

RESEARCH REACTOR DECOMMISSIONING PLAN

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Ministério da
Ciência e Tecnologia



Contents

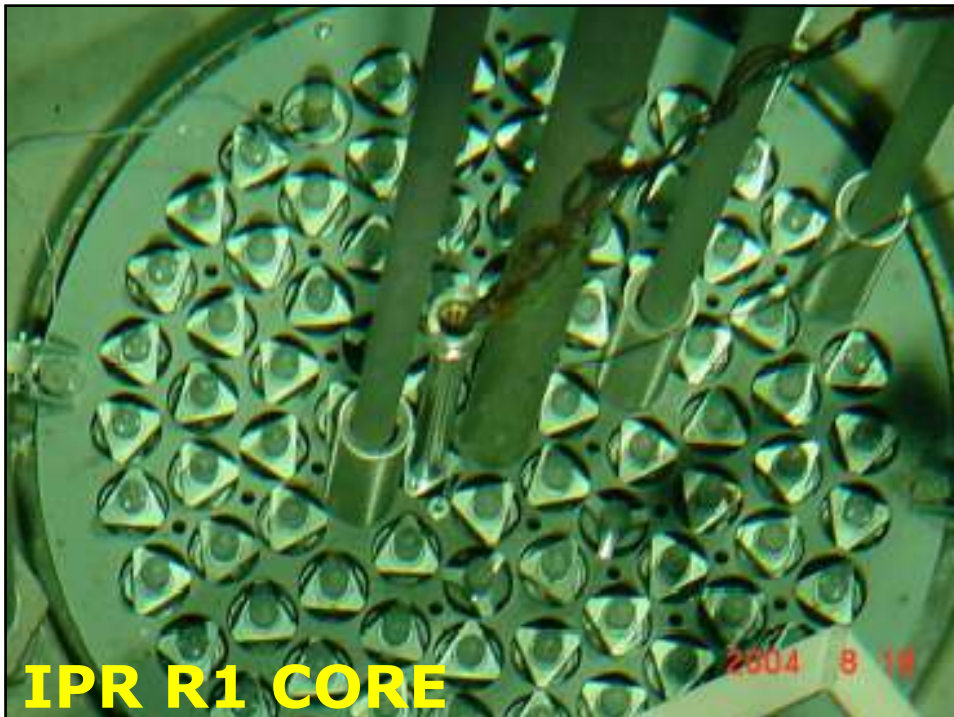


- General Aspects
- Ongoing Activities
- Decommissioning Plan
- Conclusion

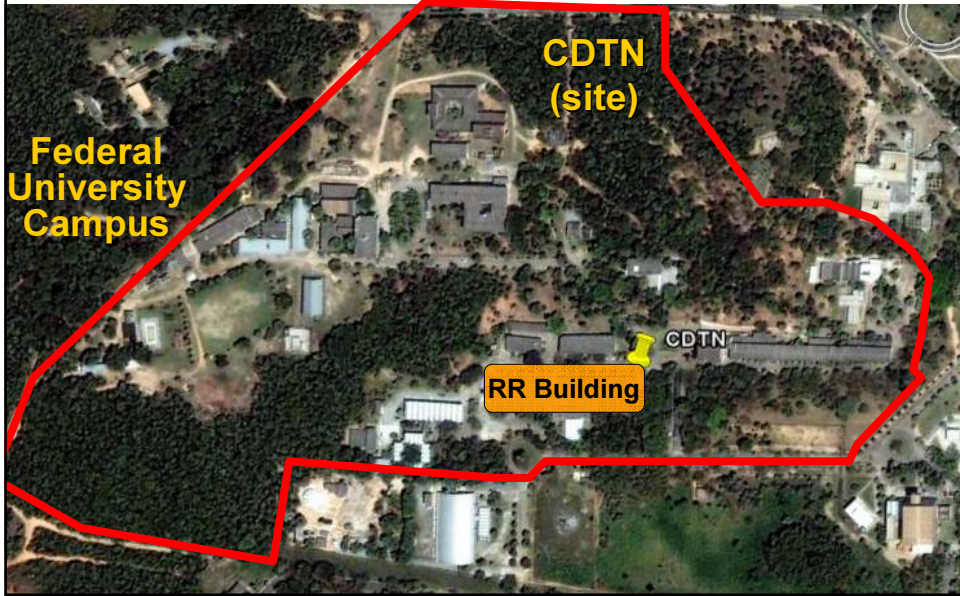
TRIGA IPR-R1 REACTOR

- Four research reactors are operated by the federal research institutes.

