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THE TRANSPORT CONTAINER STANDARDISATION COMMITTEE CODES OF PRACTICE

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ABSTRACT

The Transport Container Standardisation Committee (TCSC) began as an industry forum in the 1960's and has maintained radioactive materials transport Codes of Practice continuously for more than fifty years. The purpose of TCSC is "*to examine the requirements for the safe transport of radioactive material with a view to standardisation and, as appropriate, produce and maintain guidance in the form of standards documentation*".

TCSC is incorporated as a Company Limited by Guarantee in the UK and is self-funded by its nineteen members. TCSC's codes are developed for the benefit of its members but are also made freely available to the international transport community. TCSC currently maintains sixteen codes on a five-year review cycle.

This paper provides an overview of the TCSC codes to raise awareness of them. TCSC has authored codes providing advice on the testing, analysis and approval of specific package types. This includes the approval of Excepted packages (TCSC1089), the testing (TCSC1096) and approval (TCSC1078) of IP-1, IP-2, IP-3 and Type A packages, and drop analysis (TCSC1087), drop testing (TCSC1086) and thermal analysis and testing (TCSC1093) of Type B packages. Guidance is also provided on the design, manufacture and approval of ISO Freight Containers under the alternative requirements for IP-2 packages (TCSC1090). TCSC has also produced guidance on key topics that apply to several package types. This includes the design and operation of tie down features (TCSC1006), lifting points (TCSC1079) and fasteners (TCSC0031), shielding integrity testing (TCSC1056), the surface finishing of stainless steels (TCSC1088) and other materials (TCSC1080), packaging repair (TCSC1095) and the labelling of packages (TCSC1073). Furthermore, TCSC provides guidance on the procurement of package design, licensing, manufacture, maintenance, operation and decommissioning services (TCSC1094).

INTRODUCTION

The Transport Container Standardisation Committee (TCSC) is as a UK-based, self-financing industry forum and Company Limited by Guarantee (CLG). The purpose of the TCSC is "*to examine the requirements for the safe transport of radioactive material with a view to standardisation and, as appropriate, produce and maintain guidance in the form of standards documentation*".

TCSC has maintained radioactive materials transport Codes of Practice for more than fifty years. These codes provide guidance on the design, testing, licensing, procurement, operation and repair of radioactive materials transport packages. The codes are made freely available to the international radioactive materials transport community via TCSC's website at www.tcsc.org.uk.

HISTORY OF TCSC

TCSC began as a United Kingdom Atomic Energy Authority (UKAEA) internal committee in the 1960's and was widened to include British Nuclear Fuels Limited and the Atomic Weapons Research Establishment by 1970. At that time TCSC was responsible for developing and maintaining the UK Atomic Energy Codes of Practice (AECPs) relevant to radioactive materials transport. These were a component part of a much wider suite of AECPs covering various aspects of nuclear engineering published by the UKAEA Standards Section.

In the early 2000's, and as a result of the UK government restructuring its public civil nuclear sector, the AECPs were discontinued. However, TCSC continued to operate as a sub-group of the Nuclear Institute Safety Director's Forum and began to publish Codes of Practice under its own name in 2002. In July 2013, TCSC was registered at Companies House as a CLG and since then it has operated as a not-for-profit limited company, owned by and operated in the interest of its members.

For much of its existence, TCSC membership principally comprised representatives of UK nuclear licensed sites involved in radioactive materials transport. TCSC membership continues to include organisations involved in the nuclear energy, medical, defence, decommissioning and waste management industry sectors. Additionally, in the last decade there has been an increasing trend of new members who are package vendors, design houses or consultancies specialising in structural, thermal, containment, shielding or criticality analysis. This has broadened the experience and understanding that TCSC is able to call upon, for instance an understanding of the challenges to "small users" such as hospitals or users of industrial sources, increased awareness of and involvement in international package design activities, or input from industry-leading organisations on the use of computational methods to support package design and substantiation.

TCSC currently has nineteen member companies as follows:

- Arup
- AWE
- Croft Associates Ltd
- Cyclife UK Ltd
- Direct Rail Services
- Dounreay Site Restoration Limited
- EDF Energy
- Frazer-Nash Consultancy Ltd
- GE Healthcare

- Gesellschaft für Nuklear-Service
- International Nuclear Services
- LLW Repository Ltd
- Magnox Ltd
- Nuvia Limited
- Radioactive Waste Management
- Rolls-Royce Submarines Ltd
- Sellafield Ltd
- Westinghouse Electric Company LLC
- Wood Plc

OPERATION OF TCSC

TCSC meets four times per year. Decisions on membership, work programme, or the acceptance of revised codes are by an ordinary majority of its members in a vote at a TCSC meeting. In addition to attendance at TCSC meetings and payment of annual membership fees, members are expected to contribute their time and expertise to TCSC to support in the review and production of codes.

