

CHILEAN EXPERIENCE IN RECH-1 RESEARCH REACTOR IMPROVEMENT PROJECT

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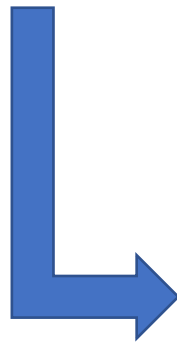
1. Chilean Nuclear Energy Commission overview
2. RECH-1 research reactor
3. Funding
4. Conclutions

Chilean Nuclear Energy Commission overview

- The Chilean Nuclear Energy Commission (CCHEN) is the technical body in matters related to peaceful applications of nuclear energy and ionizing radiation.
- CCHEN is a Government organization.

Mission

- Research, development and peaceful applications of nuclear energy.
- Transfer of technology and applications.
- Regulation, control and inspection of nuclear and relevant radioactive facilities.
- Technical and legal advisor to the Government, in nuclear matters.



To contribute to economical development of the country, to society prosperity and safety, and environmental protection.

Chilean Nuclear Energy Commission overview

- The Chilean Nuclear Energy Commission has three centers located in Santiago de Chile: (i) La Reina nuclear center, (ii) Lo Aguirre nuclear center and (iii) the administrative building. Both La Reina and Lo Aguirre are located far from downtown, but the administrative building is in downtown.

La Reina Nuclear Centre



1. Major equipment

- ✓ ***Nuclear Research Reactor, MTR Type, 5 MW***
- ✓ ***Cyclotron Cyclone 18/9***
- ✓ ***Experimental irradiators, ^{60}Co and ^{137}Cs***
- ✓ ***Speed fusion reactor 2 and plasma physics labs.***

2. Laboratories:

- ✓ ***Radioisotopes production laboratory***
- ✓ ***Radiomedicine***
- ✓ ***Environmental isotopes laboratory***
- ✓ ***Nuclear techniques in agriculture***
- ✓ ***Personnel dosimetry***

La Reina Nuclear Centre



2. *Laboratories:*

- ✓ *Clean laboratories for chemical metrology and tissue processing*
- ✓ *Neutron activation analysis*
- ✓ *Environmental radioactivity*
- ✓ *Metrology of ionizing radiation*
- ✓ *Radiological protection*
- ✓ *Physical characterization and electrochemistry*
- ✓ *RX diffractometry*

3. *Experimental facilities:*

- ✓ *Neutrography*
- ✓ *Neutron diffractometer*
- ✓ *Neutron scattering*
- ✓ *Neutron depth profiling*
- ✓ *Prompt gamma*

