Introduction

Nuclear reactors continue to play an important role in providing radioisotopes for nuclear medicine [1-2]. Most reactor-produced radioisotopes are "neutron rich" and decay by beta-emission and are thus of interest for therapeutic applications (Table 1). Routine clinical applications with therapeutic radioisotopes, include cancer therapy and bone pain palliation [3-4] (Table 2), and require reliable availability of the required radioisotopes at reasonable costs. Other important applications include the irradiation of tumors, which has been described extensively elsewhere, and the treatment of rheumatoid arthritis ("radionuclide synovectomy"). In addition, an important new application using both reactor-produced gamma- and in paticular, beta-emitting radioisotopes, is for the inhibition of arterial restenosis following high pressure balloon angioplasty, primary for the coronary vessels [5-8]. Radionuclide generators (Table 3) prepared from reactor-produced radioisotopes are of particular interest since repeated elution can inexpensively provide many patient doses. This aspect is expected to be especially important for providing a source of radioisotopes to remote sites, especially in developing regions, which involve long distances and expensive distribution costs. A major growth area in nuclear medicine is therapy, with both unsealed sources and tissue-targeted radiopharmaceuticals, and there is thus a rapidly increasing requirement for therapeutic radioisotopes, most of which are reactor-produced. With the increasing use of beta-emitting radioisotopes in nuclear medicine, oncology and interventional cardiology, nuclear reactors will play an increasingly important role in providing radioisotopes for these applications. A recent review [9] has summarized the reactors which are available internationally (297 as of 1994) and those which are used for medical radioisotope production. Although a variety of research reactors are operating throughout the world, including several which have moderate to high thermal neutron flux (Table 4), the general trend is that most of these reactors are 20-30 years old, and no new reactors are currently planned, for example, for construction in the U.S. Fortunately, several new reactors are planned for construction in Canada (Nordion; Maple X 1 and 2; expected to begin operation in the year 2000 at 10MW), Australia (HIFAR II; ANSTO; 2005; 10 MW) and Germany (FRMII; Munich; 2005; 20MW) and will hopefully represent important new resources for medical radioisotope production. The goal of this paper is to briefly review the production and use of several reactor-produced radioisotopes of current interest for bone pain palliation and intravascular brachytherapy , and to discuss the role of the *ORNL* High Flux Isotope Reactor (*HFIR*) for the production of many of these radioisotopes. Current upgrades of the *HFIR* are also described which will in particular permit increased production capabilities of tin-117*m* and tungsten-188.