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Development of Electromagnetic and Gaseous Centrifuge Technologies for the Enrichment of Stable Isotopes

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The Enriched Stable Isotope Production Facility (ESIPF) is being established at Oak Ridge National Laboratory (ORNL) by the US Department of Energy, Office of Nuclear Physics, to restart domestic production of enriched stable isotopes. This facility will help meet the enriched stable isotope needs of the medical, industrial, research, national security, and other scientific communities. The ESIPF development strategy is to modernize and improve two mature isotope separation technologies: Electromagnetic Isotope Separation (EMIS) and Gas Centrifuge Isotope Separation (GCIS). The ESIPF will use the high-throughput / low-enrichment GCIS technology to magnify the throughput of the low-throughput / high-enrichment EMIS technology to reach high enrichment for selected isotopes in less time than achievable with EMIS alone. In addition, the ESIPF isotope separators have been designed to support a wide range of elements rather than being highly optimized for a single isotope. The efficiency gained by combining these two enrichment technologies can be illustrated by a case study for enriching molybdenum 100 (100Mo; natural abundance 9.6%) and molybdenum-98 (98Mo; natural abundance 24%) to obtain approximately 50 g of each (100 g total) with an isotopic assay greater than 98%. Using a production-class EMIS device by itself is projected to require approximately 75% of that device's annual production capacity. Pre-enrichment of the natural Mo feedstock using a small GCIS cascade comprised of fewer than 10 units decreases the annual capacity demands of both EMIS and GCIS to less than 20% of their projected annual capacities. An ongoing research and development project that builds on the results obtained from an ORNL 10 mA prototype EMIS will provide a modernized, higher-throughput, high-resolution, production-class EMIS device for use in the ESIPF. The prototype EMIS device currently being operated at ORNL has enriched 10's of milligrams of nickel and molybdenum isotopes to enrichments of up to 99.9% in a single pass. Results of the prototype EMIS device will be presented.

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