RESEARCH REACTORS IN AUSTRIA - PRESENT SITUATION

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ABSTRACT

In the past decades Austria operated three research reactors, the 10 MW ASTRA reactor at Seibersdorf, the 250 kW TRIGA reactor at the Atominstitut and the 1 kW Argonaut reactor at the Technical University in Graz. Since the shut down of the ASTRA on July 31th, 1999 and its immediate decommissioning reactor and the shut down of the Argonaut reactor in Graz on August 31th, 2004 only one reactor remains operational for keeping nuclear competence In Austria which is the 250kW TRIGA Mark II reactor.

1. Introduction

The TRIGA reactor Vienna is used intensively for students education and training, all reactor systems are in excellent condition, spare fuel elements are available to operate this reactor for another 10 to 15 years and at present there is no indication whatsoever that this reactor should be closed down in the coming years.

The Argonaut reactor Graz was shut down on August 31, and will be decommissioned starting in late 2004. The fuel shipment is planned during 2005.

This paper will discusses the present decommissioning state of the ASTRA reactor, the planned fuel shipment of the Argonaut fuel and gives an outlook of possible options for the TRIGA reactor.

2. Historical survey

In the period between 1959 to 1965 three research reactors were built and operating until 1999. The first reactor was the MTR type ASTRA reactor at the Austrian Research Centre Seibersdorf (ARCS, www.arcs.ac.at) which for a long period was the main research facility for nuclear research in Austria as well as the planning centre for a nuclear power plant. As it is well known this nuclear power plant at the site of Zwentendorf (730 MWe BWR) was never put into operation due to a public negative referendum in 1978. This also effected the further development of nuclear research and in particular the programs at the ARCS. For several non-technical reasons the 10 MW ASTRA reactor was finally shut down on July 31, 1999 and immediately decommissioning started.

The second reactor was planned as typical university training and education reactor, a TRIGA Mark II (www.ati.ac.at) reactor was selected and was first critical on March 7, 1962. This reactor is well maintained and utilized and is in operation without any specific deadline for shut down.

The third reactor was a Siemens ARGONAUT reactor also to be used for university training and education at the Technical University of Graz, it became critical for the first time in May

17, 1965, the maximum licensed power is 1 kW but it operated only at 10 W. The reactor has been shut down on August 31th, 2004 and decommissioning will start by end of 2004.

3. Present situation

3.1 The ASTRA reactor at Austrian Research Centers Seibersdorf (ARC)

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 advanced state of decommissioning. During 2002 the EIA was prepared. A public hearing was held on December 19, 2002 which was followed by a license to decommission on April 8, 2003.

Preparation work has already been presented at the RRFM 2004, the actual concrete cutting started in January 2004. Before the primary water was finally drained from all systems directly connected with the tank and the lower hot cell (usually filled with primary water), the surfaces of the liners were cleaned and stabilized to prevent continuing oxidation and hence occurrence of dust. The liner of the tank was removed to a level 3 meters below the upper floor. The concrete surfaces of the upper hot cell (designed for dry use) were cleaned of contamination. All connections e.g. electricity, pressurized air, primary water supply were disconnected from the shield, wires and tubes were removed. In preparation of the intended cutting work on the first section of the biological shield working platforms were installed in the pool and in the upper hot cell. Additional measures were taken to control the drain of the cutting fluid and to remove concrete and steel particles from the solution. Calculations show that about 8 tons of cake is to be expected which should be inactive waste by definition. Therefore careful collection and preparations to achieve clearance is essential.

