International Aircraft Systems Fire Protection Working Group
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A350XWB Cargo Inerting Function

Cargo Fire Protection as Combination of Halon 1301 and Nitrogen Enriched Air (NEA)

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AIRBUS

Agenda

- Introduction
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- A350XWB FWD LDCC
- System Architecture Pre/Post
- NEA Availability
- Sizing and Performance
- Weight impact
- Combination of Halon 1301 and NEA
- Additional FHA cases
- Certification Approach
- Summary

Introduction

- In frame of the A350XWB development the current flow-metered Halon 1301 fire extinguishing bottle for cargo bay long term fire suppression shall be deleted.
- Nitrogen Enriched Air (NEA) produced by the Inert Gas Generating System (IGGS) as part of the Fuel Tank Inerting System (FTIS) will be used instead.
- Benefits:
  - First step to halon-free A/C
  - Greener A/C (less halon)
  - 20-45 kg weight saving
  - A/C level architecture synergy
  - Unlimited ETOPS

Why A350XWB

Current Aircraft

- Current Aircraft produced after 1992 having tanks with a flammability exposure of 7% or higher are required to have a Flammability Reduction Means fitted
  - Affected aircraft - **SA, LR and WB**
    (Note: A380 has no tanks with a flammability exposure above 7%).
  - Affected tanks – **centre tank**

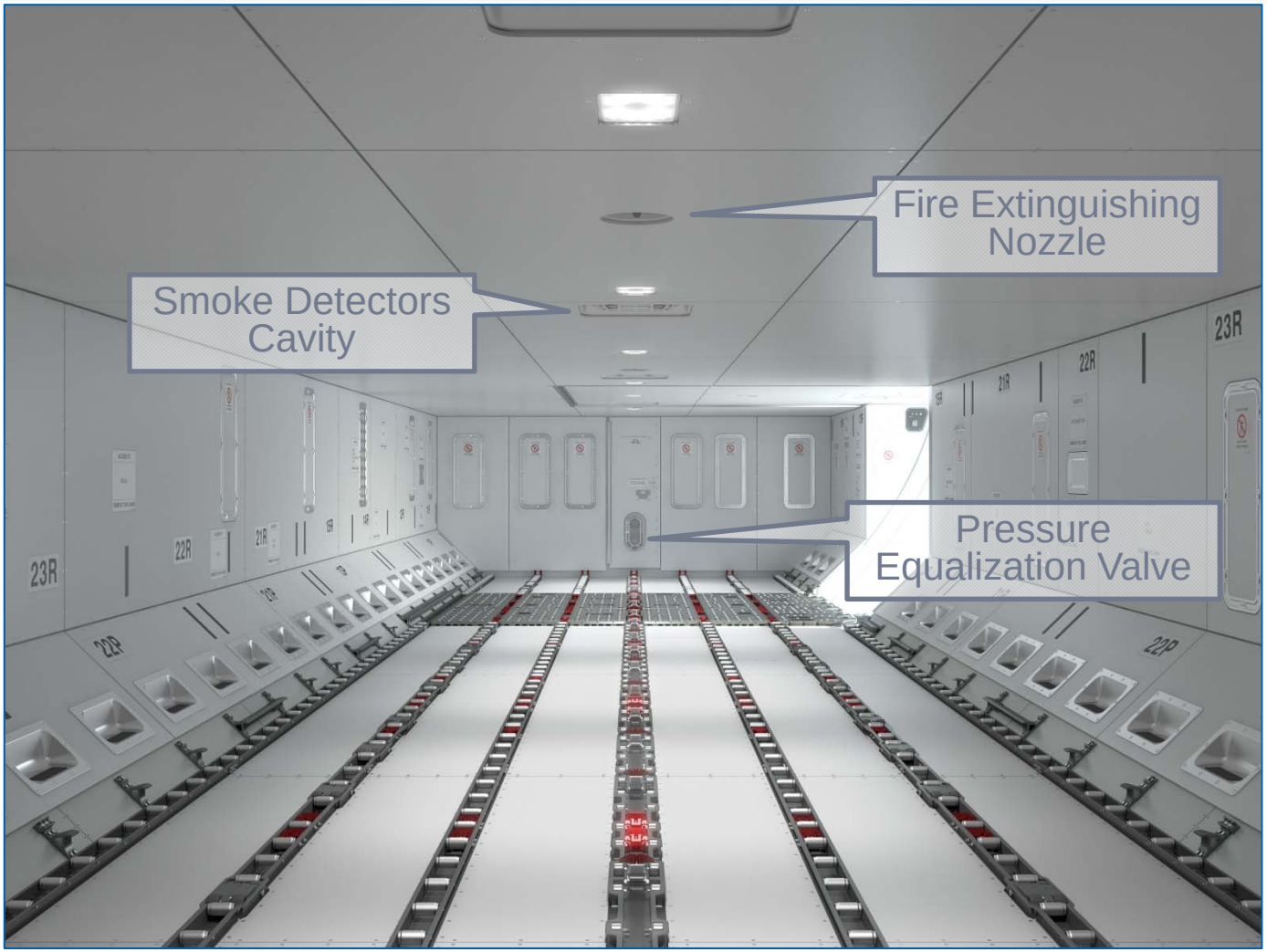
☹ FTIS performance < Cargo Inerting needs

