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MINIMISATION OF NOBLE GAS DISCHARGE FROM ^{99}Mo PRODUCTION AT ANSTO

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Molybdenum-99 is one of the most important radionuclides in modern medicine. When loaded on a chromatographic column it forms a generator that produces high specific activity ^{99m}Tc, a radionuclide widely used in nuclear medical imaging. ANSTO has been a main producer of ^{99}Mo in the Australasian region since the late 1960's and currently ranks as one of the major suppliers of ^{99m}Tc/^{99}Mo generators.

At ANSTO ^{99}Mo is produced from enriched uranium oxide (2.2% ^{235}U) after a nominal seven day irradiation period in HIFAR, Australia's high flux research reactor. Between four and six targets are processed, four to five times each week depending on the reactor operation timetable. After irradiation the targets are allowed to decay for approximately 6 hours before the uranium dioxide pellets are removed and dissolved in a fully enclosed heated vessel equipped with a reflux column. The dissolver off-gas containing noble gases and iodine isotopes released during this process are vented through a caustic scrubber, a number of iodine traps and finally through a charcoal based Noble Gas Trap (NGT). The uranium solution is passed through an alumina column to separate molybdenum from other elements. The ^{99}Mo product is eluted from the column with relatively concentrated ammonium hydroxide solution. The product recovery process consists of a volume reduction procedure followed by a recovery step designed to retrieve the product in a minimum volume of dilute nitric acid.

The radioactive Xe and Kr discharge was monitored using a NaI(Tl) detector based gamma-ray spectrometer system that was interfaced to the internal computer network. The data was collected and sent to the network server at 15-minute intervals using locally written programs that process and database the information. The discharge data is displayed in real time by the use of web browsers found on all networked workstations. The network program is also capable of interrogating the database so that the data could be graphically displayed or retrieved in a spreadsheet format in any combination of time intervals. This option allowed comparison of discharge patterns between process runs and reactor periods as well as yesterday-today comparison to be performed on-line.

The use of this software has enabled us to quantify the discharges and identify the process steps that were responsible. This information was used to modify the process, which resulted in a significant reduction in radioactive Xe discharge. These modifications reduced the discharge of short-lived Xe isotopes (^{135}Xe and ^{135m}Xe) by approximately 90% and the longer-lived ^{133}Xe discharge by 85%.

As the result of this investigation an inventory of all radwaste generated during the separation process was produced. This study enables current and future processing options to be accessed from the viewpoint of waste minimisation and cleaner production.