<i>FACILITY</i>	<i>POWER (kW)</i>	<i>TYPE</i>	<i>STATUS</i>
ARGONAUTA	0.20	ARGONAUTA	Oper.
IEA-R1	5,000.00	POOL	Oper.
IPEN-MB 01	0.10	ZPR TANK	Oper.
IPR-R1	250	TRIGA-Mark I	Oper.



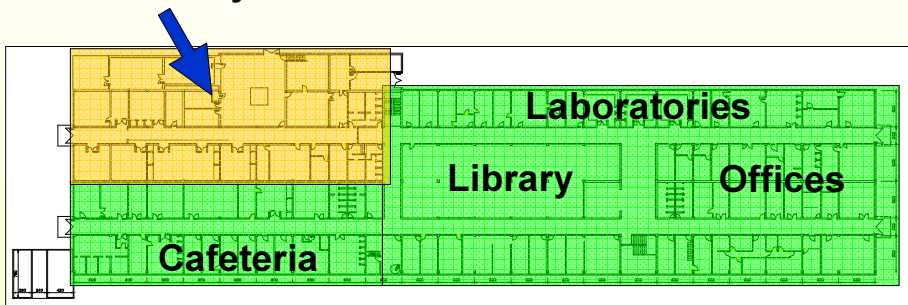
Reactor Location



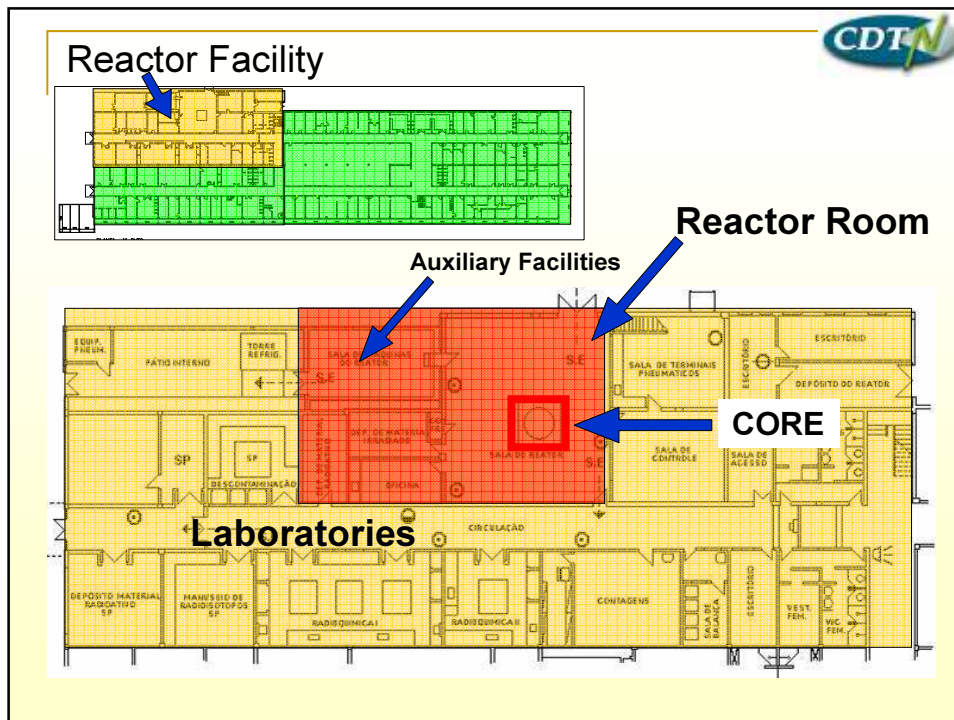
Reactor Building



Reactor Facility



- Restricted Area
- Unrestricted Area



Decommissioning options (Priority)

- 1) Protective storage in an intact condition after removal of all fuel assemblies and readily removable radioactive components and wastes (**safe enclosure**);
- 2) Removal of all radioactive materials and thorough decontamination of the remaining structures to permit unrestricted use (**immediate dismantling**);



End State of Decommissioning Activities

- The main option is ***use the area for nuclear proposes*** since this reactor area is at ***CDTN's site***, and there are often ***demands for new nuclear facilities***.
 - (as a historical museum of a TRIGA technology)
- After some decades the final goal will be the ***unrestricted use*** of the place, ***after the full decontamination***.