New Aircraft – **A350XWB**

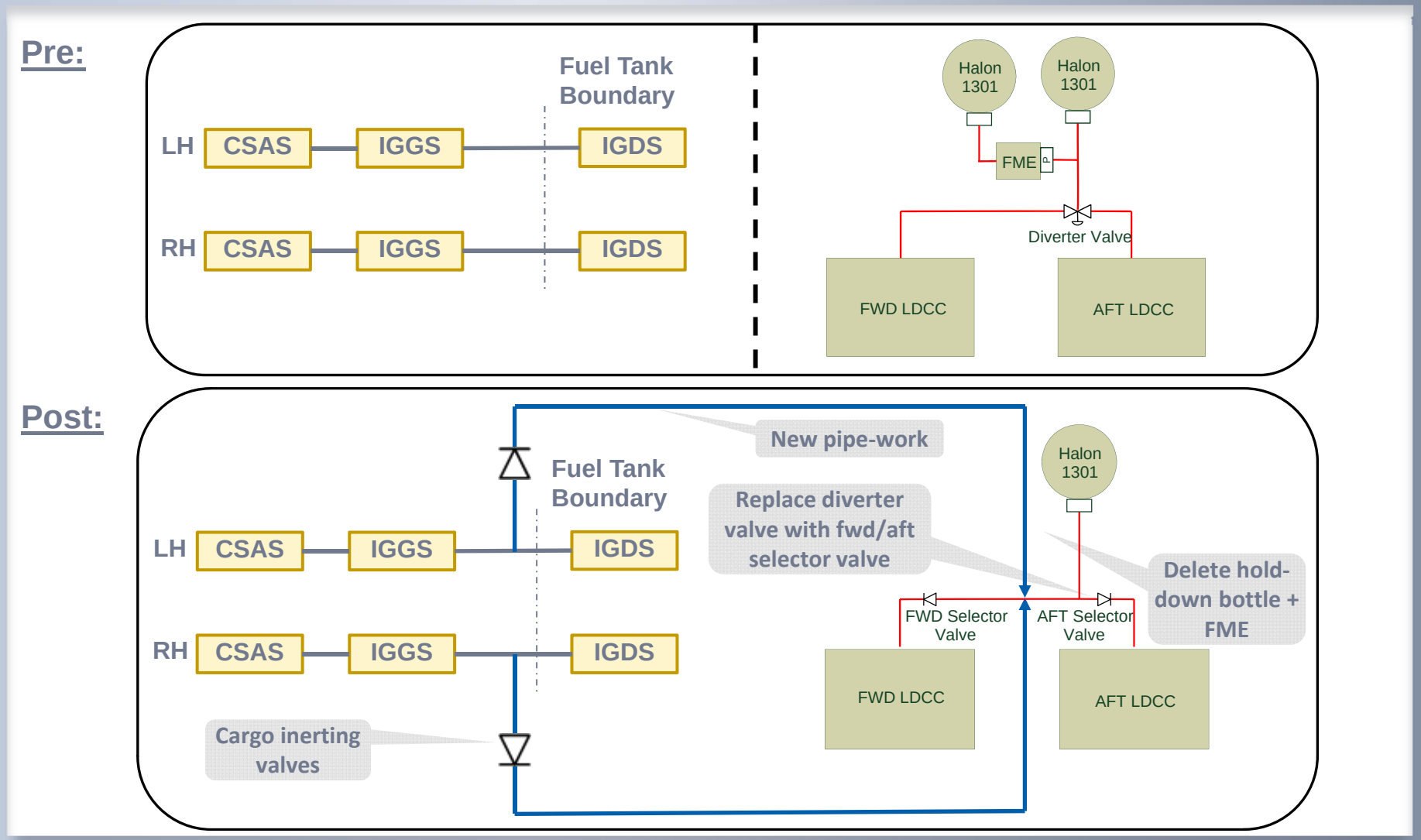
- Tanks outside the fuselage are required to meet 3% flammability exposure
  - Affected tanks – **wing tanks**
- Tanks within the fuselage wholly or partly and those normally emptied are required to meet 3% warm day requirement in addition to the 3% flammability exposure
  - Affected tanks – **centre tank**

