

RELOCATION OF A RESEARCH REACTOR

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Abstract

The research reactor RA-8 is placed in Pilcaniyeu Technological Centre (PTC) in the province of Rio Negro, approximately 70 km east from San Carlos de Bariloche city. The first time the reactor went critical was in June 1997 and it is out of operation since March 1999. Due to the intention to relocate the reactor in Bariloche Atomic Centre (BAC) a study has been done in order to assess the technical and economical feasibility. The scope of this study covers the disassembly and transport from PTC to BAC. Relocation of the reactor will reduce costs, time and difficulties in the transport of personnel (operators, researcher, and students) to Pilcaniyeu allowing the performance of nuclear research as well as academic application. The RA-8 is basically a critical facility of enriched uranium with light water as moderator. It is a pool type reactor with low thermal power, maximum 100 W and nominal 10 W. The principal assembly and the associated systems are placed in the reactor hall: consisting of a core, tanks, block, nuclear and conventional instrumentation, moderator system and the neutron source system. Also there is a control room with computers for monitoring together with the safety and control systems. The core is inside two stainless steel concentric tanks communicated with each other that contain water during the operation. The technical feasibility consists in: radiological characterization of the facility, visual inspection of the systems, structures and components, dismantling engineering, mass estimation for disassembly, packing, transport and storage. Economical feasibility has been done in order to evaluate time and costs necessities for the disassembly and transport from Pilcaniyeu to Bariloche. Regulatory aspects that must be fulfilled were considered in this study. Nothing detectable was found in water samples from pipes of the pumps' well. The systems, structures and components of the RA-8 present in general a good condition of preservation that would allow and justify its operation in another site. The inspected components presented no external degradation and those that were assayed worked correctly. Absence of contamination and activation facilitates to a great extent the disassembly of the reactor. The total mass was calculated in approximately 34 t that could be transported in 5 trips from PTC to the BAC. A minimum period of 9 months was estimated for the accomplishment of the project. Around a million U.S. dollar was the total cost evaluated for the disassembly and transports the RA-8 from PTC to BAC.

1. INTRODUCTION

The research reactor RA-8 is placed in Pilcaniyeu Technological Centre (PTC) (Fig.1) in the province of Rio Negro, approximately 70 km east from San Carlos de Bariloche city. The RA-8 (Fig. 2) is basically a critical facility of enriched uranium with light water as moderator. It is a pool type reactor with low thermal power, maximum 100 W and nominal 10 W. The principal assembly and the associated systems are placed in the reactor hall: consisting of a core, tanks, block, nuclear and conventional instrumentation, moderator system and the neutron source system. Also there is a control room with computers for monitoring together with the safety and control systems. The core is inside two stainless steel concentric tanks communicated with each other that contain water during the operation. The first time the reactor went critical was in June 1997 and it is out of operation since March 1999.



Fig. 1.

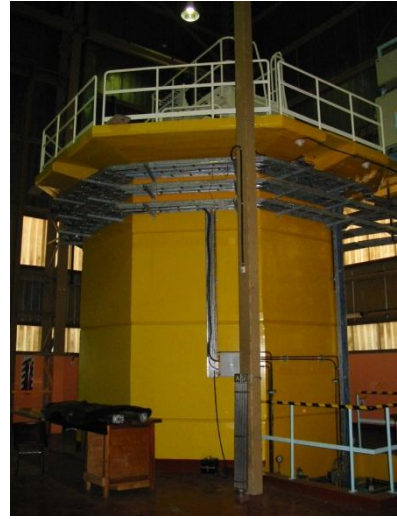


Fig. 2.

2. OBJECTIVE

The objective of the relocation is to reduce time, costs and difficulties in the transport of personnel (operators, researches, students) from Pilcaniyeu to Bariloche allowing the performance of nuclear research as well as academic application.

Therefore a technical and economical feasibility has been done for disassembly and transport from Pilcaniyeu to Bariloche [1].

The technical feasibility consists in: radiological characterization of the facility, visual inspection of the systems, structures and components, dismantling engineering, mass estimation for disassembly, packing, transport and storage.

Economical feasibility has been done in order to evaluate time and costs necessities for the disassembly and transport from Pilcaniyeu to Bariloche.

3. REGULATORY ISSUES

In order to relocate the RA-8 reactor CNEA will have to:

- Compliance with all regulatory requirements;
- Modify the operating license;
- Transport the fuel elements and neutron source to BAC;
- Prepare and perform a radiological characterization plan;
- Prepare and perform a radiological protection plan;
- Disassembly the control room desk and cables;
- Address any issues.

4. TECHNICAL FEASIBILITY

4.1 Radiological characterization of the facility

After the retirement of the fuel elements, in order to relocate the reactor, a characterization plan must be done before any other activity.

