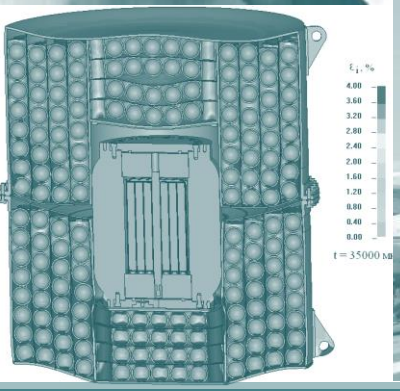


Russian-French Technical Seminar on the Safe Transport of RM

France, Fontenay-aux-Roses, February 2015

TUK-145/C Reference Manual

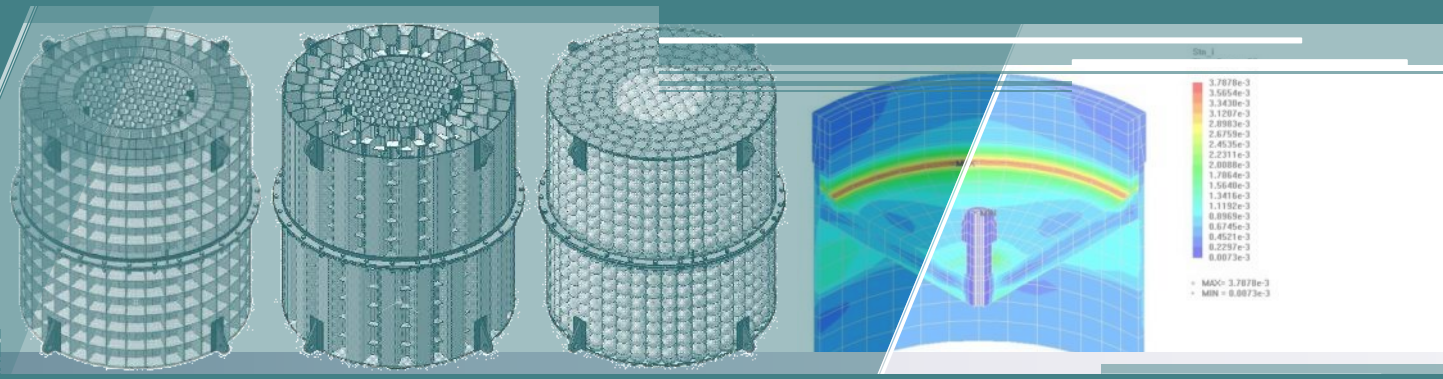
Compliance with SSR-6 and PDSR-2012

Madalina Budu, Sergey Komarov

Content

- **Introduction**
  - Evolution of requirements for air shipment of RM
  - TUK-145/C development, safety justification and licensing
- **TUK-145/C Reference Manual**
  - Brief presentation of the document
  - Comparison of regulatory requirements
  - Analysis of compliance with regulatory requirements
- **Conclusions**
  - Past shipments using TUK-145/C cask
  - Conclusions

1



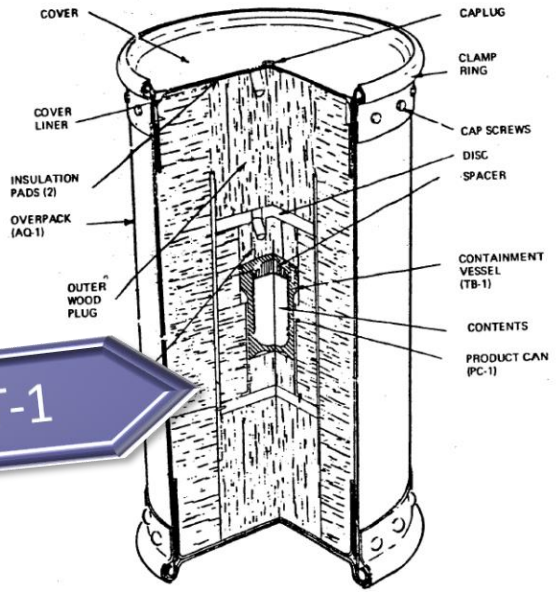
Introduction

- Evolution of requirements for air shipment of RM
- TUK-145/C development, safety justification and licensing

