



**DANGEROUS GOODS PANEL (DGP)  
WORKING GROUP MEETING (DGP-WG/16)**

**Montreal, 17 to 21 October 2016**

**Agenda Item 2: Development of recommendations for amendments to the *Technical Instructions for the Safe Transport of Dangerous Goods by Air (Doc 9284)* for incorporation in the 2019-2020 Edition**

**2.3: Part 3 — Dangerous Goods List, Special Provisions and Limited and Excepted Quantities**

**NEED FOR AN EXPERT WORKING GROUP ABOUT PRESSURE DIFFERENTIAL  
REQUIREMENT WORKING PAPER 53**

(Presented by World Nuclear Transport Institute (WNTI))

**SUMMARY**

This information paper includes, in the appendix, the presentation given by World Nuclear Transport Institute (WNTI) during discussion on proposal for review of the pressure differential requirements applicable to packagings containing radioactive material (DGP-WG/16-WP/53).

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# International Civil Aviation Organization

## Dangerous Goods Panel Working Group 16

# NEED FOR AN EXPERT WORKING GROUP ABOUT PRESSURE DIFFERENTIAL REQUIREMENT

Working Paper 53

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

ICAO - Montreal - 17<sup>th</sup> to 21<sup>st</sup> October 2016



# Pressure differential in air carriage

## The requirement



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- **The current regulations**

IAEA [SSR-6](#) § 621 and ICAO-TI Part 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) and to all physical forms (solid, liquid, gaseous)

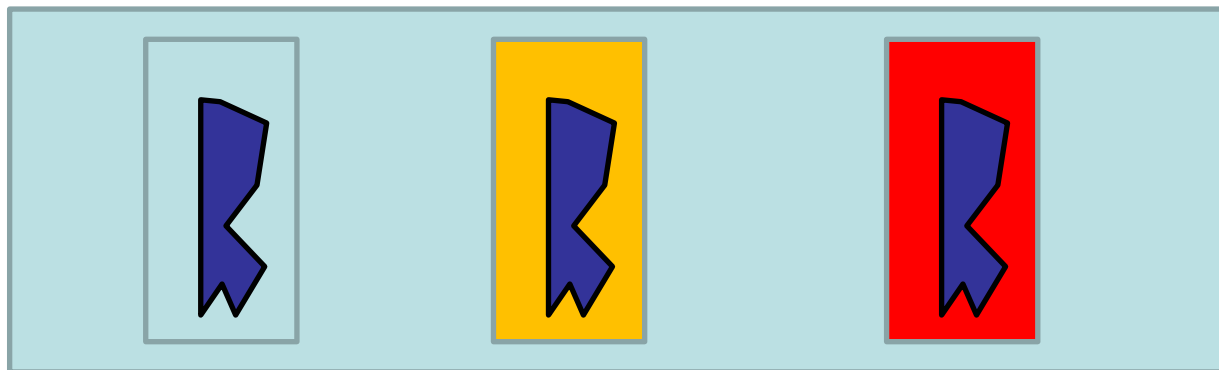
- **The possible issue**

- ✓ **A requirement difficult to achieve, for large IP like ISO containers**
- ✓ **A requirement that may seem excessively severe for low activity solid materials**

# How the requirement should be understood?

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- 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 = 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

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## 3 examples to illustrate

- ✓ **Example 1: *Solid UF<sub>6</sub> 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 UF<sub>6</sub> samples in excepted packages

## *Old configuration*

- Up to 99 g of UF<sub>6</sub> 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



**P10**



**Intermediate packaging**



**4GV/X box**

- Closing at 15°C, heating at 55°C, pressure increase = 14kPa
- Max depressurization = 75kPa (ICAO-TI Part 4);  $75+14 = 89 \text{ kPa} < 95 \text{ kPa}$
- **Safe but not strictly compliant with the requirement**

