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REACTOR PRODUCTION AND PROCESSING OF RADIOISOTOPES FOR THERAPEUTIC APPLICATIONS IN NUCLEAR MEDICINE

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Nuclear reactors continue to play an important role in providing radioisotopes for nuclear medicine [1]. Many reactor-produced radioisotopes are "neutron rich" and decay by beta-emission and are thus of interest for therapeutic applications. This talk discusses the production and processing of a variety of reactor-produced radioisotopes of current interest, including those produced by the single neutron capture process, double neutron capture and those available from beta-decay of reactor-produced radioisotopes (Table I). Generators prepared from reactor-produced radioisotopes are of particular interest since repeated elution inexpensively provides many patient doses [2]. The development of the alumina-based W-188/Re-188 generator system is discussed in detail.

Examples Produced by Single Neutron Capture - Rhenium-186 is a key example of a radioisotope of current interest which can be produced by neutron capture of enriched Re-185. Although the cross section for neutron capture by Re-185 is relatively high, the very high specific activity of Re-186 required for antibody labeling may not be achieved using many low flux reactors. However, low specific activity Re-186 can be used for preparation of phosphonates for palliative treatment of bone pain from cancer [3]. Samarium-153 can be produced with high specific activity in low flux reactors. Tin-117m is produced with low specific activity by neutron irradiation of enriched Sn-116. Specific activity have been increased in the ORNL High Flux Isotope Reactor (HFIR) by a factor of about 3 by the Sn-117(n, n', γ)Sn-117m inelastic route [4].

Examples Available From Beta-Decay of Reactor-Produced Radioisotopes - Another useful approach which provides carrier-free radioisotopes for therapy is "batch" chemical separation of the product formed by β^--decay of the reactor-produced parent. Examples produced via this route include Ag-111, As-77 and Au-199. Silver-111 is readily obtained by anion exchange chromatographic separation of Pd-111, and the 7.47 day half-life readily permits shipment to other sites. Silver can probably be