DECOMMISSIONING OF THE NUCLEAR FACILITIES OF
VKTA AT THE ROSENDORF RESEARCH SITE

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ABSTRACT

VKTA decommissions the old nuclear facilities of former GDR’s (German Democratic Republic) Central Institute of Nuclear Research which was closed end of 1991. VKTA is responsible for fissile material and waste management, environmental and radiation protection and runs an accredited laboratory for environmental and radionuclide analytics.

The Rossendorf research site is located east of the city of Dresden.

The period from 1982 to about 1997 was mainly characterized by obtaining the necessary licenses for decommissioning and developing a new infrastructure (i.e. waste treatment facility, interim storages for fissile material and waste, clearance monitoring facility).

The decommissioning work has been in progress since that time. The decommissioning projects are concentrated on three complexes:

- the reactors and a fuel development and testing facility,
- the radioisotope production facilities,
- the former liquid and solid waste storage facilities.

The status of decommissioning progress and treatment of the residues will be demonstrated.

Finally an outlook will be given on the future tasks of VKTA based on the “Conception VKTA 2000 plus”, which was confirmed by the Saxonian government last year.

INTRODUCTION
The VKTA has been charged with the decommissioning, dismantling and management of all nuclear facilities of the former Rossendorf Central Institute of Nuclear Research of the Academy of Sciences of the GDR which was wound up at the end of 1991. At that time this comprised mainly three reactors, one isotope production facility with the AMOR (Anlage Molybdänproduktion Rossendorf) plant for molybdenum production as well as storage facilities for solid and liquid wastes. The radioactive inventories are managed according to current rule and the fissile material in particular is protected according to highest standards.

The period from 1992 to 1997 was mainly characterized by extensive work for obtaining the licenses required for decommissioning under the German Atomic Energy Act. A new infrastructure had to be developed at the same time until the end of the 90-ies:

The total costs of decommissioning including the costs for new infrastructure are estimated at approx. € 300 million. In the light of this considerable amount of costs the nuclear installations of VKTA are decommissioned and managed on the basis of orders from the Free State of Saxony given by stages.

A NEW INFRASTRUCTURE AS A BASIS FOR DECOMMISSIONING

New infrastructural facilities had to be developed at the site in order to make decommissioning possible. They were in particular:

- **The Facility for Disposal of Fissile Material.** The fissile material which originally had been distributed over a number of individual storages at the site was kept at top safety level in a newly created facility in 1999. All 951 spent fuel elements of the Rossendorf Research Reactor have been kept here in 18 CASTOR MTR®2 casks since the end of 2000.

- **The Waste Treatment Facility** has been in operation since 2000. Being a central treatment facility for liquid and solid low level wastes it is a major prerequisite for the operation and the decommissioning of the facilities at the site. A mobile equipment for the transport of radioactive liquid from the site was developed and put into operation.

- **Interim Storage.** The new interim storage for solid radioactive wastes was put into operation at the end of 1999, double the size of its original design. This is the guarantee for operation and decommissioning of the nuclear facilities at the site also after the closure of the final storage facility ERAM. From today's point of view all interim storage requirements can be fulfilled with the Interim Storage Facility Rossendorf having a gross storage capacity of approx. 2,000 m³ until a federal repository is available.

The Clearance Monitoring Facility was put in operation in mid 1999. The licensing authority has regulated the procedure for clearance monitoring and release of material with negligible activity in a special license.
Control of the clearance procedure and release of the material is permitted to be done by a special commissioner for release within the VKTA organization.

The accredited laboratory for environmental and radionuclide analytics accompanies all the decommissioning steps from monitoring up to assessment and assists the decommissioning and the waste treatment with recommendations for the procedure. Extensive radiochemical analysis are inevitable especially during decommissioning of the former isotope production facility because extremely different nuclide vectors exist in this facility as a result of the former handling of a large variety of radionuclides. Analytical methods in a wide range of activity levels (from mBq up to GBq) and modern analytical technology are available for activity determination of these nuclides and enable VKTA to manage external service orders besides their own decommissioning tasks.

