Minimisation of Noble Gas Discharge From ^{99}Mo Production at ANSTO Assisted by Network Based Real-Time Monitoring System

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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, is vented through a caustic scrubber, a number of iodine traps and finally through a charcoal based Noble Gas Trap (NGT). After the pure ^{99}Mo is eluted 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 is monitored using a NaI(Tl) detector based gamma-ray spectrometer system that is interfaced to the internal computer network. A network server collects the data at 15-minute intervals using locally written software that processes and stores the information. The discharge data is displayed in real time using a web browser on a networked workstation. The real-time collection of data permits an immediate notification of readings above defined levels.

By accumulating the data on a daily and weekly basis, reports are generated using e-mail to specific groups. Equipment malfunctions are detected and reported by e-mail. A restart facility is also included to ensure that a recovery can be performed in the event of any malfunctions –with the network server system involved in data collection and transfer.

The web browser used to review historical data provides the ability to interrogate the database to provide the data graphically or in a spreadsheet format for any contiguous time intervals. The discharge patterns between process runs and reactor periods can be compared as well as yesterday-today comparison 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 assessed from the viewpoint of waste minimisation and cleaner production.