☺ FTIS performance > Cargo Inerting needs

A350XWB FWD LDCC



System Architecture Pre/Post

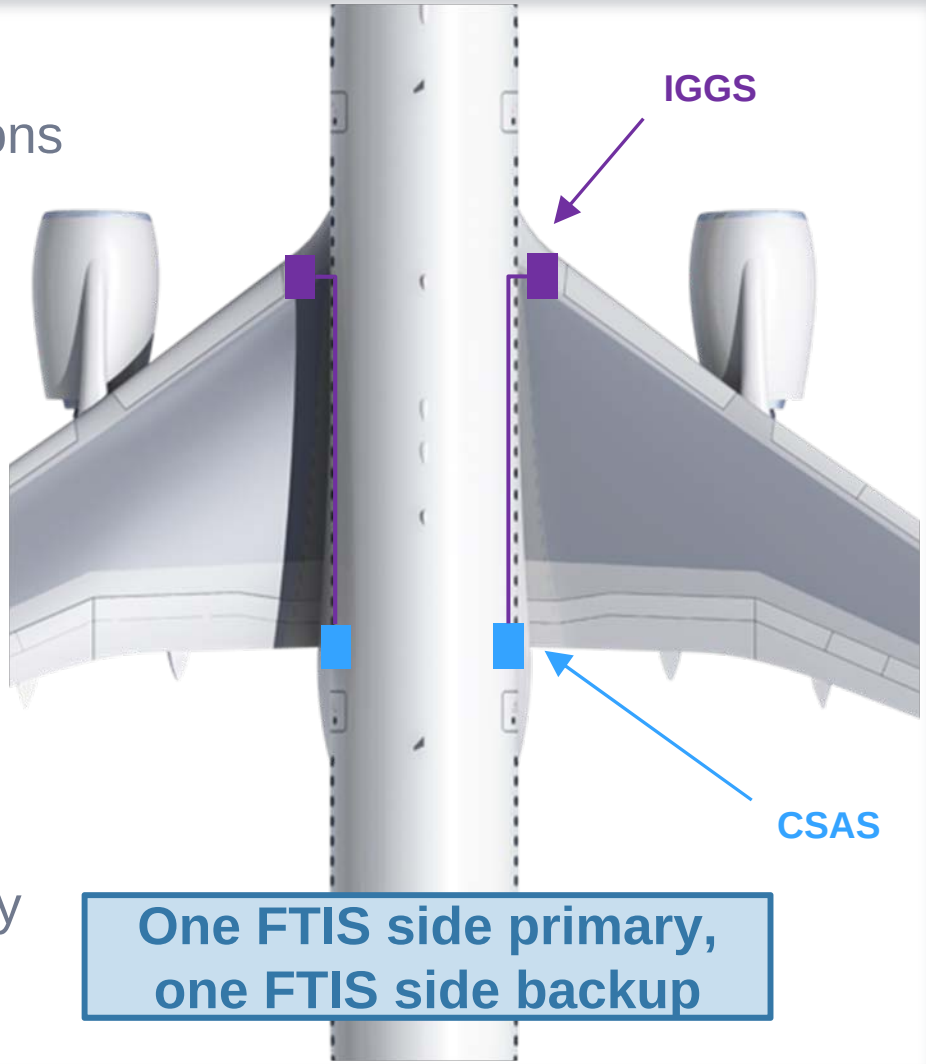


