1. **INTRODUCTION**

1.1 A working group on pressure differential requirements applicable to packagings containing radioactive material was convened from 21 to 22 April at ICAO Headquarters in Montréal.

2. **PARTICIPATION**

2.1 The following participated in the working group:

- K. Rooney, ICAO
- D. Warden, advisor to DGP member nominated by the United Kingdom
- D. Ferguson, Boeing, advisor to the DGP member nominated by ICCAIA
- S. Schwartz, DGP member nominated by IFALPA
- D. Mirko, DGP member nominated by the Russian Federation
- D. Kurdchenko, advisor the DGP member nominated by the Russian Federation
- M. Taal, ICAO
- F. Kirchnawy, Austria, Austrian Ministry of Transport (video conference)
- B. Desnoyers, WNTI, Safety Transport Expert
A. Presta, WNTI, Specialist advisor
K. Vermeersch, advisor the DGP member nominated by the Netherlands
R. Garg, Eng, CNSC, Canadian Nuclear Safety Commission, Transport Specialist
V. Fiacabrin, France (video conference)
G. Ferran, France (video conference)
M. Boehm, Observer, Austria, Civil Aviation Authority

Apologies
C. Bajwa, IAEA Transport Safety Unit

2.2 This working paper contains the report of the meeting and includes the following appendices:

Appendix A  WNTI Presentation — ICAO-IAEA Expert Working Group about Pressure Differential Requirement
Appendix B  Russian Federation Presentation — Pressure differential requirements for dangerous goods by air
Appendix C  WNTI Memo — Review of the Pressure Differential requirements applicable to packages containing Radioactive Material transported by air
Appendix D  Draft guidance material

3.  HIGHLIGHTS

3.1  Self-introductions were made by the participants.

3.2  WNTI Presentation

3.2.1  The world nuclear transport institute (WNTI) presented its proposal regarding pressure differential standards for packages containing radioactive material in air transport. They reviewed the current regulations and an associated possible issue related to radioactive material transport by air (see Appendix A).

The current regulations

IAEA SSR-6 § 621 and ICAO-TI § 6;7.2.3

“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.”

Applies to all package types: excepted packages, industrial packages (IP-1, IP-2 and IP-3), type A, type B(U), type B(M) and type C packages independently of the physical form (solid, liquid, gaseous)

The possible issue

The requirement stated above may be difficult to achieve, especially in the case of packagings of large dimensions, such as ISO freight containers which are commonly used as type IP-1 or IP-2 packages for
air carriage of tools and components as surface contaminated objects (SCO-I or SCO-II), and it may seem excessively severe for low activity materials with little risk even in case of dispersion, such as excepted packages loaded with solid radioactive materials for example.

The purpose of the experts working group

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

b) To reach a consensus on the interpretation of para. 621

1) If no consensus on the interpretation of para.621, and/or

2) If the interpretation of para. 621 appears to be difficult to implement,

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

d) 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.

4. PLENARY DISCUSSION

4.1 In 1996 Edition: IAEA extended the pressure differential requirements for air transport from liquid to all material.

4.2 In 1996 Revised Edition: the regulation was changed from a decreased of ambient pressure down to 5 kPa to a pressure differential of 95 kPa + MNOP

4.3 The intent of the pressure differential requirement is that a Radioactive material Package is required to prevent loss or dispersal of the radioactive material but not the maintenance of internal pressure.

4.4 Scope of the issue addressed in the meeting: SCO I/ LSA I material/ Excepted Packages/ Solid material.

4.5 Discussion about the IAEA definition of normal, routine, accident conditions related to radioactive material transport and package design

- IAEA SSR-6 — Edition 2012
  - Routine: every day/routine operations: incident free
  - Normal: minor mishaps
  - Accident
4.6 Discussion about the probability of aircraft depressurization issue(s)

4.6.1 According to the discussion with airworthiness and pilot representatives, the pressurization issues occur fairly regularly in transport aircraft but without fatal issues or major injuries to passengers or crews. Unexpected rapid loss of cabin pressure (or explosive depressurization) in passenger or freight aircraft is rare. Aircraft are manufactured in considering this type of unexpected event. However it should be noted that some emergency procedures for cargo aircraft may require intentional depressurization. Today’s commercial aircraft commonly fly above 40,000 ft.

