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Automated Irradiation System for the Production of Gaseous Radioisotopes in a Research Nuclear Reactor

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Some gaseous radioisotopes are produced to meet requests from companies specialized in using them as radiotracers, for quantitative and qualitative assessments of industrial plants, such as leak detection in heat exchangers and underground transport pipes. Among the gaseous radioisotopes for this purpose, ^{41}Ar and ^{79}Kr stand out, as they have a number of relevant physical and chemical properties and the production of these radioisotopes in research nuclear reactors takes place by subjecting the natural isotopes (^{40}Ar and ^{78}Kr) to a neutron flux, so that the atoms in the gas undergo the nuclear reaction (n,γ) and become radioactive. At the IEA-R1 Research Reactor, production takes place using an Irradiation System developed at the Radiation Technology Center for this purpose. The aim of this study was to automate and modernize this system for remote operation, following the ALARA (As Low As Reasonably Achievable) principle, by automating its components, the Programmable Logic Controller (PLC), installing solenoid and pneumatic valves, a pressure transmitter, mechanical adaptations and developing its own supervisory software. Subsequently, leak tests were carried out, the new operating procedure (without radioactive material) was tested and, finally, after approval by the Reactor's Internal Safety Committee, an irradiation was carried out to obtain an estimated Activity of 960 mCi (^{41}Ar) and verify radiological safety for future irradiations reaching higher Activities. After the tests and initial irradiation, it is concluded that the automated system is suitable for use in the production of the gaseous radioisotopes ^{41}Ar and ^{79}Kr , providing greater radiological safety for its operators.