Summary Report

International Workshop on the Development and Application of a Safety Case for Dual Purpose Casks for Spent Nuclear Fuel

IAEA - Vienna, Austria

19–21 May 2014

The purpose of the workshop is to enhance the participants' understanding of the proposed concept of an integrated safety case for dual purpose casks (DPCs), to analyze the gap between the current practices within Member States and the proposed concept, and to discuss ways of further improving the application of this concept.

54 participants from 19 countries and the European Union were represented at the Workshop. A website was established for the Workshop which includes the papers (available as of 22, May):
http://gnssn.iaea.org/RTWS/general/Shared%20Documents/Forms/AllItems.aspx?RootFolder=%2FRTWS%2Fgeneral%2FShared%20Documents%2FWaste%20Management%2FDPC%20WG%2FMay%202014%20Int%2E%20WS%20on%20the%20Development%20and%20Application%20of%20a%20SC%20for%20DPCs&

Agenda is attached as Attachment 1 of this report.

The interim storage of spent nuclear fuel in casks has been implemented in several Member States. Some are designed as storage-only casks, others are designed as transportable casks, which is called as DPCs.

The adoption of a DPC strategy involves the provision of an applicable regulatory framework and technical considerations for long-term management of DPCs including contingency plans should there be a need to unload the spent fuel due to technical problems, or transport from the storage facility earlier than planned, due to the results from the inspections that are specified as part of the transport and/or storage facility safety cases or other reasons.

The long-term management of DPCs requires a safety case that can evolve during the whole duration of storage period and forthcoming transport after storage in order to provide sufficient information and justification to ensure the safety of the system. Some of the important aspects include; plausible and practical regulatory framework applicable to the whole storage period; cask and facility designs that consider monitoring and inspection plans, ageing management, possible changes of storage plans, measures for future incident; research and development programs (mainly the ageing of spent fuel and the DPC) to ensure the proposed safety case is robust enough even after the long-term storage. This workshop highlighted those major topics in 3 technical sessions and subsequent panel session.

The workshop also addressed a number of non-technical concerns such as record keeping and public acceptance that will affect sound management of the DPC concept over many decades. These concerns will require further consideration on an ongoing basis in addition to the technical aspects discussed at this workshop.

At the end of the workshop, recommendations to IAEA activities were also discussed, which will be taken into consideration for future IAEA projects to ensure and enhance the safety of DPC s and other dry storage systems. .

A summary of discussions during the workshop is given below:

Session 1) Opening Session

Kumano presentation: *Overview of IAEA activities related to Storage of Spent Nuclear Fuel*: This presentation gave an overview of 1) the organization of the IAEA spent nuclear fuel issues, 2) current projects and documents, and 3) IAEA safety guides including discussion of what a Safety Case is.

Droste presentation: *Overview of Preparation of a Safety Case for a Dual Purpose Cask for Storage and Transport of Spent Fuel and Recommendations to WASSC and TRANSSC from WASSC/TRANSSC Working group*: 1) Discussion of DPC development and storage demonstrations 1982 – 1984, 2) discussion of previous DPC Safety Case meetings, 3) discussion of AMP for storage and transportation, and 4) recommendations to TRANSSC and the results of the first discussion at the TRANSSC 27 meeting, and recommendations to WASSC.

Saegusa Keynote Address: *Basis and Safety Case of Spent Fuel Storage*: Discussion of new book [Basics on storage of spent nuclear fuel, ERC publication, 2014 (in Japanese)] on the Japanese Safety case for spent fuel storage which provides supporting evidence and reasoning on the robustness and reliability of DPCs. It incorporates lesson-learned from Fukushima. For example, sequential events must now be considered. A description salient research activities which support the safety of DPCs in areas such as drop tests, seal durability studies, heat removal from buildings, ageing of seals, and vibration effects on seals are described in the book.

Whittingham presentation: *Introduction of topics to be addressed and ideas for future work:* This presentation was given to set the scene and introduce topics to be discussed during the WS.

Session 2) Legal and regulatory framework

The discussion raised several key points and questions to be resolved. The issues were primarily:

1. How do changes in regulations effect transport package design approval and storage licensing
    a. Specific regulations for DPCs
    b. How do technological advances change regulations?
    c. How to deal with DPCs when the transport package design approval expires?
2. How to ensure safe transport of the DPC after long-term storage?

More specifically the issues included:

- How to accommodate new technological advances or regulatory changes when renewing transport package design approval? For example, design modifications of the DPC impact limiter.
- How is ageing management incorporated into license renewal?
- How to harmonize storage and transport licensing in terms of validity periods and differences between international transport regulations and site-specific storage requirements.
- If a package does not meet transport regulations after storage are repackaging or use of overpacks options? Another option may include, in limited cases, special arrangement according to SSR 6.
- Issue of package design approval in origin country versus validation in user country. Cooperation between competent authorities.

