TRANSSC 33 MEETING

Agenda item 3.6
INF-28

NEED FOR AN EXPERT WORKING GROUP ABOUT PRESSURE DIFFERENTIAL REQUIREMENT

Information paper

World Nuclear Transport Institute
310-312 Regent Street, London, U.K.

IAEA - Vienna - 17th November 2016
Para 621 in IAEA SSR-6 and Part 6;7.2.3 in ICAO-TI

BACKGROUND

• The requirement

Packages containing radioactive material to be transported by air shall be capable of withstanding, without loss or dispersal of radioactive contents from the containment system, an internal pressure that produces a pressure differential of not less than the maximum normal operating pressure plus 95 kPa.

• The possible issue, if strictly interpreted

✓ A requirement difficult to achieve in certain circumstances (large freight containers as Industrial IP-1 or IP-2 for example),
✓ A requirement that may seem excessively severe for law activity materials (solid LSA-I, SCO-I, solid material in excepted packages)

• WNTI proposals in 2013 and 2015 review cycle, without success,

• TRANSSC 32: Proposition for the creation of a WG of experts to share views on implementation of this requirement and to provide adequate recommendations to TRANSSC and ICAO DGP

Para 621 in IAEA SSR-6 and Part 6;7.2.3 in ICAO-TI
Pressure differential in air carriage

- The ICAO Dangerous Goods Panel WG 16 – October 2016 – Montreal - Conclusions

  ✓ WNTI provided to ICAO DGP attendance the same information as delivered to TRANSSC 32, with illustrative examples of the issue
  ✓ The creation of the working group was agreed
  ✓ Members of the ICAO DGP with appropriate expertise were invited to join a expert working group to address the issue presented by WNTI
  ✓ The meeting Secretary noted the importance of having in the expert working group a balance of aviation safety and airworthiness expertise to complement radioactive material expertise.
  ✓ Accordingly, an appropriate mix of participants from the ICAO DGP volunteered to be part of the group:
    - Airworthiness experts (ICCAIA)
    - Representative of pilots (IFALPA)
    - States representatives
Pressure differential in air carriage

- Action expected today from IAEA TRANSSC 33 MEMBERS

The TRANSSC Members are expected to show their interest in being part of a Group of Experts in association with the ICAO Dangerous Goods Panel WG members in order to solve the issue stated above and revise the regulation accordingly if necessary.
Pressure differential in air carriage

• The purpose of the experts WG

✓ To share views on the implementation of para. 621 (ICAO-TI § 6;7.2.3)

✓ To reach a consensus on the interpretation of para. 621
  • If no consensus on the interpretation of para.621, and/or
  • If the interpretation of para. 621 appears to be difficult to implement,

✓ To reach an agreement on the optimization of the pressure differential safety requirement which is needed.

✓ To review the IAEA SSG-26 & SSR-6 to assure that the wording accurately reflects the consensus on the interpretation of para. 621 and/or the optimization of the pressure differential safety requirement; to propose revision of SSR-6 (and ICAO-TI accordingly), if needed and revision of SSG-26 to provide additional guidance if needed

✓ To draft a working plan for further actions, if needed
NEXT STEPS

1. To collect the details of the TRANSSC members interesting in being part of the expert WG,
2. To report to the ICAO the conclusions of the TRANSSC 33 meeting,
3. To decide with ICAO the date and place of the first meeting in 2017
   Probably in Montreal as a side meeting of the ICAO DGP WG by the end of April 2017 (tbc)
4. To report the conclusions of the first meeting during the TRANSSC 34 in July 2017
THANK YOU VERY MUCH FOR YOUR ATTENTION
How the requirement should be understood?

