THE MAPLE-X CONCEPT DEDICATED TO THE PRODUCTION OF RADIO-ISOTOPES

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The controlled use of ionising radiations by the medical profession, for both diagnosis and treatment of many illnesses, is now world-wide and clearly demonstrates one of the many positive aspects of radiation. The number of lives that have benefited from medical technologies in the last 25 years is incalculable.

Atomic Energy of Canada Limited is a world leader in the supply of radio-isotopes for both nuclear medicine and industry; the primary production sources being the CANDU reactors, for medium specific activity cobalt-60, and the NRU and NRX research reactors, at Chalk River Nuclear Laboratories, for the rest. However, the demands made by isotope production on operating schedules are often in conflict with the requirements of research and development programs for the NRU and NRX reactors; a situation that will be aggravated when the NRX reactor is retired in 1987.

It is planned to replace NRX with a reactor called MAPLE-X that could demonstrate the MAPLE concept for versatile, Canadian research reactors with export potential, proposed by R.F. Lidstone(1). After demonstrating the MAPLE concept, the MAPLE-X reactor would be dedicated to the production of radio-isotopes. In MAPLE-X, the NRX calandria would be replaced with an open tank, pool-type, prototype MAPLE reactor utilizing as many of the NRX reactor utilities as is economically practical. Thus MAPLE-X would serve the dual role of demonstration reactor and primary supplier of radio-isotopes.

The purpose of this paper is to define a mode of operation for the MAPLE-X concept as a dedicated isotope production facility (DIPF) that meets A.E.C.L. Radio-Chemical Company's projected requirements for fission product Mo-99 from 1988 into the next century. This isotope is the source of one of nuclear medicine's most powerful diagnostic isotopes Tc-99 m and over 60% of the world market for this product is currently supplied from the NRU reactor. Mo-99 fission product is extracted chemically from irradiated U-235 targets.
Technical and economic considerations dictate that any changes to established CRNL methods for U-235 target manufacture and post irradiation processing be kept to a minimum. Operation as a DIPF requires that the ratio of target power to reactor fuel power be maximized. Together these translate into MAPLE-X using a minimum practical critical mass of driver fuel, and U-235 targets, similar to the NRU design, placed in the highest neutron flux available at a reactor power level of around 10 MW. Details of U-235 targets and outlines of both the initial and equilibrium MAPLE-X core loadings will be described. The results of reactor physics simulations using the 3-dimensional diffusion code 3DDT, together with a 5 neutron energy group cross section library derived from WIMS, will be given. These simulations are used to estimate optimum Mo-99 production based on the assumption of a 100% reactor duty factor.

In summary MAPLE-X can be operated at a power level of 10 MW as a dedicated facility for the production of Mo-99 and thus allow the NRU reactor to be dedicated to the research and development missions of A.E.C.L.

References