WNTI

World Nuclear Transport Institute

FACT SHEET

Preparation of Natural Uranium Samples for Shipment in an Excepted Package

Dedicated to the safe, efficient and reliable transport of radioactive materials

Preparation of Natural Uranium Samples for Shipment in an Excepted Package

Purpose

This Fact Sheet has been prepared by the World Nuclear Transport Institute (WNTI) Industry Members to guide Consignors in preparing the shipment of materials containing natural uranium, chemically separated uranium concentrate samples (solids and liquids), and uranium ore samples.

The guidance given here is based upon the requirements of the International Atomic Energy Agency (IAEA) in their publication (SSR-6, formerly called TS-R-1) titled: *Regulations for the Safe Transport of Radioactive Material*. This publication is the basis of many international and national regulations for the safe transport of radioactive materials. Compliance with SSR-6 does not necessarily imply that States' regulations will be complied with. It is the Consignor's duty to ensure that the method of packaging the radioactive material is compliant with the regulations of each country that the material is being transported through or into. (A summary can be found in WNTI Fact Sheet: *Safety Regulations Governing the Transport of Radioactive Material*).

This Fact Sheet includes comments that describe the industry agreed best practices in shipping natural uranium samples.

Natural Uranium

Natural uranium is defined as uranium (which may be chemically separated) containing the naturally occurring distribution of uranium isotopes (approximately 99.28% uranium-238 and 0.72% uranium-235, by mass). A very small mass percentage of uranium-234 is present.

IAEA Regulations Requirements

The IAEA includes a graded approach within their regulations for transport; hence the regulations provide threshold activity or activity concentration values under which the transport of material is **exempt** from regulatory requirements. When the material is not exempt and presents very low radioactive danger, limited controls in transport are required and the packages are called **excepted** packages. And when the material requires full control measures whilst the degree of radioactivity concentration exhibited by the material is still lower than certain threshold values, the material is called Low Specific Activity Radioactive Material (LSA). Most natural uranium samples can be transported as being either exempt or excepted. Others, which are more active, need to be transported as LSA similarly to the uranium oxide concentrate (UOC) that uranium mines and processing plants produce. This Fact Sheet does not address bulk transport of UOC as all mining companies should be conversant with this (refer to WNTI Fact Sheets; *Package Types used for Transporting Radioactive Materials* and *The Safe Transport of Uranium Ore Concentrates*).

Exempt Material

The IAEA exemption criteria fall into either of the two categories:

1. Material that has an *activity concentration*, in Bq/g, less than a specified amount; and
2. a consignment that has an *activity*, in Bq, less than a specified amount.

The specified activity concentrations and activity amounts are not referenced in this Fact Sheet as each country may have different exemption quantities and the Consignor will need to reference the limits for each country through or into which the material is being transported.

When calculating the exemption quantities, the activity of the uranium parent in equilibrium should be used. For the activity concentration, the amount of uranium (activity) included in the sample per mass of the sample (not including the packaging) should be determined. Here, the mass of impurities within the sample is also included. For samples where the uranium parent is not in equilibrium with its progeny, then the calculation for mixture of radionuclide would need to be used.

For mixtures of radionuclides, the determination of the exemption values may be determined as follows:

$$X_m = \frac{1}{\sum_i \frac{f(i)}{X(i)}}$$

where,

f(i) is the fraction of activity or activity concentration of radionuclide i in the mixture;

X(i) is the activity concentration for exempt material or the activity limit for an exempt consignment as appropriate for the radionuclide i; and

X_m is the activity concentration for exempt material or the activity limit for an exempt consignment in the case of a mixture.

Once the uranium material within the sample has been confirmed as conforming to the exemption criteria then no further controls on the transport of this material is required.

Excepted Package

The IAEA criteria for excepted packages include material in limited quantities that do not exceed those activity limits that are specified in SSR-6.

In the case of natural uranium these activity limits are *unlimited*. Although the activity limit is unlimited for natural uranium, the uranium progeny must be considered when transporting unprocessed uranium ore samples and the radionuclide mixture calculation used. The activity limit for the uranium progeny may not be unlimited. Further requirements for an excepted package specify that *the radiation level at any point on the external surface of an excepted package shall not exceed 5 μSv/h*. If the radiation level can be demonstrated to be *equal to or less than 5 μSv/h at any point on the external surface of the package*, the package may be considered as an excepted package. For a radiation level in excess of 5 μSv/h on the external surface of the package, a different packaging should be used. Refer to WNTI Fact Sheet *Package Types used for Transporting Radioactive Materials* for more information.


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Packaging Design Requirements

Under the IAEA Regulations, the design criteria that excepted packages are required to meet are the general requirements for all packages (refer to *WNTI Fact Sheet Package Types used for Transporting Radioactive Materials*). These requirements are almost identical to those that the IAEA specifies for an industrial package Type 1 (Type IP-1) – the only difference lying in an additional requirement regarding the dimensions of the package for a Type IP-1 package.