NEA Availability

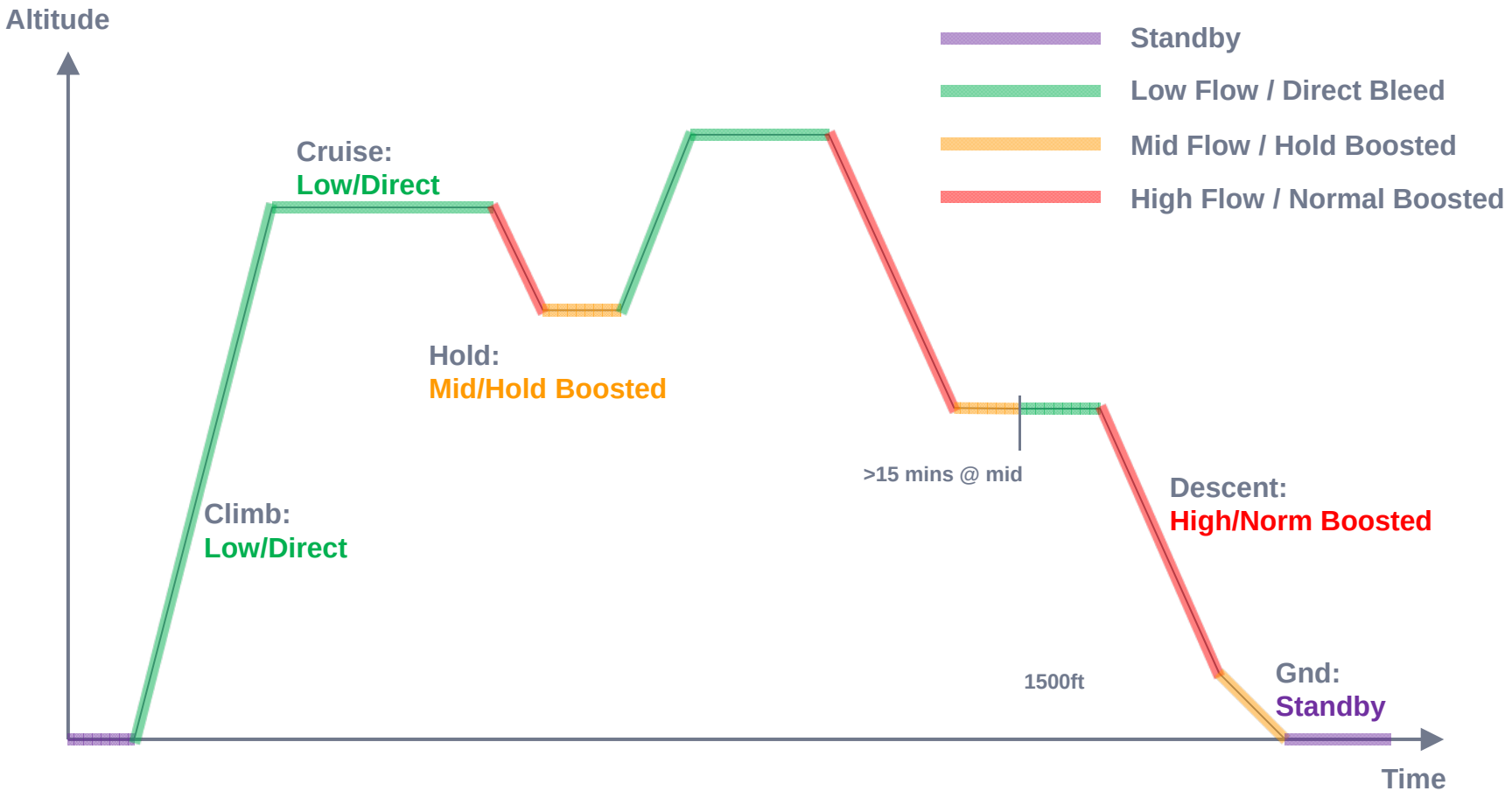
- Identical parallel sides (left/right)
  ⇨ Separated for installation reasons