Codes are subject to a maximum review cycle interval of five years, although reviews may be accelerated where there is an emerging issue to be addressed. A recent example of this is TCSC1006 *Guide to the Securing/Retention of Radioactive Material Payloads and Packages During Transport* [1]. This code was recently subjected to early revision in order to align with Appendix IV of the forthcoming International Atomic Energy Agency (IAEA) *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2018 Edition)*, which itself was partly informed by TCSC1006. Each code carries a statement requesting that comments and suggestions be addressed to the TCSC Secretariat, contactable at admin@tcsc.org.uk. TCSC welcomes constructive input from users of the codes, especially where this may result in the improvement of a code.

TCSC maintains an informal link to the International Organization for Standardization working group on the transportation of radioactive material (ISO/TC 85/SC 5/WG 4), via the working group's British Standards Institute representative. For instance ISO 12807:2018 *Leakage testing on packages* [2] was informed by TCSC1068 *Leakage tests on packages for transport of radioactive materials* [3], and due to the success of the ISO standard, TCSC1068 was made obsolescent by TCSC in 2016. Following from this success, TCSC has recently agreed to allow ISO/TC 85/SC 5/WG 4 to use three of its codes as base material for development of proposed two new work items, namely:

- *Securing of Packages during Transport* to be based on TCSC1079 [4] and TCSC1006 [1].
- *The Design, Manufacture, Approval and Operation of an ISO Freight Container for use as an Industrial Package Type 2* to be based on TCSC1090 [5].

TCSC CODES OF PRACTICE

The TCSC codes can be broadly grouped as follows:

- Those addressing specific package types, i.e. Excepted, Industrial Packages, Type A or Type B
- Those that address issues affecting many or all package types, e.g. tie-down, or package repair.

An introduction to each TCSC code is provided below, structured on the basis of the above groups.

CODES FOR SPECIFIC PACKAGE TYPES

Excepted packages

Safe Transport of Radioactive Material as an Expected Package TCSC1089 [6] helps consignors to understand the requirements for transporting radioactive material as an Excepted Package. It is suggested that the safety documentation for an Excepted Package should be in a standard format, but, unlike other TCSC codes which adopt the European PDSR Guide format [7], a simpler format, graded to the needs of Excepted Packages, is proposed. The code also identifies several sources of safe, cost-effective commercial-off-the-shelf packagings as exemplars of good practice.

IP-1, IP-2, IP-3 and Type A packages

The *Self-Assessment and Approval of Package Types IP-1, IP-2, IP-3 & Type A* TCSC1078 [8] and *Testing of Package Types IP-2, IP-3 and Type A* TCSC1096 [9] help designers of packages that do not require Competent Authority approval. TCSC recommends that the compliance documentation for package designs that do not require Competent Authority approval should be in a standard format; for IP-1, IP-2, IP-3 and Type A packages it recommends the use of the European PDSR guide [7]. TCSC1078 further explains a system to be followed for the design and approval process, as well as providing documentation templates to assist the user in compliance with the regulations.

Testing a package design is often a time consuming and expensive exercise. It is therefore important that not only is it carried out correctly, but that the testing and all the associated activities are performed efficiently so as to minimise cost. The IAEA advisory material [10] contains a lot of advice on technical aspects of testing. The purpose of TCSC1096 is to take a broader view of the process; it provides expanded guidance on the specification of a package and its contents to be tested, the tests required, pass/fail criteria and the contents of a test plan.

Freight containers provide a standardised, cost effective and convenient method of handling and transporting goods. To comply with the transport regulations as an IP-2 package, freight containers must prevent the loss or dispersal of the radioactive contents. Therefore it is unlikely that standard, commercial freight containers would satisfy the regulatory requirements. *The Design, Manufacture, Approval and Operation of an ISO Freight Container for Use as an Industrial Package type 2 (IP-2)* TCSC1090 [5] helps designers and users of IP-2 packages that are qualified under the alternative requirements for freight containers. TCSC1090 also addresses International Convention for Safe Containers (CSC) [11] approval of freight containers.

Type B packages

Drop testing of a Type B package is a key and often time consuming and costly activity in the application for Competent Authority approval. The *Good Practice Guide to Drop Testing of Type B Transport Packages* TCSC1086 [12] recommends good practice in planning, executing and analysing drop tests. The companion volume *Good Practice Guide – The Application of Finite Element Analysis to Demonstrate Impact Performance of Transport Package Design* TCSC1087 [13] discusses good practice in using finite element calculation techniques to demonstrate compliance with impact performance requirements. Finite Element Analysis (FEA) is a powerful tool for the simulation of structural and thermal behaviour of structures. In recent years, FEA has increasingly been used in the development of transport packages and as part of approval applications to demonstrate the performance of packages. The objective of TCSC1087 is to raise the standard of FEA so as to improve the confidence that can be placed in to the analyses and enable them to have a more central role in demonstrating regulatory compliance.

Thermal performance is an important aspect of the design of any transport package and a key feature in regulatory testing and approval. The *Good Practice Guide to Thermal Analysis and Testing of Transport Packages* TCSC1093 [14] provides guidance on the thermal testing and analysis of packages. It is intended to assist packaging designers in selecting their approach to thermal testing, as well as helping experimentalists performing thermal tests and analysts modelling the thermal performance of transport packages. It also provides guidance on which method (i.e. testing or analysis) might be most appropriate for different types of package.

