

**INVOLVING GREAT EXPENSE OF THE LICENSING PROCEDURE FOR  
DECOMMISSIONING OF A TRIGA RESEARCH REACTOR IN THE FEDERAL REPUBLIC  
OF GERMANY**

B. Juenger-Graef, K. H. Hoever  
DKFZ Heidelberg (German Cancer Research Center)

T. Moser  
Siempelkamp Nukleartechnik

**ABSTRACT**

The licensing steps and activities are the same as we have to perform for the decommissioning of a nuclear power plant in Germany.

We have to describe in details:

- Status indication by the point of shut down and the status indication of former operation times and conditions
- Publication of the decommissioning
- Safety report with details of the whole working procedure i.e.:
  - decommissioning and dismantling,
  - description of the applied dismantling techniques
  - worst case failure analysis
  - calculation (estimation) and evaluation of the activity amount
  - estimation of dose rates
  - waste management and detailed declaration of waste disposal
  - drawings and description of the planned steps.
  - description of machines, lifting tools, waste casks etc.
  - sequence plan and feasibility evaluation on the performance of each task
  - description of the logistics inside and outside, and the transport ways.
  - measuring methods and procedure of release from the atomic law
  - certification about the technical knowledge of the employees
  - appointment of the responsible persons for decommissioning
  - safeguard device
- Environmental review for the performance of the decommissioning/ dismantling methods
- At least an environmental report for the European Union Members:
- We must give an overview for the environmental risks, the dose rate caused by the decommissioning, and the calculation of the dose rate for the next neighbours in the European Union.

We have to perform all conditions, which the independent experts (TUEV) require. If we want to change a sequence after the survey and the permit, we have to announce that to the authority and the independent experts to get the permit again.

Additionally we want to present in our paper a virtual imaging of the several decommissioning steps by computer added 3-D simulation of dismantling the reactor core and other equipments, also of the biological shield and the logistics of waste.

## **INTRODUCTION**

In the German Cancer Research Center (DKFZ) we have a research reactor type TRIGA Mark I with 250 kW power. This reactor (TRIGA HD I ) was since August 1966 eleven years in operation in the temporary building of the Institute of Nuclear Medicine. In 1978 it was moved into the permanent building of the DKFZ (TRIGA HD II) ; the whole equipment was in a new design incl. the reactor instrumentation, only the fuel were moved to the new building after a 4 months decay.

In 1980 all the equipment of the TRIGA HD I was dismantled and only the tank and the biological shield remained in a so called “SECURE ENCLOSURE”. To get the release from the Atomic Act we have to decommission both sites and dismantle those.

The TRIGA HD II was running until the end of the millennium (November 30, 1999) and the spent fuel was shipped to IDAHO in June 2001. It was used in cancer research for the production of radioactive nuclides and the analysis of neutron activation in biology, medicine and material research.

This presentation will show the **huge expense** of the procedure to get a permit for the decommissioning of a small TRIGA research reactor in Germany and also the financial needs.

The licensing steps and activities are the same as we have to perform for the decommissioning of a nuclear power plant in Germany. There are an amount of nuclear regulations we have to perform (KTA) referring to these regulations.

### **The Technical and Administrative Needs**

The **status indication** by the point of shut down and the status indication of former operation times and conditions must be described in details: It's not allowed to dismantle even a screw that is not used any more before having the permit, and therefore you must refer a status indication

### **Publication of the Decommissioning**

The government requires a publication of the decommissioning procedure, so every citizen shall have the opportunity to make an objection to the decommissioning. This is the same procedure as if you want to build a nuclear facility.

**You have to perform a precise Safety report** with details of the whole working procedure i.e.:

- planning of the decommissioning at all. The authority review the steps you intend to perform and evaluates the sequence and the logistic procedures.
- decommissioning and dismantling steps, the radiological effects have to be considered and evaluated.
- Description of the applied dismantling techniques of the hydraulic and cylindrical splitting, the pros and cons of this method have to be considered, especially the dangerous steps, and what to care for during the whole procedure.

- Worst case failure analysis and preventive measures during the whole decommissioning time
- Calculation or estimation of the activity and evaluation of the activity amount before the begin of the dismantling procedure.
- Estimation of dose rates for the working people and methods of minimizing the dose rate
- Waste management and detailed declaration of waste disposal, we will show the flow diagram of waste management, the ways of radioactive waste to the long term storage and the ways of free release.
- Drawings and description of all planned steps with sequence plans and feasibility evaluation on the performance of each task.
- Description of all tools we use, the machines, lifting tools, lifting crane hooks, equipment casks, waste casks etc. The consideration of the “worst case” i. E. A load rejection of waste barrels and the description of the logistics inside and outside, the cleaning measurements and the transport ways to the interim/long term storage.
- Measuring methods and procedure of release from the atomic law either for components, the equipment, the tools and either the reactor building must be permitted by the government.
- We must certify that all employees have the technical knowledge and the knowledge of the atomic act and all rules of radiation protection. And the official appointment of the responsible persons for decommissioning must be presented.
- Security regulations and devices must be used and declared.