- **First cut:**
  - 33 blocks
  - average weight 7-9 tons
  - total mass 230 tons
  - total cutting area 130 m^2
- **Second cut:**
  - 50 blocks
  - average weight 8-9 tons
  - total mass 400 tons
  - total cutting area 220 m^2
- **Third cut:**
  - 15 blocks
  - average weight 7-9 tons
  - total mass 110 tons
  - total cutting area 50 m^2
- **Fourth cut:**
  - depends on the results of 3rd cut

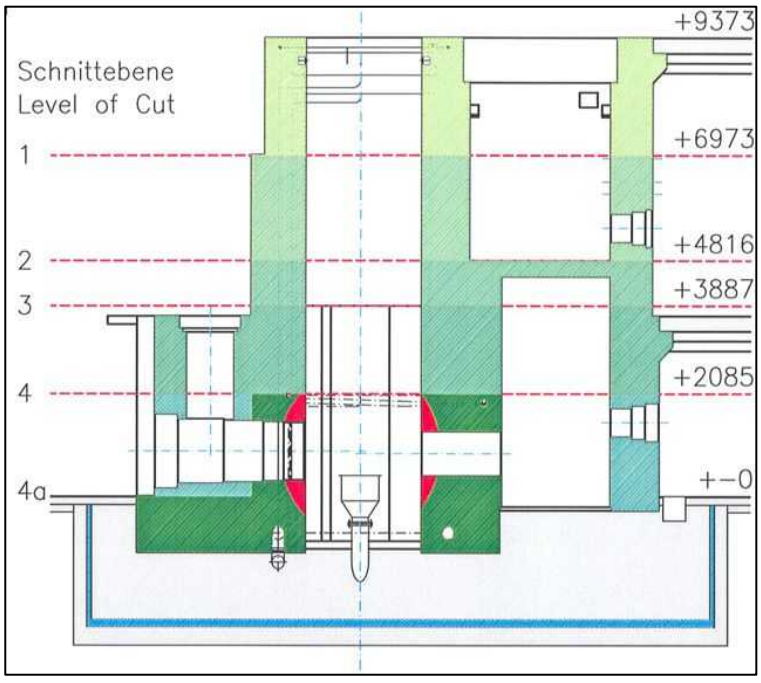

Fig. 1. Biological shield - concept of block cutting

Work carried out in 2004 were

- the dismantling of the inactive parts of the biological shield,
- radiological clearing of the removed materials,
- dismantling of the primary and secondary water installations in the pump room,
- cleaning and radiological identification of the metal parts for further conditioning
- cutting of the biological shield up to cutting level number 3 (see Fig. 1)
- removal of the graphite of the thermal column
- and decision about the further method for dismantling the active zones of the biological shield.

The project's final goal is the release of the buildings for unrestricted use and immediate dismantling was chosen to be the optimum decommissioning strategy. From today's view the estimated completion of the project is expected around June 2006, which is about 6 months later than the original planning predicted.

3.2 The TRIGA reactor at the Atominstitute Vienna

The operation of the reactor since first criticality averaged 220 days per year, without any long outages. The TRIGA-reactor is purely a research reactor of the swimming-pool type that is used for training, research and isotope production (Training, Research, Isotope Production, General Atomic = TRIGA). The reactor core consists presently of 81 fuel elements (3.75 cm in diameter and 72.24 cm in length), which are arranged in an annular lattice. Two fuel elements have thermocouples implemented in the fuel meat which allow to measure the fuel temperature during reactor operation. At nominal power (250 kW), the centre fuel temperature is about 200 °C. Because of the low reactor power level, the burn-up of the fuel is very small and most of the fuel elements loaded into the core in 1962 are still there. A summary of the fuel situation is shown in table 1.