THE CONCEPT OF DECOMMISSIONING

An efficient decommissioning management was achieved by developing three decommissioning complexes. This enables VKTA to carry out work parallel on the one hand or to concentrate work on one main subject, on the other hand.
Decommissioning Complex 1 comprises the Rossendorf Research Reactor RFR in addition to two zero power reactors (and a nuclear facility for development and testing of fuel elements /Urantechnikum/). RFR used to be the central nuclear installation at the Rossendorf Research site. It is a tank-type reactor of Soviet design and was operated by Soviet fuel elements with 36 % enrichment (Fig. 1). As it was not possible during the period of its operation to return the irradiated fuel elements to their country of origin, all the 951 spent fuel elements were stored in an underwater storage in the reactor hall. One of the major decommissioning measures was the termination of this underwater storage. By means of a special mobile transfer station all fuel elements were transferred under dry conditions into 18 CASTOR® MTR 2 casks which were transferred to an interim storage hall at a Facility for Disposal of Fissile Material. This work was accomplished end of 2000. It is scheduled to transfer the loaded CASTOR casks to the central interim fuel element storage at Ahaus, Germany. Currently the approval is still pending. After the fuel elements have been removed from the reactor hall the reactor facility was defuelled in the beginning of 2001.

The second cooling loop of the reactor is already decommissioned completely. The third step of decommissioning comprises the treatment and release of the operating media as well as the lay up and the decommissioning of all systems and components of the reactor. This work is scheduled to be finished end of 2003.

Fig. 1. Reactor block of Rossendorf Research Reactor

One of the main tasks was the dismantling of the pumps, pipes and heat exchangers. The reactor vessel was taken out of the concrete structure completely in November last year and transported to EWN GmbH at Greifswald for dismantling and conditioning as nuclear waste (Fig. 2).
The fuel development and testing facility was the largest single building of the decommissioning projects. Originally it was planned to become a fuel production facility to close the fuel cycle at the site, but the program was stopped after building construction. So it was only used for fuel development and testing. Nevertheless it was fairly contaminated. After decontamination the building was demolished completely in a conventionally way (Fig. 3) and meanwhile the area has been renaturated.

The following Table I shows the expected mass of residues and the actual result achieved at the end of 2002.

Table I. Mass of residues from Decommissioning Complex 1
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RAKE Zero Power Reactor</td>
<td>12</td>
<td>3</td>
<td>9</td>
<td>0.01</td>
</tr>
<tr>
<td>RRR Zero Power Reactor</td>
<td>251</td>
<td>203</td>
<td>10</td>
<td>38</td>
</tr>
<tr>
<td>Fuel development and testing Facility</td>
<td>13,170.5</td>
<td>13,123</td>
<td>0.5</td>
<td>47</td>
</tr>
<tr>
<td>RFR except Office Building already disposed</td>
<td>4,254 *</td>
<td>2,793 *</td>
<td>1,231 *</td>
<td>230 *</td>
</tr>
</tbody>
</table>

* estimated

Decommissioning Complex 2 comprises the former isotope production facilities and the AMOR complex.

The facility for Mo-99 production (AMOR) had reprocessed the short-term irradiated fuel elements of RFR by liquid extraction to extract in particular the molybdenum produced by fission. After the separation the fission solution was processed in order to reclaim the nuclear fuel as uranyl nitrate. Then the uranyl nitrate was converted in a separate facility so that the fission material could again be used for Mo-99 production.

The AMOR facilities and some facilities for other isotope production were situated in the same complex of buildings. Therefore various different nuclide vectors have to be taken into consideration.

The AMOR facility was free of fission material in the beginning of 2000 and the separated fission solution was solidified by cementation in a mobile facility and transferred to the waste Interim Storage. Since May 2001 the dismantling of components and systems is in progress. The structures of the buildings are not to be demolished in this context.

Main tasks of this decommissioning step are the dismantling of the equipment around and inside the cells of the AMOR facility and the radioisotope production as well as the dismantling of the underground storage and treatment tanks for fission product solutions. Therefore a ventilated hall with a caisson inside had to be constructed on top of this area. (Fig. 4)

Caused by the presence of very different nuclide vectors, consisting of alpha- beta- and gamma emitting nuclides at the different decommissioning objects, intensive analytical determination is urgent.

