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WNTI: An overview of our current work on back end transport issues and the upcoming challenges facing our industry

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ABSTRACT

The World Nuclear Transport Institute (hereinafter referred to as WNTI) was founded in 1998 to represent the collective interests of the nuclear transport industry and those who rely upon it for the safe, secure, efficient and reliable packaging and transport of radioactive materials. The WNTI has grown substantially to nearly 50 members companies, representing a wide range of the nuclear industry.

In 2008, the WNTI established a dedicated Back End Transport Working Group (hereinafter referred to as BET WG) which gathered expertise on the transport of back end materials, including radioactive waste, spent fuel and decommissioned equipment. The purpose of this Working Group is to develop discussions on back end transport issues with the potential to affect radioactive materials transport in terms of safety requirements, costs, delays and any other aspects.

The nuclear transport industry has addressed new challenges such as the transport of large objects, dual purpose casks and so on. Based on our practical experience, we were able to provide the relevant information to the Competent Authorities and International Organizations, with the goal of contributing to the development of the relevant regulations and guidance. Our own guidance can also be shared among industry stakeholders for wider implementation.

There are ongoing challenges related to back end transport. WNTI will continue to provide the view of the Industry to the Competent Authorities and International Organisations.

INTRODUCTION

The WNTI was founded in 1998 to represent the collective interests of the nuclear transport industry, and those who rely on it for the safe, secure, efficient and reliable packaging and transport of radioactive materials. The WNTI has grown from 3 Founder members to nearly 50 member companies representing a wide range of the nuclear industry. One of the WNTI roles is to share Industry Voices with the Intergovernmental Organizations and Competent Authorities. To further

this mission, WNTI has working groups to address specific issues and challenges of interest to its members.

THE BACK-END TRANSPORT WORKING GROUP

In 2008, the WNTI established a dedicated BET WG which gathered expertise on the transport of back end materials, including radioactive waste, spent fuel and decommissioned equipment. The purpose of this WG is to develop discussions on back end transport issues with the potential to affect radioactive materials transport, in terms of safety requirements, costs, delays and any other aspects.

Recently, many nuclear reactors and fuel processing sites are moving from operation to decommissioning. This change in the nuclear cycle has led to the Industry considering how waste packages will be transported and the issues that are faced regarding the transport regulations. The WNTI BET WG also deals with these topics as important issues.

This paper will introduce this BET WG's contribution to the development of the requirements related to these issues in the revision cycle of the IAEA Regulations for the Safe Transport of Radioactive Material (hereinafter referred to as SSR-6) finished in 2018.[1] In addition, this paper will discuss the new type of package for Intermediate Level Waste from decommissioning, which is currently under consideration by this WG.

UNPACKAGED SURFACE CONTAMINATED LARGE OBJECTS

Due to the routine generation of clean electricity from nuclear power stations, numerous types of equipment are contaminated and activated. This equipment has to be treated, stored and discharged for disposal or recycling in a responsible and environmentally sensitive way at the end of their operational life. This equipment includes large objects (large components), such as reactor pressure vessels and steam generators (typically, over 20 metres long, 300 tons). Similar large objects exist also in the nuclear fuel cycle facilities. Recently, the transport of large objects has been steadily increasing because of the decommissioning of nuclear power stations and nuclear fuel cycle facilities or replacing equipment to facilitate the extension of their operational life.

Such impressive and high-profile transports, however, are sometimes faced with strong opposition from the public even when the relevant Competent Authorities have approved them. For example, in Canada, Bruce Power's plan to transport 16 decommissioned steam generators from Canada to Sweden for recycling was cancelled in 2012, due to strong opposition from the public and local communities both in Canada and the U.S. even though the transport had been approved by the Canadian competent authority as being transportable under "Special Arrangement".[2,3]

The transport of radioactive material is regulated by national and international modal regulations based on the SSR-6. Generally, radioactive material is packed inside a packaging (e.g. drum, freight container or casks) which satisfies the requirements of the SSR-6, according to their radioactivity and chemical/physical properties. Previously, used radioactive large objects were usually treated and their size reduced into smaller pieces, packed into a number of packagings onsite (at the nuclear power plants or the fuel cycle facilities), then transported off site to disposal

or recycling facilities. However, this size reduction and packing may increase the exposure of workers and the risk of radioactivity release. Therefore, some large objects have been transported directly to disposal or recycling facilities without onsite dismantling or size reduction.

Intensive discussion on such transport had been conducted in the IAEA. As a first step, new IAEA guidance has been developed by the Member States and industries to assist consignors and the Competent Authorities in preparing and assessing applications for Special Arrangements for the transport of unpackaged surface contaminated large objects. This new 'Guidance for Transport of Large Components under Special Arrangement' was included as Appendix VII of the Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition) (hereinafter referred to as SSG-26).[4]

However, there has been an increasing need for the transport of surface contaminated large objects in many countries. These transports are expected to grow and become more routine in the future. Therefore, it was decided that these transports would be incorporated into the IAEA Transport Regulations, in order to avoid the potential misunderstanding of the concept of "Special Arrangement" by the public. The BET WG contributed to drafting the new edition of the SSR-6 on this topic by collecting Industry's experiences and expertise.