- Example of a package containing a solid object, solid radioactive material or radioactive material in a capsule (no thermal power, no expected radiolysis phenomena)
- What is required:

  - At loading: inner pressure = atmospheric pressure at 15°C ≈ 100 kPa
  - MNOP: increase of inner pressure between 15°C and 55°C = 14.1 kPa
  - MNOP + 95 kPa

  
  MNOP + 95 kPa
  = 14.1 + 95
  = 109.1 kPa
  ≈ 110 kPa

- Containment system shall be able to withstand a differential pressure of 110 kPa. **Are there other ways to demonstrate compliance?**
Pressure differential in air carriage

3 examples to illustrate

- Example 1: Solid UF6 samples in excepted packages
- Example 2: Large contaminated equipment in 10’ or 20’ ISO container
- Example 3: Solid uranium ore samples: Solid material in excepted packages
Solid UF6 samples in excepted packages

**Old configuration**

- Up to 99 g of UF6 in 13 P10 tubes (not able to withstand 95 kPa gauge pressure)
- 13 P10 tubes in 1 intermediate packaging qualified for 95 kPa
- One intermediate packaging in an outer packaging

- Closing at 15°C, heating at 55°C, pressure increase = 14kPa
- Max depressurization = 75kPa (ICAO-TI); 75+14 = 89 kPa < 95 kPa
- **Safe but not strictly compliant with the rules**
Solid UF6 samples in excepted packages

**Current configuration**

- Up to 49 g of UF6 in 6 P10 tubes (not able to withstand 95 kPa gauge pressure)
- 2 P10 tubes in 1 intermediate packaging qualified for 150 kPa
- 3 intermediate packagings in an outer packaging

- Closing at 15°C, eating at 55°C, MNOP = 14 kPa
- 14 kPa + 95 kPa = 109 kPa; 109 kPa < 150 kPa
- **Strictly compliant with the rules, but more expensive and less practical than before**
Large contaminated equipment in 10’ or 20’ ISO container

- Computer Numerical Controlled lathe used in NPPs for maintenance and/or repairing of control rod drive mechanism: in a 20-foot ISO container as excepted package, type IP-1 or type IP2 (SCO)
Large contaminated equipment in ISO container

• Other equipment used in NPPs for maintenance and/or repairing of control rod drive mechanism: in a 20-foot ISO container as excepted package, IP-1 or IP-2 (SCO)
Large contaminated equipment in ISO container

- ISO containers have holes fitted with high efficiency filters to allow the equalization of the pressure during the climb and descent phases (9 kPa/min)
Why these equipment are shipped primarily by air?

- Equipment used during maintenance or repair operations on NPPs are sometimes cumbersome, often expensive and very specific and usually belong to companies specializing in this type of intervention.
- The distances involved to bring this material in the different NPPs served can be large, and the required delay for intervention may be incompatible with a land and maritime transport.
Solid uranium ore samples: *Solid material in excepted packages*

- These are solid natural mineral samples (rock, sand, soil,...) presenting no significant hazard except that their specific activity exceeds the exemption level for natural uranium (1 Bq/g ≈ 80 mg U/kg of material)

Soil samples (few tens of grams per plastic bag)

Geologic carrots (rocks, 8 cm in diameter, up to 1 m long, up to 15 kg each) in plastic tubes closed by adhesive tape, or in plastic sleeves, placed in a rack, made of plywood or natural wood.
Solid uranium ore samples: How are they carried?

Plastic bags are gathered in fibreboard boxes (from few kg to few tens of kg each), placed in a plywood outer box. The whole package is UN2910.
Solid uranium ore samples: Why are they carried by air?

• The transport of these samples are needed for uranium exploration activities, often from geographical areas difficult to access (from everywhere in the world to few laboratories)

• It is necessary for the teams of geologists to know as soon as possible the results of analysis of their samples to continue their activities.

• Land transport combined with sea-carriage is not really adapted to meet these constraints.

• Carriage by air offers much more commodities for those shipments.
Pressure differential in air carriage

ADDITIONAL INFORMATION
Current requirements

- Para 620 of IAEA SSR-6; Part 6;7.2.2 of ICAO-TI:
  - Packages to be transported by air shall be so designed that if they were exposed to an ambient temperature ranging from -40 °C to +55 °C, the integrity of containment would not be impaired.