Evolution of requirements for air shipment of RM

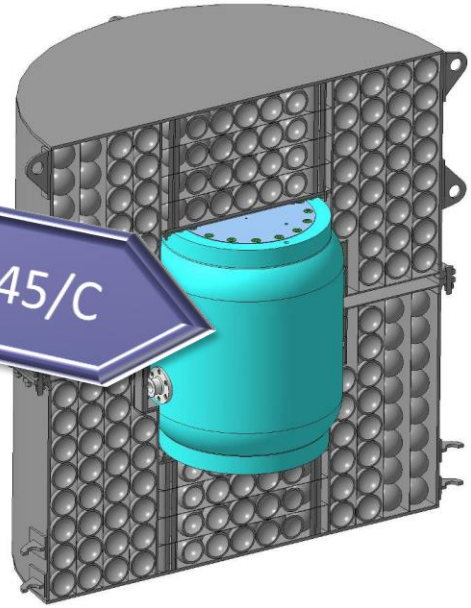
- **1973** • SS-6 (IAEA)
- **1975** • PL 94-79 (USA)
- **1978** • NUREG-0360 (USA)
- **1993** • TECDOC-702 (IAEA)
- **1996-2012** • TS-R-1/SSR-6 (IAEA)

129 m/s → **PAT-1**

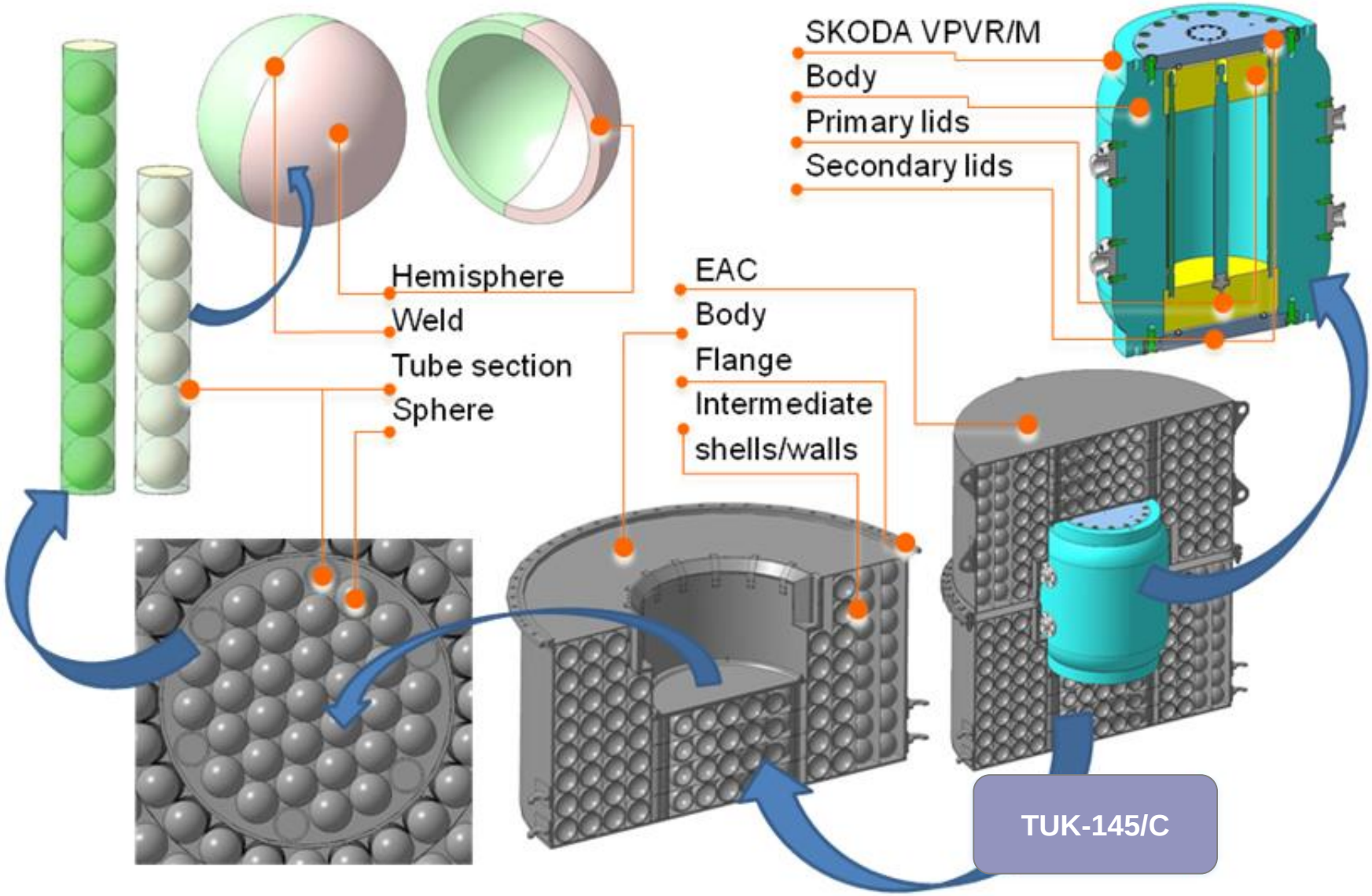


> 85 m/s

90 m/s → **TUK-145/C**

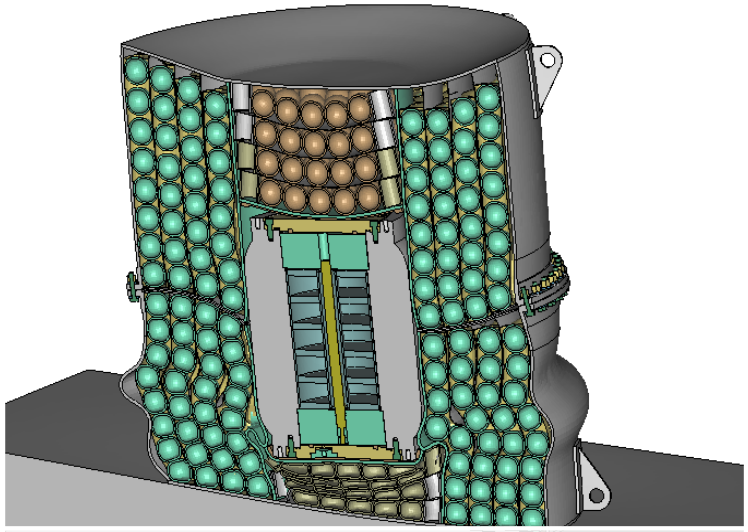


TUK-145/C development, safety justification and licensing

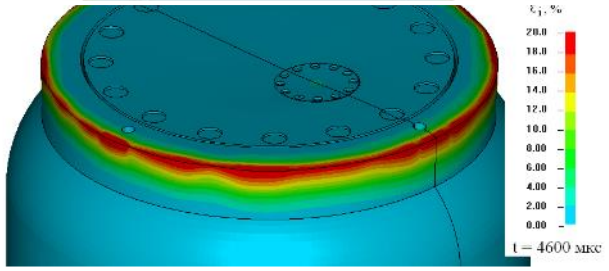


TUK-145/C development, safety justification and licensing

○ Hard-target impact test of TUK-145/C mockup (1:2.5 scale) on the rocket sled at 90 m/s



○ The state of mockup SKODA VPVR/M cask, predicted and after testing of the mockup TUK-145/C



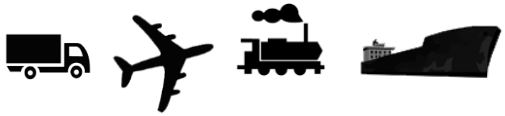
○ Fragments of the strained prototype and computational model of the TUK-145/C energy absorbing container

TUK-145/C development, safety justification and licensing

Approved Content:

- IRT-2M
- IRT-3M
- IRT-4M
- VVR-M
- VVR-M2
- VVR-M5
- VVR-M7
- VVR-(S)M
- S-36
- EK-10
- TVR-S
- IIN-3M (Liquid)
- Other if justified

