

DECOMMISSIONING OF THE ASTRA RESEARCH REACTOR – REVIEW AND STATUS ON JULY 2003

by

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The paper describes work on the decommissioning of the ASTRA research reactor at the Austrian Research Centers Seibersdorf. Organizational, planning, and dismantling work done until July 2003 including radiation protection and waste management procedures as well as the current status of the project are presented. Completion of the decommissioning activities is planned for 2006.

Key words: decommissioning, ASTRA research reactor, dismantling, waste management

INTRODUCTION

After 39 years (1960 to 1999) of successful operation, the 10 MW multipurpose MTR research reactor ASTRA at the Austrian Research Centers Seibersdorf (ARC) is now in the state of decommissioning [1, 2].

Prior to the final shut-down on July 31st, 1999, and according to the recommendations of the IAEA (Transition Period) [3], the possible options and the required stages for decommissioning and removal of the radioactive components were evaluated and appropriate financial requirements were arranged.

Of the possible options, an immediate dismantling to stage 1 of the IAEA technical guide-lines [4, 5] (storage with surveillance, final shipment of spent fuel and thus complete removal of high-level waste from the site) followed immediately by dismantling to stage 2 of these guidelines (restricted site use) was identified as the most reasonable choice.

The reasons for this choice were the low activity levels in the building and components, the low radiation exposure to be expected, as well as the op-

portunity to utilize the experienced reactor crew resulting in low exposure levels of the staff involved in decommissioning [6].

WORKING TEAM, RADIATION PROTECTION AND SPECIFIC SURVEILLANCE

A team consisting of the former reactor crew staff members (which could be temporarily reinforced by co-workers if demand should arise) was set up to perform the decommissioning. Another important decision was the employment of a radiation protection crew under the independent supervision of the ARC radiation protection officer.

Furthermore, it was necessary to implement specific surveillance and monitoring programs for radiation protection and to acquire special new low-level measuring devices. In cooperation with the authorities, appropriate standards and measuring procedures were established.

Special care was taken in preparing procedures for the removal of materials (*e. g.*, concrete, steel-structures, aluminum plates, cables *etc.*) with contamination below clearance levels. Working instructions for radiation protection and for handling and operating sequences were developed. An extensive documentation describes the project.

The planning took into account that all the work and operations for decommissioning could be performed inside the existing buildings (confinement or pump room) with the ventilation and radiological monitoring systems in operation. Hence

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Figure 1. ASTRA-reactor – view on the core

virtually no possibility for a release of activity to the environment during the whole decommissioning process would exist.

CONDITIONING AND RADIOACTIVE WASTE MANAGEMENT

A preliminary evaluation of the expected amount of radioactive waste was performed which showed that it would amount to approximately 320 kg of intermediate-level waste (ILW), mainly elements of the reactor core (see fig. 1), about 100 t of activated low-level waste (LLW), and about 60 t of contaminated LLW.



Figure 2. Inner thermal column – removing the graphite

The high-level waste (HLW) and ILW could be removed under the valid operating license of the reactor. According to EU-law, for the removal of the rest of the activity (which amounts to less than 0.001% of activity one week after the final shutdown) an environmental impact assessment (EIA) was required. The option to start work on stage 1 under the existing operating license allowed for the necessary time to prepare and carry out the EIA.

The Radioactive Waste Management Department (RWMD) of Nuclear Engineering Seibersdorf GmbH (NES) acts as the central facility for the collection, conditioning and intermediate storage of radioactive wastes arising in the country. Therefore the project of decommissioning ASTRA research reactor also includes the preparation of the occurring waste according to the waste acceptance criteria of RWMD.

Apart from standard methods for the treatment of low-level wastes, some new procedures to handle and store special materials had to be developed.

For instance, the material that will have to be conditioned and stored includes approximately 10 t of reactor-grade graphite from the inner and outer thermal columns (see fig. 2) as well as from old-type reflector elements as used between 1960 and 1970 and moderators from late experiments. Over the 40 years of reactor operation, some of the graphite had been exposed to an estimated integrated fast-neutron flux of $2.2 \cdot 10^{21} \text{ cm}^{-2}$. Since the temperature of the graphite never exceeded $100 \text{ }^\circ\text{C}$, annealing of lattice defects did not occur and the accumulation of significant amounts of Wigner energy is to be expected.

The activity of the main slow-neutron activation product ^{14}C in the material is on the order of 1000 Bq/g, with other radionuclides, *e. g.*, ^{60}Co and ^{152}Eu , present in trace amounts.

It was decided to preheat graphite exposed to an estimated integrated fast-neutron flux of 10^{19} cm^{-2} and higher under controlled conditions (fig. 3). This work is under way at the NES Hot Cell Laboratories at the moment and there are indications that a considerable release of Wigner energy does in fact occur.

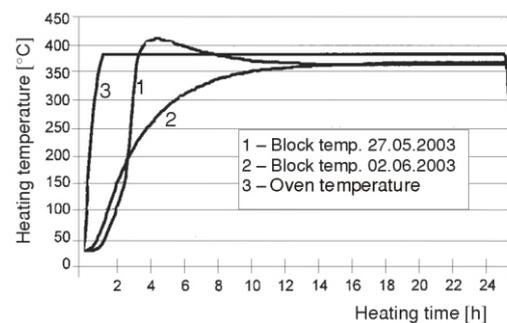


Figure 3. Preheating the graphite from the inner thermal column (calculated integrated fast neutron flux $2 \cdot 10^{21} \text{ cm}^{-2}$)

Therefore, and because samples of graphite exhibiting a wide range of irradiation histories are available, the amount of Wigner energy, its release kinetics, and associated crystal structure changes will be studied as a function of neutron flux – an approach not attempted to date – in a separate project.