- **Today (FTIS only):**
  Loss of one FTIS side =
  both sides shut down
  MMEL: GO (10 days)
- **Tomorrow (combined system):**
  Loss of one FTIS side =
  one side shut down
  MMEL: GOIF (10 days)

- One FTIS side provides enough NEA for cargo inerting, so reliability and availability targets are met



Sizing and Performance



Decent rate is sizing: Higher descent rate = higher ingress of ambient air

Weight impact

The weight reduction with respect to the conventional system depends on the ETOPS configuration:

- Up to 20 kg are envisaged for 195 min diversion time.
- Up to 45 kg are envisaged for 360 min diversion time.

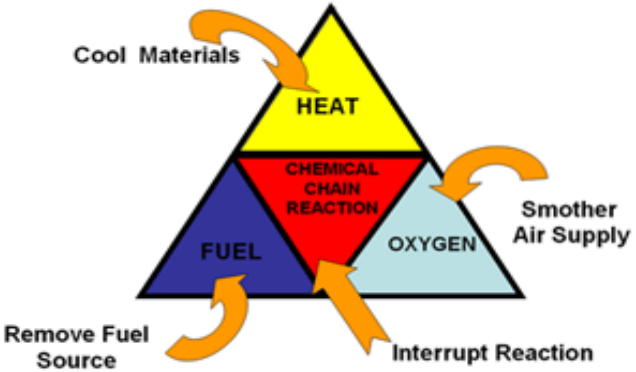
Combination of Halon 1301 and NEA

Halon 1301

- Requirement
  Initial concentration 5%by vol.
  Suppression concentration 3%by vol.
- Effectiveness
  Inhibition
  (interrupt chemical reaction)

NEA

- Requirement
  min. Oxygen Concentration
  12 %by vol.
- Effectiveness
  Oxygen Suppression

