

# Radioactive Transports

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## **Abstract**

The transport of radioactive materials has a long experience at PSI, both at national and international basis. The range of radioactive materials transport includes waste, radioisotopes, components, fuel elements/pins and samples of MOX. A Quality Assurance System is used and Safeguards controls are applied. PSI has also transport packages of type A and Type B (U) for small quantities of fuel.

## **1. Introduction**

The transport of radioactive materials at PSI started almost 40 years ago with national and international R&D activities and transport of nuclear fuel for the former research reactors SAPHIR, DIORIT and the PROTEUS reactor still under operation. Spent fuel was sent in the 60's to France and Belgium for reprocessing (reactor DIORIT) and fuel was brought from USA for the reactor SAPHIR. At the zero power reactor PROTEUS fuel ranging from fast breeder, HTGR, MOX and advanced LWR (PWR & BWR) has been studied and measured.

Meanwhile, spent fuel from SAPHIR has been returned to USA and spent fuel from the last DIORIT core has been stored in a dry transport Castor cask (since about 20 years).

## **2. Transport modes and experience**

All mentioned activities have demanded very intensive transport work in Europe and in the USA and accomplished without problems. Different casks have been used for MTR fuel (fresh and irradiated), large casks for MOX and special ones for HTGR fuel and transport modes ranging from road, sea and air carriers have been achieved without problems.

On the other hand an intensive R&D programme and supply service of radioisotopes for medicine, industry and research has been carried out at PSI in the last 20 years and covering transport activities in Europe, USA and other countries.

Additionally, PSI is responsible for the collection, conditioning and interim storage of all radioactive materials produced in medicine, research and industry facilities in Switzerland; yearly transports of these materials to PSI are required.

## **3. Transport of R&D fuel**

Parallel to the mentioned activities, the PSI Hot laboratory started operations in the sixties and dealing with fuel examination (PIE), isotope production, reactor material and components examination and nuclear waste disposal research.

Meanwhile a plutonium fuel R&D programme achieved international status in Europe, Japan, France etc. and MOX fuel has been transported nationally and abroad.

Developments on higher burnup of LWR fuel continue to be examined at PSI, including mechanical testing of irradiated cladding materials; the international collaboration with other research facilities abroad demands the transport of these materials from the Swiss nuclear power plants to PSI and also to the foreign facilities.

Recent developments dealing with the Generation IV Systems ( R&D efforts on advanced nuclear power concepts) show the necessity of advanced fuels e.g. TRISO UOC (VHTR), UO<sub>2</sub> (SCNR-Th) etc; these fuels aim to high temperatures and therefore to higher burnup and of course to the transport of specimens/fuel elements in adequate casks. A new situation which must be addresses properly and as required.

## **4. The transport technology**

The transport of radioactive materials is not trivial; this activity is included in the group dealing with dangerous goods and regulated in all modes of transport: road, rail, air, sea and waterways. All

regulations are based on the IAEA Safety Standards and in the specific transport modes and additional national legal framework.

In order to comply with the regulations and the legal framework, it is demanded by the nuclear regulatory authorities to use among others, a Quality Assurance System in accordance with the IAEA regulations and implemented as needed with ISO-standards and own procedures.

A Quality Assurance System which complies with the mentioned regulations was developed at PSI and applied since 1994; most of all requirements and corresponding controlling activities existed, nevertheless the building-up effort to tight the different quality elements in the transport process was done.

The transport process follows the specific radioactive material e.g. three main types of them and five lower categories under the general radioactive materials (none fuel). In order to apply the QA-System to a given material, specific Quality Assurance Plans (QP) are used. The QP covers basically the following main steps of the transport process:

- ❖ Transport Planning and Organisation
- ❖ Transport Arrival (with empty or loaded package)
- ❖ Transport Departure
- ❖ Package Arrival verification (empty or /loaded)
- ❖ None Conformity control and procedures
- ❖ Documentation

All these process steps follow the QA-System elements, their requirements, responsibilities and verification documents.

The operational success of the QA-System requires not only the system documents from the user and elsewhere (transport company, cask supplier, regulatory authority etc.) but a continuous control of the technical status of the transport systems, the personnel qualification and effective management. The coordination and team work with qualified transport organisations is required in order to sustain the achieved high nuclear safety records.

We have a safeguard control system and also a security control organisation at all nuclear facilities and coordinated with the transport activities of fissile material and we report to the IAEA and other control Organisations as required.

## **5. Conclusions**

The transport of radioactive materials – fissile and others – is a vital link in the nuclear activities and required worldwide. For the short term, there are bottlenecks in the availability of certified casks complying with the actual regulations. It is necessary that the nuclear regulatory authorities response with flexibility, in order to grant adequate transition time for new casks to be operated.

An increasing set of standards, regulations, procedures, legal requirements, etc. leads today to highly regulated transport processes. An effort to optimise the amount of paperwork is required, in order to keep the transport process transparent and efficient.

Because of limitations in cask availability, it might be useful to share casks with different owners; nevertheless there is the requirement of extended validations for the transit and user countries and the time required to obtain them.

PSI has transport packages of type A , as well as casks of type B (U) F-85 and B (U)-85 adequate for small fuel quantities; PSI uses currently various larger casks e.g. R-52, TN6, PADIRAC RD 25 II B, TNB-Casks etc. which are used also at various Swiss nuclear power stations and research facilities abroad. Some interim storage facilities are available at the institute.

Air transport restrictions, added to the lack of type C casks or acceptable type B (U) casks, limit also the transport of MOX fuel. Some road/sea transport developments show potential limitations in Europe and require specific clarifications in order to avoid complications in the timing and compliance of important international projects.