Report on Neutron Metrology at the National Research Council Canada
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1. Introduction

The Ionizing Radiation Standards laboratory (IRS) at the National Research Council Canada (NRC) has a dedicated laboratory for neutron metrology. Over the past several years, ongoing efforts have been made to improve upon the extensive history of neutron physics at the NRC.

The main activities over the last two years have been maintaining and improving the neutron irradiation services, continuing to revive the primary standard for neutron emission rate and commissioning the recently purchased neutron generator.

1. Facilities

The neutron laboratory at the NRC is a unique facility ideally suited to the measurement of low-intensity neutron fields generated by neutron sources. A large 16 m × 16 m × 10 m room with a false floor permits calibration and irradiation services to be performed with minimal effects due to room scatter. Several fast neutron sources are available for experiments, including americium-beryllium (AmBe), americium-boron (AmB), plutonium-beryllium (PuBe), and radium-beryllium (RaBe). These are cylindrical in geometry, and roughly 2 cm in height and diameter.

As of March 2013, the NRC has a Thermo-Scientific P385 (D-T) neutron generator, purchased through funds granted by the Canadian Safety and Security Program of Defence R&D Canada’s Centre for Security Science. The generator will eventually be integrated into our calibration services as well as used for research and development for security-related projects.

2. Neutron Irradiation Services

Over the past few years, the number of neutron survey meter calibrations performed by IRS has remained steady between 15-20 per year for clients throughout Canada. In addition, an average of six independent tests of neutron dosimeters per year has been performed for clients in Canada as well as in the United States.

3. Neutron Emission Rate Primary Standard

The manganese sulfate bath technique was previously operational in the 1960’s at the NRC. Work is continuing to revive the standard. Since 2013, more of the original manganese sulfate has been dissolved, allowing for the bath to be completely filled. However, new manganese sulfate has been purchased and will be used once the full measurement cycle has been established and tested.
Monte Carlo models of the bath are being constructed using MCNP5 to estimate the values of the correction factors needed for the final neutron emission rate. The model will also be used to estimate the efficiency of the gamma detection and can be compared to the measurements from the standardized Mn-56 sample prepared by the radionuclide laboratory.

4. Commissioning of the Neutron Generator

A commissioning license for the neutron generator was granted by the Canadian Nuclear Safety Commission (CNSC) in June 2013. Since then, a series of preliminary measurements have been performed to characterize the neutron output. Dose measurements were made in workspaces surrounding the lab and were found to be well below CNSC safety limits for all generator operating values of current and high voltage.

The stability of the neutron output was tested for a series of beam currents and at a fixed high voltage of 90 kV. The currents tested ranged from (10-70) µA, in increments of 10 µA. The results indicate stability within the 2% statistical uncertainties.

The linearity of the neutron output was investigated as a function of beam current at a fixed high voltage of 90 kV. The neutron output was found to be linear in the operating range of (20-70) µA.
National Research Council Canada Activities, 2013-2015
CCRI(III), March 4-6, 2015

The following are the refereed publications and conference presentations involving members of the Ionizing Radiation Standards Group of the National Research Council Canada during the years 2013-2015.

1 Refereed publications, 2013-15


2 Conference presentations, 2013-15


[8] L. Matei, et. al., "A new approach for manufacturing and processing targets used to produce 99mTc with cyclotrons", proceedings for the International Workshop on Targetry and Target Chemistry, August 18-21, 2014, to be published in Radiochimica Acta


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