# 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



**P10**



**Intermediate packaging**



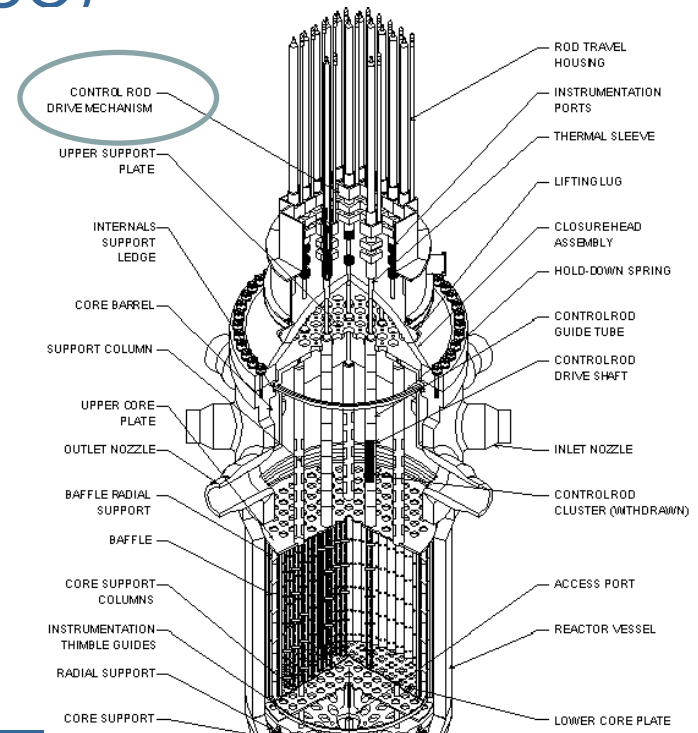
**4GV/X box**

- Closing at 15°C, eating at 55°C, MNOP = 14 kPa
- 14 kPa + 95 kPa = 109 kPa; 109kPa < 150 kPa
- **Strictly compliant with the requirement, but more expensive and less practical than before**



# Large contaminated equipment in 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)



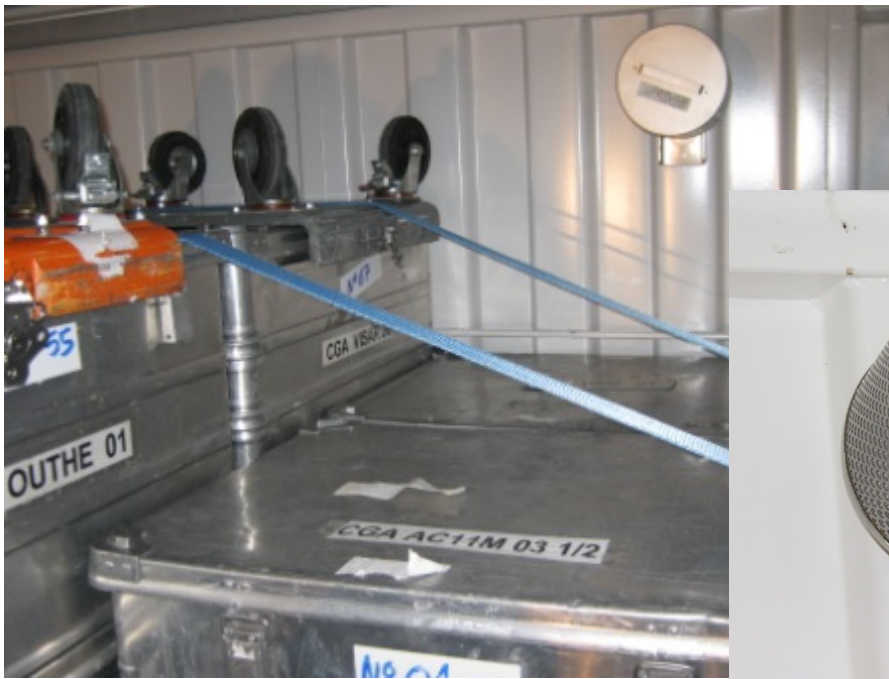
## *Large contaminated equipment in ISO container*

- 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?***

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- 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: in excepted package

- 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 ( $1 \text{ Bq/g} \approx 80 \text{ mg U/kg}$  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: in excepted package



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



Several racks closed, placed in an outer steel box. The whole package is UN2910



## Solid uranium ore samples : *Why are they carried by air?*

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- 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

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- **The proposal made by WNTI to solve the possible issue**

- First proposal submitted by WNTI in the IAEA 2013 review cycle
- Submitted for comments to the ICAO DGP in November 2013
- Redrafted proposal submitted in the 2015 review cycle.

