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CHALLENGES OF SAFE AND SUSTAINABLE OPERATION OF THE IAN-R1 NUCLEAR REACTOR OF COLOMBIA

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ABSTRACT.

This study presents the management of the use and sustainability of Colombia's only IAN-R1 nuclear research reactor, initially a low-power Argonaut reactor installed in 1965 and later converted to a TRIGA reactor in 1998. It also shows significant upgrades over the past 60 years to extend its useful life and improve its use through applications. It highlights the challenges to co-existence and sustainability in a country lacking specific nuclear culture and legislation. It disseminates Colombia's commitment to a nuclear research reactor dedicated to providing services to different branches of geology and improving the environment, maintaining sufficient trained personnel for the facility's licensing, and fostering a culture of disseminating nuclear technology in Colombia for citizens, industry, and academics. It serves as a national standard in nuclear applications and secures the resources to keep the nuclear facility safe, operational, and licensed.

Keywords: TRIGA, IAN-R1, Nuclear research reactor, sustainable operation.

INTRODUCTION

The IAN-R1 Nuclear Research Reactor Argonaut type was build through the American program "Atoms for peace" by Lookeed in 1965.
Its core was formed by 16 fuel elements MTR type (^{235}U), with an enrichment of 90 % , and distributed in a 4x4 array. Its initial power was 10 kW and was putted critic for first time in 1965. Later the power was upgraded to 30 kW.
In 1997 the reactor was modificated by General Atomics, the fuel elements were replaced by TRIGA type, with an enrichment of 19.75 %, I&C, heat interchanger, controls rods system also was replaced, GA tried to upgrade the reactor to 100kW but the shield was not enough so the reactor power was conserved at 30 kW. In 2012 the console control was replaced new digital design

Actual use of the IAN-R1: Analysis of Geological Samples by:
Fission Tracks-Thermo chronology.
Instrumental Neutron Activation Analysis
Delayed neutrons analysis.
. Geological, environmental and forensic multi-elemental samples determination

Potential applications to develop:

- ENAA. LSNAA.
  Neutron diffraction Radioisotopes production (^{82}Br, ^{32}P, ^{198}Au)
  Dating Ar-Ar

- **Training and research:**
  - Nuclear Physics. Operation of Nuclear Reactors.

