- 1800 mm x 3000 mm working table

Fig. I

Fig. II

There is a possibility of entering fuel elements or other elements of considerable size to this cell line through a transfer pool (Fig. III) of sufficient depth so as to provide proper biological shielding to γ radiation and a fuel element lifting system of the following characteristics:

Fig. III

- Lifting height: 16 m
- Activation system: double stainless steel cable that moves a basket assembled to a system that places it in horizontal position above the inner cell counter
- Activation and safety systems located outside the cell

- **Cutting Cell:**
  Dimensions: 3.3 m wide x 5 m high x 3.15 m long
  Volume: 52 m3

Surface: 10.40 m2
Equipped with the following:

- One Telescopic Power Manipulator, remotely controlled, capacity in the hand 3500 N, 1 ton at the hook. (Fig. IV)
- one leaded glass window, 1 m thick
- two HWM A –100-type master-slave manipulators
- one working post
- direct access devices through standardized DTPE –type double airtight doors with their corresponding mobile equivalent shields
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Spent and decayed MTR-type fuel elements are expected to be disassembled and conditioned in this facility, due to which the following will be installed inside it:

- one unit to disassemble the fuel element (FE)
- one device to weld the capsules in which the F.E.s will be located for their final dry disposal
- one device to close the capsule in airtight fashion
- elements for holding different tests
- one cutter to reduce solid waste

It is also possible to disassemble and cut FE and prepare samples and to mechanize channel pieces for mechanical tests, as well as to carry out any other operation involving the handling of contaminated materials or materials with high or low $\alpha\beta\gamma$ activity .

Related to the Access Cell there is one transfer pool system, the pools being built in concrete with the following characteristics:

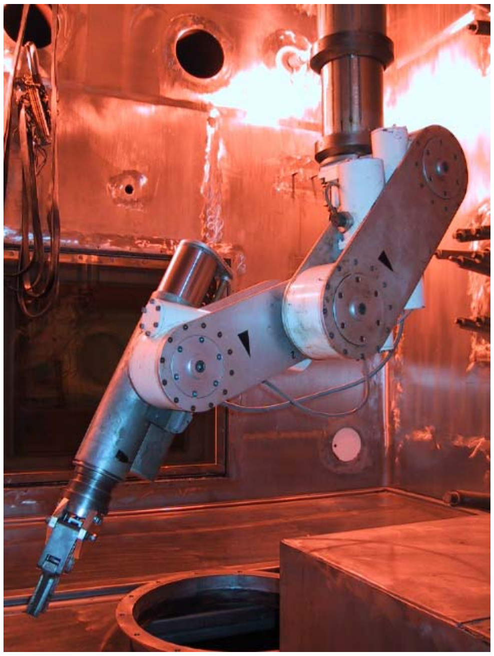

Fig. IV

- stainless steel lining
- maximum depth: 16 m
- possibility to store FE of the CNA-1, CNE (CANDU), RA-3 (MTR), RA-8 critical facility and CAREM types
- pool water recirculation and purifying system through a column filled with ion exchange resins that allows maintaining water purity and retaining any type of contaminant element that may have been spread from any damaged FE.

The Access and Cutting Cells connect through a transfer SAS, since the latter is α airtight while the former is not.

- **One line of Analytical Cells**: 6 α-airtight cells with 200 mm and 100 mm thick lead shield, equipped with HWM A-202-type master-slave manipulators with one working post each, having the following characteristics:

- α-airtight boxes, removable for decontamination
- interconnection tubes between α-airtight boxes to transfer materials without need of removing them from the shielded system
- double La Calhéne-type α-airtight doors, ϕn 270 mm and ϕn 105 mm, with their respective access doors in cell II
- mobile wall with 200 mm shield thickness at the rear of the shield (restricted hall)
- absolute filter boxes for the first injection stage and activated-coal filters for a third I and II cell removal filtering stage.

Applied research tasks can be carried out in these cells. Several tasks are foreseen: cutting of the cladding of irradiated FE with a certain degree of burnup, sample-taking, analysis of density, stoichiometry and gases in pores, dissolution for radiochemical and mass spectrometry determinations, preparation and sample-taking for analysis in the analytical laboratory.

- **Analytical Chemistry Laboratory**: equipped with 3 α-airtight glove boxes with glove compartments and replaceable neoprene gloves aimed at preparing and immobilizing samples for metallographic studies, and apt to continue the analytical cell line technique, such as chromatography, ion exchange, removal with solvents and preparation of samples for the mass spectrometer.

