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Editor's Note

Whether civilian nuclear energy grows slowly as at present or rapidly as part of a real nuclear renaissance, it is virtually certain that there will be a proliferation of gas centrifuge plants to enrich uranium. The first two articles in this issue review some of the basics on centrifuges vital to an understanding of how best to minimize any adverse security impacts of their increased use and salience.

The first article, by Alex Glaser, develops a model to understand the separation power of centrifuges of various configurations and dimensions. It then uses this model to investigate different break-out scenarios where cascades of machines initially configured to produce low-enriched uranium are converted to produce weapon-grade uranium. These include batch recycling, where the cascades do not have to be modified, partial reconfigurations where existing cascades are joined together, and a full repiping of the cascades. In any of these cases, centrifuges do provide a much more rapid route to weapons usable material than does the main competing enrichment technology, gaseous diffusion.

We expect to publish in the following issue, a companion article on centrifuges, which will review the development of centrifuges in the United States with some emphasis on U.S. contributions to the theory of centrifuges.

In natural uranium, there are trace amounts of the minor isotope ^{234}U in addition to the more abundant ^{235}U and ^{238}U. Uranium irradiated in a reactor and separated from the spent reactor fuel by reprocessing will contain additional minor isotopes. Any uranium enrichment will affect the concentrations of these minor isotopes as well as of the isotope ^{235}U. The second article in this issue, by Houston Wood, develops calculations to allow one to measure the concentration of these minor isotopes under different assumptions, including the differences between gas centrifugation and gaseous diffusion. Understanding how enrichment processes affect the concentrations of minor isotopes can be useful in forensic analysis. Such analysis could be valuable in determining the source of enriched uranium, either intercepted prior to its use in an explosive device or after an explosion. The author's M* code described in the article is being used by the International Atomic Energy Agency and other institutions.

The final article of this issue, by C.L. Morris et al. turns to a topic covered in other recent journal articles—how to detect nuclear weapons materials entering this (or other) country. The past articles have mostly focused on material entering via containers, where various active interrogation techniques

such as X-ray radiography could be used. The article here focuses instead on material entering by occupied auto or truck and puts forward a scheme to use tomography based on detection of muons created by multiple scattering of cosmic radiation as it transits each vehicle to detect the illicit material.