Number of FE	Location	Cladding		Enrichment	Remarks
		Al	SST		
81 + 3 stor.	core	57	27	75 FE 20% 9 FE 70%	2 instr. FE
11	fresh fuel storage	-	11	20%	2 instr. FE
8	spent fuel storage	8	-	20%	1 instr. FE
1	hot storage facility	1	-	20%	cut into 3 pieces
total: 104		66	38	84 FE	

Table 1: Fuel element situation at the TRIGA Vienna as of 1. 10. 2004

The TRIGA reactor is heavily used for training and education of students in the nuclear field but also used for national and international training courses with the IAEA and with neighbour countries (Germany, Czech Republic, Slovak Republic, European Nuclear Engineering Network - ENEN). Many cooperation projects exist with the IAEA as the TRIGA reactor Vienna is the closest nuclear facility to the IAEA and the irradiation services have increased since the shut down of the ASTRA reactor although in many service requests

the TRIGA cannot offer the requested power and neutron flux. In view of remaining the only research reactor in Austria both the government and the academic environment has interest to keep this nuclear facility alive for as long as possible. At present there is no indication from the government that an imminent shut down of this facility is taken into consideration.

3.3 The ARGONAUT Reactor in Graz

The Reactor Institute Graz, attached to the University of Technology Graz, Austria, operated a low power Siemens-ARGONAUT Type reactor (10 W) for education and training in the academic field (Fig. 2).

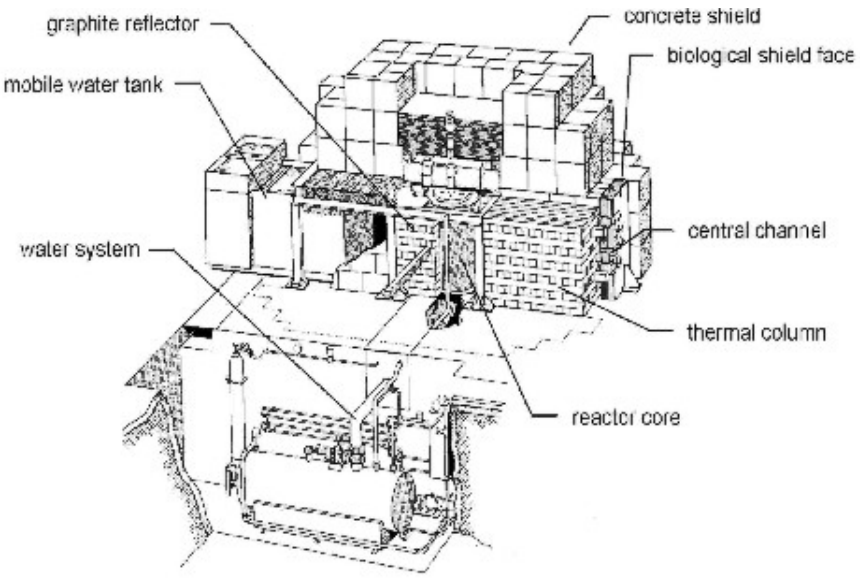

Fig. 2. Pictorial view of the Siemens-Argonaut-Reactor Graz.

From May 1965 to April 1985 the Siemens-ARGONAUT Reactor (SAR), located in Graz, was driven alternatively by an annular core with 234 low enriched (20% U 235) fuel plates and an asymmetrical one-slab loading with 125 high enriched (90% U 235) fuel plates. Since 1985 all low enriched fuel plates have been located in a dry storage because on 50% of the plates the aluminum cladding was damaged by corrosion. During the reactor operation from 1965-1985 the average reactor power was 1-10 W (10^7-10^8 neutrons/cm²s). The last core was composed of 108 fuel plates (90% U 235) from the second delivery at 1969, while 17 fuel plates, also enriched at 90%, were stored in the fresh fuel storage. The SAR-Graz was finally shut down on August 31, 2004. All fuel plates (low and high enriched) will be returned to USA by 2005. A contract has been signed in summer 2004 with NAC to ship the fuel plates from Graz via the port of Koper/Slowenia to Savannah River not later than end of 2005.

As the shielding construction consists of individual concrete blocks assembled together the dismantling of this structure does not pose any technical problem. Further due to the low power level only a very few components will show a slight increase of activity and will be considered as low active waste. Therefore it is expected that the decommissioning of the ARGONAUT reactor will proceed smoothly and should be finished in a very short period.