Approved Transport Means:



Main Parameters:

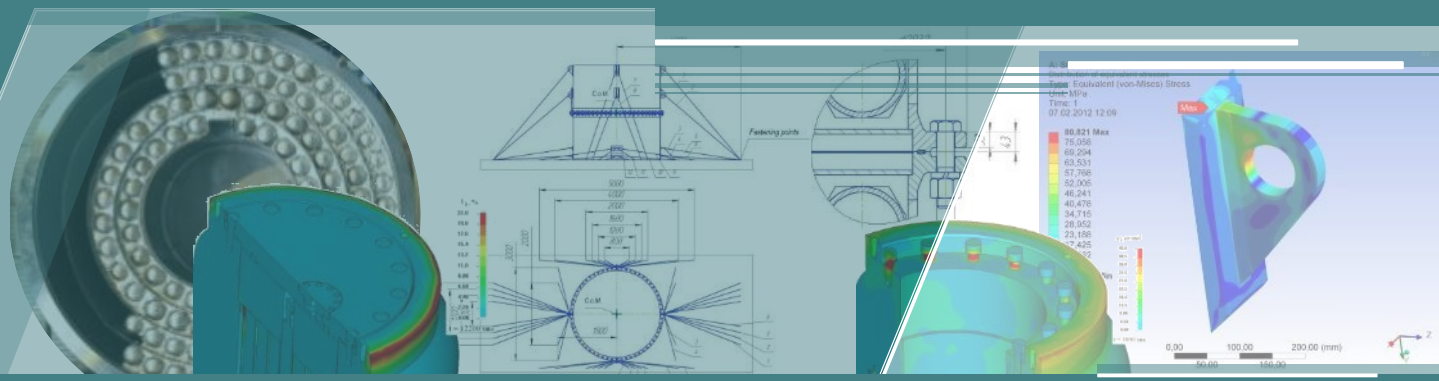
- Mass of loaded TUK-145/C, kg: 29 650
- Mass of empty TUK-145/C, kg: 29 200
- Mass of EAC, kg: 18 500
- Maximal mass of SNF loading, kg: 450
- Number of cells for SFAs: 36
- Useful lifespan, years: 30
- Height, mm: 3065
- Width, mm: 3168
- Diameter, mm: 2816

Quality Assurance:

ISO 9001|14001|18001

Approved countries:

2



TUK-145/C Reference Manual

- Brief presentation of the document
- Comparison of regulatory requirements
- Analysis of compliance with regulatory requirements

Brief presentation of the TUK-145/C Reference Manual

Task Description:

- Basic technical requirements for packages are very much similar in most of the countries, being based on the IAEA Regulations for the Safe Transport of Radioactive Materials
- Regulatory requirements regarding the content of package safety documentation and the administrative procedures for issuing certificates of approval for package design and shipment are not harmonized at the international level
- To make possible the design approval in any country
- Unified package safety report

Content:

- General Information
- TUK-145/C Package Description
- Structural Evaluation
- Thermal Evaluation
- Containment
- Shielding Evaluation
- Criticality Evaluation
- Package Operations
- Acceptance Tests and Maintenance Program
- Quality Management System

Steps:

- Identification and comparison of requirements: IAEA TS-R-1 (SSR-6), US NRC Regulatory Guides 7.9 and 7.10, Russian NP-053-04 and Rosatom's Administrative Regulation No. 527/2007, EU Package Design Safety Report
- Identification of Reference Manual content to satisfy all identified requirements
- Identification of available information from the completed Russian safety analysis reports and technical documentation

Working design documents
Preliminary Design
Quality Assurance Programs
Operation Manual

Expert Assessments
Certificate of Approval
Technical Specifications

- Identification of missing information, obtain additional documents and perform additional analysis to complete the missing information
- Development of the TUK-145/C Reference Manual
- Independent review by ORNL experts

Comparison of regulatory requirements

Little information on the content of the application and the level of details expected

Clear and efficient structure that can be easily applied to any type of package safety documentation

Existence of supplementary requirements in comparison with other similar regulations