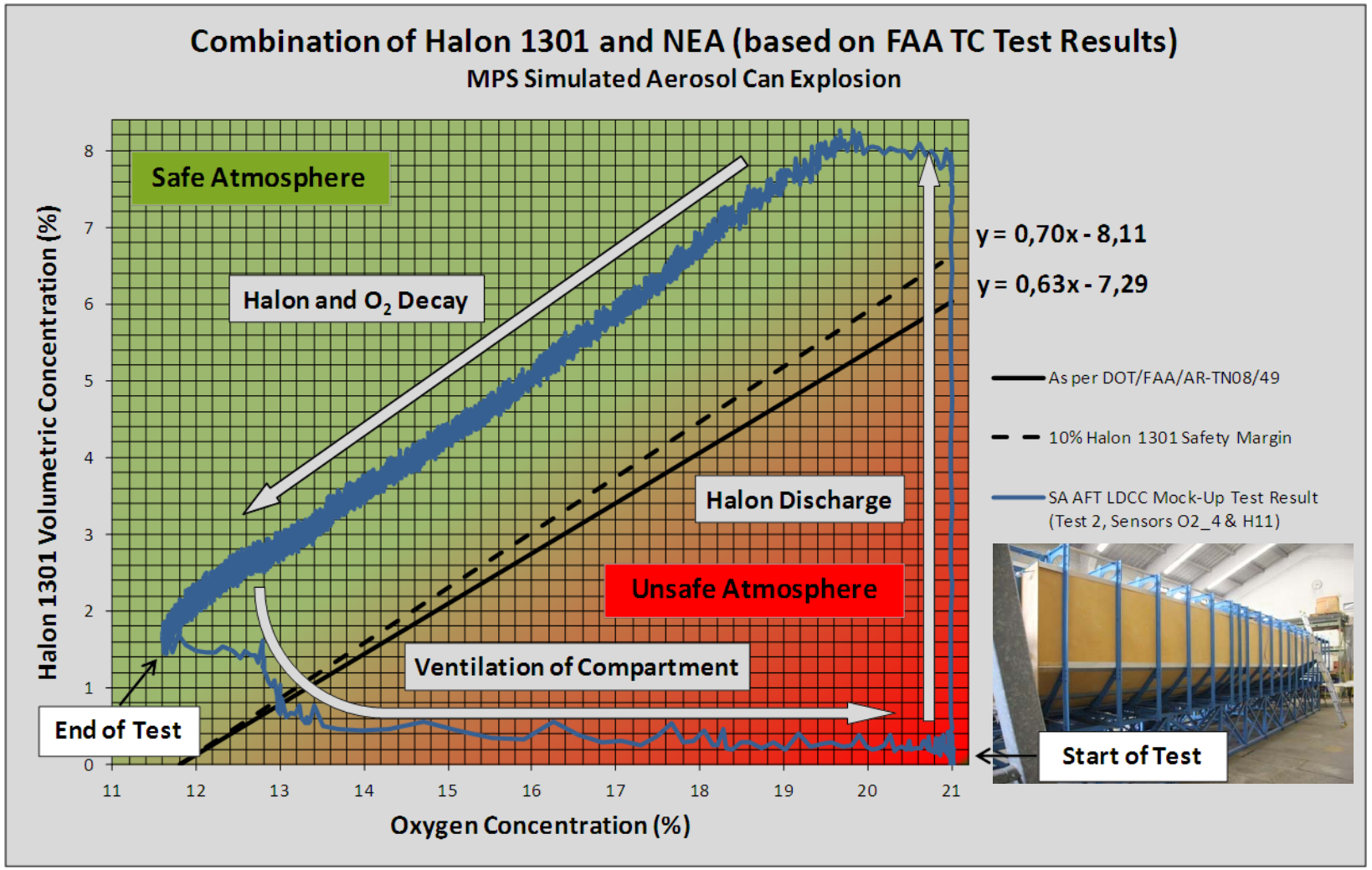


The Fire Triangle

History:

- FAA Tech Center MPS Aerosol Can Test Campaign
- Airbus Halon-IGGS MPS Tests Campaign
  (Bulk-, Container-, Open-Surface-Fire Engineering Tests)
- Airbus Halon-NEA Small-Scale “Cold” Tests
  (A320 AFT LDCC mock-up)

Combination of Halon 1301 and NEA



Additional FHA cases

- Provision of gas to the fuel tanks above 200 deg C resulting in ignition (CAT) 1.0E-9
- Inability to prevent fuel vapour back-flowing onto an ignition source resulting in ignition within FTIS and subsequent tank ignition (CAT) 1.0E-9
- Provision of gas to the fuel tank at flow rates above the tank pressure limits (CAT) 1.0E-9
- Asphyxiation of ground crew due to discharge of NEA into the fuel tanks during maintenance operations (HDA) 1.0E-7