There was discussion on how to ensure that all safety systems (e.g., lid closure system) meet regulatory requirements for transportation after storage. Topics regarding this issue included:

- Leak testing opportunities
- Aged seal issues under accident conditions. Options for replacing seals. – Alternative option: 3rd lid.
- Test programs in Japan (e.g., drop tests including one with aged seal).
- Uncertainty in ageing: how to add sufficient safety margin. At what point is a cask harmfully “aged”?
- Required infrastructure to accommodate possible actions that may need to be taken to transport after long-term storage. -- Option of hot cell.
- Confidence in safety for a certain period of time: how to balance with need to collect data during storage to give confidence for future actions?
- Safety margins cask-design specific; design criteria must envelope aged materials by providing conservatism in safety margins.

Session 3) Design of storage facilities and operational experience of DPCs

The main topic of this Session was to exchange design and operational experiences of storage facilities using DPCs. Actual inspection results from Member States and ageing management issues were discussed. Specifically:

- Differences between pressure switches and pressure gauges: criteria for selecting one over the other.
- Quality assurance for avoidance of unexpected contamination of the cask that could create safety issues (e.g., cask drying; cleaning of cask after machining to prevent corrosion).
- Ageing Management Plans and international / national exchange of operational experience.
    - Records retention methodology, media.
    - Criteria for inspecting casks; what are the phenomena requiring inspection?
    - Inspections, inspection criteria, and criteria justification.
    - How can data from periodic inspections be made more widely available?

Session 4) Designing casks for dual-purpose operations

Key points of discussion in this Session were:

- How to design a DPC when there are conflicting requirements for transport versus storage?
- Incorporation of AMP into design, e.g., designing to enhance monitoring / inspection.
- Design and manufacturing records need to be preserved for potential remediation and licensing actions.
- Fuel designers should consider the storage / transportation of the spent fuel.
- How to incorporate uncertainties of ageing in design for extended storage period?

Session 5) Panel Session: Discussions on implementation of safety case / future IAEA activities

Although Member States follow different licensing strategies, the TECDOC draft is already used as a guideline for DPC design, safety assessment, and licensing procedures. Continuous and periodical review of their safety cases is inevitable. Comments on the TECDOC on DPC safety case for design provides a good outline for Member States safety cases and provides regulators as a reference for the standard review plans.

Based upon Member States comments, the following recommendations for future IAEA activities were proposed:

- Some participants thought that there were some missing contents in draft TECDOC, but those need to be considered in future activities. These include:
    - The discussion of the AMP could be more specific and provide a detailed structure.
    - Impact of basket deformation on retrievability of spent fuel.
    - Thermal effects of casks in an array on pads.
    - Transport and storage of damaged fuel.
    - DPC for high-level waste.
    - Standardized acceptance criteria for storage; generic storage accident conditions / generic safety case for storage.
    - Multi-purpose containers to include use for disposal.
- A document providing guidance for developing an AMP specifically for DPCs should be developed.
    - Experience compendium.
    - Lessons learned, design changes towards inspection for ageing management.
- Guidance for developing a safety case for spent fuel in canisters for storage and transportation.

Additional recommendations include:

- Consideration of changes in transport regulations with respect to DPC issues.
- Keep activities like this Workshop.

Attachment 1: Agenda

International Workshop on the Development and Application of a Safety Case for Dual Purpose Casks for Spent Nuclear Fuel

IAEA Headquarters
Vienna, Austria

19–21 May 2014

IAEA Scientific Secretaries:
Yumiko Kumano and Stephen Whittingham

Chair: Bernhard Droste
(BAM Federal Institute for Materials Research and Testing, Germany)

Scientific Secretary: Paul McConnell
(Sandia National Laboratories, United States of America)

Agenda

Monday, 19 May 2014

9:30-12:30 Session 1) Opening session

Chairperson: Bernhard Droste
(BAM Federal Institute for Materials Research and Testing, Germany)

(Welcome address) Pil-Soo Hahn, Director, NSRW

(Remarks from the Chair) Bernhard Droste, Chairperson of the Meeting

(Introduction of participants) Participants

(Administrative matters) Yumiko Kumano, IAEA

(Adoption of the agenda) Bernhard Droste, Chairperson of the Meeting

10:10-10:30 Yumiko Kumano (IAEA)
Overview of IAEA activities related to Storage of Spent Nuclear Fuel

