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Monitoring and dose assessment of liquid waste sources

The amount of liquid radioactive waste produced and stored around the world is increasing. As such, the development and implementation of waste treatment options are progressively becoming essential requirements for the approval and acceptance of future nuclear facilities built around the world. Liquid waste typically presents as a mixture with complex physical, chemical, and radiological properties. Dose assessments, though challenging to develop, are essential in order to facilitate waste characterisation programmes, and for the design, development, and operation of waste treatment technologies. In addition, freshly produced wastes typically have high concentrations of radioisotopes (such as fission and activation products), and associated dose rates, which makes such material difficult to access for a direct dose measurement. In such case, theoretical dose assessments become an essential tool in the development program to characterise nuclear waste.

ANSTO Synroc have been developing Synroc waste treatment technologies for over 30 years and have built substantial expertise in radioactive waste characterisation, including dose assessments and monitoring. In this paper the approach that is used by ANSTO Synroc to conduct dose rate assessments and monitoring of liquid waste sources will be discussed. The focus of the presentation will be the Intermediate Level Liquid Waste (ILLW) by-product from ANSTO's Mo-99 radiopharmaceutical production. This waste stream will be treated at ANSTO using its own proprietary Synroc technology to produce a wasteform suitable for geological disposal. In order to develop a design basis for the Synroc facility to operate safely, dose assessments are required for all stages of the treatment process, including waste sampling and characterisation, Synroc processing, transport, and storage of the final wasteform. Initial assessment of a neat ILLW sample is performed based upon available theoretical data and allows to establish risk acceptance criteria for the skin dose and inhalation during unsealed liquid handling. This information is used to facilitate further sampling and direct dose measurement, as well as chemical and radiological waste characterisation. Real measurements are used to verify that the doses are within the accepted design basis. Once properties of the waste are established, controls can be developed to minimise planned and emergency exposure for all stages of the Synroc process. Since the ILLW contains numerous fission and activation products of high specific activity, decaying the waste in an appropriate manner is also an important design and operational safety decision to minimise beta dose and this will be addressed in this paper.

Name of Member State/Organization

ANSTO, Australia

Speakers affiliation

ANSTO

Speakers email

peristya@ansto.gov.au

Authors: PERISTYY, Anton (ANSTO); GRIFFITHS, Grant (ANSTO); GREGG, Daniel (ANSTO); HOLMES, Rohan (ANSTO); TRIANI, Gerry (ANSTO)

Presenter: PERISTYY, Anton (ANSTO)

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