  ⇨ Therefore, “undetected discharge of NEA into the cargo hold” should have a design objective of 1.0E-07

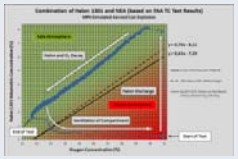
Certification Approach

- Goal: Certification with as much commonality to standard system as possible.
- Proposed applicable certification requirements

CS-25 Req'mt	Paragraph Title	Means of Compliance										Remarks
25.851 (b)	FIRE EXTINGUISHERS - Built-in Fire Extinguishers	0	1	2		4		6	7			
(b) (1) (i)	hazardous extinguishing agent in occupied areas											
(b) (1) (ii)	structural damage											
(b) (2)	adequate system capacity					X		X				ref. AMC 25.851(b)
25.855 (h)	CARGO OR BAGGAGE COMPARTMENT - Flight Tests	0						6				
(h) (2)	hazardous quantities of extinguishing agent in occupied areas											
(h) (3)	agent dissipation											
25.855 (i)	CARGO OR BAGGAGE COMPARTMENT - Inadvertent Detector Operation	0						6				
25.857 (c)	CARGO COMPARTMENT CLASSIFICATION - Class C	0	1	2				6	7		9	
(c) (2)	approved system controllable from cockpit											
(c) (3)	exclude hazardous quantities from occupied areas											
(c) (4)	control ventilation and draughts											
25.1309 (a)	EQUIPMENT, SYSTEMS AND INSTALLATION - Intended Function	0	1	2			5	6	7		9	
(a) (1)	perform intended function under aeroplane operating and environmental conditions											
(a) (2)	no adverse effect on proper function											

- Only for CS 25.851(b)(2) MoC changes are envisaged
- Compliance to CS 25.851(b)(2) via MoC 4&6 (lab & flight tests)

Certification Approach

	Mock Up "Cold Test"	Mock Up "Hot Test"
Test Objective	• Provide agent distribution profile • MoC 4 justification	• Perform testing on product regarding the MPS characteristics • MoC 4 justification
Test Demonstration 	• Demonstration of sufficient mixing and distribution of Halon/Oxygen (NEA) concentration in accordance to the diagram • Identification of worst case loading configuration	• Demonstration of sufficient fire suppression performance for MPS test scenarios in A350 FWD LDCC configuration with four MPS fire loads (bulk-load fire, containerized fire, aerosol can explosion, surface burn fire)
Test Configuration	• A350 FWD LDCC geometry (largest volume) • Simulated NEA mixture as specified will be used	

Way forward

- Preparation of draft CRI based on Airbus working paper
- Preparation of mock-up tests at DLR in Trauen

Summary

- A350XWB will be the first Airbus A/C with cargo fire protection as combination of Halon 1301 and Nitrogen Enriched Air (NEA).
- Benefits:
  - First step to halon-free A/C
  - Greener A/C (less halon)
  - 20-45 kg weight saving
  - A/C level architecture synergy
  - Unlimited ETOPS
- NEA availability, function reliability as well as sizing and performance fulfill the needs.
- Effectiveness of a combined Halon 1301 / NEA system has been shown.
- Certification approach with as much commonality to standard system as possible.

Thank you!

Questions?

Glossary

- FTIS – Fuel Tank Inerting System (ATA47)
  - IGGS – Inert Gas Generation System (ATA47)
  - IGDS – Inert Gas Distribution System (ATA47)
  - CSAS – Conditioned Service Air System (ATA21)
- LDCC FES – Lower Deck Cargo Compartment Fire Extinguishing System (ATA26)
  - FME – Flow Metering Equipment
  - MPS – Minimum Performance Standard
- NEA – Nitrogen Enriched Air
  - sometimes called “ODA” – Oxygen Depleted Air.

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