10:30-11:15 Bernhard Droste (Germany)
Overview of Preparation of a Safety Case for a Dual Purpose Cask for Storage and Transport of Spent Fuel and Recommendations to WASSC and TRANSSC from WASSC/TRANSSC Working group
(NOTE: Draft TECDOC is available at http://www-ns.iaea.org/downloads/rw/waste-safety/disp/dual-purpose-spent-fuel-cask-draft-tecdoc-2014.pdf)

11:15-12:00 **(Keynote)** Toshiari Saegusa (Japan)
Basis and Safety Case of Spent Fuel Storage

12:00-12:30 Stephen Whittingham (IAEA)
Introduction of topics to be addressed and ideas for future work

12:30-14:00 *Lunch break*

14:00-18:00 Session 2) Legal and regulatory framework

Session Chairs: Toshiari Saegusa (Central Research Institute of Electric Power Industry, Japan)
Manuel Garcia Leiva (Consejo de Seguridad Nuclear, Spain)

14:00-14:05 **Session Introduction** Session Chairs

14:05-14:25 Holger Völzke (Germany)
Long-Term Interim Storage of Spent Nuclear Fuel and HAW in Dual Purpose Casks – Perspectives and Challenges

14:25-14:45 Manuel García Leiva (Spain)
Spanish Regulatory Approach for Dual Purposes Casks for Spent Nuclear Fuel

14:45-15:05 Peter Lietava (Czech Republic)
Regulatory Framework on DPC Licensing in the Czech Republic

15:05-15:25 Michele Sampson (USA)
Regulatory Framework for Spent Nuclear Fuel Storage and Transportation

15:25-15:50 *coffee break*

15:50-16:10 Ingo Reiche (Germany)
The German Regulatory Concept of Transport Package Design Approval for Dual Purpose Casks

16:10-16:30 Frank Wille (Germany)
Transportability of Dual Purpose Casks in Germany

16:30-17:50 Discussions – Theme 1 (see APPENDIX for further information)

18:00- *Welcome Reception hosted by the IAEA*

Tuesday, 20 May 2014

9:00-17:30 Session 3) Design of storage facilities and operational experience of DPCs

Session Chairs: Robert Einziger (U.S. Nuclear Regulatory Commission, USA)
Dietmar Wolff (BAM Federal Institute for Materials Research and Testing, Germany)

9:00-9:05 **Session Introduction** Session Chairs

9:05-9:25 Jiri Gerza (Czech Republic)
Experience with DPC Storage System in Dukovany NPP

9:25-9:45 Matthias Walter Heck (Germany)
GNS' Experience in the Long-term Storage at Dry Interim Storage Facilities in Ahaus and Gorleben

9:45-10:05 John Kessler (USA)
Extended Storage Collaboration Program and EPRI Extended Storage Projects

10:05-10:25 Frank Koch (Switzerland)
Dual Purpose Casks in Dry Storage in Switzerland

10:25-10:50 *coffee break*

10:50-11:10 Xavier Van Mierloo (Belgium)
Experience Dry Storage of Spent Fuel/ Belgium NPP Doel

11:10-11:30 Andrey Kirkin (Russian Federation)
SECNRS Experience on Safety Review of Cask Type Spent Fuel Storage using DPC

11:30-12:30 Discussions – Theme 2 Part 1 (see APPENDIX for further information)

12:30-14:00 *Lunch break*

14:00-14:20 Miguel Angel Martinez (Spain)
Licensing a Centralized Spent Fuel Storage Facility

14:20-14:40 Tatsuya Ishikawa (Japan)
Current Status of Interim Storage Facility for Spent Fuels in Japan

14:40-15:00 Olaf Schilling (Germany)

Inspections of DPC during Manufacture and before Transport in Germany

15:00-15:20 *coffee break*

15:20-15:40 Tatiana Makarchuk (Russian Federation)
SNF Dual-Purpose Cask: Creation Experience

15:40-16:00 Robert Einziger (USA)
Role of In-service Inspections for Aging Management of SNF Dry Storage Systems

16:00- 17:30 Discussions – Theme 2 Part 2 (see APPENDIX for further information)

Wednesday, 21 May 2014

9:00-12:30 Session 4) Designing casks for dual-purpose operations

Session Chairs: Paul McConnell (Sandia National Laboratories, USA)
Frank Koch (Swiss Federal Nuclear Safety Inspectorate, Switzerland)

9:00-9:05 **Session Introduction** Session Chairs

9:05-9:25 David Garrido (Spain)
Recent Issues Found in a Dual Purpose Metal Cask Design and Operation. ENSA's experience in Spain

9:25-9:45 Rainer Noering (Germany)
GNS Experience in Design and Licensing of Dual Purpose Casks