That means, the radiological situation has to be examined very thoroughly. VKTA use in-situ technology as well as analytical examinations in the laboratories as the case may be. For example, an area of about 10,000 m² was monitored with in-situ gamma spectrometry in the former radioisotope production facilities.
The decommissioning of the AMOR complex is scheduled to be finalized by the end of 2005. After that the objective of a final license will be to finalize demolishing of the buildings to “Greenfield level” and to release all the areas of the former production facilities from the ambit of the Atomic Energy Act by approximately 2008. (The following table II shows the expected and actually mass of residues.)

<table>
<thead>
<tr>
<th>Facility</th>
<th>Total Mass[Mg]</th>
<th>Unrestricted/Restricted Release[Mg]</th>
<th>Radioactive Waste[Mg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMOR-Complex already disposed</td>
<td>180 *</td>
<td>132 *</td>
<td>48 *</td>
</tr>
<tr>
<td>Isotope Production already disposed</td>
<td>775 *</td>
<td>340 *</td>
<td>435 *</td>
</tr>
<tr>
<td>Building structures already disposed</td>
<td>350 *</td>
<td>335 *</td>
<td>15 *</td>
</tr>
</tbody>
</table>

* estimated

Decommissioning Complex 3 comprises the former facilities for the storage of solid radioactive wastes and for the treatment and storage of radioactive liquid effluents including the special canalization system.

The former storage for solid radioactive wastes consisted of an underground monolithic concrete block with six lined containers. The solid radioactive wastes from the reactors and the isotope production were dropped and cemented in these containers. The content of these containers was removed by remote handling equipment conditioned and stored in the new waste interim storage. The building is already decontaminated and it is scheduled to release it from the ambit of the Atomic Energy Act before the end of this year.

The former facilities for the treatment and storage of radioactive liquid effluents consisted mainly of underground cooling ponds and a special canalization system consisting of pump shafts, holdup and neutralization ponds and a waste water pilot plant.

CONCEPT FOR RELEASE OF PREMISES

Based on its detailed analytical experience and in accordance with the de-minimis-concept VKTA has worked out a concept for the release of premises with contaminated soil in deeper layers under their surface with a view to decommissioning these nuclear facilities and the area. The objective of this concept is to leave contaminated soil and remaining concrete structures of buildings in deeper layers in place without affecting the environment. Meanwhile this concept has received an affirmative examination by the Öko-Institute Darmstadt, Germany and will be approved by the licensing authority shortly.

Following this concept, we expect to reduce the amount of soil which has to pass our clearance monitoring facility down to less then 20% of the original estimate.

According to today's knowledge we expect an overall amount of approx. 1.300 m³ of solid radioactive waste by the end of the decommissioning measures. I.e. approx. 7.000 m³ of low level radioactive residue material will arise, out of that approx. 3.700 m³ rubble of concrete structures, 2.700 m³ of soil and approx. 600 m³ of other materials which may probably be released without restriction and/or within certain limits after successful free release measurement.
MANAGEMENT OF FISSILE MATERIALS

VKTA is responsible for the aggregate fissile material of the former nuclear research programs carried out at this site. In this context we separate the irradiated fuel elements of the RFR from other fissile material. Currently we still have at the site approximately 0.01 kg of plutonium, about 200 kg of highly enriched uranium, about 800 kg of low-enriched uranium, about 3,000 kg of natural uranium and about 4,500 kg of thorium.

We are currently working on a project together with BNFL for the treatment of approx. 4 m³ of highly enriched uranyl nitrate solution. I.e. the uranyl nitrate solution is enriched to < 2 % U-235 in an initial blending process in Rossendorf and then transported to BNFL, Sellafield. There the uranyl nitrate solution is blended in a second blending process to an enrichment according to the requirements of the Magnox facility and processed in this facility. The final product, i.e. depleted uranium oxide is returned to VKTA.

FUTURE OUTLOOK

VKTA has developed a concept for the future, i.e. for the time following the decommissioning of the nuclear facilities. It is currently discussed with our supervisory board and the Saxonian government. It is our objective to create the necessary preconditions for a continuous expansion of the existing service potential of VKTA (see www.vkta.de) and to make it increasingly accessible for external customers with a view to developing a future for the expert staff and to preserve the know-how for the tasks to be accomplished until the end of the decommissioning process.