- Para 621 of IAEA SSR-6; Part 6;7.2.3 of ICAO-TI:
  - Packages containing radioactive material to be transported by air shall be capable of withstanding, without loss or dispersal of radioactive contents from the containment system, an internal pressure that produces a pressure differential of not less than the maximum normal operating pressure plus 95 kPa.

- Para 229 of IAEA SSR-6; Part 1;3.1 of ICAO-TI:
  - Maximum normal operating pressure (MNOP): For the transport of radioactive materials, shall mean the maximum pressure above atmospheric pressure at mean sea level that would develop in the containment system in a period of one year under the conditions of temperature and solar radiation corresponding to environmental conditions in the absence of venting, external cooling by an auxiliary system or operational controls during transport.
621. *Packages* containing *radioactive material* to be transported by air shall be capable of withstanding, without loss or dispersal of *radioactive contents* from the *containment system*, an internal pressure that produces a pressure differential of not less than the maximal gauge pressure that may be developed in the package at 55°C when it has been filled at 15°C (or the *maximum normal operating pressure*) plus 75 kPa, with a minimum of 95 kPa. This requirement is not applicable to the following packages provided they would prevent loss or dispersal of their radioactive contents with a reduction of ambient pressure to 25 kPa:

- *packages* containing only special form radioactive material, SCO-I or SCO-II;
- excepted *packages*, industrial *packages* and type A *packages*, containing solid radioactive material, excluding powders;
- *packages* containing LSA-I material in powder form.
Non exhaustive list of items which could be discussed by the Expert WG

- Minimum ambient pressure inside cargo holds of a commercial aircraft: 25 kPa as stated in ICAO-TI? or other value?
- Maximum pressure rate variation in cargo holds of a commercial aircraft in phases of climb and descent: 9 kPa per minute (2500 feet/ minute)? or other value?
- Shall depressurization incident be considered as part of normal conditions of transport?
- Maximum ambient pressure decrease in case of depressurization incident? 50 kPa? 75 kPa? or other value?
- Which are the recommendations against the risk of over pressure for large packages or containers not able to withstand the pressure differential resulting of a depressurization incident?
- Could/should the requirement and/or the guidance be amended?
### Graded approach in package design

**The graded approach of IAEA SSR-6**

#### Activity of the content

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<th>Package type</th>
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#### Fissile material

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#### UF6

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Pressure variation outside and inside an aircraft - routine

- Typical altitudes and pressure differentials

![Diagram showing pressure variation](image)

- Flying altitude all kinds of aircraft
- Max cargo hold altitude
- Non pressurized aircraft
- Pressurized and partially pressurized aircraft

* Introductory note 3 in ICAO-TI Part 4
Pressure variation outside and inside an aircraft NCT or ACT?

- Typical depressurization incident (A330 – Toulouse 2006)

![Diagram showing pressure variation and depressurization rates.](image)

- Flying altitude
- Max cabin altitude
- Normal cabin altitude

- Depressurization timeline:
  - Initial 5 minutes: >7000 ft/minute
  - Subsequent: approx. 50 kPa

- Pressurized aircraft:
  - 8000 ft (sea level) initial altitude
  - 25 kPa normal cabin pressure
  - 75 kPa max cabin altitude
  - 100 kPa emergency pressure

- Chart indicates:
  - 500 ft/minute = 1.8 kPa/minute
Pressure variation outside and inside an aircraft NCT or ACT?

- Typical depressurization accident (B747 Qantas – Asia 2008)

![Diagram showing pressure variation outside and inside an aircraft during depressurization and emergency descent.](image)

- Flying altitude
- Max cabin altitude
- Normal cabin altitude

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<td>29000 ft</td>
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<td>8000 ft</td>
<td>75 KPa</td>
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<td>0 ft (sea level)</td>
<td>100 KPa</td>
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Depressurization: 0 → 1
Emergency descent: 1 → 7 min

Depressurization rate: >20000 ft/minute
Decrease in pressure: ≈40 KPa
Rapid Decompression Events: Current Solutions

IATA 80/2 (International Air Transport Association):
11.8 psi to 2.14 psi in 1 second

Open aperture (hole)

Spring-actuated valves

Rupture (burst) panel

Magnet valves

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