9:45-10:05 Justo Garcia (France)
Dual Purpose Casks in Operation

10:05-10:25 Ryoji Asano (Japan)
Japanese Cask Vender's Prospective on Design, Licensing and Fabrication of DPC

10:25-10:50 *Coffee break*

10:50-12:30 **Discussions – Theme 3** (see APPENDIX for further information)

12:30-14:00 *Lunch break*

14:00-16:00 Session 5) Panel session : Discussions on implementation of safety case / Future IAEA activities

Moderator: Bernhard Droste
(BAM Federal Institute for Materials Research and Testing, Germany)

Panelists: Makoto Hirose (Secretariat of Nuclear Regulation Authority, Japan)
Rainer Noering (GNS Gesellschaft fur Nuklear-Service mbH T, Germany)
Michele Sampson (U.S. Nuclear Regulatory Commission, USA)
David Garrido Quevedo (Equipos Nucleares S.A, Spain)
Xavier Van Mierloo (Transnubel, Belgium)

IAEA: Gerard Bruno (Radioactive Waste and Spent Fuel Management Unit)
Stephen Whittingham (Transport Safety Unit)

16:00-17:00 Session 6) Closing session

Chairperson: Bernhard Droste
(BAM Federal Institute for Materials Research and Testing, Germany)

(Session Summaries) Session Chairs

(Chairperson's summary) Bernhard Droste

(Closing remarks) IAEA

17:00 Adjourn

APPENDIX: PRELIMINARY LIST OF TOPICS TO BE DISCUSSED AT DISCUSSION SESSIONS

This appendix provides list of topics that will be considered during the "discussion" sessions. The "discussion" sessions will be moderated by the session chairs. Participants are requested to review the below suggested topics beforehand as a preparation for the sessions.

Day 1: Theme 1

Q1. What are the specific requirements for DPC design and operation, and their safety assessment / What are the problems do you expect in meeting different acceptance criteria for storage and transport

Q2. How do you take into account operational experiences during the first operational period when the license needs to be reviewed?

Q3. How the license renewal is different from the first licensing process? Consideration of regulatory changes

Q4. Requirements for periodic safety reviews, gap analysis, and design modifications

Q5. Interaction between transport / storage, on-site transfer / off-site transport

Q6. Regulatory framework for dual purpose cask (DPC) design approval and certificate renewal (interface between nuclear power plant licensing, transport licensing, and storage facility licensing)

Q7. Experience related to the safety review of a DPC safety case

Q8. Requirements for a management system (Management system (interfaces between stakeholders, allocation of responsibilities, record management for spent fuel characterization, DPC, and storage facility conditions)

Day 2: Theme 2 - Part 1 and Part 2

Q1. How to justify and define the design specifications of storage facilities to meet safety requirements

Q2. Experiences in the consideration of accident conditions during handling and storage including natural events, and related requirements for cask design

Q3. Experiences in design considerations for maintenance and repair of DPC packages

Q4. Experience related to periodic safety reviews and design modifications

Q5. Inspections to verify that DPC acceptance criteria are met

Q6. Member States ageing management programmes: what are they?

Requirements for monitoring and periodic inspections during operation of the storage facility

Q7. What experiences, positive or negative, do Member States have related to periodic safety reviews?

Q8. How do Member States do record preservation and knowledge management (technical basis for the safety case, inspection data, operational experience, etc.)

Day 3: Theme 3

Q1. What is the knowledge basis to support the design specifications of DPC or multi-purpose canister components including spent fuel assemblies to meet safety requirements?
Q2. Do you consider (and how) the phenomena such as burnup credit, long-term safety, water exclusion, damaged fuel, monitoring system, closure system repair concept, etc.?
Q3. What accident conditions during on-site activities and storage (handling accident, severe accident, etc.) do you consider when designing casks? What are the related requirements for cask design?
Q4. Management system for cask fabrication, package preparation, and maintenance work during storage and before transport after storage
Q5. How do you incorporate changes of models, standards, and regulations (gap analysis), in periodic safety reviews and design modifications?
Q6. What are the problems in meeting different acceptance criteria for storage and transport?

Day 3: Panel session

Questions closely related to the TECDOC concept and implementations

Q. How the concept in the TECDOC can be used in the design?
Q. What is not included in the draft TECDOC (current proposed framework of safety case)?

Questions directly related to future activities:

Q. Needs to expand the concept to multi-purpose casks / canisters? / HLW?
Q. Needs for generic test case for storage?
Q. Some additional international cooperation activities on ageing management?
Q. Some additional international cooperation activities on development or implementation of safety case concept into practice?