CODES ADDRESSING SPECIFIC TOPICS

Procurement

The *Procurement Guide for Transport Packaging* TCSC1094 [15] provides guidance for the supply of services to enable the user to procure goods and services in a responsible manner and to operate as an Intelligent Customer[1]. TCSC1094 provides good practice advice on:

- Specification of functional requirements
- Activities associated with design, licensing, testing, manufacture, maintenance, operation and decommissioning
- Records Management

Tie-down

It is essential that radioactive material is adequately restrained within transport packages and that the transport packages are adequately secured to conveyances during transport. The *Guide to the Securing/Retention of Radioactive Material Payloads and Packages During Transport* TCSC1006 [1] discusses the main requirements governing tie-downs, provides strength and fatigue design assessment methodologies and criteria for various modes of transport, illustrates typical tie-down systems and makes recommendations regarding operation and inspection. TCSC1006 has recently been revised to align with the forthcoming 2018 edition of the *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material.*

Lifting points

The provision of adequate means for lifting a radioactive materials transport package is essential for efficient handling and to minimise the risk of injury and damage. *Lifting Points for Radioactive Material Transport Packages* TCSC1079 [4] makes recommendations on the design, testing, examination and marking of lifting points. It defines recommended design criteria and minimum safety factors for lifting points, including methods for designing specific handling features such as, lugs and trunnions.

Fasteners

Design and Operation to Minimise Seizures of Fasteners TCSC0031 [16] provides guidance to designers and operators on the precautions that can be taken to minimise the risk of galling for fasteners. It applies to ISO metric screw threads to BS 3643 and Pipe threads of Whitworth form to BS EN ISO 228-1. Other threads to Whitworth form, although obsolescent, are included for use on existing equipment only.

[1] Intelligent customer is defined in IAEA Nuclear Safety Series NG-T-3.10 as "an organization (or individual) that has the competence to specify the scope and standard of a required product or service and subsequently assess whether the supplied product or service meets the specified requirements".

Surface finishing

Finishing Systems for Transport Containers TCSC1080 [17] is a comprehensive guide on the specification and application of coating systems to a range of commonly encountered surfaces. It covers aluminium and aluminium alloys, brass, carbon steel, cast iron, concrete, copper and copper alloys, cork, galvanised iron and zinc, lead and lead alloys, low alloy steels, plastics, stainless steels and wood. As well as providing detailed descriptions of these coatings, a series of look-up tables allows a complete finishing system to be matched with the substrate to provide the optimum protection under selected conditions.

Contamination management can be considered as made up of three components: prevention, minimisation and decontamination. The surface finish of a package is a key factor in all these components. *Surface Finish Guide for Transport Containers Manufactured from Stainless Steel* TCSC1088 [18] provides designers with in-depth guidance on surface finish for transport containers manufactured in stainless steel in order to minimise the uptake, and ensure the ease of removal, of contamination.

Shielding integrity

Shielding Integrity Testing of Radioactive Material Transport Packaging TCSC1056 [19] addresses the inspection of shielding integrity against gamma and neutron radiation. It provides guidance to designers when specifying shielding integrity test requirements, as well as details of the methodology for assessing the quality of shielding. It covers gamma radiography, radiation survey and X-radiography as common and recommended methods of testing. In addition, it also describes and addresses the shortcomings of ultrasound and conventional dimensional and weight checks.

Labelling

Format for Supplementary Labelling of packages used for the safe transport TCSC1073 [20] provides advice to designers and consignors when considering supplementary marking and labelling of packages. It describes additional labels which are not specified in any of the applicable regulations. Experience has led to a need for such labels and their use is considered to be an example of good practice.

Repair

Guide to Packaging Repair TCSC1095 [21] provides guidance on the process to be applied for the repair of packaging. These activities are considered to include the minimum requirements to enable the user to repair packaging in a responsible manner and to operate as an Intelligent Customer. In particular, this document aims to provide guidance on the activities required to ensure that, during service, the packaging remains compliant with the design intent.

FUTURE WORK

TCSC keeps the need for its existing and new codes under review. From time to time, this results in TCSC codes becoming obsolescent or withdrawn as the demand for them reduces, or the commissioning of a new code. TCSC's current work plan identifies the need for two new codes.

Applicant's Guide

TCSC has begun work on a new code, *Technical Guidance on the Design and Licensing of Radioactive Materials Transport Packages* TCSC1097. This will provides technical guidance to aid the design of packages types requiring Competent Authority approval. It will provide information on package design safety report format and contents, the approval process and on structural, thermal, containment, external dose rate and criticality safety design and analysis.

Rather than repeat information available elsewhere, it will identify and signposts other information sources, highlighting noteworthy aspects. In addition to TCSC codes it will refer to relevant guidance and standards produced by other organisations.

Elastomeric Seals

TCSC has identified the need to produce a code addressing the selection and justification of elastomeric seals. It is intended the code will cover seal material grades of particular relevance to the radioactive materials transport industry, e.g. silicone rubber (MVQ), fluorocarbon rubber (e.g. Viton) and ethylene-propylene rubber (EPDM). In addition, the code will address O-ring groove and leak interspace design and use of the Seals3 software as a reference.

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