Based on multiple separate documents, rather than a unified package safety report

- TS-R-1/SSR-6

- PDSR

- RG 7.9

- AR 527/2007

TUK-145/C Reference Manual

Analysis of compliance with regulatory requirements

○ Regulations Chapters/Paragraphs	○ TUK-145/C Reference Manual Chapters										
	GENERAL INFORMATION	TUK-145/C PACKAGE DESCRIPTION	STRUCTURAL EVALUATION	THERMAL EVALUATION	CONTAINMENT	SHIELDING EVALUATION	CRITICALITY EVALUATION	PACKAGE OPERATIONS	ACCEPTANCE TESTS AND MAINTENANCE PROGRAM	QUALITY MANAGEMENT SYSTEM	APPENDIXES	REGULATION OR GUIDE
	-	809b, 809a	809c, 809f	809c, 809f	809c, 809e, 809f	809 f	809c, 809f /677b	809d, 809g	809d	809i	809a-h	IAEA TS-R-1/ SSR-6
	1.1	1.2	2	3	4	5	6	7	8	- (RG 7.10)	At the end of each chapter.	US NRC Regulatory Guide 7.9
	11.2l	11.2a, 11.2b, 11.2g	11.2b, 11.2c, 11.2d, 11.2j, 11.2m	11.2c, 11.2d	11.2c, 11.2d, 11.2e	11.2c, 11.2d	11.2c, 11.2d, 11.2h	11.2f	11.2c	11.2k	11.2o, 11.2g, 11.2n	Rosatom's AR 527/2007
	1.2	1.2, 1.3, 1.5	1.4, 1.6, 2.1, 2.2.1	1.4, 2.1, 2.2.2	1.4, 2.1, 2.2.3	1.4, 2.1, 2.2.4	2.1, 2.2.5	1.7	1.7, 1.8	1.9	1.10	EU PDSR 2012



3

Conclusions

- Past shipments using TUK-145/C cask
- Conclusions

Past shipments using TUK-145/C cask

- One certificate of approval for road shipment of SKODA VPVR/M (Type B)
- One certificate of approval for combined road and air shipment of TUK-145/C (Type C)
- Mass of 1 package with base plate – 32.2 t
- Capacity – up to 3 TUK-145/C
- Total cargo weight – 104 t (with base plate)

- Single certificate of approval for combined road and air shipment of TUK-145/C (Type C)
- Mass of 1 package with truck – 47 t
- Capacity – up to 2 TUK-145/C
- Total cargo weight – 94 t (with truck)

Conclusions

- The modern international and national regulatory frameworks are now sufficiently developed in comparison with the 1970s and efficiently assure the safety of spent nuclear fuel air shipments, in normal and emergency situations of transport.

- The first Type C package for research reactor spent nuclear fuel shipments by air was created, as a universal set of technical means, which includes:
  - SKODA VPVR/M cask and auxiliary equipment that provides for spent fuel assemblies' loading from the bottom in spent fuel cooling or storage pools, as well as from the top using a set of transfer equipment;
  - Special trucks and semitrailers for the TUK-145/C shipment, that can also be transported by air in AN-124-100;
  - Two EAC.

- The flexible TUK-145/C technology and its international licensing possibilities can comply with the requirements for any future shipments:
  - RR SNF (liquid or solid form) for research, reprocessing or storage,
  - Power reactors fuel fragments for research of failure causes,
  - High-level radioactive waste,
  - Sealed radioactive sources,
  - Miniature Neutron Source Reactor shipments,
  - Emergency shipments during war or terrorist threats or extreme meteorological events.

- In the case of air shipments and other long route radioactive material shipments involving transit of several countries a better international harmonization of the requirements for the applications on certificates of approval for package design and shipment and their review by regulatory bodies is highly needed in order to improve the efficiency of the radioactive materials transports regulatory process worldwide. This could be achieved by the development and adoption of new IAEA guidance documents for the applicants and the regulators concerning package design and shipment application documentation and review, based on the European Union PDSR model, which has successfully started the path of harmonization for EU countries.

Thank you for your attention!

Questions?

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