Best Practice 1: Source a package that has been qualified as being an industrial package of Type IP-1 category. UN packages or Intermediate bulk containers (IBCs) qualified for dangerous goods could also be used, as long as they are fit for this purpose. Consignors of uranium bearing materials need to take particular care in ensuring that the containment systems used are robust enough to maintain their integrity in case of minor transport mishap. Special attention must be paid to satisfy the IAEA additional requirements for packages of radioactive material transported by air.

Radiological Requirements

From the SSR-6, the excepted package must adhere to the following:

- The non-fixed contamination level of the external surfaces of the packages must not exceed an average value of **4 Bq/cm² for any area of 300 cm²**.

Best Practice: If ores and concentrates are visible or if the packaging looks dirty – clean it, before controlling the level of non-fixed contamination

- The radiation level at the external surfaces of the packages shall be **less than 5 Sv/h (0.005 mSv/h)**.

Best Practice: If possible pack lower activity samples at the outer edges of the package to provide further shielding from any gamma radiation.

Marking Requirements

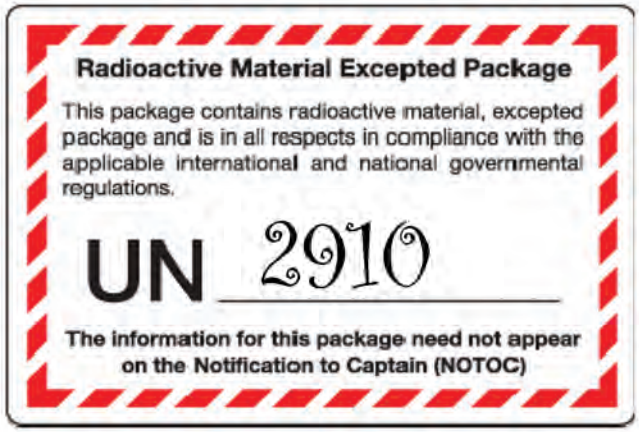
Each package shall be legibly and durably marked on the outside with:

- "**UN2910**";
- name and address of **Consignor and/or Consignee** (for air transport, both are required); and
- the **gross mass** when exceeding 50 kg.

Labelling Requirements

As noted above, the symbol "**UN2910**" needs to be displayed on the outer surface of the package and the marking "RADIOACTIVE" indicating that **the contents are radioactive** must be visible on opening the package.

In accordance with the Air Transport Regulations (International Civil Aviation Organization (ICAO)'s Annex 18 Safe Transport of Dangerous Goods by Air and the associated Technical Instructions for the Safe Transport of Dangerous Goods by Air (the "Technical Instructions")), and as also detailed in the International Air Transport Association (IATA) Cargo Dangerous Goods Regulations , when transported by air, the handling label "**Radioactive Material Excepted Package**" (as below) completed with the UN number "**2910**" should be affixed to the outside of the package.

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Documentation

The Consignor shall include in the transport documents with each consignment the identification of the Consignor and Consignee, including their names and addresses, and the contents should be described as UN2910.

In addition for:

- Air carriage:
  - **"UN2910 – Radioactive Material, Excepted Package – Limited Quantity of Material"** as the description of the material in the airway bill (Shipper's Declaration for Dangerous Goods is not required for excepted packages).

- Sea carriage:
  - At least a **"Shipper's Declaration for Dangerous Goods"** per consignment completed with at least:
    - "**UN2910 – Radioactive Material, Excepted Package – Limited Quantity of Material**"; and
    - "**Marine Pollutant**"

Other Dangerous Properties

Any other dangerous properties of the material must be taken into account in order to be compliant with the relevant international dangerous goods regulations and legislation of each country that the transport encroaches on.

Emergency Response

According to SSR-6, a graded approach is applicable when defining emergency response measures. In the case of excepted packages, which contain small amounts of natural uranium at low concentrations, the consequences of accidents, if any, are minor and there are no radiological reasons for taking special protective actions. Priorities for rescue, life-saving, first aid, and control of fire and other dangers should take precedence over measuring radiation levels. Unauthorised personnel must be kept away from any accident scene. Radiation Authorities must be notified of accident conditions.

Photographs

1 Package used to transport empty spent fuel baskets (Type A package)
2 Drums of uranium ore concentrate (Industrial package)
3 Spent nuclear fuel cask (Type B package)
4 MOX fuel cask (Type B package)
5 48" cylinders for transporting Hex
6 Tie-down for fresh fuel transport
7 Cask for MOX fuel
8 30" Hex cylinders with overpacks
9 Sea/rail transfer of test reactor fuel casks
10 Purpose-built vessel, Mutsu-Ogawara Port, Japan
11 Unloading operations
12 Sea transport of spent fuel

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