- **Hot Cells Facility (CELCA):** comprising two γ cells and two αβγ airtight cells (Fig. V and VI), with the following characteristics:

- 200 mm thick lead shield
- HWM A-100-type master-slave manipulators with nine working posts

γ cells:

- Volume: 37.8 m^3
- Surface: 12.2 m^2
- Viewing: 5 leaded viewing glasses, 400 mm x 700 mm, with shield thickness equivalent to 200 mm of lead
- 5 working posts

Fig. V – Operation Area

Fig. VI – Restricted Area

Equipped to carry out traction, resilience (Charpy), creep and fractomechanic tests with the following tooling:

- MTS unit: Material Test System 800 for traction tests
- Environmental traction chamber
- Micrometer adapted for use with master-slave manipulators
- High-precision digital coordinate table with external reading
- Impact pendulum, 300 joule capacity
- Combined test-tube heater-cooler device with shuttle

Both αβγ airtight cells are classified as follows:
Non-Destructive Test box and Metallographic box (destructive test cell). They each have the following characteristics:

- Volume: 7.9 m^3
- Surface: 4.65 m^2
- 2 leaded viewing glasses, 400 mm x 700 mm, with shield thickness equivalent to 200 mm of lead
- 2 working posts each

They are equipped as follows:

Non-destructive test box:
- Visual inspection
- Metrology equipment
- Induced current test unit
- Gamma spectrometry unit
- Multiple-purpose robot to carry out scheduled tests with different instrumentation

Destructive test cell:
- Equipment for rod punching and fission gas removal
- Equipment for sample preparation for microscopic analysis

- Equipment to carry out the following tasks:
  - Rod cutting
  - Sample inclusion
  - Grinding
  - Mechanical polishing
  - Chemical polishing
  - Chemical attack
  - Sample washing
  - Drying
  - Measurement of pellet fragment density

Fig. VII

- **One Metallographic Microscope Cell** (Fig. VII), located in the Hot Cell line after the Non-Destructive Test cell, with 200 mm thick lead shielding, α-airtight, with removable airtight box, double airtight door system and mobile shielded wall that allows the removal of the microscope stage for its repair and conditioning for different tasks, equipped with an optical microscope, model MM5-RT Leitz, used in the preparation and study of metallographic samples.

This cell has two working posts and a HWM A – 202-type master-slave manipulator. It is equipped with an α-airtight transfer tunnel that allows entering or sending elements to the αβγ and CELCA cell lines. Its characteristics are:

- Volume: 1.40 m^3
- Surface: 1.20 m^2
- 1 leaded viewing glass, 400 mm x 700 mm, with shield thickness equivalent to 200 mm of lead
- 1 leaded viewing glass, ϕn 230 mm, for shielding thickness equivalet to 200 mm of lead
- 1 HWM A –202-type master-slave manipulator
- 1 articulate remote tong
- 2 working posts

- **A dry storage installation** (Fig. VIII), designed for the interim storage of CANDU-type rods and MTR-type plates, as well as activated material samples such as channel pieces or materials from reactors, contained within special airtight vessels until they are analyzed or transported for further management.

Its characteristics are as follows:

- Concrete shielding thickness: 1 m
- 33 storage niches
- connection to the CELCA ventilation system

- front part with 250 mm thick lead shield

Hot αβγ cells as well as the metallographic microscope cell and the concrete hot cell have special shielded ports in their upper part to allow removal and transportation of the slave arms of the master-slave manipulators and other units by means of a container specially designed. This allows their decontamination and repairing in special units

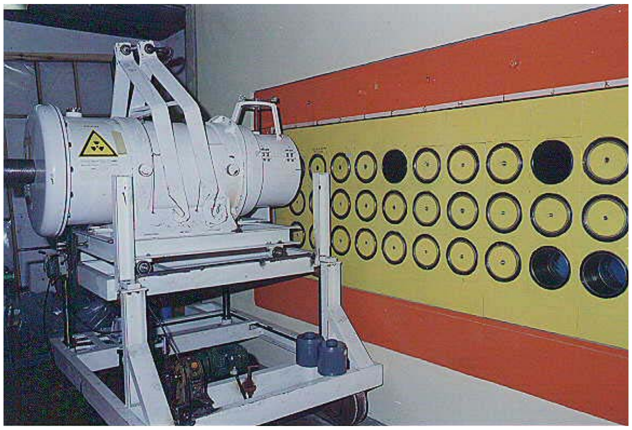

Fig. VIII