As a result, the group SCO-III of Surfaced Contaminated Objects (SCO) is included as a new category of material into the 2018 Edition of the SSR-6 (SSR-6 (Rev. 1)).

The WNTI has a publication named 'Transport of Large Objects and Special Arrangement'.[3] The WNTI publications are one of the most important added value aspects of WNTI work and include over 30 Standards, Good Practice Guides, Fact Sheets and Information Papers. WNTI has initiated the review of the publication on the transport of large objects to incorporate the nature of the group SCO-III. This publication will complement the SSR-6 and SSG-26, and facilitate the shipment of large objects by contributing to clearer interpretation.

DUAL PURPOSE CASKS

With the shortage of reprocessing plant capacity or the lack of repository site, large amounts of spent fuels are accumulated in nuclear power plants. An option for the management of spent fuel is to use dual purpose casks which are designed to meet the requirements for both storage (interim and/or long term) and transport. Some interim storage facilities have already been installed or are planned in some countries. Governments, intergovernmental organisations and industries have considered and discussed, during the past several years, issues associated with the shipment of dual purpose casks, particularly with regard to the shipment of such casks after several decades of storage.

The IAEA established the Joint Working Group on Guidance for an Integrated Transport and Storage Safety Case for Dual Purpose Casks for Spent Nuclear Fuel in 2011, and started the discussions internationally to provide guidance to Member States for integrating the safety cases for storage and transport in a holistic manner. BET WG members participated in these activities and the draft TECDOC 'Methodology for a Safety Case of a Dual Purpose Cask for Storage and Transport of Spent Fuel' was finalized, and will be published by the IAEA. The joint working

group recommended the IAEA Transport Safety Standards Committee (TRANSSC) to incorporate the concept of the dual purpose casks into the transport regulations.

The IAEA TRANSSC organized a consultancy meeting to discuss the issues invoked by the proposed new provisions in the SSR-6 and SSG-26. The BET WG collected facts on dual purpose casks in industry and reviewed the technical issues around applicants maintaining package approval, ageing mechanisms and ageing management programs.

As a result, the concept of dual purpose casks was not included per se in the IAEA Transport Regulations. Instead, the concept of "shipment after storage" was properly introduced into the 2018 Edition of the SSR-6 (SSR-6 (Rev. 1)). To place a special focus on the "shipment after storage" allows the actual issues arising from the use of dual purpose casks to be taken into account. It is now explicitly required for those packages that it shall be ensured, before each shipment, that all packaging components and radioactive contents have been maintained during storage. The way is that all requirements specified in the relevant provisions of the Transport Regulations and in the applicable certificates of approval have been fulfilled, even after several decades of storage. Moreover, it is required that a justification of considerations to ageing mechanisms in the safety analysis and within the proposed operating and maintenance instructions is included in the application for approval. A gap analysis programme describing a systematic procedure for a periodic evaluation of changes of regulations, changes in technical knowledge (i.e. changes in the expectations of the competent authorities and in the method of analysis to demonstrate compliance with the regulations) and changes to the state of the package design during storage, is also required to be part of the application.

NEW TYPE OF PACKAGE FOR INTERMEDIATE LEVEL WASTE

As mentioned earlier, many nuclear reactors and fuel processing sites are moving from operation to decommissioning and this change raises various issues. Radioactive waste requires large volume packages due to the requirements of disposal at the final facility and due to the size of some of the items. This normally results in the use of an IP-2 package, by classifying the material in the groups LSA-II or LSA-III. However, in some instances, the material classification requirements may be met for the groups LSA-II or LSA-III, but the transport in an industrial package Type 2 (Type IP-2) may be rendered impossible, as the dose rate limit is exceeded for the unshielded content due to the nuclides that are present. This waste would currently require that a waste package is licensed as a Type B(U) (or Type B(M)) package.

The Type B(U) criteria results in more complicated design, testing, approval and manufacturing standards. This increases timescales from conception to implementation of a new packaging design from as little as 1 year for an IP-2 to more than 5 years for a Type B(U). Similarly, packaging lifecycle costs are increased by an order of magnitude. In addition, the Type B(U) criteria prohibit large payload packages from being realised due to the difficulty of meeting the 9m drop test containment requirement for high mass packages. For example, an existing IP-2 packaging has a volume of 20 m^3 with payloads of up to 65 tonnes. It is currently impossible for Type B(U) packages to have similar volumes with similar payloads.

For these reasons, there is a need for a new type of package that can be used efficiently for wastes of medium dose rate and medium activity which considers combination of wastes and container performance. This would result in a new category that sits between a Type IP-2 and a Type B(U) package.

For a Type IP-2 package, safety and protection of people, property and the environment in potential accidents is assured through:

1. The requirement for the contents to be classified as LSA-II, LSA-III or SCO-II, which limits the inhalation, ingestion or contamination spread hazard of the contents, even if the contents escape from the packaging.
2. A limitation on the unshielded dose rate of the contents of 10mSv/h at 3 m, which limits the direct radiation hazard of the contents, even if the contents escape from the packaging.

