

# South Africa and the RERTR Programme

## Current Status \* An AEC Perspective

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### 1. Introduction

The Atomic Energy Corporation (AEC) of South Africa fully endorses the principles of the RERTR programme. To this end in 1994 the AEC, together with Argonne National Laboratory (ANL), undertook a study into the feasibility of converting the SAFARI-1 reactor to LEU silicide fuel. More details are contained in Section 2 below. Due to the commercial pressures on the AEC at that time, the AEC decided not to convert SAFARI-1 to LEU silicide fuel. The AEC did, however, undertake to reevaluate the situation periodically.

Five years have passed since the detailed study of 1994 and the changing conditions now warrant another detailed study taking into account the current situation.

In the sections to follow, a brief historical background is given on the RERTR activities in South Africa since 1993 followed by a summary of the current situation.

### 2. Historical Background

#### RERTR activities

After discussions between ANL and AEC representatives in September 1993, a protocol agreement was signed which made provision for a technical and economic feasibility study into the possible conversion of SAFARI-1 to LEU fuel.

The technical study[1,2] was performed jointly by AEC and ANL staff during the second half of 1994 and a final report issued in May 1995. The report indicated that it is technically feasible to convert SAFARI-1 to LEU fuel. The results of the study with respect to fuel usage and fluxes in irradiation positions was used in an economic feasibility study which was performed by the AEC during the third quarter of 1995 and a report issued in October of that year.

The economic study[3] showed, that under the conditions prevailing at that time, the overall effect of converting SAFARI-1 to LEU fuel would result in fuel costs increasing by 80%. In addition to this, the study also showed that the overall effect, taking into account loss of income due to decreased isotope production capacity, amounted to a nett cost increase of 163%. The cost increase was prohibitive for the AEC and resulted in the

decision to remain on HEU fuel and update the economic study periodically to account for changing conditions.

### **Commercial and Institutional activities**

Since 1993, the AEC also continued with its commercialisation drive. The SAFARI-1 isotope product portfolio, irradiation services, client base and market share showed a substantial increase.

Products originating from SAFARI-1 are currently exported to 14 countries. The radioisotope product portfolio now includes the following: fission  $^{99}\text{Mo}$ , fission  $^{131}\text{I}$ ,  $^{192}\text{Ir}$ ,  $^{125}\text{I}$ ,  $^{32}\text{P}$ ,  $^{35}\text{S}$ ,  $^{140}\text{La}$ ,  $^{90}\text{Y}$ ,  $^{153}\text{Sm}$  and  $^{198}\text{Au}$ . The quantity of fission molybdenum-99 sold to clients has grown from under 1,000 curies per annum in 1993 to over 22,000 curies in the 1997/98 financial year and continues to grow.

Several tons of silicon are irradiated annually on a commercial basis. Despite the decline in the NTD market internationally, contracts for silicon doping at SAFARI-1 have not diminished.

A quality system has been implemented at SAFARI-1 to ensure that the products and services are of a consistently high standard. SAFARI-1 was accredited with the ISO-9001 certification in October 1998.

The use of SAFARI-1 by academic institutions from within South Africa and abroad has grown rapidly since 1993.

SAFARI-1 is currently operated 24 hours per day, 7 days per week for 42 weeks per year. Power levels vary between 10MW and 20MW depending on client demand. The average power level over the past financial year was 15.6MW.

## **3. Current Status**

In the light of international RERTR trends and in support of non-proliferation considerations the AEC has committed itself to relook at the conversion of SAFARI-1 to LEU fuel. During the United States/South African bi-national meeting held in February 1999 discussions were held in this regard which paved the way for opening up the study once again.

The AEC in collaboration with Argonne National Laboratory will once again perform a detailed technical and economic feasibility study into the conversion of SAFARI-1 to LEU fuel.

At a meeting between representatives of the US DOS/DOE/ANL/AEC held during June 1999 the framework of a new joint AEC/ANL techno-economic study was agreed to.

The assumptions forming the basis of the previous study have been revised. The new study makes provision for a new technical study allowing for core design changes to optimise a possible LEU core. LEU core design studies have already commenced and are expected to be completed by mid 2000.

The possibility of manufacturing LEU fuel in South Africa will also be investigated. This option was not considered in the previous study.

The characteristics of the new core design, particularly with respect to fluxes and spectra in irradiation positions, will be used together with other data in the economic study to be performed during the second half of year 2000.

#### **4. References**

- [1] Ball G, Pond R, Hanan H & Matos J, 'Neutronic Study on Conversion of SAFARI-1 to LEU Silicide Fuel', Proceedings of the 1994 International RERTR Meeting, Williamsburg, USA, 18-23 September 1994
- [2] Ball G, Pond R, Hanan H & Matos J, 'Technical Feasibility Study of Converting SAFARI-1 to LEU Silicide Fuel', ANL/RERTR/TM-21, May 1995
- [3] Ball G & Malherbe FJ, 'Techno-Economic Study on Conversion of SAFARI-1 to LEU Silicide Fuel', Proceedings of the XVIII International RERTR Meeting, Paris, France, 17-21 September 1995