BR2 REACTOR: MEDICAL AND INDUSTRIAL APPLICATIONS

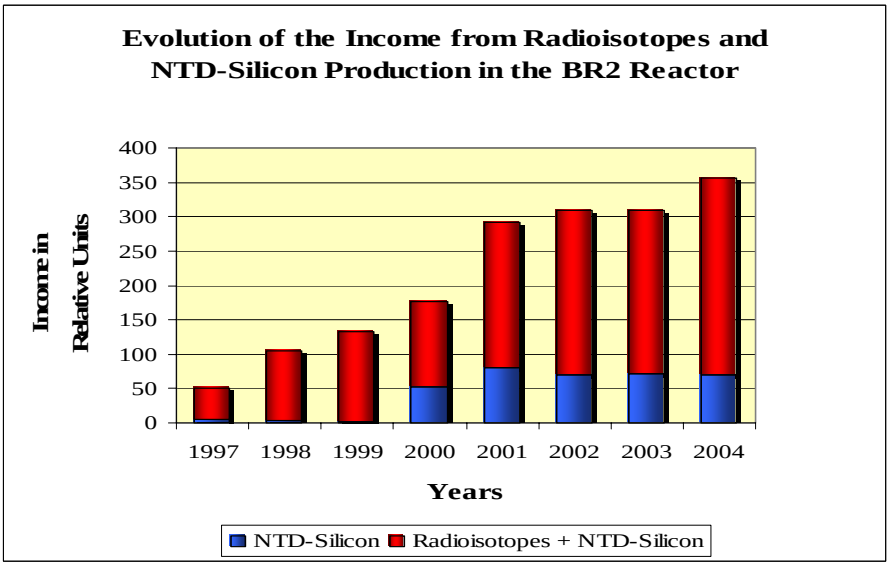
Background

The radioisotopes are produced for various applications in the nuclear medicine (diagnostic, therapy, palliation of metastatic bone pain), industry (radiography of welds, ...), agriculture (radiotracers, ...) and basic research. Due to the availability of high neutron fluxes (thermal neutron flux up to 10^{15} n/cm².s), the BR2 reactor is considered as a major facility through its contribution for a continuous supply of products such ^{99}Mo (^{99m}Tc), ^{131}I, ^{133}Xe, ^{192}Ir, ^{186}Re, ^{153}Sm, ^{90}Y, ^{32}P, ^{188}W (^{188}Re), ^{203}Hg, ^{82}Br, ^{41}Ar, ^{125}I, ^{177}Lu, ^{89}Sr, ^{60}Co, ^{169}Yb, ^{147}Nd, ... Neutron Transmutation Doped (NTD) silicon is produced for the semiconductor industry in the SIDONIE (Silicon Doping by Neutron Irradiation Experiment) facility, which is designed to continuously rotate and traverse the silicon through the neutron flux. These combined movements produce exceptional dopant homogeneity in batches of silicon measuring 4 and 5-inches in diameter by up to 750 mm in length.

Objective

To provide a reliable and qualitative supply of radioisotopes and NTD-silicon to the customers in accordance with a quality system that has been certified to the requirements of the "EN ISO 9001: 2000". This new Quality System Certificate has been obtained in November 2003 for the "Production of radioisotopes for medical and industrial applications" and the "Production of Neutron Transmutation Doped (NTD) Silicon" in the BR2 reactor.