For a Type B(U) package, safety is provided through the containment and shielding provided by the package which must be demonstrated to be maintained in the tests for accident conditions of transport.

It is proposed that a new package type is defined, which is a hybrid of the two regimes. Namely utilising the:

1. Requirement for classification as LSA-II, LSA-III or SCO-II (and consequently the absence of inhalation and ingestion hazards, due solely to the contents properties, and not on the package performances).
2. Requirement for shielding to be maintained in accident conditions of transport as per a Type B(U) package.

The intent is to define a packaging standard equivalent to an enhanced IP-2 where only the shielding performance needs to be justified in the tests for accident conditions of transport, in the expectation that this is significantly less onerous than demonstrating that the Type B(U) containment standard is met.

Recently, the BET WG has been discussing this topic and they consider that it is possible to formulate regulatory criteria for this new type of package in several ways. This helps to convey the nature of the proposal, and an example of incorporating this proposal into the SSR-6 is shown below. The new type of package is expressed as the Type W package.

> Para. 411 Revised – The radioactive contents in a single package of LSA material shall be so restricted that the dose rate specified in para. 517 shall not be exceeded, except if transported in a Type W package, and the activity in a single package shall also be so restricted that the activity limits for a conveyance specified in para. 522 shall not be exceeded.
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> Para. 414 revised – The radioactive contents in a single package of SCO shall be so restricted that the dose rate specified in para. 517 shall not be exceeded, except if transported in a Type W package and the activity in a single package shall also be so restricted that the activity limits for a conveyance specified in para. 522 shall not be exceeded.
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> REQUIREMENTS FOR TYPE W PACKAGES

Para. 651A- Type W packages shall be designed to meet the requirements specified in paras 607-618 and, in addition, the requirements specified in paras 619-621 if carried by air and in paras 636-649, and in addition, the requirements specified in paras 651B and 666.

Para. 651B - A package shall be so designed that if it were subjected to the tests specified in paras 726, 727(b), 728 and 729 and either the test in:

— Para. 727(c), when the package has a mass not greater than 500 kg, an overall density not greater than 1000 kg/m3 based on the external dimensions, and radioactive contents greater than 1000A2 not as special form radioactive material; or

— Para. 727(a), for all other packages,

it would retain sufficient shielding to ensure that the dose rate 1 m from the surface of the package would not exceed 10 mSv/h with the maximum radioactive contents that the package is designed to contain.

Approval of Type W package designs

Para. 807A – Each Type W package design shall require unilateral approval, except that a package design for fissile material, which is also subject to paras 814–816, shall require multilateral approval.

Para. 807B – An application for approval shall include:

(a) A detailed description of the proposed radioactive contents with reference to their physical and chemical states and the nature of the radiation emitted.
(b) A detailed statement of the design, including complete engineering drawings and schedules of materials and methods of manufacture.
(c) A statement of the tests that have been carried out and their results, or evidence based on calculations or other evidence that the design is adequate to meet the applicable requirements.
(d) The proposed operating and maintenance instructions for the use of the packaging.
(e) If the package is to be used for shipment after storage, a justification of considerations to ageing mechanisms in the safety analysis and within the proposed operating and maintenance instructions.
(f) Any special stowage provisions necessary to ensure the safe dissipation of heat from the package considering the various modes of transport to be used and the type of conveyance or freight container.
(g) A reproducible illustration, not larger than 21 cm × 30 cm, showing the make-up of the package.
(h) A specification of the applicable management system as required in para. 306.
(i) For packages which are to be used for shipment after storage, a gap analysis programme describing a systematic procedure for a periodic evaluation of changes of regulations, changes in technical knowledge and changes of the state of the package design during storage.

Para. 807C – The competent authority shall establish a certificate of approval stating that the approved design meets the requirements for Type W packages and shall attribute to that design an identification mark.

The BET WG will continue to work on this topic to be able to make a proposal for modification during the next SSR-6 review and revision cycle, in order to improve regulations and guidance on the transport of radioactive waste meeting the requirements for LSA material, but with medium dose rate.

CONCLUSIONS

The WNTI established a working group in 2008 to promote the developments in the safe, efficient and reliable transport of radioactive waste and spent fuel. Recently, new issues with the transport of radioactive wastes and spent fuels have occurred given the expansion of the decommissioning of the old facilities, and the BET WG has continued to tackle these issues flexibly with members' expertise and experience. The activities contributed to the incorporation of the new provisions on transport of unpackaged surface contaminated large objects and dual purpose casks into the SSR-6 through the discussions in the IAEA.

The BET WG is currently considering a new type of package that could be used efficiently for wastes of medium dose rate and medium radioactivity from decommissioning. The WNTI believe that the regulations should keep evolving in accordance to meet new situations and the WNTI will continue to provide a channel for the industry to facilitate the safe, efficient and reliable transport of radioactive waste materials.

REFERENCES

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3. WNTI Fact Sheet 'Transport of Large Objects and Special Arrangement', World Nuclear Transport Institute, 2013.
4. Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material, 2012 Edition, Specific Safety Guide, No. SSG-26, International Atomic Energy Agency, 2012.