End State of Decommissioning Activities

- A good solution was adopted by FZK – *Forschungszentrum Karlsruhe*. The ***FR2 reactor was decommissioned*** and the ***auxiliary installation and rooms*** were ***completely decontaminated***, so that the area is now a ***museum of nuclear science*** [TREN/05/NUCL/S07.55436, 2007].

End State of Decommissioning Activities



Brazilian ongoing activities

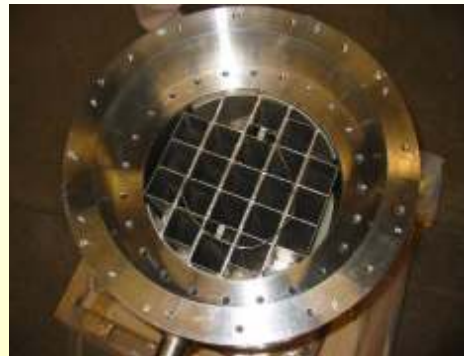
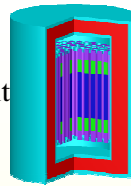
- Disassembly procedures and equipments
 - review and updating
- Spent fuel safe storage/transport package (cask in development / dry storage)
 - IAEA regional project
 - prototype performance tests
 - correction of the non-conformities

Latin American Cask



Prototype – external view

Numerical Assessment
Project Parameters



Prototype – internal view

2 basket types (78 TRIGA or 21 MTR elements) USD\$ 60,000.00

IPR-R1 Lifetime Estimation



■ Codes:

- **MCNP transport;**
- **ORIGEN 2.1 burn-up;**
- **MONTEBURNS radioactive decay.**

■ Parameters for numerical simulations:

- 68 fuel elements inserted on TRIGA core (note: there are 5 fresh stainless-steel elements that have never been used);
- operation at 250 kW (conservative hypothesis);
- average work demand based on the past 48 operation years,

IPR-R1 Lifetime Estimation



Actual Status:

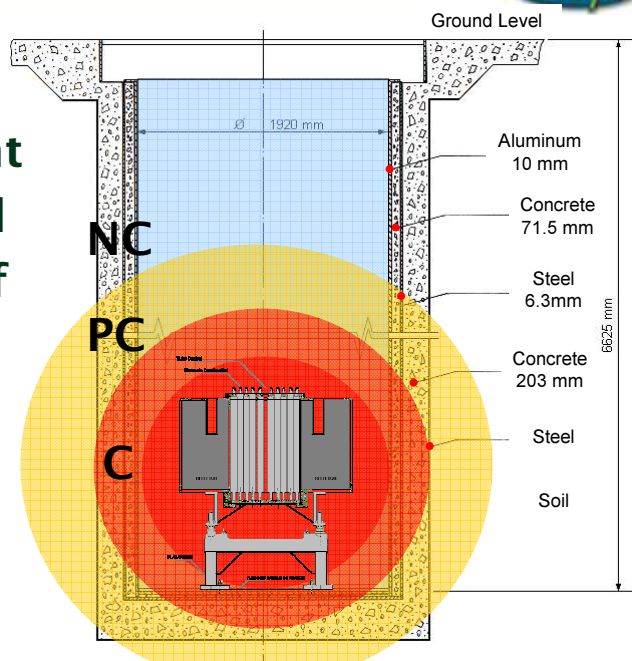
- reduction of 96 g of ^{235}U mass, regarding to initial mass of 2.3 kg;
- a total burn-up near to 4.17% or 2000 MWh until June 2008.

Results of Lifetime estimation:

- The estimated lifetime for the IPR-R1 is of more **34 years** with a **total burn-up of 3500 MWh**.
- The final burn-up of 12.1 % (mean of 68 elements) were observed, indicating a reduction of 307 g of ^{235}U mass.
- The total burn-up of the *central elements* would be *less than 20%* (as recommend by the manufacturer).

