Fissile Mass Flow Monitor Source-Strength Calibration Using the ORNL Neutron Detector System

Taner Uckan, José March-Leuba, and Danny Powell

Oak Ridge National Laboratory
P. O. Box 2008, Oak Ridge, Tennessee 37831
email: uckant@ornl.gov, march-leubaja@ornl.gov, powelldh@ornl.gov

In this paper the neutron detector system (NDS) developed for the ^{252}Cf neutron source measurements of the fissile mass flow monitor (FMFM) will be presented. The FMFM measures the ^{235}U fissile mass flow of the UF_6 gas streams and uses ^{252}Cf neutron sources for the fission activation of the UF_6 gas. Three FMFMs are operational in Russian facilities for the U.S. Department of Energy Highly Enriched Uranium Transparency Program. The FMFM ^{252}Cf sources are replaced about every two years due to their relatively short half-life (~2.65 years); the sources are manufactured in Russia and are handled and installed by Russians. During the FMFM source replacement the new ^{252}Cf sources are calibrated with the previously installed sources (i.e., relative source measurements are made) to ensure proper and seamless FMFM performance. The NDS was developed for the FMFM ^{252}Cf relative source measurements. The NDS consists of a neutron detector (commercially available high-efficiency ^{3}He proportional counter) and the electronics, which are commercial NIM modules. During the measurements the ^{252}Cf source is placed into its FMFM source plug and is then inserted into a polyethylene source plug holder. For health and safety considerations, the source plug holder and the NIM that contains the electronics are separated by a 20-m-long cable. Thus, during the source replacement, the U.S. participant can observe the process at a distance while the NDS data are collected. The NDS measurement time is 10 s for each source, with a statistical uncertainty of less than 5%. The NDS measurement repeatability is good (< 1%), and is not sensitive (< 0.5%) to the orientation of the source plug inside the NDS poly source holder. A detailed description of the NDS, its performance characteristics, and results of measurements performed on the FMFM sources are presented and discussed.