THE SHIPMENT OF EMPTY FRESH-FUEL PACKAGES

Herman Sannen, Serge Hérin
Transnubel
Gravenstraat 73
B-2480 Dessel

ABSTRACT

If empty fuel-element packages are shipped under schedule 4 "empty packages as excepted packages", the consignee will receive packages with an external contamination below 0.4/0.04 Bq/cm² (SS6) or -R-1), respectively. The internal contamination is limited to 40/400 Bq/cm². The complexity of the internal structure of such packages results in a potentially high total contamination, well above the acceptable working limits for areas not controlled as potentially contaminated areas. Some fuel fabrication plants require a certificate of no contamination (below 0.4/0.04 Bq/cm²) and/or a consignment limit (e.g. total alpha emitter content below 5,000 Bq) in order to comply with their internal procedures (and possible legal requirements). Such certificates are difficult to deliver, due to the complex internal structure of such packages, on a routine basis. A complete whole package verification to certify these very low limits is very time consuming.

A workaround was developed in order to comply with these requirements. Before the start of the campaign, the package is thoroughly verified and controlled for absence of contamination. Verification may be performed by two different people, one who is independent from our company. Proper certification of the absence of any contamination and a total amount of alpha emitters below 5,000 Bq is issued by the health physics service. After each step in the campaign (loading in the fuel fabrication plant, and unloading at the nuclear power plant), the health physics/radioprotection staff members of the concerned installation issue a certificate stating that, based upon the former certificate, their measurements, and the events which occurred under their responsibility that the package remains free from any contamination (above the 0.4/0.04 Bq/cm² limit) and (if applicable, apart from the fuel elements present) no alpha activity above 5,000 Bq is present. This certification allows the transport to be executed without supplementary provisions.

INTRODUCTION

The shipment of empty packagings, having contained e.g. fresh fuel elements is routinely done under class 7 as "empty packagings as excepted packages" (schedule 4).

The regulatory provisions as required by the transport regulations can be summarised as follows :

- Radiation level : 5 µSv/h at the surface of the package.
- Internal non fixed contamination : 400 Bq/cm² (beta-gamma and low toxicity alpha emitters)
  40 Bq/cm² (other alpha emitters).
- External non fixed contamination* : 4 Bq/cm² (beta-gamma and low toxicity alpha emitters)
  0.4 Bq/cm² (other alpha emitters)

* These values are applicable if TS-R-1 is applied - under SS6-ed.85 the applicable values are 1/10 of these.

Compliance with these provisions is not a big issue and can easily be confirmed and certified by consignors, shippers, carriers and consignees.

On the other hand, other supplementary requirements originating from other regulations can be much more difficult to meet.

REQUIREMENTS SUPPLEMENTARY TO TRANSPORT REGULATIONS

Internal contamination level :
due to the fact that the storage and handling of the empty packagings (maintenance etc) and that the loading and unloading operations routinely are done in non controlled area or in area only controlled on radiation not on contamination, the maximal contamination levels as guaranteed and certified by the transport regulations (400/40 Bq/cm²) are much too high. Routine requirements for these purposes are 4 and 0.4 Bq/cm² (resp. beta-gamma and alpha) or in some cases 0.4 Bq/cm² and 0.04 Bq/cm² (non controlled area).

Consignment limit :
in order to be exempted from the requirement for a site license (controlled area) or, in some countries for an import license the consignment limit is set to max. 5 KBq for low enriched U or Pu and to max. 50 KBq of isotopes like ^{60}Co.

These figures are actually based on the exemption limits in function of the radiotoxicity as laid down in the directive 80/836/Euratom from 15 July 1980.

In the near future these exemption levels will be replaced by those of the BSS (very similar to the values in table I of TS-R-1 last column - Activity limit for an exempt consignment).

