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C. F. Guenther, H. A. Elayat, W. J. O'Connell

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C. F. Guenther, H. A. Elayat, and W. J. O'Connell
Lawrence Livermore National Laboratory
7000 East Ave., Livermore, CA 94550-9234, USA (925) 424-2528

ABSTRACT:

Efforts have been under way at Lawrence Livermore National Laboratory (LLNL) to develop detailed analytical models that simulate enrichment and conversion facilities for the purpose of aiding in the detection of material diversion as part of an overall safeguards strategy. These models could be used to confirm proper accountability of the nuclear materials at facilities worldwide. Operation of an enrichment process for manufacturing commercial reactor fuel presents proliferation concerns including both diversion and the potential for further enrichment to make weapons grade material. While inspections of foreign reprocessing facilities by the International Atomic Energy Agency (IAEA) are meant to ensure that such diversion is not occurring, it must be verified that such diversion is not taking place through both examination of the facility and taking specific measurements such as the radiation fields outside of various process lines. Our current effort is developing algorithms that would be incorporated into the current process models that would provide both neutron and gamma radiation fields outside any process line for the purpose of to determining the most effective locations for placing in-plant monitoring equipment. These algorithms, while providing dose and spectral information, could also be designed to provide detector responses that could be physically measured at various points on the process line. Such information could be used to optimize detector locations in support of real-time on-site monitoring to determine the enrichment levels within a process stream. The results of parametric analyses to establish expected variations for several different process streams and configurations are presented. Based upon these results, the capability of a sodium iodide (NaI(Tl)), high-purity germanium (HPGe), or neutron detection system is being investigated from the standpoint of their viability in quantitatively measuring and discerning the enrichment and potential throughput variations thereof. The benefits and issues associated with both passive and active interrogation measurement techniques are also discussed.

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