- **The decision taken by IAEA TRANSSC 31 in November 2015**

*“No action taken. Decision on the proposal is deferred to the IAG (Inter Agencies Group) and other appropriate aviation organizations for further discussion and development.”*

- **The WNTI suggestion to the IAEA TRANSSC 32 in June 2016**

- Creation of a dedicated WG of experts from aviation organizations, IAEA, interested competent authorities and the industry



# Pressure differential in air carriage

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- **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\***
- **The pace of the experts WG**

A two days meeting should be enough to provide the adequate recommendations to IAEA TRANSSC
- **The attendance of the experts WG**

Dangerous Goods experts having some expertise in class 7 such as TRANSSC Member States representatives from Safety Authorities, WNTI, and experts from International Aviation Organisations including aircraft manufacturers and airworthiness experts.

\*Actions, if needed can be implemented during the next IAEA review and revision cycle

## 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.*
  
  - Return

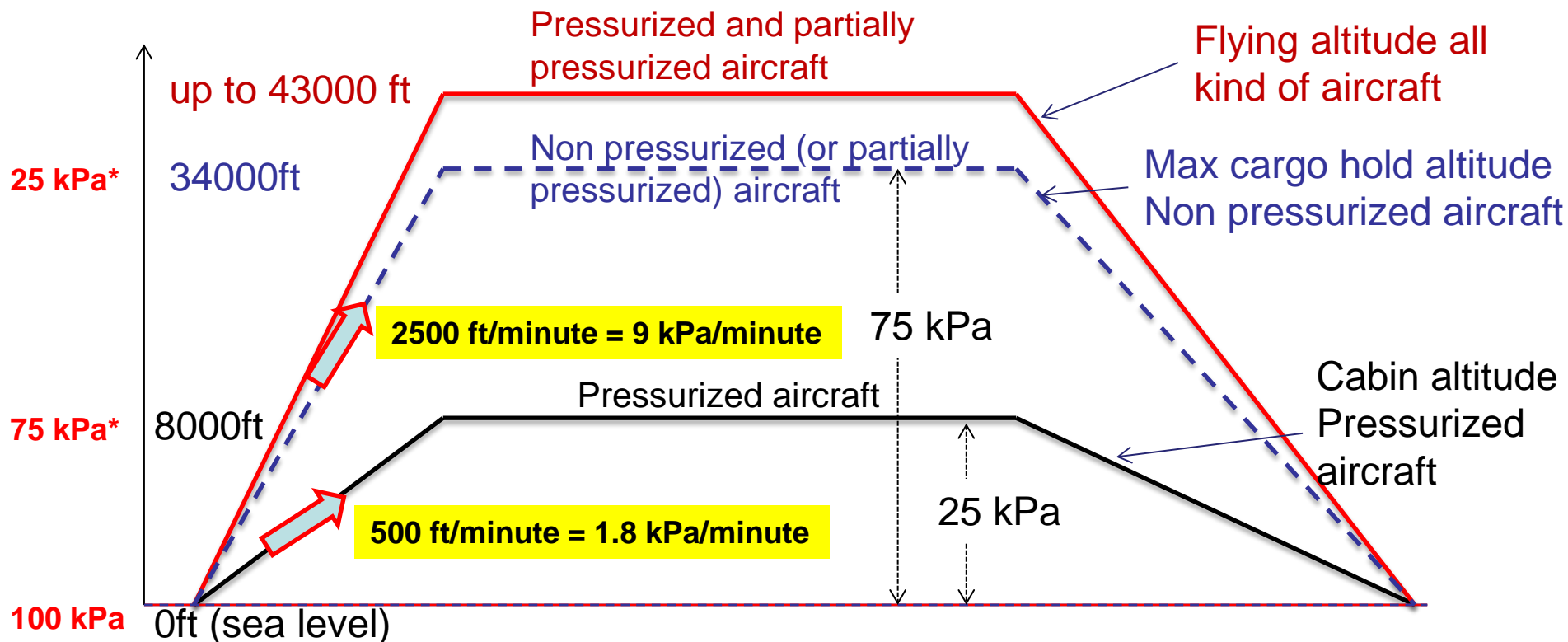
- 621. *Packages containing radioactive material* to be transported by air shall be capable of withstanding, without loss or dispersal of *radioactive contents* from the *containment system*, an internal pressure that produces a pressure differential of **not less than the maximal gauge pressure that 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 95kPa**. 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.**
- return Graded approach