These values can be lower than the present limits, for instance :

present limit for nat. U : 5 MBq
future limit for nat. U : 1 KBq

present limit for low enriched U : 5 KBq
future limit for low enriched U : 1 KBq

SETTING OF THE PROBLEM

Due to the complexity of the internals of fresh fuel packagings (U or MOX based fuel) and the large complex surfaces (several tens of thousand square centimetres), it is very difficult to demonstrate by measurement (direct or through wipe test) a consignment limit of 5000 Bq on activity. Even the demonstration of the internal alpha contamination level below 0.04 Bq/cm² is not evident routinely for such complex structures. The measurements necessary in order to justify the mentioned statements are very time consuming and require specialised equipment and personnel. During a standard fuel delivery campaign, where the same packages are used several times subsequently, time constraints are such that it is impossible to do all the necessary measurements each time. Taken into account that routinely the loading and unloading of fuel assemblies is done in a clean area, it is relatively easy to avoid any contamination (also for QA reasons and in order to maintain the quality of the fuel such precautions are mandatory).

On the other hand it is difficult to obtain a certificate stating contamination levels as required without a 100 percent verification (the problems with contamination on spent fuel casks have their influence on this).

PRAGMATIC SOLUTION

After several discussions with various health physics services of nuclear power stations and fuel fabrication plants we agreed upon the following procedure.

Before the start of the fuel delivery campaign, during the routine maintenance and cleaning process, the packagings are thoroughly measured and controlled by direct measurement and through wipe test on the complete absence of contamination (non fixed and fixed).

Some measurements are verified by a second operator (other company or independent control organism).

The packagings are then certified as not radioactive and transported as neutral equipment (not class 7 – not dangerous goods) to the fuel fabrication plant. The packagings each have a certificate of "not radioactive" and are accepted as such by the health physics service of the fuel fabrication plant (after control measurements).

Based upon :

- the certificate they received;
- the measurements they executed;
- what happened (or did not happen) during handling in their facility, under their responsibility

the health physics service of the fuel fabrication plant (consignor) delivers a certificate (see appendix 1) stating that, apart from the fuel assemblies, the packages are free from any contamination and radioactivity.

Before loading, the vehicles are verified by measurement as free from contamination.

Because the shipment of fresh fuel from the fuel fabrication plant to the nuclear power station is normally done under exclusive use routinely in closed sealed vehicles (physical protection) it is obvious that during transport no contamination hazard occurs.

On arrival in the facility of the consignee, the health physics service of the power plant accepts the packages (after some control measurements for confirmation of the accompanying certificate) and takes over the responsibility.

After unloading of the packages and after some control measurements the health physics service of the nuclear power station will then issue a certificate of non contamination (consignment limit $\leq$ 5 KBq alpha contamination level < 0.4 resp. 0.04 Bq/cm^2) based upon :

- the certificate they received;
- the measurements they executed;

- the events noticed during handling and unloading of the packages in their facility under their responsibility (see appendix 1).

With this certificate, the packagings return to the fuel fabrication plant for the next delivery in the campaign (to the same consignee).

After the last delivery the empty packagings return to the storage place with a certificate of no contamination and total activity limit (consignment) < 5 KBq.

After verification (by measurements by the health physics service of e.g. the owner of the packaging) of the absence of any contamination or radioactivity the packagings can be stored in a non controlled area.

CONCLUSION

Using this procedure and agreement, the necessary documents and certificates required to comply with all regulations, can be issued each time after a normal and realistic series of measurements. After several campaigns to different power plants, up to now, no real problems occurred.

With some specific packagings, immediately after unloading of MOX fuel some fixed β-γ radiation (very low level) has been noticed. Apparently this radioactivity disappears after relatively short time completely. Further investigations are ongoing. Probably some local activation resulting in some short living β-γ emitters isotopes is occurring due to the neutron flux originally from the MOX fuel.

DECLARATION

Type N°

Packaging

Taking into account the control measurements and the history of the packagings we declare that :

- the exemption level given in art. 4 and appendix 1 of the directive 80/836/Euratom from I5/07/1980 is not superseded

- that no contamination
  (higher than 0.4 Bq/cm² for beta-gamma and low toxicity alpha emitters
  and 0.04 Bq/cm² for other alpha emitters)
  is present.

Consequently the transport, import and storage are exempted to be covered by authorisations or licenses in Belgium (cfr art. 38 and art. 56 KB 28/2/63 ARBIS).

Date	
Name of the company	
Address	
Name and signature	