4.6.2 Two examples of depressurization incidents given in plenary: A330 – Toulouse 2006 and B747, N-W Manila, 2008. WNTI cited the study conducted by the Australian Transport Safety Bureau regarding depressurization accidents and incidents involving Australian Civil Aircraft from 1975 to 2006 resulting in 517 events reported. One resulted in the loss of the aircraft and fatal injuries to occupants and only 9 led to hypoxia or minor injury to occupants.

4.7 Discussion about non-pressurized aircraft

4.7.1 Some cargo-only aircraft are designed and operated such that the cargo compartment is not pressurized during flight. For these type of aircraft the normal rate of pressure change experienced by the cargo is the actual rate of aircraft climb and descent which is expected to be greater than the “normal” pressure change provided in the ISO standard 11242.

4.8 Discussion about the presence of filters and valves on packages

4.8.1 See Appendix C — WNTI Memo Appendix 1. Presentation by WNTI of the method for demonstrating compliance for cases where dispersal of the radioactive material is highly unlikely due to its form (Special form, SCO, Solid LSA in non-powder form, solid radioactive material in a Type A) and for LSA-I in powder form.

4.8.2 It is possible to use a packaging equipped with valves and filters to allow pressure equilibrium without dispersal of radioactive solid material content when the content can be subject to dispersal or to use a packaging equipped with valves without any supplementary equipment if the content is not subject to dispersal.

4.8.3 For solid package contents the consequence of exposure to a pressure differential must be considered to identify potential mechanisms for loss or dispersal of radioactive material. If “no loss of dispersal” can be justified when the package is exposed to the pressure differential the package design is considered to meet the requirement even if the internal pressure is not maintained.
4.9 Discussion about the IAEA graded approach related to package types depending on transport conditions

4.10 Discussion about the different types of material to be transported as SCO I/LSA I/ Excepted Packages/Solid material


4.11.1 Provides information on pressure environment on aircraft for some normal and some emergency conditions. However it should be noted that the overall pressure differential in this standard is not consistent with the ICAO regulatory requirement of 95 kPa.

4.11.2 There was discussion about contamination consequences and the difficulties involved with decontamination of the aircraft

4.12 Russian Federation Presentation

4.12.1 A presentation was given in plenary by the Russian Federation regarding the pressure differential requirements for transport of dangerous goods by air (see Appendix B).

5. CONCLUSIONS

5.1 The meeting agreed a common interpretation of SSR-6 Edition 2012 Para 621 / ICAO -TI Part 6 Para 7.2.3: that a package design would meet the requirement if the pressure differential was not maintained due to leakage of air provided that there was no loss or dispersal of radioactive material.

5.2 Additional guidance on the existing regulatory requirements would provide clarification of the SSR-6 Edition 2012 Para 621 / ICAO -TI Part 6 Para 7.2.3.

5.3 No detailed information regarding the maximum normal operating pressure is provided in ICAO –TI.

5.4 Aircraft depressurization may result in very high airflow rates, and may result in greater contamination of aircraft than might result from ordinary leakage from a package containing radioactive material. It was noted that air transport of unpackaged surface contaminated objects is forbidden.

5.5 The mobility of solid radioactive material and its likely release under pressure differential conditions needs to be considered by the package designer. It should not be assumed that maintenance of the pressure differential is always the preferred design solution, particularly where the solid materials are immobile.

