Enhanced Algorithm for Traceability Measurements in UF_6 Flow Pipe

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The Blend Down Monitoring System (BDMS) is used to continually assess the mixing and downblending of highly enriched uranium (HEU) with low-enriched uranium (LEU). This is accomplished by measuring the enrichment and the fissile mass flow rate of the UF_6 gas located in each process pipe of the system by inducing the fission of the ^{235}U contained in the gas. Measurements are taken along this process route to trace the HEU content all the way to the product stream, ensuring that HEU was down blended.

A problem associated with the current traceability measuring algorithm is that it does not account for the time-varying background that is introduced to the system by the movement of the shutter located at the HEU leg of the process. The current way of dealing with that problem is to discard the data for periods when the HEU shutter is open (50% of overall data) because it correlates with the same timeframe in which the direct contribution to background from the HEU shutter was seen.

The advanced algorithm presented in this paper allows for continuous measurement of traceability (100%) by accurately accounting for the varying background during the shutter-movement cycle. This algorithm utilizes advanced processing techniques that identify and discriminate the different sources of background radiation, instead of grouping them into one background group for the whole measurement cycle. By using this additional information, the traceability measurement statistics can achieve a greater number of values, thus improving the overall usefulness of these measurements in the BDMS.

The effectiveness of the new algorithm was determined by modeling it in a simulation and ensuring that it retained its integrity through a large number of runs, including various shutter-failure conditions. Each run was performed with varying amounts of background radiation from each individual source and with varying traceability counts. The simulations documented in this paper prove that the algorithm can stand up to various transients introduced into the system, such as failure of shutter movement.

Biographical Sketch

Thomas E. Copinger is currently pursuing a M.S. in Nuclear Engineering under Dr. Belle Upadhyaya at the University of Tennessee, Knoxville (UTK). His degree will be in Instrumentation and Control of Nuclear Processes. He received a B.S. degree in Nuclear Engineering from UTK in 2006. He works part time at Oak Ridge National Laboratory under Dr. Jose March-Leuba with the Blend Down Monitoring System team. He has been a member of the American Nuclear Society since 2004 and served as the president of the student chapter at UTK from 2005–2006.