Another subject is the conditioning of ASTRA Beryllium elements. Two Mosaik containers have been readied to store the 18 reflector elements and the 7 radiation elements together with the active blades of the ASTRA Hf-control rods. The conditioning will again be undertaken at NES Hot Cell Laboratories. For this purpose, individual containers for each element were designed from high-grade stainless steel, a remote-controlled orbit welding facility was modified and adapted and hot cell No. 6 underwent general restoration to be able to handle the work.

REVIEW ON WORK UNDER STAGE 1

The 54 MTR-fuel elements (310.5 kg of HLW) were shipped to US-DOE Savannah River Plant for ultimate disposal in May 2001.

In the immediate succession and still under the operating license, all experimental facilities and components of the reactor within the vicinity of the core or in intermediate storage within the building *e. g.*, old beam-tube-inserts, 492 kg of ILW and 5212 kg of LLW were removed and treated.

In the course of this procedure custom-designed, remote-controlled equipment had to be built and three GNS-Mosaik containers were filled, partly under water, with the remaining material (fig. 4).



Figure 4. Conditioning of ILW – Under water loading of GNS-Mosaik Container

Also the task of clearing the reactor building from remaining experimental equipment, obsolete storage facilities and the transfer of the structures of the industrial source services including a 21-ton-lead-cell to NES Hot Cell Laboratories were accomplished to 90% under this stage. Work under stage 1 ceased by May 2003.

STATUS ON WORK UNDER STAGE 2

During 2002 the EIA was prepared. The public hearing was held on December 19th, 2002 and was followed by a license to decommission on April 8th, 2003.

Preparing stage 2 was well under way during stage 1; nevertheless, actual work could only be started after May 2003. It comprises the dismantling of the primary and secondary cooling facilities and the removal of the biological shield (roughly 160 t of LLW). A major part of stage 2 is the “clearing” of the remaining buildings, which are to be used for other purposes, *e. g.*, as interim LLW storage facility.

A building directly attached to the reactor will have to be erected in which clearance measurements and procedures will be performed. Completion is planned for November 2003. Part of the reactor basement was modified to an enclosed and directly ventilated working place for the dismantling and cutting of contaminated metals.

It is intended to take down the structures of the biological shield (400 m³ reinforced barite-concrete totaling approx. 1400 t) by cutting blocks (fig. 5) of between 7 and 9 t (limited by the 10-ton-capacity of the crane) from the inactive zones using wire-cut techniques, and to obtain clearance for the material by mea-

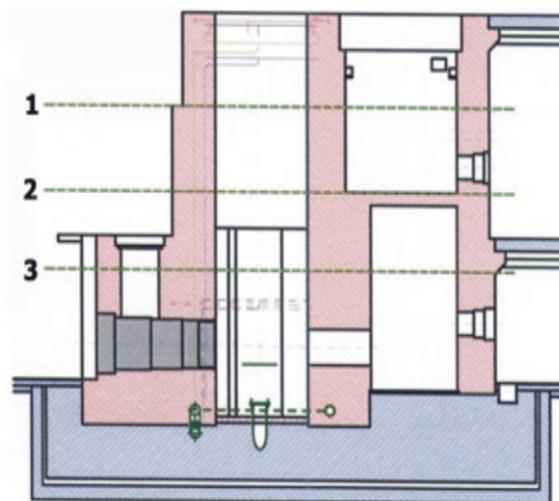


Figure 5. Biological shield – Concept of block cutting; 1, 2, 3 – cutting planes

asuring the surface activity and by additional internal probing (fig. 5). For surface activity measurements we prepare to use an available Canberra ISOCS device. A validation of the method under ASTRA conditions is just being carried out. It is planned to apply the validated ISOCS procedure to effect final clearance of the building-structures at the last stage of the decommissioning.

Actual cutting is supposed to start in January 2004. To reach a decision on how to cope best with the materials of the activated zone an extensive sampling program started immediately after the decommissioning license was granted.

CONCLUSION

The decommissioning of ASTRA was initiated in 1999 after the conditions of transition were cleared. The project's final goal is the release of the buildings for unrestricted use and an immediate dismantling was chosen to be the optimum decommissioning strategy.

Decommissioning work followed the IAEA recommendations starting with the removal of HLW immediately followed by ILW. At the moment, the removal of LLW is under way.

From today's view, the estimated completion of the project is expected around June 2006, which is about 6 months later than originally planned.

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Франц МАЈЕР

ДЕКОМИСИЈА ИСТРАЖИВАЧКОГ РЕАКТОРА ASTRA – Преглед и стање у јулу 2003. године –

У раду је описана декомисија истраживачког реактора ASTRA у аустријском истраживачком центру Сајберсдорф (Austrian Research Centers Seibersdorf). Приказане су организационе активности, планирање и активности демонтаже реакторских система, обављене до краја јула 2003. године, са освртом на мере заштите од зрачења и третман радиоактивног отпада. Завршетак пројекта декомисије планиран је за 2006. годину.