Lo Aguirre Nuclear Centre



1. Nuclear Research Reactor, 10 MW

2. Plants:

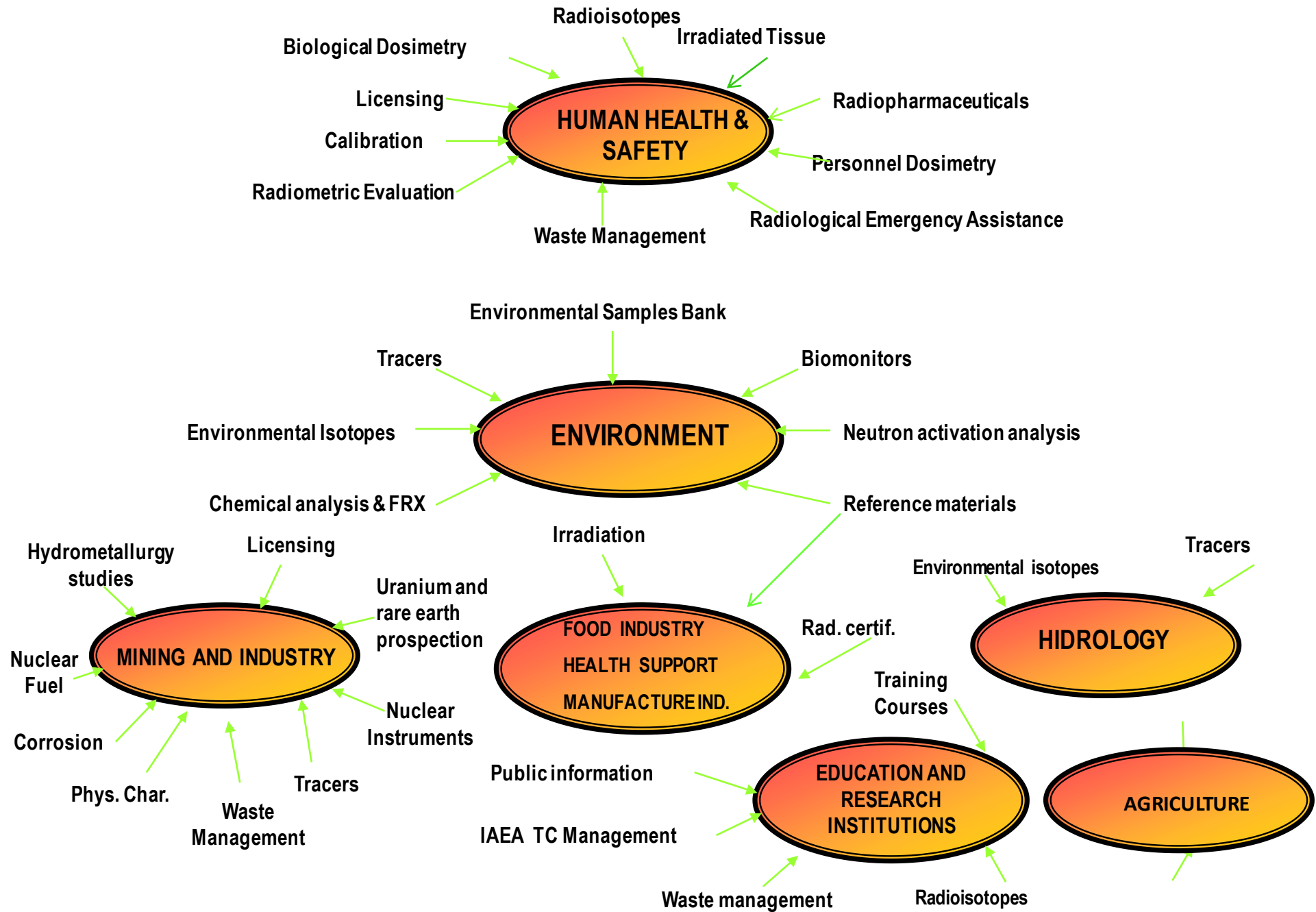
- ✓ ***MTR fuel fabrication***
- ✓ ***Multipurpose gamma irradiation***
- ✓ ***Waste conditioning and storage***

3. Laboratories:

- ✓ ***Conversion (UF₆ to U).***
- ✓ ***FRX and chemical analysis***
- ✓ ***Geology and mining***
- ✓ ***Radioisotope processing***

Chilean Nuclear Energy Commission overview

- Since the Chilean Nuclear Energy Commission is a public service, its major goal is to create public value, which means that with our activities we must benefit people.
- So, the challenge is to identify population needs that could be fulfilled with peaceful applications of nuclear energy and ionizing radiations.

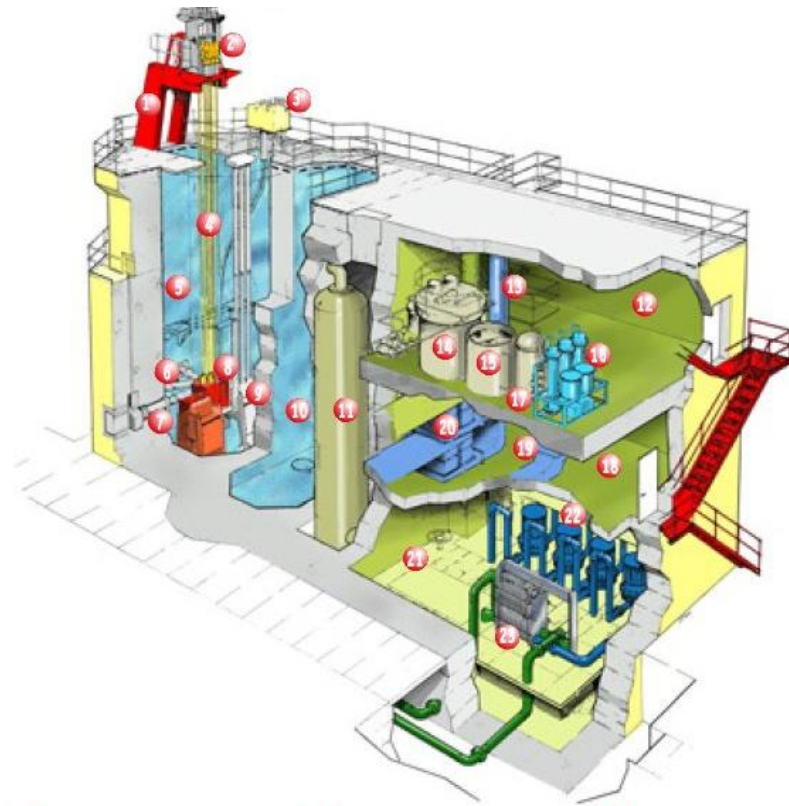


RECH-1 research reactor

- MTR research reactor open pool type
- Maximum thermal flux: 8×10^{13}
- First criticality: 1974 (46 years)
- Moderated and coolant by light water
- Reflector: Beryllium
- 32 – 33 fuel elements
- Operation cycle: 22 - 26 hours/week
- Main utilization: radioisotope production