### **The Environmental Review**

for the performance of the decommissioning/ dismantling methods must be described and licensed. This is a paper, that contents all aspect of the environment, it is about a100 pages long and you must show how you care for the people living around the facility, - in our case also the institutes and the students of university campus and even each living creature.

### **At Least an Environmental report for the European Union Members:**

We must give an overview for the environmental risks, the dose rate caused by the decommissioning, and the calculation of the dose rate for the next neighbours in the European Union. You have to present that by the federal government to the government of the European Union six month before you will begin with the decommissioning.

Before we start with any decommissioning step we have to perform all **survey conditions**, which the independent experts (TUEV) require. If we want to change a sequence or to make a modification after the survey and the permit, we have to announce that to the authority and the independent experts to get the permit for this point again.

Start of the dismantling procedure will hopefully be in the first days of February 2004. Additionally we want to present in our presentation **a virtual imaging** of the several decommissioning steps by computer

aided 3-D simulation of dismantling the reactor core and other equipments, also of the biological shield and the logistics of waste.

### **Method of Dismantling the Biological Shield**

Just on site of the reactor is a still running cyclotron machine and several laboratories beneath. Therefore we will make sure, that the method of dismantling is “very soft”, with as less vibration as possible and also so noiseless as possible. That surely couldn't be all the time, but therefore we choose a hydraulic split method for the concrete dismantling. The upper part of the shield will not be activated, and all will be released by passing a radiation measurement system.

The activated zone surrounding the core area in depth of about 20 cm should be delivered to the long term storage, and along the boarder between activated and free concrete there must be measured very carefully. Therefore we decided and agreed with our authority, that we will measure each barrel with waste and each component that goes out of the facility.

### **Waste Management**

Everybody knows that the question of long term storage in Germany is a very hot and trouble making theme.

We proposed a motion (referring to the German radiation Shielding Regulation) to the State Government to deliver our waste to the state long term storage (that's a part of the interim storage), where 20 years ago the waste of the TRIGA HD I was stored. Normally the reactor facilities must deliver the waste to an interim storage.

In this proposal we had to calculate the amount of waste, the different materials, the activity and to give an real nuclide vector for all materials. This is very difficult, because not each material is well known, and it is not easy to estimate the amounts of concrete, even we could not take samples of the bio-shield, while the equipment is under water still in the reactor tank

### **Financial Situation and Costs**

For the decommissioning of the TRIGA reactors in Heidelberg the estimated costs of all parts are about 11,5 to 12,0 million Euros. The first part of the return of the fuel to the country of origin with preparing the building by static supporting of the truck gallery for the cask handling, the survey.

- Engineering and tendering 0.5 Mill €,
- Transport to the USA was all inclusive about 4.8 Mill €,
- Decommissioning and dismantling of the TRIGA will cost about 3.5 Mill €,
- Survey maybe will cost about 1.5 Mill €,
- Waste management and long term storage we are considering another 1.5 Mill €.

We had an examination by the Ministry of the Federal Government of Germany in the last summer (2003), and the members of this committee were very content and excited, that our project is running very

quickly and very well, so even under the very urgent restrictions to cut down expense, we got all the money we need for this year. And hopefully it continues in the same way for the next year.

### **Time Schedule**

We decided in the end of 1996 to shut down the reactor finally.

At the end of 1999 the final shut down happened, and in 2000 we began to prepare all administrative needs. We announced our project all over the European countries, we got many applications and we found out the consortium of NCS/GNS, that offered the return and shipment of the fuel to a good and trusted price. The contract with this consortium was made in May 2000.

Then we had to make two notices of change, because we want to handle the fuel within our operation license. Because some delays in planning and priorities in the organisation of the consortium, there was much stress and it cost a huge effort to ship the fuel in time. On June 1, 2001 three transport casks with our fuel to the USA were on the road and four weeks later they arrived in Idaho Falls.

After fuel return the same procedure of an European announcement of the decommissioning began. It took much time to evaluate seven large offers for the decommissioning. That was a huge procedure too, and after 15 month (end of 2002) we made the contract with GNS Gesellschaft für Nuklearservice, Essen for decommissioning, because we were convinced that their way of decommissioning will be the best.

In the early summer last year we made a notice of change for the building preparations (locks, air conditioning systems, material transport lock, etc) and we got the permit for that in August 2003.

The proposal for the decommissioning we gave to the authority, the Ministry of economy and the Ministry of environment on February 26, 2003 and quite after that we started to write the documents for the dismantling of the reactor in, and about 11 month later (late January) we hopefully will get the permit for the decommissioning. The begin of the dismantling will be in February 2004, it starts with taking out the in core components, than the technical equipments and cooling systems will be taken out, and we will continue with dismantling and measuring of the biological shield and with the logistics and transport of the waste.

At the end of the year 2004 we will dismantle the TRIGA HD I and in the first half year 2005 we make all the measuring of the building structures and hopefully will get the release from the atomic act and finish the project in the mid of 2005.