# 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 ?

# Pressure variation outside and inside an aircraft - routine

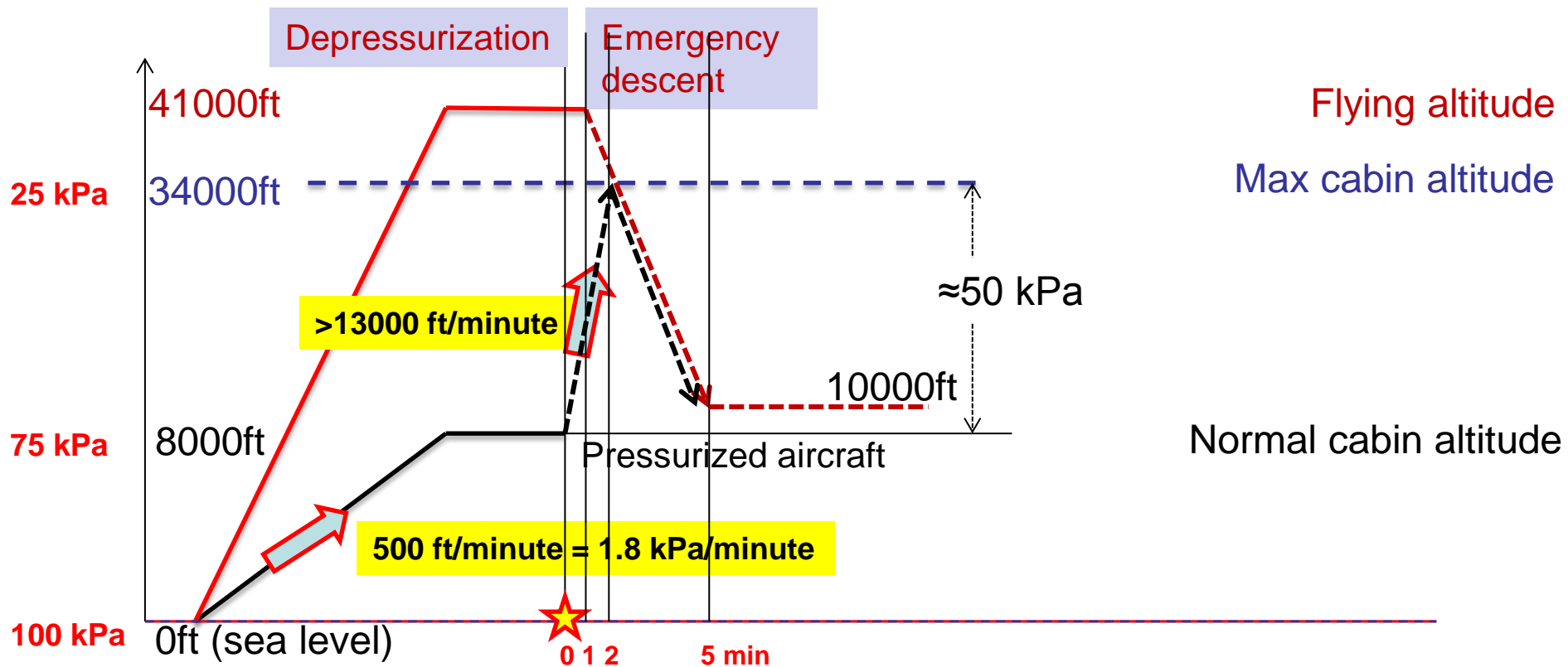
- Typical altitudes and pressure differentials



