

## **DEVELOPMENT AND APPLICATION OF INDICATORS FOR THE ASSESSMENT OF RADIATION SAFETY SYSTEMS IN RADIOPHARMACEUTICALS PRODUCTION FACILITIES WITH CYCLOTRON**

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Radiopharmaceuticals production facilities with cyclotron have to implement radiation safety systems in order to control and mitigate not only external exposure risks due to gamma and neutron fields generated during the cyclotron operation and the radioisotope production, but also internal exposure and surface contamination that may occur while working with unsealed sources.

Safety systems have to be prioritized in the features planned in the design of the facility and can be complemented with operational procedures with the purpose of ensuring the protection of workers, the public and the environment.

The design of these systems depend on the type of facility; the equipment, for example, whether the cyclotron is self-shielded or not; and the production processes that are carried out, among others. In addition, normal operational situations as well as incidents and accidents need to be considered.

The “Class I Particle Accelerators Control Department” of the Nuclear Regulatory Authority detected the need of a tool that helps perform safety assessments, particularly for the evaluation of safety systems implementation at the facilities under regulatory control and for monitoring the application of radiation safety standards in facilities that are currently operating.

For its development, it was used as a reference the document “Criterios para el licenciamiento y requisitos de inspección en instalaciones con ciclotrones para producción de radioisótopos utilizados en aplicaciones e investigaciones médicas” (2013) from Foro Iberoamericano de Organismos Reguladores Radiológicos y Nucleares as, considering the guidelines presented there for interlocks, alarms, manual safety systems, plans and records. This document was chosen because it was considered the most representative of the state of the art concerning radiation safety in this type of facilities when the tool was developed.

Afterwards, the conditions at cyclotron facilities in operation stage from Argentina were analyzed and indicators were developed by the “Class I Particle Accelerators Control Department”. These indicators are intended to measure the level of adequacy of each facility compared to what is recommended in the referenced document. The indicators were collected and presented in an organized way using a spreadsheet and graphics which makes easier its display and allows its interpretation depending on different criteria such as the type of safety system or type of facility.

Finally, the follow up of these indicators was done from 2018 to 2021 and a tendency to improvement was detected as a consequence of the update of procedures and also due to the implementation of new safety systems. Moreover, through this tool, the Nuclear Regulatory Authority could monitor indirectly the success of the regulatory functions in the increase of the level of intrinsic safety at cyclotron facilities.

**REFERENCES**

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- [5] IAEA, TRS N°471 – “Cyclotron produced radionuclides: Guidelines for setting up a facility”