Assessment of type and amounts of RadWaste

Buried Reactor Pool





Assessment of type and amounts of RadWaste

- This simulation will give the first approach for the characterization plan:
 - grid map;
 - equipment;
 - sampling program;
 - radiation protection planning for this tasks.
- Waste management strategy
- Waste and cost minimization.



Brazilian ongoing activities

- Internal and National Standards
 - Joint Convention and decommissioning policy
- Waste management
 - Brazilian Nuclear Program
 - Budget PAC
 - Interministerial Committee
 - National Waste Management Program
 - WM Brazilian Agency
 - Repository for LLRW and ILRW
 - Repository for HLRW



DECOMMISSIONING PLAN

- **QA plan:** there are Quality Assurance Program and a Team that takes care of this subject. For the decommissioning activities will be developed specific procedures, including audits.
- **Radiation Protection, Health and Safety plan:** additional procedures will be developed for the surveillance, characterization, demolishing and decontamination activities, including radiological and non-radiological risks.
- **Characterization plan:** description of characterization (deepness of sampling, grid, number of samples, analysis, etc).
- **Decontamination plan:** radiological criteria for clearance level; decontamination; classification, recycling and reuse of the material.
- **Waste management plan:** segregation and collection procedures, processing options, packaging, storage and disposal routes for the radioactive waste.



TRIGA IPR-1 REACTOR
DECOMMISSIONING PLAN

(DRAFT)

Elaborated by the CDTN Decommissioning Group

September 2014

Decommissioning Plan Contents



1. INTRODUCTION
 2. OBJECTIVE
 3. TRIGA IPR-R1 DESCRIPTION
 - Historical
 - Properties and construction aspects
 - Lifetime estimation
 - Location and using area description
 - Drawings and maps
 4. DECOMMISSIONING STRATEGY AND END STATE
 5. RESPONSIBILITIES
-

Decommissioning Plan Contents



6. FINANCIAL ASPECTS
 7. QUALITY ASSURANCE PROGRAM
 8. RELATED DOCUMENTATION
 - Federal Standards
 - CNEN Standards and Procedures
 - CDTN Procedures
 - Environmental Standards
 - IAEA Recommendations
 - Other relevant documents
-

Decommissioning Plan Contents



9. CHARACTERIZATION PROGRAM

- Maps of the installation
 - Contamination Level Approach
 - Gridding for Sampling and number of samples to be taken
 - Clearance Values
 - Analysis and Results (Standard Values)
 - Destiny of the samples (release or stored as witness)
 - Classification of the material as non-radioactive or radioactive waste, recyclable, reusable material
-

Decommissioning Plan Contents



10. TEAMS AND ACTIVITIES (FLOWSHEET)

- Reactor Operation
 - Health & Safety
 - Radiological Protection
 - Waste Management
 - Infra-structure & General Maintenance
 - Administrative and Financial
 - Legal
 - Environmental
 - Risk, Burn-up and Waste Approach Assessment
 - Audit and QA
 - Communication
-

Decommissioning Plan Contents



11. EQUIPMENT AND INSTRUMENT
 12. ROUTES
 - Personnel
 - Wastes
 - Other Materials
 13. EMERGENCY PLAN
 14. TIMETABLE
 15. CONCLUSION
 16. TABLE OF REVISION
 17. ANNEXES
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KNOWLEDGE DIFFUSION



- “IPR-R1 TRIGA Research Reactor Decommissioning: Preliminary Plan“.
 - International Congress in Santos, Brazil, in October 2007.
 - “IPR-R1 TRIGA Research Reactor Decommissioning Plan”
 - IRPA 12 – Buenos Aires, Argentina, October 2008
 - Regional Workshop in Decommissioning of Radioactive Facilities – October 2008.
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CONCLUSION

- The Brazilian regulatory body so far do **not have a decommissioning policy** established, but after some discussion this subject is being addressed.
- **IPR-R1 decommissioning planning will be a model** used to develop the national regulatory standards on this issue and applied to Brazilian RR and other nuclear facilities.
- The existent individual efforts are being integrated to establish a Decommissioning Group (matrix structure) to perform the decommissioning planning and activities.

THANKS
SALAMAT



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