PROGRESS ON RERTR ISSUES IN AUSTRALIA

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Abstract

Australia has long been involved with and sympathetic to the goals of the RERTR program. This overview paper gives a brief introduction to RERTR-related activities in Australia since RERTR-2000.

1 INTRODUCTION

Australia has long been involved with and sympathetic to the goals of the RERTR program, namely to develop the technology needed to minimise and eventually eliminate use of high-enriched uranium (HEU) for civilian applications. RERTR activities fall into four broad areas:

a) Use of low-enriched uranium (LEU) in new research and test reactors;

b) Conversion of existing HEU research and test reactors to LEU;

c) Replacement of HEU by LEU for manufacture of Mo-99 for medical usage, and

d) Disposal of spent HEU research reactor fuel.

ANSTO has undertaken activities over the past two years (and previously) which come under these four main areas of interest of the RERTR programme. These activities were:

a) Design, manufacture of prototypes, and testing by INVAP of fuel assemblies using LEU for ANSTO's Replacement Research Reactor (RRR);

b) Modification of the HIFAR safety case to enable operation with a partial 20% LEU core;

c) Development of 20% LEU targets for Mo-99 production, and

d) Shipment of spent HEU fuel for reprocessing or storage

These four activities are outlined in the following sections.

2 LEU FUEL FOR THE REPLACEMENT RESEARCH REACTOR (RRR)

The RRR design is for a 20 MW pool-type research reactor which is light water-cooled and heavy water moderated. The RRR will be a multi-purpose reactor optimised for production of radioisotopes and for neutron beams. The contract to build the RRR was awarded to the Argentinian company, INVAP, in July 2000 at a cost of A$297 million (in 1997 dollars).

Following preliminary design work by INVAP, ANSTO and INVAP wrote the Preliminary Safety Analysis Report (PSAR) for the reactor. The PSAR formed the centrepiece of an application for a facility license that was submitted in May 2001 to the Australian regulator

(ARPANSA). The PSAR largely follows the structure recommended by the IAEA and gives extensive details of the design and associated safety analyses. A summary of the report, along with the other major documents relevant to the regulatory approval process, is available on the ARPANSA website (www.arpansa.gov.au/rrrp).

The PSAR was displayed for public scrutiny and comment and was the subject of public hearings in the latter half of 2001. It was also reviewed for ARPANSA by an IAEA expert team and they found that "The PSAR reflects the present design of the RRR accurately, effectively and in considerable detail. It has been prepared using IAEA safety standards and reflects good current international practice. It provides an adequate basis for licensing purposes."[1] Following acceptance of the PSAR, ARPANSA issued a construction licence on 18th April, 2002 allowing construction to proceed immediately.

In accordance with RERTR principles, ANSTO's Request for Tender for the RRR issued in 1999 specified that only LEU fuel would be acceptable. INVAP's successful design for the RRR uses conventional MTR-type fuel with 19.9% enriched U – fuel.

Following current practice in research reactors, the RRR will use 4.8 gmU/cc U_3Si_2 fuel at startup. However, as is also the case for research reactors in many countries, Australia does not want the legacy of spent fuel stored on its territory for the indefinite future. Nor can it avail itself of the US spent fuel take-back program since it does not apply to fuel from new reactors. A pre-requisite of the Australian regulator, ARPANSA, for construction of the RRR was demonstration of a disposal route to ensure that spent fuel would not be stored on site for long periods as has occurred with HIFAR. The route Australia has put in place is to have RRR spent fuel reprocessed and the waste eventually returned to Australia as ILW.

However, silicide fuel is not easily reprocessable in commercial reprocessing plants and ANSTO is looking to change to UMo fuel as soon after startup as is practicable. The higher uranium density of the UMo fuels that are being developed will have benefits for cycle time and flux, as well as being more readily reprocessed. This changeover to UMo fuel has been envisaged by ANSTO and INVAP from an early stage of planning for the RRR and the fuel has been designed accordingly – details of the neutronics of both the silicide and UMo fuels are given in the paper of Villareno[2] in this conference.