\* *Introductory note 3 in ICAO-TI Part 4*

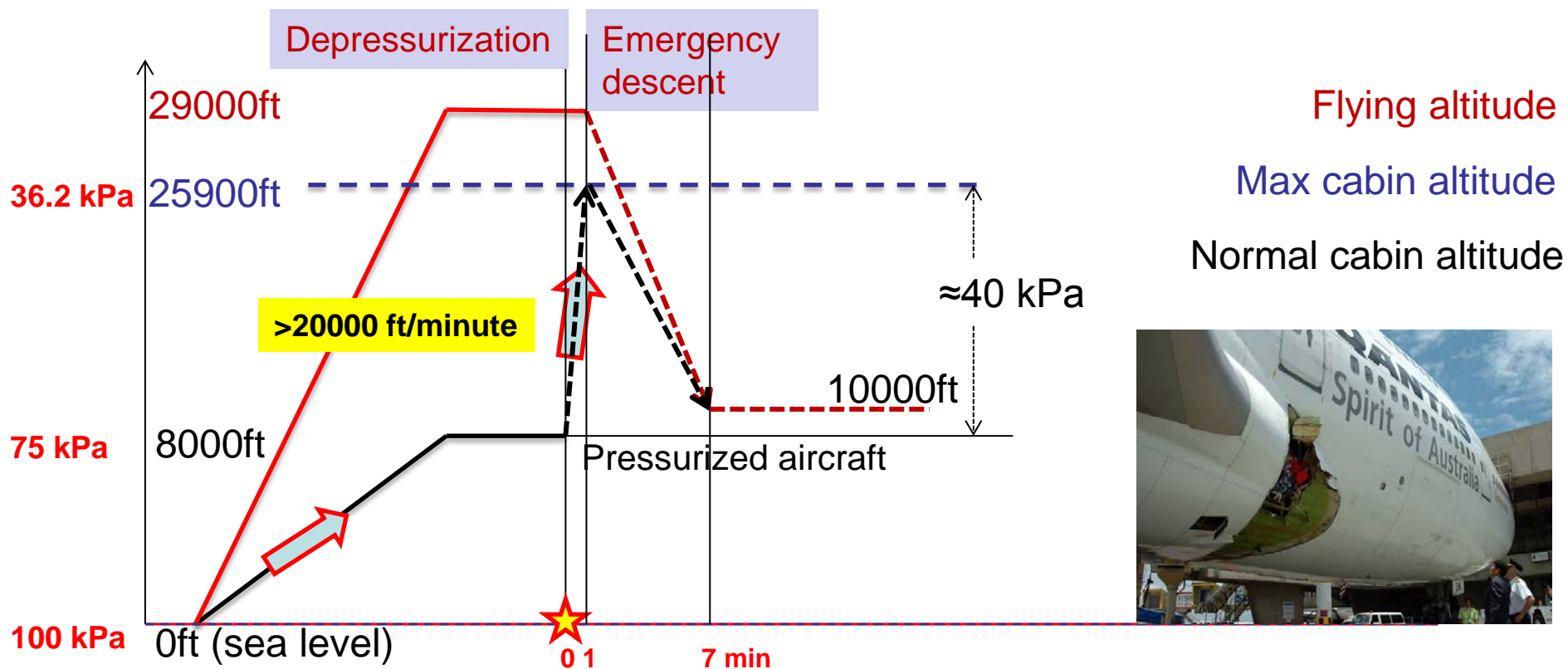
# Pressure variation outside and inside an aircraft NCT or ACT?

- Typical depressurization incident (A330 – Toulouse 2006)



# Pressure variation outside and inside an aircraft NCT or ACT?

- Typical depressurization accident (B747 Qantas – Asia 2008)





# 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)



Rupture (burst)  
panel

Spring-actuated  
valves



Magnet valves

# Graded approach in package design

## The graded approach of IAEA SSR-6

### Activity of the content

> 3000 A <sub>2</sub>	Type C	Routine + Normal + Accident	Approved package designs
> 1 A <sub>2</sub>	Type B(M)		
> 1 A <sub>2</sub>	Type B(U)		
1 A <sub>2</sub>	Type A	Routine + Normal	Non approved package designs
LSA-III	Type IP-3		
LSA-II/SCO-II	Type IP-2		
LSA-I/SCO-I	Type IP-1	Routine	
≈ 1/1000 A <sub>2</sub>	Excepted package		
<b>Content</b>	<b>Package type</b>	<b>Transport conditions</b>	<b>Approval</b>

### Fissile material

FISSILE	Routine + Normal + Accident	Approved package designs
FISSILE paras 674 or 675	Routine + Normal	Non approved package designs
Fissile excepted	Routine	
<b>Content</b>	<b>Transport conditions</b>	<b>Approval</b>

### UF6

≥ 0.1 kg UF6	Routine + Normal + Fire	Approved package designs
< 0.1 kg UF6	Routine	Non approved package designs
<b>Content</b>	<b>Transport conditions</b>	<b>Approval</b>

[return](#)

**THANK YOU VERY MUCH FOR YOUR ATTENTION**

**QUESTIONS AND DISCUSSION**