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Radioisotope Production for Medical and Physics Applications[1]

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Radioisotopes are critical to the science and technology base of the US. Discoveries and applications made as a result of the availability of radioisotopes span widely from medicine, biology, physics, chemistry and homeland security. The clinical use of radioisotopes for medical diagnosis is the largest sector of use, with about 16 million procedures a year in the US. The use of ^{99}Mo/^{99m}Tc generator and ^{18}F make up the majority, but ^{201}Tl, ^{123}I, ^{111}In, and ^{67}Ga are also used routinely to perform imaging of organ function. Application of radioisotopes for therapy is dominated by use of ^{131}I for thyroid malignancies, ^{90}Y for some solid tumors, and ^{89}Sr for bone cancer, but production of several more exotic species such as ^{225}Ac and ^{211}At are of significant current research interest. In physics ^{225}Ra is of interest for CP violation studies, and the actinides ^{242}Am, ^{249}Bk, and ^{254}Es are needed as targets for experiments to create superheavy elements. Large amounts of ^{252}Cf are needed as a fission source for the CARIBU experiment at ANL. The process of radioisotope production is multidisciplinary. Nuclear physics input based on nuclear reaction excitation function data is needed to choose an optimum target/projectile in order to maximize desired isotope production and minimize unwanted byproducts. Mechanical engineering is needed to address issues of target heating, induced mechanical stress and material compatibility of target and claddings. Radiochemists are involved as well since chemical separation to purify the desired final radioisotope product from the bulk target and impurities is also usually necessary. Most neutron rich species are produced at a few government and university reactors. Other radioisotopes are produced in cyclotrons in the commercial sector, university/hospital based facilities, and larger devices at the DOE labs. The landscape of US facilities, the techniques involved, and current supply challenges will be reviewed.

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