3 20% ENRICHED URANIUM TARGETS FOR MO^{99} PRODUCTION

ANSTO produces sufficient Mo-99 to service the needs of Australian hospitals and others in the region. It does this by irradiating uranium oxide enriched to 2.2% uranium-235 in HIFAR and extracting the fission Mo-99. A steady increase in demand and a desire to reduce the radioactive process waste stream has led to ANSTO's investigating the use of higher enrichment and other means to increase Mo-99 production[3].

With the success of its program for reducing HEU use in reactors, the RERTR program has focussed more of its attention in recent years on the Mo-99 production industry, being the other major user of HEU. It has been looking at alternative production routes for Mo-99 in order to encourage major suppliers to switch from their current HEU targets to LEU. This work has had benefits for ANSTO because of the potential to increase from 2.2% to 20% LEU for its Mo^{99} production. A project to develop and license use of 20% LEU has been running for several years at ANSTO and further progress to that reported at RERTR-2000 is given in the paper by Donlevy et al[4] at this conference

4 USE OF LEU IN HIFAR

HIFAR is a DIDO-type reactor which currently uses 60% enriched fuel. This class of reactor was designed to be operated with 93% enriched uranium fuel and HIFAR started up in 1957 with such fuel. The enrichment was reduced to 80% in 1962 and later, in keeping with the principles of RERTR, was downgraded in a number of steps to 60% enrichment in 1984. The enrichment was not reduced further at that time in order that sufficient flux levels for the dual-purpose nature of HIFAR as a provider of neutrons for beam experiments and radioisotope production be maintained. Nor for the same reasons, despite world trends, was the effort made to further reduce the enrichment at a later date. This decision to maintain the use of 60% enriched fuel was reinforced by the announcement in 1997 by the Australian Government that HIFAR will be shut down following the construction of a replacement research reactor to be commissioned in 2005.

However, due to the unexpected shutdown in October 2000 of another DIDO class reactor, the DR-3 reactor at Risø in Denmark, a number of fresh fuel assemblies became available. This fuel contains 19.75% enriched uranium and is of a design which can be readily used in HIFAR. Its availability was judged sufficient reason to do the work to modify the safety case and to accept a flux penalty towards the end of HIFAR life when commissioning and operation of the RRR will be imminent. A description of the work done for this change to LEU fuel and the current status of the project is given in the paper by Vittorio and Durance [5] in this conference.

5 SHIPMENT OF SPENT FUEL

The Australian Government has funded ANSTO to ship overseas all the spent fuel arising from the operation of the HIFAR research reactor. Much of the total inventory of HIFAR spent fuel has been stored on site in dry storage for many years and this reduction in the storage of spent fuel at Lucas Heights is strongly supported by the local community.

In January 2001 ANSTO shipped 360 HEU spent fuel assemblies to the French COGEMA fuel reprocessing facility at La Hague for reprocessing. This was the fourth shipment since 1996 and brought to a total of 932 fuel assemblies of UK origin and 240 of US origin returned. There are at least 900 fuel assemblies remaining and further shipments are planned to La Hague and the US, the latter as part of the US take-back program. HIFAR now has less than five years to run and will generate approximately 200 further spent fuel assemblies. These too will be returned after a suitable cooling period and all HEU spent fuel is planned to be returned for storage or reprocessing by 2007-2008.

A more complete description of ANSTO's experience with storage and shipment of spent fuel and the current status of the project is given in the paper[6] by Irwin in this conference.

6 REFERENCES

[1] IAEA, Final Report of "Experts Mission to review the PSAR of the RRR for ARPANSA", 10th July, 2001

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[3] Donlevy, T. M., Anderson, P. J., Storr, G., Yeoh, G. Beattie, D., Deura, M., Wassink, D., Braddock, B. J., and Chant, W. "Low Enrichment Mo-99 Target Development Program at ANSTO" Proc. RERTR 2000

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