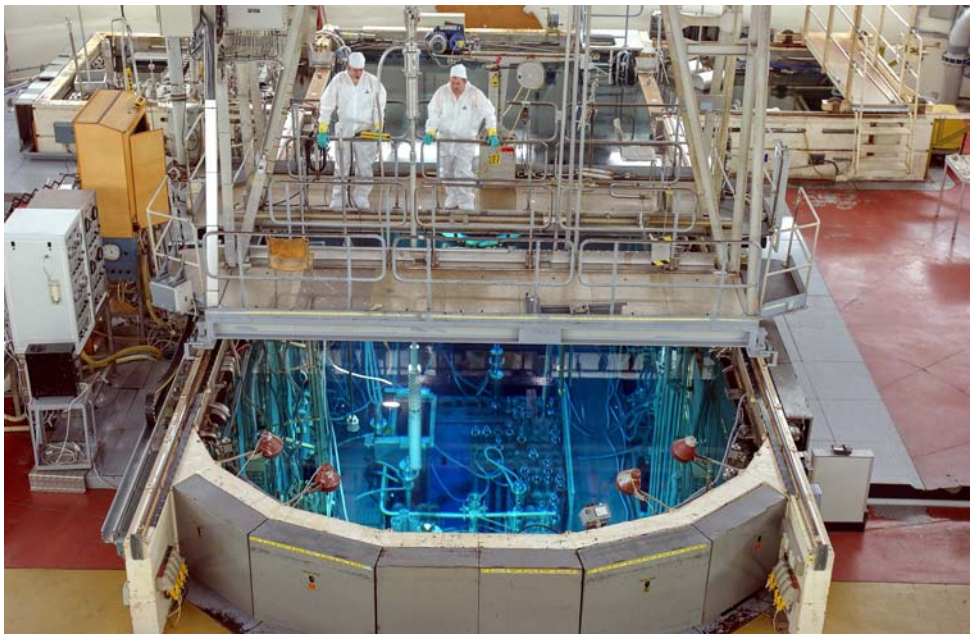
Principal results



Evolution of the income from radioisotopes and NTD-silicon production in the BR2 reactor

1. Since the restart of the BR2 reactor in 1997, after its refurbishment in 1995-1997, the income from the production of radioisotopes and NTD-silicon increased considerably as shown in the figure above in relative units.
2. The loading of an additional PRF irradiation device in the reactor in 2004 enhanced the position of BR2 on the European market for the production of ^{99}Mo ($T_{1/2}$=66 h), which is the major isotope produced in the BR2 reactor for the manufacture of ^{99}Mo/^{99m}Tc ($T_{1/2}$=6 h) generators.
3. BR2 has consolidated its market position in the production of large quantities 'high specific' activities of ^{192}Ir ($T_{1/2}$=74 d) for both therapeutic and industrial applications.

4. Highly enriched ^{176}Lu targets are routinely and successfully irradiated for the production of ^{177}Lu, which is an ideal candidate for future targeted radiotherapy with radiolabelled peptides: long half life ($T_{1/2}$=6.71 d), good physical properties, emitting both beta (maximum 0.5 MeV; average 0.17 MeV) for therapy and gamma rays (113 keV and 208 keV) useful for imaging.
5. BR2's silicon irradiation service performed very satisfactorily throughout 2004 in terms of its level of business and the record income that it generated.



Handling of irradiation baskets in the reactor main pool

Future Developments

1. BR2 is working on a project to supply ^{188}W ($T_{1/2}$=69.4 d) for the manufacture of ^{188}W/^{188}Re generators. Several medical applications of ^{188}Re ($T_{1/2}$=16.9 h) are actively under consideration in cardiology and bone pain palliation.
2. The present irradiation capacity for NTD-silicon is booked out for 2005. The ongoing study to identify the technical feasibility of new schemes to increase BR2's NTD-silicon capability by more than 100%, whilst also taking into account the industry increasing demand for 6-inch irradiation capacity, will be finalised. A positive decision to build a new facility is expected after production of a favourable business plan.

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Main references

B.Ponsard, J.Hiltunen, P.Penttilla, H.Vera Ruiz, A.L.Beets, S.Mirzadeh, F.F. (Russ)Knapp. "*The Tungsten-188/Rhenium-188 Generator: Effective Coordination of Tungsten-188 Production between the HFIR and BR2 Reactors"*, 4th International Conference on Isotopes, 4ICI, Cape Town, South Africa, March 10-14, 2002. Published in the Journal of Radioanalytical and Nuclear Chemistry (JNRC), Volume 257, Number 1, pp. 169-174, July 2003.