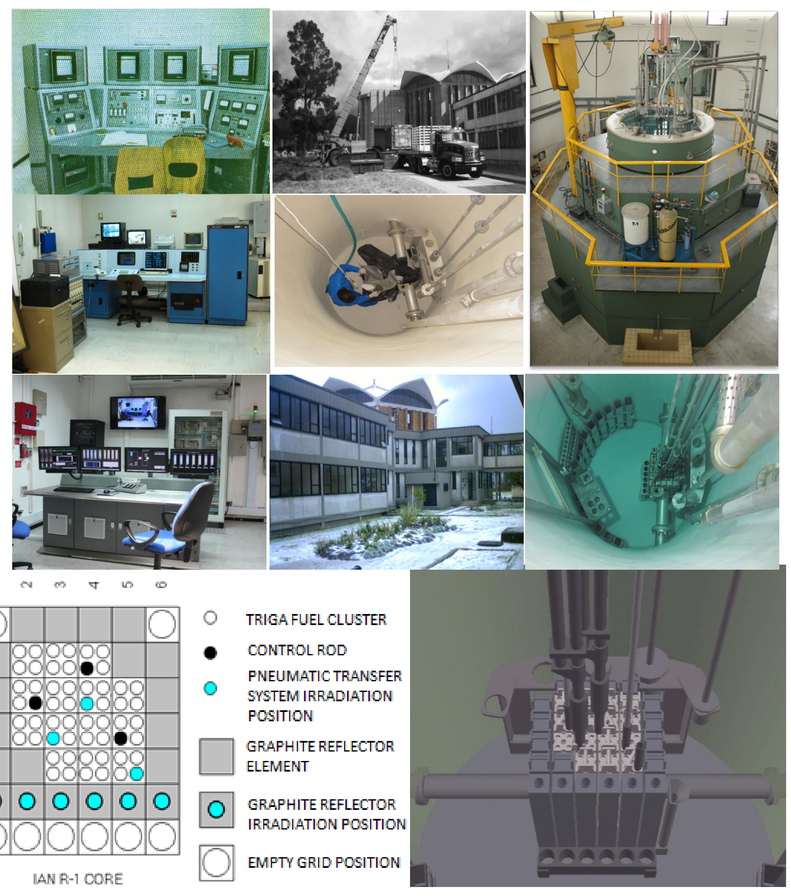

Figure 1 Diagram of the IAN-R1 reactor core

METHODOLOGY

Establish the administrative measures, conditions, and requirements related to the organizational structure, the provision of irradiation services, the cross-cutting processes, and the continuous improvement necessary to ensure that the operation of the IAN-R1 nuclear reactor is carried out under the guidelines of the Institutional Management System of the Colombian Geological Service, promoting a safety culture and complying with the operating conditions and specific safety requirements established by the Regulatory Body.

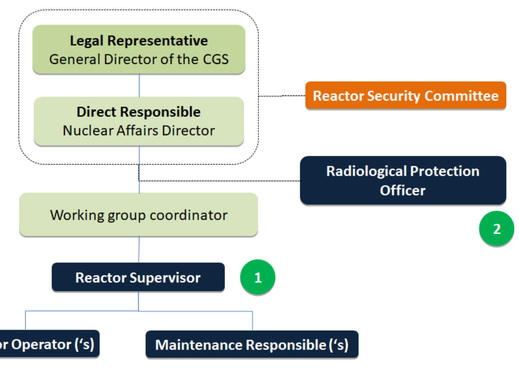

Figure 2. Structure Nuclear Research reactor

Research at the reactor is part of the Colombian government's policies and the geological survey strategic plan.

Promote and advance research in the field of nuclear and radioactive applications; characterize geological materials using nuclear techniques; irradiate materials; safely process radioactive waste; and apply radiation metrology through the application of nuclear technologies, in order to contribute to geological knowledge and to the users of radioactive materials and nuclear technology.

ANALYSIS AND RESULTS

The Colombian Geological Survey has a technical program for the use of the IAN-R1 Nuclear Reactor, which includes the following activities:

1. Irradiate geological, environmental and forensic samples for neutron activation analysis (NAA), fission track geochronology, and delayed neutron analysis (DN).
2. Provide personnel training.

The irradiation of samples considers operating the IAN-R1 Research Nuclear Reactor with a power of 30 kW for 8 hours a day, 4 days a week, during the 52 weeks of the year, one day of each week is considered to carry out maintenance work.

Within the process-based approach established within the Colombian Geological Survey, the RNI IAN-R1 belongs to the mission process of Nuclear and Radioactive Research and Applications, and therefore, within its operation, assumes the controls and provisions for the characterization of said process, as shown in Figure 3.

Figure 3. Nuclear Research reactor chain value

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CONCLUSIONS

The IAN-R1 reactor contributes to the institutional mission by irradiating geological samples for elemental determination using the Neutron Activation Analysis (NAA) technique. It can also be used to date samples using fission traces and has the potential to produce radioisotopes useful in key areas such as hydrology, agriculture, and industrial processes. To achieve this, it is necessary to extend the useful life of the facilities with the required safety margins, optimizing the reactor's capabilities and expanding its impact on the scientific community and strategic sectors of the country. In this regard, the project seeks to strengthen collaboration with various stakeholders, such as Nuclear Research and Applications and Geochronology, with the goal of enhancing analytical techniques that require irradiation processes in the reactor. Likewise, integration with research groups focused on environmental studies, hydrology, and other areas that can benefit from the use of nuclear techniques is proposed.