This plan has to contain:

- Quantity and type of radionuclides;
- Distribution of contaminants in the areas;
- Physical and chemical state of contaminants;
- Decontamination plan.

This activity is a Regulatory requirement for the reactor disassembly.

During inspection nothing detectable was found in water samples from pipes of the pumps' well.

4.2 Visual inspection of systems, structures and components (SSCs)

During visual inspections in 2009 and 2010 in the facility SSCs present in general good condition of preservation (Fig. 3) that would allow and justify its operation in another site.

No external degradation was observed in materials like cables, pipes, and that components (valves, pumps, etc) that were assayed worked correctly. (Fig.4)

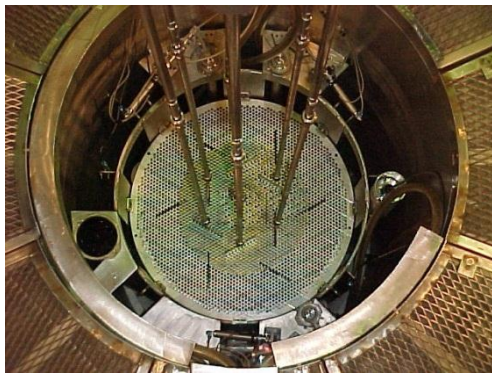


Fig. 3. Reactor core.



Fig. 4. Pump 's well.

4.3 Disassembly plan (DP)

DP consist in the preparation of supporting documents like working plan, mechanical and electrical/electronic disassembly procedures, work instructions, quality assurance plan, etc.

A detailed description of systems, structures and components has to be done.

Other points are:

- Staff and manpower requirements;
- Heavy equipment and small tools purchase;
- Facility and site preparations;
- Identify modifications to the SSCs necessary for disassembly;
- Proposed disassembly activities and schedule (no demolition);
- Waste management plan;
- Use of contractors;
- Facility release and reporting.

DP should be consistent with regulatory requirements and is the key document needed.

4.4 Inventory of SSCs for disassembly and transport

After inspections and with mechanical, electrical and construction drawings the total mass to be disassembly was calculated [1].

RA-8	Mass (kg)
Cables (10 km)	4000
Pipes and valves	500
Bridge crane and structures	7600
Electrical switchboards and racks	6000
Control room equipment	600
Cable trays	3500
Heaters and pipes	600
Compressor, pumps and electrical engines	600
Reactor vessel	4500
Reactor internals components	1200
Neutron source	300
Control rods and mechanisms	1400
Monorail	700
Water tanks	300
Structures and platforms	1100
Others	1000
TOTAL	~ 34000

4.5 Packaging

The most important task is the preparation of all the documents and the right identification for the reassemble in particular the electrical connexions (approximately 23000 electrical ends).

Appropriates containers with estimated sizes has to be rent to avoid damage during transport.

The packaging must be done in clean environmental conditions.

4.6 Transport

For the land transport a route/road plan must be done prior the first trip. All the permits, from the local authorities, have to be obtained before transport. The climate factor is very important, special in winter, and we have to take it in account.

We estimated five trips from PTC to BAC and must be in accordance with regulatory transportation requirements.

4.7 Storage

For storage and conservation will be necessary a indoor area of 160 m² with a height bigger than 8 m. Appropriated environmental conditions inside the building will be required.

5. ECONOMICAL FEASIBILITY

5.1 Time estimation

A minimum period of 9 months was estimated for disassembly, packaging and transport the systems, structures and components and transport it from PTC to BAC [1]. Approximately 20.000 man hours will be necessary for this work. Important factor that affect the time are: distance, dirt road and the winter.

5.2 Cost estimation

Around a million U.S. dollar was the total cost evaluated for disassembly, packaging and transports the RA-8 from PTC to BAC [1]. Different private companies were consulted in this matter.

The major factors that affect costs are: planning and documentation, man power, tools and equipments purchase, packaging, containers, transport, contractors and insurances.

Relocation costs depend on the complexity of the facility, its physical and radiological inventory, transport, distance and local factors

6. CONCLUSIONS

- The SSCs present in general a good condition of preservation that would allow and justify its operation in another site;
- No external degradation was observed in inspected components, and those that were essayed worked correctly;
- Absence of contamination and/or activation facilitates the disassembly and transport of the reactor;
- The total mass was calculated in approximately 34 t that could be transported in 5 trips from PTC to the BAC;
- A minimum period of 9 months was estimated for the accomplishment of the project;
- Around a million U.S. dollar was the total cost estimated for disassembly and transports the RA-8 from PTC to BAC.

REFERENCES

- [1] FABBRI, S., et al., “RA-8 Relocation: Technical Feasibility for Disassembly and Transport from Pilcaniyeu Technological Centre to Bariloche Atomic Centre” IN-EN-GV/RRA8-20, Buenos Aires, (2010).