Planning for final operation of the HIFAR Reactor

David Vittorio, Rodney Hall.
ANSTO
PMB 1 Menai 2234 NSW AUSTRALIA
david.vittorio@ansto.gov.au

ABSTRACT

The Australian Nuclear Science and Technology Organisation (ANSTO) has operated the HIFAR research reactor since 1958. Construction of the new OPAL research reactor commenced in 2002 and commissioning is due to commence in late 2005.

ANSTO faces a number of challenges during the final year of HIFAR operation and dual operation of HIFAR and the OPAL reactor. These challenges include plant staffing for the dual operation phase, regulatory expectations, HIFAR's ageing plant and fuel supplies.

HIFAR operation has been extended by the procurement of a number of LEU silicide fuel elements purchased from RISO, Denmark, and the implementation of a program to convert to a LEU fuelled core. This will enable continuing operation of HIFAR during the commissioning and early operation phases of the OPAL reactor. A decommissioning plan will be implemented following the final shutdown of HIFAR.

This paper discusses the challenges that face ANSTO during the operational transition from HIFAR to the OPAL reactor.

INTRODUCTION

HIFAR is a 10 MW 'DIDO Class' research reactor. The core consists of 25 fuel elements of concentric tube type, each containing a hollow central region for high flux irradiations. HIFAR is heavy water moderated and cooled and is surrounded by a graphite reflector. Reactor control and shutdown is achieved with six europium tipped cadmium control blades, which move between the rows of fuel elements.

The construction of HIFAR commenced in February 1956, criticality was first achieved on 26th January 1958 and routine full power operation commenced in January 1960. Fuel elements initially contained uranium enriched to 93 % U235. From that time, the level of enrichment gradually reduced to 80 % in 1962, 60 % in 1984 and recently to 19.75 % in 2004.

HIFAR is a multipurpose reactor, used primarily for neutron scattering, industrial and medical radioisotope production and neutron transmutation doping of silicon.

A contract was awarded to INVAP S.E. in mid 2000 to design and construct the new reactor, OPAL, to replace HIFAR. Concrete pouring commenced in November 2002 and commissioning is scheduled to commence in late 2005.

A number of challenges face ANSTO during the operational transition from HIFAR to the OPAL reactor.

PRINCIPLES AND EXPECTATIONS

It is expected that HIFAR remain fully operational throughout the commissioning phase and early operation of the OPAL reactor. Concurrent operation of the two reactors is expected for approximately six months. The purpose of this concurrent operation period is primarily to guarantee continuation of reactor based services which include continued supply of Australian produced radioisotopes. One major task will be to undertake a quality assessment of a range of medical radioisotope products. The assessment will involve a comparison of product quality for radioisotopes produced in OPAL as compared to HIFAR. This is necessary as part of the Pharmaceutical licence granted by the Australian Therapeutic Goods Administration. Similarly the period of concurrent operation will provide a continuity of quality products and services to Neutron beam users, Australian Radioisotopes and Silicon customers.

Arrangements are currently in place for HIFAR to continue operating until December 2006. It is expected that HIFAR continue to operate safely and reliably in order to provide continuous quality products and services to all customers until it is finally shutdown.

OPERATIONAL CHALLENGES

A number of unique challenges face ANSTO during the concurrent operation of two reactors and the transition from HIFAR to OPAL. Reactor safety is and always has been of prime importance to ANSTO's operations. The three main areas providing the greatest challenge to HIFAR over the coming years are staffing, maintaining HIFAR's ageing plant and continuity of fuel supplies.

Staffing

During the transitional period from HIFAR operation to OPAL commissioning and routine operation it is expected that sufficient staffing levels will be available to safely and efficiently operate two reactors. This is quite a challenge for ANSTO as traditional staffing levels within the Reactor Operations Group are sufficient to operate only one reactor.

This particular issue was identified some time ago and as a result additional HIFAR operators and support staff have been recruited. Additional changes have also been made to the operations shift roster to better utilise available staff. This change has enabled five HIFAR operators to attend an OPAL operations training program in order to be trained as OPAL reactor operators. A number of other Reactor Operations support staff such as Engineers, Scientists, and maintenance personnel have also been released from HIFAR to provide full time or part time support to OPAL operations. Vacant positions within reactor operations have been filled by suitably qualified personnel from other ANSTO divisions.