5.6 The proposed approach by the WG is to develop ICAO guidance text:

a) to point the reader to existing guidance text:

1) IAEA Advisory Material SSG-26 on loss and dispersal provided in para 648.3
2) IAEA Advisory Material SSG-26 on methods of demonstration of compliance para 701.1

3) ISO Standard 11242 - Para 3.3 and 3.4

Proposition of draft text: The pressure changes which may be experienced by a package in air transport, include the conditions of ISO 11242 para 3.3 and 3.4 (or IATA Standard Specification 80/2 para 3.2 and 3.3)

b) To submit the draft guidance text contained in Appendix D to this working paper to the ICAO DGP WG 17 for review before submission to the IAEA TRANSSC 34 for consideration.
APPENDIX A

PRESENTATION BY WNTI
APPENDIX B

RUSSIAN FEDERATION PRESENTATION — PRESSURE DIFFERENTIAL REQUIREMENTS FOR DANGEROUS GOODS BY AIR
APPENDIX C

WNTI MEMO — REVIEW OF THE PRESSURE DIFFERENTIAL REQUIREMENTS APPLICABLE TO PACKAGES CONTAINING RADIOACTIVE MATERIAL TRANSPORTED BY AIR
Chapter 7

REQUIREMENTS FOR THE CONSTRUCTION, TESTING AND APPROVAL OF PACKAGES FOR RADIOACTIVE MATERIAL AND FOR THE APPROVAL OF SUCH MATERIAL

7.2 ADDITIONAL REQUIREMENTS FOR PACKAGES TRANSPORTED BY AIR

7.2.3 Packages containing radioactive material must 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 maximum normal operating pressure plus 95 kPa.

Note.—The intent of this requirement is to avoid loss or dispersal of radioactive material out of the package during its carriage in an aircraft taking into account of the pressure variation that can be encountered in in the cargo hold of an aircraft. [see Supplement xxx for further guidance.]

The normal conditions of flight and the emergency flight conditions are defined in ISO Standard 11242 as follows:

Normal flight conditions: Flight conditions with cabin/cargo compartment pressure decreasing from standard sea level 100 kPa to minimum cruise flight cabin altitude pressure 75 kPa (8000 ft) during climb at minimum rate of 150 Pa/s (2500 ft/min), and increasing back to standard sea level during descent, at minimum rate of 90 Pa/s (1500 ft/mn). Some cargo-only aircraft are designed and operated such that the cargo compartment is not pressurized during flight. For these type of aircraft the normal rate of pressure change experienced by the cargo is the actual rate of aircraft climb and descent which is expected to be greater than the “normal” pressure change provided in the ISO standard 11242.

Emergency (rapid decompression) flight conditions: Cabin/cargo compartment atmosphere dropping linearly from a minimum normal equivalent altitude of 6000 ft, i.e. a maximum normal pressure of 81 kPa in cruise flight, to the standard ambient pressure of 15 kPa at 45000 ft altitude in a duration of 1 s.
The maximum normal operating pressure (MNOP) is at least the gauge pressure developed in the containment system of the package at 55°C (primary receptacle, or intermediate packaging or outer packaging), i.e. the absolute pressure developed in the package at 55°C less 100 kPa.

The differential pressure of MNOP + 95 kPa results from a consideration of aircraft depressurization at a maximum civil aviation flight altitude together with any pressure already inside the package, plus a safety margin.

In the particular case of solid material, in order to comply with Part 6, 7.2.3 other means of demonstration than pressure resistance may be used by the designer of a package design.

If “no loss or dispersal” can be justified when the package is exposed to pressure differential the package design is considered to meet the requirement even if the internal pressure is not maintained.

ICAO-TI Part 1, 3.1: definition of Maximum normal operating pressure (MNOP)

**Maximum normal operating pressure.** For the transport of radioactive material, 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.

ICAO-TI Part 6, 7.2.2:

Packages must 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.

IAEA SSG-26 para

621.3. If, within the definition of MNOP, the phrase “conditions of temperature and solar radiation corresponding to environmental conditions” is interpreted to include consideration of conditions specific to air transport (para. 620), then the MNOP does provide a suitable basis for specifying this requirement. If the temperature range given in para. 620 (–40°C to 55°C) is used, self-heating of the package contents is taken into account and the solar radiation input is considered to be zero, as the package is inside an aircraft, and hence the MNOP is consistent with the ICAO approach.