RECH-1 research reactor



Principales componentes:

- 1.- Sistema secundario de refrigeración
- 2.- Sistema primario de refrigeración
- 3.- Sistema de placas de control
- 4.- Núcleo del reactor
- 5.- Tubos de haces de neutrones
- 6.- Sistema de ventilación
- 7.- Sala de filtros
- 8.- Planta de agua
- 9.- Sistema de protección física

- | | | |
|--------------------------------|-----------------------------------|------------------------------|
| 1 Plataforma Barras de Control | 9 Cámaras de Ionización | 17 Filtro a Presión |
| 2 Embragues Electromagnéticos | 10 Segunda Piscina | 18 Planta de Ventilación |
| 3 Celda de Plomo | 11 Estanque de Retardo | 19 Filtro de Carbón Activado |
| 4 Barras de Control | 12 Planta de Purificación de Agua | 20 Filtros Absolutos |
| 5 Piscina del Reactor | 13 Unidades de Intercambio Iónico | 21 Sala de Bombas |
| 6 Tubos de Haces Radiales | 14 Estanque de Asentamiento | 22 Bombas Centrífugas |
| 7 Tubos de Haces Tangenciales | 15 Estanque de Agua Filtrada | 23 Intercambiador de Calor |
| 8 Núcleo del Reactor | 16 Planta de Desionización | |

RECH-1 research reactor

- As it was mentioned before, the chilean research reactor RECH-1, started operation in 1974. Since then, it has been the driver of national development in essential fields such as: nuclear medicine, research and all peaceful applications of nuclear energy in Chile.
- Over time, the facility has experienced few minor modifications, having to date mainly the original systems, structures and components.

RECH-1 research reactor

1. Increased cost of maintenance program due to: (i) difficulty in obtaining spare parts and (ii) increase of frequency of maintenance activities.
2. Increase of non programmed maintenance activities.
3. While today's technology allows meeting all regulatory requirements, new technology allows to do more with less.

In conclusion... it's time to make a major upgrade!

RECH-1 research reactor

- Definition of requirements
 - 20-year projection of the use of the facility
 - Regulatory requirements
 - OMARR
 - IRURR
- Definition of the actual state of the installation
 - OMARR
 - IRURR
 - Technical studies of SSC's

RECH-1 research reactor

- Identification and prioritization of upgrades and/or updates
 - Radiological surveillance system, both environmental and personal
 - I&C system

Funding

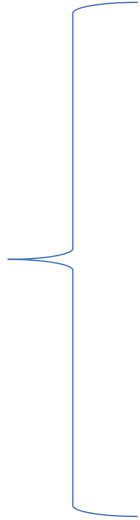
- According to the Chilean public system organization, if a public institution, such as CChEN, has an initiative for public investment, the institution has to submit a project to the Ministry of Social Development and Family for evaluation.
- However, this is not a traditional economical evaluation, but a social evaluation. The project must be relevant from its public value, not from the revenue perspective. In this case, concepts such as Net Present Value (NPV) and Internal Rate of Return (IRR), among others, will have the suffix “s” for social.

Phases

Stages

Evaluation

Preinvestment



Idea

Outline

Prefactibility

Factibility

Design



Ex-ante

Investment



Execution

Physical and finance follow
up

Operation



Operation

Ex-post

Funding

- Currently CChEN is in the pre-investment phase, complying with the following stages: (i) idea, (ii) outline and (iii) pre-feasibility, the feasibility and design stages are being worked on simultaneously.
- According to the planning, the project will be delivered for evaluation during the first semester of the year 2022, so the financing will be available during the year 2023.

Conclusions

- According to the Chilean public investment system, the State invests in a project that has a public value that will benefit a large part of the population, or that allows one or more sectors to be strengthened (medicine, education, agriculture, industry, etc.)
- With the kind support of the IAEA, the CChEN will be able to identify the necessary improvements to be made in: the facilities, the equipment and the management system, in addition to developing a positioning strategy, to increase the public value that until now has been delivered to the society.