However staffing remains an issue of importance for ANSTO and this is being continually monitored by management. ANSTO is confident that with the flexibility and commitment of ANSTO personnel together with the pool of knowledge available within the organisation, a smooth transition from HIFAR operation to OPAL operation is possible.

HIFAR's ageing plant

The year 2006 will see the commencement of the 49th year of HIFAR operation. The issue of HIFAR's ageing is another area of focus. ANSTO is committed to safely and reliably operate HIFAR and as a result, improvements have been made to maintenance activities. HIFAR operates on a 35 day operating cycle where the reactor has traditionally operated at power for 31.5 days and shutdown for refuelling and maintenance for 3.5 days. More recently the scheduled shutdown time has been extended to 4.5 days to encourage a greater level of safety culture awareness and recognition of HIFAR's ageing plant. This additional shutdown time has been used to increase the amount of predictive and preventative maintenance activities being performed. This has resulted in improved reactor reliability and less need for breakdown maintenance or unscheduled shutdown periods. An additional four maintenance technicians are being recruited to support both HIFAR and OPAL maintenance activities.

HIFAR system upgrades or improvements, particularly for safety significant systems requiring regulatory approval are continuing to be performed. An appropriate amount of capital funding has been allocated to ensure that there is no degradation to HIFAR systems, including those plant systems required for decommissioning activities.

Fuel supplies

HIFAR fuel assemblies have traditionally been fabricated by the United Kingdom Atomic Energy Agency (UKAEA). These fuel assemblies were fabricated using Uranium Aluminium Alloy enriched with 60 % U235. Since the shutdown of the UKAEA production facility ANSTO have purchased additional fresh fuel from the RISO National Laboratory, Denmark, following the permanent shut down of the Danish DR3 reactor. RISO made minor modifications to the non-fuel structure of the fuel assemblies to make them compatible with the HIFAR design. These fuel assemblies purchased from RISO utilise Low Enriched Uranium (LEU) Silicide fuel with a U235 enrichment of 19.75 %.

The conversion of HIFAR to use LEU Silicide fuel assemblies has required a comprehensive set of reactor physics calculations to be performed as part of the revised safety analysis for the utilisation of the LEU silicide fuel in HIFAR. This was undertaken as a safety category 1 project requiring regulatory approval from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and required an amendment to the HIFAR operating licence. HIFAR is currently operating with a mixed core with both 60 % and 19.75 % enriched fuel assemblies and a full LEU core will be achieved by early 2006.

As discussed earlier, it is expected that HIFAR operate concurrently with OPAL for a period of approximately six months. In order for this to occur a further quantity of

fresh fuel is needed to extend HIFAR operation until December 2006. The French company CERCA was recently chosen to supply this additional quantity of HIFAR fuel and fabrication has commenced.

Regulatory Expectations

The expectations of ARPANSA are to ensure that HIFAR operates safely within the bounds of the Operating Limits and Conditions and the Operating licence. ARPANSA also expect to be consulted on any changes made to HIFAR plant or operating practices, where relevant to the ARPANS regulations, particularly any changes which may have an impact on safety.

Planning for Decommissioning

Once HIFAR is permanently shutdown the fuel assemblies, control absorbers and heavy water moderator will be removed from the core. The long term strategy for HIFAR decommissioning is currently in the preliminary planning stage. At present there are three options:

- Allow reactor components to decay for approximately five years then decommission the reactor and return to a greenfield site.
- Remove all activated plant and equipment over approximately five years and then utilise the reactor building as a heritage building or museum.
- Initially remove unactivated plant and equipment followed by a long term care and maintenance program. Full decommissioning would then be performed sometime in the future.

The decision to decommission HIFAR rests with the ANSTO Board. Any decision made would then require ARPANSA approval to commence and continue decommissioning activities.

DISCUSSION

HIFAR has served the Australian and International community since 1958 and as the construction of the OPAL reactor nears completion, plans are in place for the transition of staff and supporting services. A number of challenges face the organisation as we approach OPAL commissioning and concurrent operation of HIFAR and OPAL for approximately six months. Arrangements are in place for this transition period as the knowledge and experience of individuals from across ANSTO will be utilised.